MINES AND QUARRIES BY STATES AND TERRITORIES

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INTRODUCTORY STATEMENT.

At the census of 1870, when the statistics of mining were first presented separately, they were summarized to show the totals in each state for each mineral and for all minerals. This practice was not followed at the censuses of 1880 and 1890, and comparable data are available for only a few states and the principal minerals. The great diversity of minerals now produced, and the great and increasing importance of the mineral industry in many states, make a summarization of this character again desirable. The detailed statistics for all productive mines in each state and territory, irrespective of the character of the ore, are shown in Table 2, and for the active but nonproductive mines, in Table 14, on page 57.

In the following discussion of the statistics for mines, quarries, and natural-gas and petroleum wells for each state, the states and territories are considered in alphabetical order. For each state a table is first presented, which shows the principal items for each of the leading minerals, and for all other minerals produced in commercial quantities during 1902. This table is followed by a general description of the state's mineral resources, and a summary of the statistics for the active but nonproductive mines. A brief résumé is also given of the products of manufactures that are closely allied to, or based on, the mining industry, because of the use of the products of mines as raw materials. The value of the production of the leading minerals is shown for a series of years, and the nature, occurrence, and history of each is discussed, together with a statement of the relative importance of the state in its production.

ALABAMA.

Table 1 is a summary of the statistics of the productive mines and quarries in the state of Alabama for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Iron ore.	Limestones and dolomites.	Sandstones and quartzites.	Clay.	All other minerals.[1]
Number of mines or quarries	260	145	59	33	7	5	11
Number of operators	172	91	31	29	7	5	9
Salaried officials, clerks, etc.:							
Number	947	623	227	63	6	.....	28
Salaries	$979,117	$709,449	$188,441	$54,597	$2,650	.....	$23,980
Wage-earners:							
Average number	19,132	12,930	4,864	1,002	58	33	245
Wages	$10,345,148	$7,841,457	$2,029,807	$354,718	$30,523	$9,634	$79,009
Contract work	$267,279	$265,579	$500	.....	.....	.....	$1,200
Miscellaneous expenses	$858,851	$734,972	$88,008	$25,954	$1,535	$3,866	$4,516
Cost of supplies and materials	$2,043,914	$1,219,310	$592,286	$149,012	$5,230	$1,993	$76,083
Value of product	$17,367,992	$12,419,666	$3,936,812	$759,617	$42,706	$19,742	$189,449

[1] Includes operators as follows: Bauxite, 1 (3 mines); cement, 1; gold, 4; graphite, 1; marble, 1; and pyrites, 1.

Alabama is especially rich in coal and iron, ranking fifth among the states in coal production and third in iron ore. It is also a producer of limestones and dolomites, sandstones and quartzites, clay, gold and silver, bauxite, graphite, marble, and pyrites. Extensive deposits of phosphate exist in what is locally known as the "black belt" extending across the central portion of the state. The phosphatic marls have very nearly the same percentage of phosphate and carbonate of lime as the Greensand marls of New Jersey.[1] In 1900 there was a production of 334 long tons of phosphate rock of a value of $544.[2]

Soapstone, as well as kaolin, is found throughout the metamorphic region of the state, large outcroppings that give very satisfactory results under fire tests occurring in Tallapoosa, Randolph, and Clay counties; these show indications of value for furnace linings.[3] The Indians made use of soapstone in many localities in the manufacture of various utensils. Not far from Tallahassee Falls there was the old Indian village, Tuckabatcha, near an outcropping of this mineral worked by them.

Tantalite has been found in the vicinity of Rockford, Coosa county, and a considerable amount has been sold for cabinet specimens. Tin found near Ashland, in Clay county, was mined at the Broad Arrow mines in 1883. The ore exists in considerable quantity, but is associated with titaniferous iron and can not be obtained in a sufficiently pure state to be marketable. Very pure specimens of tin ore were found, in 1880, near Rockford, in Coosa county, in association with tourmaline, biotite, and tantalite.[4]

Other minerals found in the state but not reported as commercially mined in 1902 are as follows: Beryl and feldspar, found in Coosa county; copper, in the old Woods or Copper Hill mine, in Cleburne county, which was worked awhile in the seventies, and is said to contain extensive ore bodies; and mica, formerly mined at Pinetucky, in Randolph county.

Development work was reported by 5 operators engaged in the development of gold and silver, bituminous coal, and iron ore deposits. They gave employment during the year to 10 salaried officials, clerks, etc., who received $9,010 in salaries, and to 45 wage-earners, who were paid $15,244 in wages. The miscellaneous expenses amounted to $889, and the cost of supplies and materials to $1,048.

Table 2 shows the value of the products of the manufacturing industries of the state, based primarily upon minerals mined and quarried, and the value of all products manufactured in Alabama in 1900.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures	.....	$80,741,449
Based upon products of mines or quarries:		
Chemicals and allied products	$2,068,162	
Clay, glass, and stone products	1,482,611	
Iron and steel and their products	22,930,924	
Metals and metal products, other than iron and steel	587,619	
Miscellaneous industries	5,635,801	
	.....	32,705,117
All other	.....	48,036,332

[1] United States Geological Survey, "Mineral Resources of the United States," 1883–84, page 794 ff.

[2] Ibid, 1900, page 813.

[3] Transactions of the American Institute of Mining Engineers, Vol. X, page 204.

[4] Alabama Geological Survey, Bulletin No. 1.

As shown in Table 2, the value of the manufactures based primarily on minerals mined or quarried amounted to $32,705,117, or 40.5 per cent of the total value of all manufactured products in 1900. The combined value of the products of mines and quarries in Alabama in 1902 and of manufactures in 1900 was $98,109,441, of which amount the manufactures contributed 82.3 per cent and mines and quarries 17.7 per cent.

The average number of wage-earners in Alabama engaged in manufacturing, as reported at the Twelfth Census, was 52,902, and the wages paid amounted to $15,130,419. In 1902 the average number of wage-earners reported as engaged in mining was 19,132, and the wages paid amounted to $10,345,148. The two industries together gave employment to an average of 72,034 wage-earners during the year and paid $25,475,567 in wages, manufactures accounting for 73.4 per cent of the wage-earners and 59.4 per cent of the wages, and mines and quarries accounting for 26.6 per cent of the wage-earners and 40.6 per cent of the wages.

Table 3, compiled from reports of the United States Geological Survey, shows the value of the annual production of the principal minerals of the state from 1889 to 1902.

TABLE 3.—*Value of annual production of principal minerals: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Iron ore.	Limestone.
1889	$3,961,491	$1,511,611	$324,814
1890	4,202,469	(1)	324,814
1891	5,087,596	(1)	300,000
1892	5,788,898	2,442,575	325,000
1893	5,096,792	1,490,259	205,000
1894	4,085,535	1,240,895	210,269
1895	5,126,822	1,460,600	222,424
1896	5,174,135	1,417,451	180,924
1897	5,192,085	1,546,543	221,811
1898	4,932,776	1,632,208	242,295
1899	8,256,462	2,601,609	364,636
1900	9,793,785	2,629,068	533,608
1901	10,000,892	2,587,719	619,423
1902	12,419,666	3,936,812	759,617

[1] Not reported.

Coal.—The coal fields of Alabama form the southern end of the great Appalachian basin, extending from near the northern boundary of Pennsylvania to Tuscaloosa, Ala. The Warrior is the principal field and underlies an area estimated at 7,810 square miles, or nearly ten times the combined areas of other fields in the state, known as the Cahaba and Coosa fields.[1] It is made up of beds in Jefferson, Walker, Winston, Tuscaloosa, Fayette, Marion, Blount, Cullman, and Etowah counties, and contains 23 regular seams, varying in thickness from a few inches to some 16 feet, the total thickness of all seams reaching in some places as high as 115 feet.[2] This is one of the richest coal fields in the world, the quantity of available merchantable coal being estimated at 108,394,000,000 tons—enough at the present rate of consumption to supply the world for over 270 years. The Cahaba field, the area of which has been estimated at 435 square miles, lies in St. Clair, Jefferson, Shelby, and Bibb counties, and the Coosa field, with an area of 415 square miles, embraces portions of Calhoun, St. Clair, and Shelby counties.[3]

The earliest notice of the use of Alabama coal appears in a letter written in 1834.[4] It was then brought down to Mobile from Tuscaloosa in flatboats and sold at the same price as the Liverpool coal, from $1 to $1.50 per barrel. In 1849 but three beds were worked underground, the rest of the coal being taken from the bed of the Warrior river and other streams during the low stages of the water. Before and during the Civil War the industry progressed slowly.

The coal and iron development of the state began about 1870, and with the exception of the panic years 1893–94 each year since has shown an increase in the coal production. The coal counties are Bibb, Blount, Cullman, Etowah, Jefferson, Marion, St. Clair, Shelby, Tuscaloosa, Walker, and Winston; but a little more than one-half of the coal is produced in Jefferson county and over 89 per cent in Jefferson, Walker, and Bibb counties. Cannel, lump, free burning, coking, and gas coals are produced. The manufacture of coke consumed 4,237,491 tons in 1902, 2,760,298 tons of which were made into coke at the mines.[5]

The following table shows the production of bituminous coal in Alabama from 1870 to 1902, inclusive, the figures being compiled from the reports of the United States Geological Survey, "Mineral Resources of the United States:"

TABLE 4.—*Annual production of coal, bituminous: 1870 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
Total	102,405,636	1886	1,800,000
		1887	1,950,000
		1888	2,900,000
1870	13,200	1889	3,572,989
1871	15,000	1890	4,090,409
1872	16,800	1891	4,759,781
1873	44,800	1892	5,529,312
1874	50,400	1893	5,136,935
1875	67,200	1894	4,897,178
1876	112,000	1895	5,603,775
1877	196,000	1896	5,748,697
1878	224,000	1897	5,893,770
1879	280,000	1898	6,535,283
1880	380,800	1899	7,593,416
1881	420,000	1900	8,394,275
1882	896,000	1901	9,099,052
1883	1,568,000	1902	10,354,570
1884	2,240,000		
1885	2,492,000		

Iron ore.—Almost all of the known ores of iron occur, but (except for small quantities of specular hematites, magnetites, and pyrite) only two are mined, the red hematite—Clinton fossil ore, red ore or Red Mountain

[1] Transactions of the American Institute of Mining Engineers, Vol. XIX, page 296.

[2] Alabama Geological Survey, Report on the Warrior Coal Basin, 1899, page 4.

[3] Transactions of the American Institute of Mining Engineers, Vol. XVII, page 207.

[4] Handbook of Alabama, by Saffold Berney, 1878, page 256.

[5] United States Geological Survey, "Mineral Resources of the United States," 1902, page 453.

ores—and limonite or brown ores. The red hematite or Clinton fossil ore belt has been the main dependence of the coke-iron industry.

The first iron furnace was built about 1818, a few miles west of Russellville, in Franklin county, and was abandoned in 1827.[1] A furnace was built at Polksville, in Calhoun county, in 1843, the Shelby furnace at Shelby, in Shelby county, in 1848, and one at Round mountain, in Cherokee county, in 1853. These were all charcoal furnaces, and were the only ones in Alabama enumerated by Leslie in 1856. The total product in that year was 1,495 gross tons of pig iron.[2] During the Civil War several new iron enterprises were undertaken, but it was not until about 1870 that the industrial development of the region of which Birmingham is the center set in. The history of Birmingham, which, in 1900, had a population of 38,415, dates from July, 1871, when it was laid out by the Ealyton Land Company.

The following table, compiled from the reports of the United States Geological Survey, shows the production of iron ore from 1889 to 1902:

TABLE 5.—*Annual production of iron ore: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1889	1,570,319	1896	2,041,793
1890	1,807,815	1897	2,098,621
1891	1,986,830	1898	2,401,748
1892	2,312,071	1899	2,602,943
1893	1,742,410	1900	2,769,247
1894	1,493,086	1901	2,801,732
1895	2,199,890	1902	3,574,474

Limestones and dolomites.—The state has extensive deposits of limestone, and 33 quarries were in operation in 1902 in the counties of Blount, Calhoun, Colbert, Dekalb, Etowah, Franklin, Jackson, Jefferson, Lee, Shelby, and Talladega. Naturally the iron furnaces are the largest consumers of limestone as flux, and over 90 per cent of the state's output was for flux and lime burning. A dark, compact limestone occurs near Calera, Shelby county, and a light colored, finely fossiliferous one near Dickson, Colbert county.

Sandstones and quartzites.—The sandstone quarries are in the Potsdam sandstone, which has been opened in Colbert and Talladega counties, and in the sandstones of the Coal Measures. On the line of the Alabama Great Southern Railroad there occurs a yellow sandstone which is sufficiently soft to be cut with an ax, but hardens on exposure.

Clay.—Fire clays are common in the Coal Measures and also in the lowest Cretaceous beds. In the Tuscaloosa formation pottery or stoneware clays are found in Blount, Cherokee, Colbert, Elmore, Tuscaloosa, Pickens, Lamar, Fayette, Marion, and Franklin counties. China clays, kaolin, and ball clays have been found at Rock Run, Cherokee county; Gadsden, Etowah county; Kymulga, Talladega county; Fort Payne, Dekalb county; Chalk Bluff, Marion county; and Pegram, Colbert county. The kaolin found in many portions of the state is in purity all that could be desired. At New Jacksonville and 4 miles northeast of Louina, Randolph county, extensive beds occur. As the reported clay product of the state is only for clay dug or mined and sold as such, it is by no means a measure of the total volume of the product mined, since most of the manufacturers dig their own clay. The extent and diversity of the clay manufactures are shown by the fact that there were 93 establishments in 1900 in the classes of brick and tile and pottery, terra cotta and fire clay products, having a value of $883,129.

All other minerals.—The bauxite belt extends in a northeasterly and southwesterly direction through Cherokee, Etowah, Calhoun, Cleburne, and Talladega counties, with an average width of about 10 miles. It is at the bottom of the Knox dolomite of the Lower Silurian rocks.[3] As early as 1888 ore from near Anniston, in Calhoun county, was identified as bauxite and tested in iron furnaces as to its adaptability for furnace linings.[4] The deposits are all in pockets and are definitely connected with the numerous fault lines of the region. On the expiration of the patents under which the manufacture of aluminum is now held as a monopoly, the manufacture of this metal should be added to the industries of the state, since the state possesses both the ore and cheap power for electric generation. Numerous waterfalls and rapids are available for power, though the abundance and cheapness of coal has much retarded their utilization.

The state possesses all the materials for the manufacture of hydraulic cement, both from natural products (limestone and clay), and from basic slags and lime. Undoubtedly this is destined to be a growing industry. The state now has one Portland cement plant and two slag cement establishments.

Although the present gold yield is trifling, the extent of the auriferous deposits makes it probable that the gold mines of the state may again become of some importance. The state possesses an abundance of low-grade ores, which, with improved methods of concentration and extraction, may be worked profitably. The discovery of gold in Alabama followed soon after the gold discovery in Georgia in 1829, though there were no mint returns from the state until 1840. Gold is found in Cleburne, Clay, Talladega, Coosa, Chilton, Elmore, Tallapoosa, Chambers, and Randolph counties, both in quartz veins and surface gravel. All the earlier

[1] Annual Statistical Report of the American Iron and Steel Association, 1900, page 17.
[2] Iron in All Ages, by James M. Swank, page 293.
[3] United States Geological Survey, "Mineral Resources of the United States," 1892, page 237.
[4] The Mineral Industry, 1895, Vol. IV, page 49.

mining was placer, no attention being given to auriferous quartz until later. The chief districts were the Goldville district, Tallapoosa county, and the Arbacoochee district, Cleburne county, the latter at one time employing from 1,500 to 1,800 men in the placer mines. The total value of the gold and silver product to date, excluding that for 1895, which was not separately reported, is, according to the estimates of the Director of the Mint, $450,289, of which $365,300 was produced prior to 1880, the greatest product being between 1840 and 1849.

Graphite has been mined in Cleburne and Clay counties and largely used for furnace linings. The graphite mined in 1902 was from Clay county.

The state is rich in marbles, and a report of their production was made for 1902. A white marble occurs 4 miles west of Talladega and at several other points in the same county, and a black marble is obtained south of Talladega. Variegated marbles are widely distributed in the Tennessee valley, and the mountain limestone at many points is of great purity. The colors are gray with red veins, red and yellow, buff with fossils, and white crystalline clouded with red and black.[1]

Pyrite occurring in a semicrystalline state has been prospected in Clay county, and the pyrite output for 1902 came from this county.

[1]Stones for Building and Decoration, by George P. Merrill, page 204.

ARIZONA.

Table 1 is a summary of the statistics of the producing mines and quarries of the territory of Arizona for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Copper.	Gold and silver.	Sandstones and quartzites.	All other minerals.[1]
Number of mines or quarries	113	30	74	4	5
Number of operators	158	30	74	4	50
Salaried officials, clerks, etc.:					
Number	445	258	169	9	9
Salaries	$710,183	$399,275	$283,033	$16,775	$11,100
Wage-earners:					
Average number	5,323	3,797	1,442	32	52
Wages	$5,059,065	$3,497,528	$1,498,251	$24,922	$38,364
Contract work	$159,942	$122,337	$37,605		
Miscellaneous expenses	$302,495	$256,753	$114,046	$9,005	$12,691
Cost of supplies and materials	$3,060,521	$2,135,676	$873,091	$50,220	$1,534
Value of product	$11,197,375	$8,279,224	$2,764,677	$107,910	$45,564

[1] Includes operators as follows: Fluorspar, 2; lead and zinc, 1; precious stones, 46 (1 mine); siliceous crystalline rocks, 1.

Arizona ranks third among the states and territories in copper product, with a rapidly increasing output. The territory has extensive mineral deposits, and is famous for the number of its big copper camps—among them being Bisbee, Jerome, Clifton-Morenci, and Globe—and the deposits are not confined to one locality or district. It is also a large producer of gold and silver, and the agatized forest near the town of Holbrook is unique.

There are evidences of rude mining by prehistoric people at a number of points, and it is more than probable that the reduction of copper carbonates was practiced by the aborigines. Lieutenant Cushing discovered ancient oven furnaces in the Salt river valley near ancient copper quarries or pocket mines, with slag and charred grease wood in them, and tests of copper smelting which he made therein, produced copper buttons.[1] It seems likely that the iron ochers, malachites, and azurites were mined in a crude way for pigments, and prehistoric turquoise mines have been found at several points, notably in the Dragoon mountains.[2] The various canyons are said to afford sections of every geological formation known in America and present unsurpassed facilities for the study of the earth's crust to a great depth.[3]

In addition to the mines referred to in Table 1 and which were the source of commercial production in 1902, coal is found in the territory—the Deer Creek or San Carlos field having been known for many years—but on account of its inaccessibility it has not been commercially worked. Extensive deposits of onyx on Big Bug creek, Yavapai county, were located in 1890, since which time the beds have been opened at many places there, and also at Cave creek. The colors are various shades of red, pink, brown, yellow, and green, the latter predominating. These have been worked to a considerable extent but were idle in 1902. Onyx marble in black and white occurs in Kirkland valley and also near Greaterville.[4] Tungsten was discovered in the Dragoon mountains near Benson, Cochise county, in 1896, and the domestic production in 1898 was chiefly from this locality. It is of the manganiferous variety known as hübnerite.[5] It also occurs in the Arivaca district, Pima county; in Mohave county, 16 miles south of Hackberry; and at the Mammoth mine in Pinal county. Gypsum deposits are found near Phoenix and at many other points. In the Santa Rita mountains, Pima county, extensive deposits of a thickness estimated at over 200 feet were discovered by Prof. W. P. Blake in 1896. Nickel has been reported as found in Pima county,[6] and quicksilver ore occurs near Copper Basin, Yavapai county.[7] Bismuth, magnesite, and molybdenum are also found.

There were 381 operators engaged in development work, without production, during the year, of whom 380 were reported for gold and silver and 1 for petro-

[1] American Anthropologist, January, 1904, pages 95 and 96.
[2] The Copper Handbook, by Horace J. Stevens, page 100.
[3] Lippincott's Pronouncing Gazetteer of the World, page 523.
[4] United States Geological Survey, "Mineral Resources of the United States," 1900, page 775.
[5] The Mineral Industry, 1898, Vol. VII, page 719.
[6] Ibid., 1901, Vol. X, page 484.
[7] United States Geological Survey, "Mineral Resources of the United States," 1892, page 161.

leum. These operators gave employment during the year to 386 salaried officials, clerks, etc., who received $459,452 in salaries and 2,246 wage-earners, who were paid $2,329,945 in wages. For work done by contract $197,324 was paid to 317 employees. The miscellaneous expenses amounted to $124,849 and the cost of supplies and materials to $924,313.

Table 2 shows the value of the products of the manufacturing industries of the territory, based primarily upon minerals mined or quarried, and also the value of all products manufactured in Arizona in 1900.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of products.	
All manufactures		$21,315,189
Based upon products of mines or quarries:		
Clay, glass, and stone products	$108,758	
Iron and steel and their products	49,975	
Metals and metal products, other than iron and steel	17,301,417	
Miscellaneous industries[1]	267,722	
		17,727,872
All other		3,587,317

[1] Includes products of 1 establishment under chemicals and allied products.

According to Table 2 the value of the products of manufactures, based primarily upon minerals mined or quarried, amounted to $17,727,872, or 83.2 per cent of the total. The total value of the product of mines and quarries in Arizona in 1902 and manufactures in 1900 was $32,512,564, of which amount mines and quarries contributed 34.4 per cent and manufactures 65.6 per cent.

The average number of wage-earners in Arizona engaged in mining, as reported for 1902, was 5,323 and the wages paid amounted to $5,059,065. The average number of wage-earners engaged in manufactures as reported at the Twelfth Census was 3,266, and the wages paid amounted to $2,369,065. Thus, the two industries together gave employment to an average of 8,589 wage-earners during the year and paid $7,428,130 in wages. Mines and quarries, therefore, gave employment to 62 per cent of the wage-earners and paid 68.1 per cent of the wages, while manufactures furnished employment to 38 per cent of the wage-earners and paid 31.9 per cent of the wages.

Copper.—Within the present area of the United States the first western smelting was done before the Gadsden Purchase, in New Mexico and Arizona, which were not separated until 1863. The copper mines in the Santa Rita mountains near Silver City, N. Mex., were actively worked and their ores smelted early in the century, and the first copper smelting done after the cession of New Mexico and Arizona and before the Civil War was at the Hanover mine. The copper bars were hauled to Galveston, Tex. Shortly afterward copper was mined on the Bill Williams Fork, Arizona, which empties into the Colorado at Aubrey. Most of it was shipped as ore, but there stood at Aubrey in 1895 an old ruined water-jacketed furnace of most odd design. There is no local tradition as to when it was used, and, therefore, it may represent the first attempt at water-jacketed furnaces, as applied to copper smelting.[1]

The Clifton copper district, now generally known as Clifton-Morenci, was discovered about 1865 and has been the scene of continuous mining since 1872. It is the oldest producing copper mining district in Arizona.[2] The first smelting was done in 1874 at the Longfellow mine, with a small Mexican adobe furnace, a blast being supplied by a common blacksmith's bellows.[3]

The second copper district to become productive was the Warren district, better known as the Bisbee mining camp, located in the Mule Pass mountains, Cochise county. It was originally discovered by Henry Warren, but it was not until 1879 that any work of moment was done. The first water-jacket furnace put up in Arizona, of which there is an authentic record, was erected in the autumn of 1880 at the since famous Copper Queen mine, which from that time to the present has been a famous producer.[4]

A great impetus has been given to mining in this district by the success of the Calumet and Arizona Mining Company in developing ore with deep mining. Although nothing of particular value was encountered above a depth of 700 feet, the immense ore bodies opened up below that level have made this property, which became a producer in 1902, one of the future great mines of the world.[5] The deep developments on an extensive scale inaugurated by a number of companies in this camp gives promise of a large increase in the copper product of the territory within the near future.

The Globe district in Gila county has been a large producer since 1882. The original discovery was made many years before, but no locations were made, as copper was at that time valueless in that inaccessible territory.[6]

The Jerome district has been made famous by the United Verde, which was originally a small gold and silver mine. The mine is opened on a single monstrous lens of sulphide ore, in slate, said to be at least 1,900 feet long, with an extreme width of 600 feet and having a dip of 72 degrees. The ore, owing to excess of sulphur, frequently catches fire from spontaneous com-

[1] The Mineral Industry, 1895, Vol. IV, page 280.
[2] Transactions of the American Institute of Mining Engineers, Vol. XV, page 28.
[3] Ibid., page 42.
[4] Ibid., page 52.
[5] The Copper Handbook, Vol. III, page 225.
[6] Transactions of the American Institute of Mining Engineers, Vol. XV, page 60.

bustion, and the mine has suffered much from fires. Owing to the precipitous nature of the ground and the location of the smelter and town of Jerome in a narrow gorge, with the smelter squarely on top of the mine, the ore is handled in a somewhat unique fashion. All ore is sent to the 500-foot level and thence trammed out through a 1,300-foot tunnel to the roast yard. When roasted, the ore is trammed back through the tunnel into the mine and hoisted through the shafts to the smelter.[1]

Besides these big camps, there are a number of others which would be notable in any other section of the country. The Ajo copper mines in Yuma county were among the first discovered.

Gold and silver.—Ores of gold and silver are widely distributed and the territory has a number of notable mines. The bonanza of the Silver King mine of Pinal county, discovered in 1874, is famous in the annals of the territory.[2] It is credited with the payment of $2,000,000 in dividends. The first locations in Tombstone, Cochise county, were made in 1878, and up to January 1, 1882, or in less than three years, the gold and silver output of the camp aggregated $7,359,200, of which over $3,000,000 had been disbursed in dividends.[3] Following the decline in the price of silver, and partly on account of difficulties experienced in draining the mines at Tombstone, they closed down and remained idle for a number of years. Active work was resumed in the Tombstone mining district in 1901–2, nearly all the important claims having been combined in the hands of one company.[4]

The Congress mines in Yavapai county were first opened in 1887, and were successfully operated until September, 1891, when they were closed, and the property remained idle until March, 1894. The mines have now been opened to a depth of 1,300 feet.[5]

The La Fortuna and the King of Arizona, of Yuma county, the Mammoth, of Pinal county, and the famous Vulture, of Maricopa county, which in years past was one of the great wealth producers of the Southwest, are but a few of the mines which have helped to make the reputation of Arizona.

Table 3, compiled from the annual reports of the Director of the Mint, shows the annual production and value of gold and silver in the territory of Arizona from 1889 to 1902, inclusive.

[1] The Copper Handbook, Vol. III, page 530.
[2] The Mineral Industry, 1892, Vol. I, page 230.
[3] Transactions of the American Institute of Mining Engineers, Vol. X, page 334.
[4] Report of the territorial governor of Arizona, 1902, page 40.
[5] Ibid., 1903, page 123.

TABLE 3.—*Annual production and value of gold and silver: 1889 to 1902.*

[Reports of the Director of the Mint.]

YEAR.	GOLD.[1]		SILVER.[1]	
	Fine ounces.	Value.	Fine ounces.	Coining value.
1889	43,537	$900,000	1,500,000	$1,9[illegible]
1890	48,375	1,000,000	1,000,000	1,2[illegible]
1891	47,166	975,000	1,480,000	1,9[illegible]
1892	51,761	1,070,000	1,161,900	1,5[illegible]
1893	57,286	1,184,200	2,935,700	3,7[illegible]
1894	96,313	1,990,956	1,539,453	1,9[illegible]
1895	95,072	1,965,300	986,900	1,2[illegible]
1896	125,978	2,604,200	1,913,000	2,4[illegible]
1897	140,089	2,895,900	2,239,900	2,8[illegible]
1898	119,249	2,465,100	2,246,800	2,9[illegible]
1899	124,133	2,566,100	1,578,300	2,0[illegible]
1900	202,856	4,193,400	2,995,500	[2]1,8[illegible]
1901	197,515	4,083,000	2,812,400	[2]1,6[illegible]
1902	198,933	4,112,300	3,043,100	[2]1,8[illegible]

[1] Estimates of the Director of the Mint, value of refined product, silver at coining value. The values given in Table 1 are the values at the mine.
[2] Commercial value.

All other minerals.—Fluorspar was mined by two operators in Yuma county.

Lead ore was only produced by one mine operated as such, though the territory produces considerable lead as a by-product of its gold and silver ores.

The production of the territory classified under precious stones comprises, in the order of their values, turquoise, silicified wood, garnet, and peridot or chrysolite. Turquoises were found worn by the natives on the first entry of Marcos de Niza into the country in 1539, and prehistoric turquoise mines have been found at several points. Turquoise mining was almost unknown in the United States when the census of 1890 was taken, but it is now a regular industry. The present production of the territory comes from Mohave county. The agatized forest of Arizona, located in Apache county, not far from the town of Holbrook, affords a wealth of beautiful ornamental stone unequalled anywhere in the world. The logs and trunks of ancient trees, converted into agate and chalcedony of mingled shades, when cut and polished, give most exquisite effects of line and color. The yield reported in the last four years was $2,000 in 1898, $3,000 in 1899, $6,000 in 1900, and $7,000 in 1901.

Bohemian or pyrope garnets are found in several places in northern Arizona, and are sometimes called Arizona rubies. They are found generally around ant hills and scorpion holes, where they have been brought up and thrown out by the insects. The production of peridot or chrysolite is reported from Gila county, the specimens being found and brought in by Indians and others. The sandstone quarried was used chiefly for building stone, and the siliceous crystalline rock or granite quarried was all dressed for monumental work.

ARKANSAS.

Table 1 is a summary of the statistics of the productive mines and quarries in the state of Arkansas for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Limestones and dolomites.	Sandstones and quartzites.	Oilstones and whetstones.	Bauxite.	Siliceous crystalline rocks.	All other minerals.[1]
Number of mines or quarries	120	53	13	18	4	19	3	10
Number of operators	131	33	12	17	3	3	3	60
Salaried officials, clerks, etc.:								
Number	210	146	16	11	2	13	2	20
Salaries	$191,528	$148,113	$7,864	$5,806	$1,050	$10,875	$1,650	$16,170
Wage-earners:								
Average number	2,944	2,574	119	111	23	30	10	77
Wages	$1,945,479	$1,780,061	$63,680	$52,170	$10,615	$14,504	$4,260	$40,189
Contract work	$860	$485				$375		
Miscellaneous expenses	$95,481	$82,949	$1,716	$1,530	$685	$4,176	$945	$3,481
Cost of supplies and materials	$244,379	$177,716	$32,579	$7,915	$1,625	$10,602	$650	$13,292
Value of product	$2,840,341	$2,530,214	$113,163	$85,917	$21,275	$13,920	$12,115	$54,737

[1] Includes operators as follows: Asphaltum and bituminous rock, 1; fuller's earth, 2; gold and silver, 1; manganese ore, 2; marble, 1; mineral pigments, crude, 1; phosphate rock, 1; precious stones, 50 (no mines); slate, 1.

The chief mineral product of the state is bituminous coal, though the amount is not large. The mining of bauxite is a new and growing industry. The oilstones and whetstones of the state, made from novaculite, have a high reputation.

In addition to the minerals referred to in Table 1, there are other important mineral products of which the state has been a producer, though they were not reported as being mined in commercial quantities in 1902, and still others that exist in such quantities as to justify the belief that with development or with improved transportation facilities they may add to the wealth of the state. Among these are: Antimony, which is said to occur in sufficient quantity in Sevier county to be of commercial value;[1] Portland cement, which was formerly manufactured at White Cliffs from the chalk deposits of southwest Arkansas, but which was not produced again until 1903, the remodeling of the plant being in progress in 1902; copper, which, in the form of carbonates and sulphates, has been found in many counties, notably in Searcy, and which was partially developed in 1885;[2] and iron ores, which are found at many points in the state, but not in extensive deposits.

The tardiness of the development of the zinc and lead deposits is due in part to the topography of the district, through which there have been no railroads until recently. The zinc bearing ore district of north Arkansas is a part of the Missouri district. The first active mining was in 1875, when a smelter was erected at Calamine, Sharp county, for the reduction of carbonate ores. The enterprise was not successful, and was abandoned. In 1880 a lead smelter was erected at Leadhill and was operated for a short time. The next development of note was in 1882, when a smelter was built and a town laid out at Boxley, Newton county. Operations were continued for a year, but the long wagon haul of 95 miles to the nearest railroad was too great a tax, and operations were suspended. The Morning Star mine, in Marion county, was discovered in 1884. The exhibitor of a monster piece of zinc carbonate, which weighed 12,750 pounds, from this mine, was awarded a gold medal at the Chicago Columbian Exposition. Smithsonite, calamine, and sphalerite ores are found, the last named being the most frequent in occurrence.[3] Argentiferous lead has been found in Pulaski, Sevier, Polk, Montgomery, and Howard counties.[2] Extensive beds of gypsum, often crystallized into selenite, are found in Pike, Bradley, and Howard counties;[2] kaolin is known to occur in Pike, Pulaski, Saline, and Ouachita counties;[4] lithographic stone of excellent quality occurs near Little Rock;[5] soapstone is found in Saline county, and has

[1] Bureau of Mines, Manufactures, and Agriculture of Arkansas, Sixth Biennial Report, page 162.

[2] Products and Resources of Arkansas, by D. McRae, 1885, page 11.

[3] Transactions of the American Institute of Mining Engineers, Vol. XXXI, page 396.

[4] Bureau of Mines, Manufactures, and Agriculture of Arkansas, Fourth Biennial Report, page 110.

[5] United States Geological Survey, "Mineral Resources of the United States," 1889-90, page 519.

been quarried to some extent;[1] nickel occurs sparingly in Saline county; and oil and gas have been found in small quantities.

Development work on deposits of asphaltum, gold and silver, and natural gas was reported by 3 operators. The total expense for development work was $5,800; of this amount $4,500, expended for work done by contract, furnished employment to 5 employees.

The following table shows the value of the products of those manufacturing industries of the state in 1900 that were based primarily upon minerals mined or quarried, and also the value of all products manufactured in Arkansas during that year:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$45,197,731
Based upon products of mines or quarries:		
Clay, glass, and stone products	$652,676	
Iron and steel and their products	456,814	
Metals and metal products, other than iron and steel	229,697	
Miscellaneous industries	876,703	
		2,215,890
All other		42,981,841

According to the foregoing table the value of the products of manufactures, based primarily upon minerals mined or quarried, amounted to $2,215,890, or 4.9 per cent of the total. The combined value of the products of mines and quarries in Arkansas in 1902 and manufactures in 1900 was $48,038,072, of which amount manufactures contributed 94.1 per cent and mines and quarries 5.9 per cent.

The average number of wage-earners in Arkansas engaged in manufacturing at the Twelfth Census was 26,501 and the wages paid amounted to $8,686,291. In 1902 the average number of wage-earners reported as engaged in mining was 2,944 and the wages paid amounted to $1,945,479. The two industries, therefore, gave employment to an average of 29,445 wage-earners during the year and paid $10,631,770 in wages. Manufactures alone gave employment to 90 per cent of the wage-earners, who received 81.7 per cent of the wages, while mines and quarries furnished employment to only 10 per cent of the wage-earners, who received 18.3 per cent of the wages.

Table 3 shows the value of the annual production of the principal minerals of the state from 1890 to 1902.

[1] Products and Resources of Arkansas, 1885, page 13.

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Limestone and dolomite.	Sand and gravel.
1890	$514,535	$18,360	[illegible]
1891	647,560	20,000	[illegible]
1892	666,230	18,000	[illegible]
1893	773,347	7,611	[illegible]
1894	631,988	38,228	[illegible]
1895	751,156	47,376	[illegible]
1896	755,577	30,708	[illegible]
1897	903,993	44,222	[illegible]
1898	1,238,778	54,373	[illegible]
1899	989,383	71,965	[illegible]
1900	1,653,618	71,407	[illegible]
1901	2,068,613	68,319	[illegible]
1902	2,539,214	113,163	[illegible]

Coal.—Practically no coal was mined prior to 1878, though it has been stated that some was taken out that year. Mining on a commercial scale can hardly be considered to antedate 1883, and from that time to 1888 the production was almost entirely confined to Johnson and Polk counties.[2] Most of the coal mined is of a very superior quality.

In 1902 coal production was reported from Sebastian, Johnson, Franklin, Pope, Scott, Logan, and Ouachita counties, over 68 per cent of the product being from Sebastian county alone.

Table 4 shows the annual production of bituminous coal in Arkansas from 1880 to 1902, inclusive, the figures being taken from the 1902 report of the United States Geological Survey.

TABLE 4.—*Annual production of coal, bituminous: 1880 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
Total	13,027,979	1891	[illegible]
		1892	[illegible]
		1893	[illegible]
1880	14,778	1894	[illegible]
1881	10,000	1895	[illegible]
1882	15,000	1896	[illegible]
1883	50,000	1897	[illegible]
1884	75,000	1898	[illegible]
1885	100,000	1899	[illegible]
1886	125,000	1900	[illegible]
1887	129,600	1901	[illegible]
1888	276,871	1902	[illegible]
1889	279,584		
1890	399,888		

Limestones and dolomites.—Limestone occurs quite generally throughout the state.[1] The production in 1902 was valued at $113,163, of which $82,853 was for stone made into lime and $22,510 for crushed stone used for roadmaking and railroad ballast. The balance was for

[2] Arkansas Geological Survey, 1888, Vol. III, page 35.

riprap, building stone, curbing, and other uses. A marked increase is shown for 1902 in the value of limestone crushed for roadmaking.

Sandstones and quartzites.—The whole western side of the state is underlaid with a metamorphosed sandstone, and quarries have been opened in Carroll, Conway, Crawford, Independence, Johnson, Polk, Pope, Pulaski, Sebastian, Washington, and White counties.[1] Nearly one-half of the sandstone product was used for railroad ballast.

Oilstones and whetstones.—In the Washita mountains west of Little Rock are large masses of novaculite from which the finest whetstones, known in the market as "Arkansas" and "Washita" stones, are made. The principal quarries are on Quarry or Whetstone mountain, near Hot Springs, Garland county, though the stone is also quarried in Saline county. The stones were first put on the market about 1840, in which year a quantity of rough stone was shipped to Europe and cut into whetstones. The next year a small quantity was cut up and manufactured into oilstones at St. Louis, and since that time the demand has continued steady.[2] The Arkansas stone is a true novaculite, an average analysis showing it to contain 99.5 per cent of silica.[3]

Bauxite.—The bauxite beds of Pulaski county were discovered by John C. Branner, state geologist, in 1887. At the time the rock was identified it was being extensively used for roadmaking. In some cases it contains so much iron that the beds have been prospected with a view to using the material as an iron ore. In other cases it contains so much silica and so little water that it is not distinguishable by analysis from ordinary kaolin, and the varieties grade insensibly into each other with no line of demarcation. It has been found in Arkansas only in Tertiary areas and in the vicinity of eruptive syenites. The beds vary greatly in thickness, the thickest found being 40 feet.[4]

The production of bauxite since 1899, when it was first reported, is shown in the following table:

TABLE 5.—*Annual production of bauxite: 1899 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.
1899	5,045
1900	3,445
1901	867
1902	4,645

[1] Bureau of Mines, Manufactures, and Agriculture of Arkansas, Fourth Biennial Report, page 117.
[2] The Mineral Industry, 1892, Vol. I, page 464.
[3] United States Geological Survey, "Mineral Resources of the United States," 1901, page 785.
[4] Transactions of the American Institute of Mining Engineers, Vol. XXX, page 347.

All other minerals.—Asphaltum was reported from Pike county in 1902 by one operator.

The only states producing fuller's earth in 1902 were Arkansas and Florida, the Arkansas product coming from Saline county. It was first discovered in the United States at Quincy, Fla., in 1893, where the greater part of the output of the United States has since been obtained.

The Arkansas granite, whether as paving stone or as building material, is unsurpassed and has been used to a considerable extent within and without the state.[5] The Pulaski county quarries, three in number, were the only ones reported as in operation in 1902, with a product valued at $12,115. This is a decline from former years, the product in 1900 having been valued at $62,500.

Manganese ore was mined in 1860, though the first report of output was made in 1868. The industry increased steadily, and a decade ago Arkansas was the principal manganese producing state. Its maximum output was in 1892, when the quantity reported was 6,708 tons. Since 1896 the output has declined rapidly. The entire production has come from the Batesville district, Independence county. There are vast deposits in Polk county and also in Izard county, but the high phosphorous contents, distance from railroad, and expense of mining have rendered much of it unmarketable.[6] The annual production of this mineral from 1881 to 1902, inclusive, is shown in the following table:

TABLE 6.—*Annual production of manganese ore: 1881 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1881	100	1892	6,708
1882	175	1893	2,020
1883	400	1894	1,934
1884	800	1895	2,991
1885	1,485	1896	3,421
1886	3,310	1897	3,240
1887	5,051	1898	2,662
1888	4,312	1899	856
1889	2,528	1900	145
1890	5,330	1901	91
1891	1,650	1902	82

Although Arkansas does not take high rank as a producer of the precious metals, yet gold and silver occur in many localities. Argentiferous galena is found in Pulaski, Sevier, Polk, Montgomery, and Howard counties.[7] Gold and silver mines in Polk county were prospected as early as 1860, and mining and development work was reported in 1902, with production from one mine in Polk county.

[5] Bureau of Mines, Manufactures, and Agriculture of Arkansas, Sixth Biennial Report, 1899–1900, page 167.
[6] Products and Resources of Arkansas, 1885, page 10.
[7] Ibid., page 11.

Marble is found in Independence, Izard, Marion, Searcy, Carroll, Saline, Newton, and Madison counties. It is of fine texture and various colors—pink, gray, white, and black.[1] The value of the product reported for the state in 1899 was $3,410. A small amount was also reported in 1901. The production reported for 1902 was from Carroll county.

There are extensive deposits of ocher found near Monticello, in Drew county, and in Clay county. There are also deposits in southern Arkansas and in other parts of the state. The production of crude mineral pigments reported for 1902 was from Clay county.

Phosphate beds occur—associated with what is known as the Sylamore sandstone and the Eureka shale—in the vicinity of Hickory valley, in the neighborhood of Cushman, Independence county, and at other points. The production reported for 1902 was from Independence county. Phosphate beds are also found in connection with the beds of the Ouachita uplift, and are known to occur in some of the Cretaceous beds of the state. The Cretaceous marls of the southwestern portion of the state are very like the Greensand marls of New Jersey, and are in all probability equally suitable for fertilizers.[2]

As precious stones, the quartz crystals of Hot Springs, Garland county, are famous, and their collection for sale to tourists has been an industry of many years' standing. Though not large enough for art purposes, they are beautiful as specimens. They are also found in Montgomery and Saline counties.

Roofing slate is found in Montgomery, Pike, Polk, Pulaski, Saline, and Sevier counties. The production reported for 1902 was from Montgomery county.

[1] Products and Resources of Arkansas, 1885, page 12.

[2] Transactions of the American Institute of Mining Engineers, Vol. XXVI, page 580.

CALIFORNIA.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of California for 1902, which includes 2 operators in Alaska and 1 operator in Hawaii, to avoid disclosing operations of individual concerns.

TABLE 1.—SUMMARY: 1902.

	Total.	Gold and silver.	Petroleum.	Borax.	Copper.	Quicksilver.	Siliceous crystalline rocks.	Limestones and dolomites.	Sandstones and quartzites.	Asphaltum and bituminous rock.	All other minerals.[1]
Number of mines, quarries, and wells	4,037	1,020	2,757	4	7	36	64	17	[3]15	9	108
Number of operators	1,552	1,020	290	4	7	31	62	14	11	9	101
Salaried officials, clerks, etc.:											
Number	1,632	748	381	10	38	98	38	7	8	3	98
Salaries	$1,887,860	$1,049,846	$452,320	$14,778	$48,033	$131,278	$15,054	$9,400	$11,840	$8,280	$144,031
Wage-earners:											
Average number	12,964	7,989	1,112	141	496	1,096	920	281	363	32	534
Wages	$11,050,666	$7,101,003	$1,087,839	$108,525	$445,247	$793,926	$687,658	$163,130	$269,433	$20,631	$373,874
Contract work	$520,894	$47,066	$131,699			$22,929		$1,000			$15,200
Miscellaneous expenses	$1,783,790	$967,755	$571,138	$16,206	$15,367	$53,462	$39,232	$15,790	$11,758	$1,185	$58,897
Cost of supplies and materials	$5,673,755	$2,966,102	$1,479,528	$210,729	$211,163	$248,891	$115,429	$111,564	$80,967	$1,350	$248,029
Value of product	$28,870,405	$15,473,091	$4,873,617	$2,370,994	$1,599,663	$1,295,740	$1,137,679	[3]$521,093	$469,016	$101,353	$1,028,159

[1] Includes operators as follows: Cement, 2; chrome ore, 1; clay, 6; coal, bituminous, 10 (including 2 operators in Alaska); gypsum, 1; infusorial earth, tripoli, and pumice, 1; lithium ore, 2; magnesite, 1; manganese ore, 3; marble, 5; mica, 1 (10 mines); mineral pigments, crude, 2; natural gas, 15 (29 wells); precious stones, 47 (31 mines); slate, 1; sulphur and pyrite, 2; and talc and soapstone, 1.

[2] Includes 1 operator in Hawaii.

[3] Exceeds United States Geological Survey report by $24,250, the value of limestone quarried for cement.

Gold is by far the most important mineral product of the state. The production of gold in 1902 exceeded in value that of all other minerals combined, being approximately $15,000,000, which was nearly one-fifth of the refined gold product reported for the United States (including Alaska). Petroleum was the mineral product next in value, borax was third, copper fourth, and quicksilver fifth.

A large number of minerals are known to exist in the state that were not mined in commercial quantities in 1902: Asbestos occurs in Tulare, Yolo, Butte, Placer, San Diego, Eldorado, and Mariposa counties in small quantities. Barytes has been observed in Calaveras, San Bernardino, Plumas, and Inyo counties. Buhrstones are known to exist in Inyo county. Corundum is found in drift at San Francisco pass, Los Angeles county, and feldspar is obtainable in Mariposa county. Iron ore exists in Placer, Sierra, Eldorado, Napa, Shasta, Amador, Inyo, Alameda, Del Norte, Butte, Alpine, and Nevada counties. Marl is found in various localities; nickel is obtainable in San Benito, Kern, Monterey, Tuolumne, and Mono counties; and cobalt occurs in Los Angeles county. Tin ore is known to exist in San Bernardino county, as well as lead, which also occurs in small deposits in Mono, Shasta, Amador, and other counties. Zinc is found in Tulare and San Mateo counties.[1] A deposit of fuller's earth was opened in 1898 near Bakersfield, in Kern county.[2]

In addition to the productive mines, quarries, and wells for which statistics are shown in Table 1, considerable development was done in 1902. The operators engaged in such work exclusively, reported an expenditure of $2,925,700 for salaries and wages, contract work, supplies and materials, and miscellaneous expenses. Of this amount, 81.3 per cent was expended upon gold and silver mines, and 17.5 per cent upon petroleum interests, the remainder being for limestones and dolomites, quicksilver, iron ore, siliceous crystalline rocks, borax, asphaltum, bituminous rock, and marble.

Table 2, showing the annual value of production of the principal minerals from 1890 to 1902, except copper ore, for which values can not be obtained, has been compiled from the United States Geological Survey, "Mineral Resources of the United States," and from reports of the Director of the Mint.

[1] United States Geological Survey, "Mineral Resources of the United States," 1887, pages 704 to 707.

[2] The Mineral Industry, 1898, Vol. VII, page 271.

TABLE 2.—VALUE OF PRODUCTION OF PRINCIPAL MINERALS: 1890 TO 1902.

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Gold.[1]	Petroleum.	Borax.	Silver.[1]	Siliceous crystalline rocks.	Limestones and dolomites.	Sandstones and quartzites.	Coal, bituminous.	Natural gas.	Marble.	Manganese ore.
1890	$12,500,000	(2)	$480,152	$1,163,636	$1,329,018	$516,780	$175,598	$283,019	$33,000	$87,030	$3,176
1891	12,600,000	$401,264	640,000	969,697	1,300,000	400,000	100,000	204,902	30,000	100,000	3,850
1892	12,000,000	561,333	838,787	465,155	1,000,000	400,000	50,000	209,711	55,000	115,000	.....
1893	12,080,000	608,092	593,292	607,806	531,322	288,626	26,314	167,555	62,000	10,000	2,000
1894	13,863,282	823,423	807,807	927,506	307,000	288,900	10,087	155,620	60,350	13,420	1,800
1895	14,928,600	819,082	595,900	845,180	348,806	322,211	11,933	175,778	55,000	22,000	5,400
1896	15,235,900	1,240,990	675,400	776,533	215,883	143,805	7,267	220,523	55,682	4,000	3,415
1897	14,618,300	1,713,102	1,080,000	613,366	167,518	308,925	4,035	265,236	50,000	48,690	2,788
1898	15,637,900	1,917,596	1,153,000	830,448	247,420	229,720	358,908	405,915	65,337	40,200	3,222
1899	15,197,800	2,508,751	1,139,882	1,065,762	471,665	287,295	261,193	430,636	86,891	6,500	855
1900	15,816,200	4,076,975	1,013,251	[3] 583,668	738,993	407,489	200,090	523,231	79,083	17,500	1,310
1901	16,891,400	4,974,540	1,012,118	[3] 555,360	1,134,675	645,455	301,028	394,106	67,602	6,642	3,610
1902 [4]	16,792,100	4,873,617	2,370,994	[3] 477,424	1,137,679	521,093	462,328	254,350	120,648	92,298	10,175

[1] Estimates of the Director of the Mint, coining value.
[2] Value not reported—307,360 barrels.
[3] Commercial value.
[4] Census figures, except for gold and silver.

Of the principal minerals, bituminous coal and siliceous crystalline rocks are the only ones for which the value of production was smaller in 1902 than in 1890. The production of petroleum, which is rapidly replacing coal as a fuel, has very largely increased since 1890. Gold has increased from $12,500,000 in 1890 to $16,792,100 in 1902, but the value of the silver production has fluctuated. There has been a steady increase in the production of building stone since 1896, and in 1902 quarrying stood among the important industries of the state. The value of siliceous crystalline rocks in 1902 was $1,137,679, or more than one-half the value of all stone quarried. Limestone, sandstone, marble, and slate were also produced, ranking in value of product in the order named.

Gold and silver.—In California gold is found chiefly in a belt from 20 to 60 miles wide extending along the lower slopes of the Sierra Nevadas a distance of about 700 miles.[1]

The principal gold regions were in Amador, Butte, Calaveras, Eldorado, Fresno, Inyo, Mariposa, Mono, Nevada, Placer, Plumas, San Bernardino, San Diego, Shasta, Sierra, Siskiyou, Trinity, and Tuolumne counties.[2] California gold averages about 88 per cent fine (United States Mint). Many analyses, however, ran up to 95 per cent or higher.[3] The gold occurs principally in auriferous gravels, high or deep gravels, and in gold-bearing quartz veins.[4]

The occurrence of placer gold in California was discovered near the Colorado river in San Diego county as early as 1775.[5] On January 19, 1848, it was found near Coloma, Eldorado county, on Col. John Sutter's land, by James Wilson Marshall. The California legislature, in 1887, honored the memory of Marshall by appropriating $5,000 for a monument over his grave in Coloma.

[1] Treatise on Ore Deposits, by J. A. Phillips and Henry Louis, page 741.
[2] Dana's Mineralogy, page 1095.
[3] Ibid., page 15.
[4] Ore Deposits of the United States, by James F. Kemp, pages 243 and 248.
[5] California State Mining Bureau, Fourth Annual Report, 1884, page 217.

The first deposit of California gold in a United States mint was made on December 8, 1848, and in 1850 an assay office was established at San Francisco. At the outset the precious metal was obtained by alluvial washings, but in 1852 quartz mining became prominent, and has now largely supplanted the placer operations.

In 1849, the first year after its discovery by Marshall, the production of gold in California was $5,000,000. Rapidly increasing year by year, the production in 1853 was nearly $60,000,000. Since then it has diminished until in 1866 the amount was but $27,000,000, and from 1881 to 1888 it varied from $18,200,000 to $12,750,000.[6] During the last ten years, up to 1902, the California gold production has been more steady, the average yearly value of product for this decade being $15,106,148.

Silver mining interests in the state are small as compared with gold. Deposits of silver chloride, occurring in fissure veins, small fractures, and pockets in liparite and tufaceous sandstone, are disseminated sparingly in the southwestern and other portions of the state.[7]

The production of silver in 1902 was reported in 27 counties, the principal of which are Shasta, Kern, San Bernardino, Calaveras, Mono, Fresno, and Inyo in the order named.[8]

The following table of annual production in fine ounces of gold and silver is compiled from the estimates of the Director of the Mint:

TABLE 3.—*Annual production of gold and silver: 1890 to 1902.*

YEAR.	Gold (fine ounces).	Silver (fine ounces).	YEAR.	Gold (fine ounces).	Silver (fine ounces).
1890	604,687	900,000	1897	707,160	474,400
1891	609,525	750,000	1898	756,483	642,300
1892	580,500	392,200	1899	735,194	824,300
1893	584,370	470,100	1900	765,109	941,400
1894	656,468	717,368	1901	817,121	925,600
1895	722,171	653,700	1902	812,319	900,800
1896	737,036	600,600			

[6] Descriptive Mineralogy, pages 18 and 19.
[7] Ore Deposits of the United States, page 242.
[8] Report of the Director of the Mint, 1902, page 79.

Petroleum.—The area of petroleum bearing land has proved much greater than was at first supposed, and a good demand has stimulated prospecting in new territory. Oil bearing territory has even been found to extend under the ocean, and at Summerland, wells have been driven 200 feet from shore. The saving by the use of oil in the generation of steam for electric light and power plants and as a locomotive fuel, estimated at from 30 to 50 per cent, has caused it to replace coal, especially in sugar and other manufactories. Petroleum has also been quite extensively introduced as a household fuel. In the region of Los Angeles successful experiments with it have been made in improving the public highways. When sprinkled on a dry road the hot oil combines with the dust and forms a hard surface, durable and dustless.[1]

The production of petroleum has increased from a product of 303,220 barrels, valued at $356,048, in 1889, to 13,984,268 barrels, having a value of nearly $5,000,000, in 1902. This increase is best illustrated in the following table, compiled from reports of the United States Geological Survey, "Mineral Resources of the United States":

TABLE 4.—*Annual production of petroleum: 1891 to 1902.*

YEAR.	Barrels (42 gallons).	YEAR.	Barrels (42 gallons).	YEAR.	Barrels (42 gallons).
1891	323,600	1895	1,208,482	1899	2,642,095
1892	385,049	1896	1,252,777	1900	4,324,484
1893	470,179	1897	1,903,411	1901	8,786,330
1894	705,969	1898	2,257,207	1902	13,984,268

[1] United States Geological Survey, "Mineral Resources of the United States," 1899, page 156.

California oil is generally dark in color and heavy in specific gravity, differing from the Pennsylvania and Ohio product in that its base is asphaltum rather than paraffin. This quality makes it very valuable for the manufacture of varnishes, lubricants, etc. In some instances the oil is a semiviscid bitumen called maltha or brea. This substance, when refined as petroleum, reveals a considerable by-product of asphaltum, which has a limited market on the Pacific coast for paving purposes. Gasoline and a very satisfactory grade of lubricating oil are produced, but the illuminating product does not compare favorably with the eastern production.

Borax.—The Great Basin, lying between the Wasatch and the Sierra Nevada mountains, forms an alkaline plain which has been found to contain valuable borax deposits.[2] This plain is marked by desiccated lake beds in which certain salts derived from the rocks of their watersheds have concentrated. These dry lakes and alkali marshes may be found in all degrees of saturation, often covered with a crust beneath which is deep water or slime.

The mineral borax was discovered in Borax Lake, Lake county, by Dr. John A. Veatch, in 1856, but no attempt at working the deposit was made until 1864. The following table of borax production in the state, illustrates the growth, value, and locality of the industry up to 1890:[3]

[2] The Mineral Industry, Vol. I, 1892, page 43.

[3] California State Mining Bureau, Bulletin No. 24, May, 1902, "The Saline Deposits of California," by Gilbert E. Bailey, E. M., Ph. D., page 39.

TABLE 5.—ANNUAL PRODUCTION AND VALUE OF BORAX: 1864 TO 1889.

YEAR.	Production (pounds).	Value per pound (cents).	Value per ton (dollars).	Total value (dollars).	Remarks.
1864	24,304	39	780	9,478	Lake county, Borax Lake.
1865	251,092	37½	750	94,099	Lake county, Borax Lake.
1866	401,632	33	660	132,538	Lake county, Borax Lake.
1867	430,824	35½	710	150,137	Lake county, Borax Lake.
1868	64,513	33½	666	22,384	Lake county, Borax Lake.
1869	Nil.	35½	704	Nil.	None produced.
1870	Nil.	30½	604	Nil.	None produced.
1871	Nil.	31½	625	Nil.	None produced.
1872	280,000	32	640	89,600	Lake county, Lake Hachinhama.
1873	1,030,000	24¾	496	255,440	San Bernardino county, 760,000 pounds; other counties, 280,000 pounds.
1874	1,829,771	14¼	284	259,427	San Bernardino county, 1,729,891 pounds; other counties, 99,980 pounds.
1875	2,336,000	12⅜	247½	289,080	San Bernardino county, 2,147,000 pounds; other counties, 189,000 pounds.
1876	2,873,909	10⅞	201½	312,537	San Bernardino county, 2,752,000 pounds; other counties, 121,909 pounds.
1877	1,986,970	9¾	195	193,705	San Bernardino county, marshes.
1878	746,840	8⅞	161½	66,257	San Bernardino county, marshes.
1879	727,146	9	180	65,443	San Bernardino county, marshes.
1880	1,218,000	12¼	245	149,245	San Bernardino county, marshes.
1881	1,380,000	13¾	275	189,750	San Bernardino county, marshes.
1882	1,464,000	13¾	275	201,300	San Bernardino and Inyo counties, marshes.
1883	1,800,000	14¾	295	265,500	San Bernardino and Inyo counties, marshes.
1884	2,038,000	9¾	195	198,705	San Bernardino and Inyo counties, marshes.
1885	1,884,000	8¼	165	155,430	San Bernardino and Inyo counties, marshes.
1886	2,570,000	6¾	135	173,475	San Bernardino and Inyo counties, marshes.
1887	2,030,000	5¾	115	116,725	Suspension of marsh bed workings.
1888	2,810,000	7	140	196,636	San Bernardino county, Calico district; Ventura county.
1889	1,930,000	7	140	145,473	San Bernardino county, Calico district; Ventura county.

Lake, San Bernardino, Inyo, and Ventura counties are the principal fields of borax deposits. In the Calico district, San Bernardino county, borate of lime is taken from a fissure vein and this is said to be the only place in the world where deep mining for borax is carried on.[1] These deposits, discovered in 1882, are very productive, and the workings have been extended to a considerable depth.

An interesting feature in connection with borax production is the phenomenal decrease in the value from 39 cents per pound to about 7 cents at the present time. The deposits of California are very extensive, and in some instances only an increased demand and a consequently higher price are necessary to make them profitable workings.

Copper ore.—Copper was not mined in California until 1860,[2] although the mineral was discovered in Los Angeles county as early as 1840. The period from 1860 to 1867 was one of considerable activity, and thousands of tons of copper ore were shipped to the Atlantic coast and Europe for reduction. Then occurred a depression in copper production in California due to a fall in prices, and for over fifteen years copper remained as one of the minor minerals of the state. In 1895 and 1896, when the rich deposits of Shasta county began to be worked with success, there occurred a general revival of copper mining in the entire state, and from 1897 copper production has been accounted one of the leading industries of California.

Copper deposits are said to occur in almost all of the counties of the state, but the principal regions of commercially important production are as follows:[3] Shasta county, the Coast Range, the Sierra Nevada, and the mineralized deserts of southeastern California. The Shasta county copper mines, in the north central part of the state, are the principal source of production, and the copper belt of the western slope of the Sierras, with its 400 miles of almost continuous copper deposits, occupies second place. The Coast Range copper deposits have been developed only in Del Norte county, but superficial prospecting displays the existence of the mineral throughout almost the entire length of the range. The copper deposits of southern California are scattered and do not form a regular chain or belt as do those of the three more important localities.

Quicksilver.—The American production of this mineral is principally in California. Cinnabar or sulphide of mercury was discovered there in 1845, and mining began at New Almaden in 1850.[4] In the Coast Range for 100 to 150 miles north and south of San Francisco occurrences of this ore are found to exist, most generally in irregular bodies distributed through metamorphic rocks of Cretaceous age. Quartz, calcite, and magnesite are the usual gangue minerals. In 1902 production was reported in nine counties in the state, amounting to $1,295,740 in value, of which $1,228,498 was the value of refined product in flasks of 76½ pounds each, and $67,242 the value of crude cinnabar not concentrated.

Siliceous crystalline rocks.—The quarrying of siliceous crystalline rocks in California began as early as 1853,[5] and in 1902 this industry ranked sixth in value of products among the mineral industries of the state.

Limestones and dolomites.—The total production of limestone in 1902 was somewhat less than that of the preceding year, due largely to the great decrease in its use as a paving material. Considerable interest centers in the use of limestone in the manufacture of cement, and in 1902 an amount valued at $24,250 was reported as used for this purpose.

Sandstones and quartzites.—The value of sandstone product reported in 1902 was $462,328, the largest production in any year during the period 1890 to 1902. During the last five years the quarrying of this stone has advanced from a minor industry to a position of importance in the state, and in 1902 California ranked fifth in sandstone production in the United States. Extensive quarrying was begun in 1898 to supply rough stone for breakwaters and jetties, and for several years was used principally for this purpose. In 1901 and 1902 its use for building purposes became of most importance.

Marble.—The value of production of marble in 1902 amounted to $92,298, or more than that of any other year since 1892. Of this amount $33,198 was reported as the value of the rough, unfinished marble for all purposes and $55,000 as that of marble used in interior decoration, the remainder being the value of the marble intended for monumental and ornamental work. The deposits are principally in the southern portion of the state, although occurrences are reported in the extreme north. California onyx is the most valuable of the marbles quarried, and is generally found in proximity to hot springs or associated with minerals known to have resulted from such waters.[6]

Slate.—A roofing slate, blue-black in color, with good cleavage, is produced in Eldorado and Mariposa counties, but statistics can not be given without disclosing the operations of individual establishments.

Asphaltum and bituminous rock.—The mineral asphaltum was known to exist in California long before it was commercially produced; there is a record of its use by the Indians and the Catholic fathers. The discovery of bituminous rock is said to have been in 1868 near Santa Cruz, and its use at that time, although local, was considered a success. The hard asphaltum occurs chiefly in Santa Barbara and Ventura counties; the

[1] California State Mining Bureau, Bulletin No. 24, page 38.
[2] Ibid., Bulletin No. 23, "The Copper Resources of California," by L. E. Aubury, page 23.
[3] Ibid., Bulletin No. 23, page 10.
[4] Eleventh Census, Report on Mineral Industries, page 186.
[5] United States Geological Survey, "Mineral Resources of the United States," 1882, page 663.
[6] Ibid., Twentieth Annual Report, Part VI, page 288.

liquid or maltha, in Santa Barbara and Kern, and the asphaltic sandstone and bituminous rock in Monterey, San Luis Obispo, and Santa Cruz counties. California asphaltic localities are thus in the vicinity of the Coast Range and south of San Francisco bay. A valuable and interesting deposit of the hard variety exists in Goleta, in Santa Barbara county. The asphaltum appears in a ledge washed by the Pacific ocean, and is exposed for a distance of several hundred yards. It occurs in pockets of from 1,500 to 3,000 tons, and is almost pure, containing only a small percentage of sand. Asphaltum is chiefly used as a rust proof coating for submarine and underground iron pipes. The commercial production of the mineral began in California in 1888, and flourished for two years, but the industry did not prove a financial success at the outset, and in 1890 no production was reported.[1] A resumption of activity in 1891 was more successful. Since that time there has been a general increase of production, and in 1902 California ranked first in this industry.

Coal.—Coal was discovered in the state during 1852, although no productive mining occurred until after 1860. In 1902 the production amounted to 84,984 short tons, principally lignite, which is a decrease of 66,095 short tons from the preceding year and less than one-half the production of 1900. The discovery and utilization of extensive oil fields is the principal cause of the marked decrease in coal production.

Natural gas.—Natural gas was known to exist in California as early as 1854, and the Court House well near Stockton, in San Joaquin county, was bored prior to 1858.[2] The principal localities in which gas was produced commercially during 1902 were Sacramento, San Joaquin, Santa Barbara, and Los Angeles counties. Important occurrences have been observed in Contra Costa, Fresno, Humboldt, Lake, Marin, Mendocino, Solano, Sonoma, Tehama, Tulare, and other counties. In some instances the gas is found in connection with petroleum, while in other cases it bubbles up in mineral springs or in artesian water flows.[3] The accumulation of very large high-pressure reservoirs of natural gas in this region has probably been prevented by the folded formation of the strata and the occurrence of earthquakes of greater or less severity. It is thought probable that larger quantities may be stored at greater depth than has yet been mined. The production of California natural gas in 1902 is valued at $120,648, in which is included gas to the value of $31,604, obtained from petroleum wells.

Manganese ore.—The first mining of manganese ore in California was at Corall Hollow in Alameda county in 1867.[4] Other deposits were known to exist, but for a number of years they were not considered to be of commercial importance. In 1902, however, several of these were opened up. The total product reported was 846 long tons, valued at $10,175, a very large increase when compared with the preceding years. The manganese ore is used principally in the manufacture of chlorine gas for working sulphureted gold ores.

The following are the minerals grouped in Table 1 under "all other minerals":

Cement.—The California production in 1902 was entirely of the Portland cement and was reported only in San Bernardino and Solano counties. Two establishments were in operation in 1902, and the production was much larger than that of previous years.

Chrome ore.—Chromic iron ore occurs in more than one-half the counties of California,[5] but the commercial production in 1902 was all reported by the Mt. Shasta chrome mine near Simms in Shasta county. This was the only active mine in the United States during 1902, and the product was sold principally in its crude state for furnace lining.

Clay.—Practically inexhaustible beds of clay, some of which is of very good quality, are found in California, accessible by railroad.[6] Extensive utilization of these vast deposits is somewhat discouraged by heavy eastern and European importations of clay manufactures at so low a rate as to curtail profitable local manufacture. The quantity produced in 1902 was somewhat less than that reported by the Geological Survey for the previous year, but an increase in the value of products, as compared with 1901, indicates that better prices prevail. In 1902 a total of 23,483 short tons, valued at $24,445, was produced; while in 1901 a production of 28,085 short tons, valued at $22,535, was reported.

Gypsum.—This mineral is commercially produced by one company in Los Angeles county. Of the product reported in 1902, 9.4 per cent was sold in crude form, 6.4 per cent was ground into land plaster, and 84.2 per cent was calcined into plaster of Paris.

Infusorial earth, tripoli, and pumice.—A deposit of infusorial earth of diatomaceous origin is found in Santa Barbara, and a considerable production was reported in 1902, which was all sold in the crude form.

Lithium ore.—Lepidolite and amblygonite are the principal lithium minerals[7] obtained. They are used chiefly in the manufacture of lithium effervescent tablets and lithium carbonate for the preparation of mineral waters for medicinal purposes. The California product, obtained only in San Diego county, is nearly all shipped to New York for treatment, and constitutes a very large portion of the United States production.

Magnesite.—Although this mineral occurs in several states it is mined commercially only in California.[8] There is an abundance of the ore in the state, but dis-

[1] United States Geological Survey, Twentieth Annual Report, Part VI, pages 254 and 255.
[2] Eleventh Census, Report of Mineral Industries, page 566.
[3] United States Geological Survey, Nineteenth Annual Report, Part VI, page 179.
[4] Eleventh Census, Report on Mineral Industries, page 291.
[5] Eleventh Census, Report on Mineral Industries, page 333.
[6] Ninth Annual Report of the State Mineralogist, page 297.
[7] United States Geological Survey, "Mineral Resources of the United States," 1902, page 260.
[8] Ibid., Sixteenth Annual Report, 1894–95, Part IV, page 515.

tance from large manufacturing centers prevents shipment under present conditions. The production during 1902 was all mined in Tulare county, and is reported by one company.

Mica.—The operations during 1902 were mostly development work, although a small production was reported from Ventura county. The product was entirely scrap mica, which was ground for lubricants and other purposes.

Mineral pigments, crude.—Yellow ocher is produced in Calaveras county, near Valley Springs, and in Stanislaus county. There were but two companies operating in California in 1902.

Precious stones.—The principal precious stones reported in California are turquoise and tourmaline, with chrysoprase and gold quartz in minor quantities, the total production in 1902 being valued at $65,000. Diamonds have been found at irregular intervals,[1] principally by placer gold miners, but every discovery thus far has been purely accidental, and none was reported during the census year. Quartz crystals have been found near Placerville, and chiastolite macle, or crossstone, has been obtained in Madera county, but no product was reported for 1902.

Sulphur and pyrite.—A considerable production of pyrite was reported from Alameda county. The ore averages from 49 to 50 per cent sulphur and is chiefly used for the manufacture of sulphuric acid.

Talc and soapstone.—Serpentines and soapstone occur in Los Angeles county, on Santa Catalina Island, and were mined in considerable quantity in 1902.

[1] Eleventh Census, Report on Mineral Industries, page 669.

COLORADO.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of Colorado for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Gold and silver.	Coal, bituminous.	Iron ore.	Petroleum.	Sandstones and quartzites.	Limestones and dolomites.	Copper ore.	Clay.	Siliceous crystalline rocks.	Uranium and vanadium.	Lead and zinc ore.	All other minerals.[1]
Number of mines, quarries, and wells	1,147	772	126	33	111	51	11	18	4	10	3	3	5
Number of operators	1,011	772	80	20	12	47	9	18	4	10	3	3	33
Salaried officials, clerks, etc.:													
Number	1,898	1,148	611	33	23	33	6	25	3	7	2	3	4
Salaries	$2,663,333	$1,687,518	$818,445	$42,577	$43,055	$28,704	$6,566	$17,398	$2,460	$6,345	$3,500	$2,025	$4,800
Wage-earners:													
Average number	20,519	11,200	7,955	418	147	343	188	115	50	46	19	5	33
Wages	$18,874,836	$11,726,123	$6,006,183	$417,162	$138,436	$237,905	$127,747	$108,981	$32,642	$34,082	$17,940	$5,475	$23,060
Contract work	$393,985	$360,707	$14,413		$9,650			$965	$7,450			$800	
Miscellaneous expenses	$3,032,544	$2,156,217	$681,494	$114,540	$40,163	$12,089	$5,886	$4,608	$7,637	$2,930	$490	$490	$6,060
Cost of supplies and materials	$7,006,846	$5,603,452	$1,039,831	$137,450	$68,708	$36,196	$21,440	$38,221	$5,608	$4,720	$3,010	$3,060	$45,210
Value of product	$40,003,286	$29,655,974	$8,397,812	$1,084,424	$484,683	$366,161	$203,700	$71,411	$67,434	$66,023	$48,125	$22,398	$135,141

[1] Includes operators as follows: Cement, 1; gypsum, 1; natural gas, 3; precious stones, 25 (no mines); tungsten, 3.

The state is notable for its range of mineral wealth. In the production of both gold and silver, it is first among the states and territories producing the precious metals in 1902, over 36 per cent of the refined gold product and over 27 per cent of the silver product reported for the United States (including Alaska) being contributed by this one state. In coal it ranked eighth among the 29 coal producing states, tenth among the 25 states producing iron ore, and ninth among the 18 petroleum producing states. Moreover, it produced all of the uranium and vanadium and almost all of the tungsten reported.

In addition to the minerals referred to in Table 1, there are found within the state—although these minerals were not produced in commercial quantities in 1902—antimony, arsenic, cobalt, corundum, flint and feldspar, fluorspar, graphite, infusorial earth, marble, mica, molybdenum, nickel, pyrites, quicksilver, serpentine, soapstone, tellurium, and tin.

Although no bismuth production was reported for 1902, the state supplied the entire United States output in 1901, amounting to 318.6 short tons, valued at $25,488. Of this, 253.6 tons came from Lake county and 65 tons from Ouray county. The bismuth contents varied from 4 to 12 per cent, and the ores also carried gold and silver values.[1]

The 964 operators reporting development work, distributed through the industries of gold and silver, bituminous coal, petroleum, asphaltum, iron ore, and manganese ore, gave employment during the year to 456 salaried officials, clerks, etc., who received $437,788 in salaries, and to 2,337 wage-earners, who were paid $2,340,058 in wages. They also paid $582,948 for work done by contract, which furnished employment to 911 employees. The miscellaneous expenses amounted to $213,816, and the cost of supplies and materials to $1,030,605.

The relative importance of the manufacturing industries closely allied to or based on the mining industry, using as their raw material the product of the mine or quarry, is shown in Table 2.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$102,830,137
Based upon products of mines or quarries:		
Chemicals and allied products	$1,306,845	
Clay, glass, and stone products	1,976,711	
Iron and steel and their products	10,365,780	
Metals and metal products, other than iron and steel	46,217,288	
Miscellaneous industries	6,046,255	
		65,912,879
All other		36,917,258

According to the above table, the value of the products of manufactures based primarily upon minerals mined and quarried amounted to $65,912,879, or 64.1 per cent of the total. The combined value of the product of mines and quarries in Colorado in 1902 and of

[1] Unites States Geological Survey, "Mineral Resources of the United States," 1901, page 259.

manufactures in 1900 was $143,433,423, of which manufactures constituted 71.7 per cent and the products of mines and quarries 28.3 per cent.

The average number of wage-earners in Colorado engaged in manufacturing, as reported at the Twelfth Census, was 24,725 and the wages paid them amounted to $15,146,667. In 1902 the average number of wage-earners reported as engaged in mining was 20,519 and the wages paid them amounted to $18,874,836. The two industries together, therefore, gave employment to an average of 45,244 wage-earners, and paid $34,021,503 in wages. Manufactures gave employment to 54.6 per cent of the wage-earners and paid 44.5 per cent of the wages, while mines and quarries furnished employment to 45.4 per cent of the wage-earners and paid 55.5 per cent of the wages.

Table 3, compiled from the reports of the United States Geological Survey, shows the value of the production of the principal minerals of the state, except copper ore for which values can not be obtained, from 1890 to 1902.

TABLE 3.—VALUE OF ANNUAL PRODUCTION OF PRINCIPAL MINERALS: 1890 TO 1902.

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Gold.[1]	Silver.[1]	Coal, bituminous.	Iron ore.	Petroleum.	Sandstones and quartzites.	Limestones and dolomites.	Siliceous crystalline rocks.
1890	$4,150,000	$24,307,070	$4,344,196	(2)	$280,240	$1,224,098	$138,091	$314,673
1891	4,600,000	27,358,384	4,800,000	(2)	559,005	750,000	90,000	300,000
1892	5,300,000	34,433,681	5,685,112	$587,903	692,160	550,000	100,000	100,000
1893	7,527,000	33,407,483	5,104,602	514,312	497,681	126,077	60,000	77,182
1894	10,616,463	30,704,375	3,516,340	676,141	303,652	69,105	132,170	49,302
1895	13,305,100	30,252,600	3,675,185	702,520	336,010	63,237	116,355	35,000
1896	14,911,000	29,185,293	3,606,642	524,915	318,977	58,989	65,063	36,517
1897	19,104,200	27,974,335	3,947,186	485,009	332,122	90,847	79,256	44,284
1898	23,195,300	29,498,958	4,686,081	553,406	367,447	89,637	109,310	25,923
1899	25,982,800	29,301,527	5,363,667	749,734	404,110	129,815	96,456	78,261
1900	28,829,400	[3]12,700,018	5,858,036	1,510,831	323,434	119,058	160,587	143,954
1901	27,693,500	[3]11,062,080	6,441,891	1,284,255	461,031	237,331	245,799	138,996
1902[4]	28,468,700	[3]8,308,280	8,397,812	1,081,424	484,683	366,161	203,700	66,023

[1] Estimates of the Director of the Mint for refined product—silver at coining values; the value in Table 1 is the value at the mine.
[2] Value not reported.
[3] Commercial value.
[4] Census figures, except for gold and silver.

Gold and silver.—Gold was discovered in 1852 near the mouth of Clear creek within the present boundaries of Arapahoe county by a Cherokee cattle trader, and in 1858 an expedition was organized to search for gold in the state. The passing of this expedition through Missouri and Kansas caused others to join the movement, and the reports of the discoveries that were carried back to "the states" spread like wildfire. The next spring and summer witnessed the great stampede for Pikes Peak and the Rockies. The first gold bearing lode was discovered May 6, 1859, in what is known as the Gregory mining district in Gilpin county.[1]

The mining growth of the state is best reviewed by considering the development of the more important of the gold and silver producing counties.

Boulder county is one of the pioneer counties of the state and has been the scene of active mining since its first settlement. The mining area is divided by somewhat indefinite boundaries into six mining districts, locally known as Grand Island (Caribou-Eldora), Sugar Loaf, Magnolia, Gold Hill, Central (Jamestown), and Ward. The county records show that the lode claim, placer claim, tunnel site, and mill site locations filed for record aggregate nearly 15,000. Of these, United States patents have been issued for about 1,000. Many of the location certificates filed are, of course, relocations of the same property. The ores are varied, including the common forms of iron and copper sulphide, chalcopyrite, and marcasite, while the complex silver and copper sulphides are not uncommon. The so-called telluride belt, extending from Magnolia to Ballarat, produces high-grade gold and silver telluride ores and is noted for its fine minerals.[2]

Chaffee county was formerly a part of Lake county, and the discovery of gold in the placer mines near Granite in the early days was almost coincident with the discovery of the placers of Clear Creek and Boulder counties. Great activity prevailed until 1862, when there was an exodus to other and supposedly better sections. The mining districts again became active during 1874–76. Since 1897 interest in the mines of this county has been gradually increasing, and the year 1902 marks not only more active operations but also a great increase in the list of new operators. The old placer mines near Granite have been operated with improved appliances. The leading districts are La Plata, Hope, and Red Mountain, in the northwestern part of the county; Dewey and Granite, in the northeastern; the Park Range region; the country adjacent to Turret, Whitehorn, Manoa, and Calumet; the Cleora district; and the Chalk Creek district. The county records show the filing of nearly 14,000 locations for placer and lode claims and mill sites and tunnel sites, and the issue of nearly 1,000 United States patents.[3]

[1] Harper's Encyclopedia, Vol. 2, page 246.

[2] Report of the State Bureau of Mines, Colorado, 1901–2, pages 19 to 21.

[3] Ibid., pages 27 to 32.

Clear Creek county embraces the location of the first remunerative placer mine located in Colorado, discovered in 1859 near the mouth of Chicago creek. The county records show nearly 23,000 lode and placer claims and mill and tunnel sites, and the issue of about 1,300 United States patents. The county contains some of the most famous mining camps in the state—Idaho Springs, Silver Plume, Georgetown, and Empire. The underground development of some of the older mines has become quite extensive—the Dives-Pelican, Bismarck, and 7-30 group near Silver Plume aggregating some 20 miles of underground workings.[1]

The mining history of Eagle county began with the year 1879, following the Leadville boom. The ores of the two regions are of a similar character. The county is rugged and contains within its confines the famous Mount of the Holy Cross. The mines are generally opened up by tunnels or inclines.[2]

Gilpin county, although the smallest in area, has always been one of the most important mining sections in the state. Beginning with 1859, mining has been continuous and its production large. Placer mining has been prosecuted each year since 1859–60, and the explorations of its lode mines have been carried even as deep as 2,200 feet. Central City, Black Hawk, Nevadaville, Eureka, and Gregory are some of its famous mining districts, the latter embracing Black Hawk and the Bates and Bobtail hills.[3]

Gunnison, one of the western slope counties, was the scene of a "rush" during 1880, second to none in the history of the state. Mining camps sprang up at numerous points, followed by smelting plants and mills.[4]

The first valid mineral locations were made in Hinsdale county in 1874. The ores of the district are, however, as a whole, of low grade and require concentration prior to shipment. The mineral resources are great and of a character to insure permanency of output.[5]

Lake county has been made famous by Leadville. Auriferous sand and gravel was the quest of the first gold seekers, and in 1860 a party of Gilpin county gold hunters crossed the range and discovered rich placers of California gold which produced several millions and were active for many years. It was not until the seventies that it was discovered that the heavy bowlders and dirt which had bothered the gulch miners were argentiferous lead carbonates. Leadville was settled in August, 1877, and at once became a heavy producer. The production of Lake county in 1902 was 47,357 fine ounces of gold, valued at $903,602, and 3,265,597 fine ounces of silver, valued at $1,659,210.

The history of Ouray county began practically with the year 1875, and was made famous at an early day by the rich copper-silver ores of the Yankee Girl, Guston, and other mines of the Red Mountain district. Later the publicity given to the Camp Bird mine of the Mt. Sneffles district added greatly to the reputation of the county and swelled the gold product of the state. This mine was discovered early in the eighties and was worked for a number of years to a limited extent on a pay streak near the foot wall, the operators being in ignorance of the immense values contained in an ore band near the hanging wall.

Pitkin, another of the leading mining counties, was traversed casually by early prospectors who made no discoveries of importance. But after experience gained at Leadville important discoveries were made in 1879 at Aspen, the most famous camp of the county. Owing to the inaccessibility to market, production was restricted until the Denver and Rio Grande Railroad reached Aspen in 1887.[6]

The veins of San Miguel county, which was established by legislative enactment in 1883, are similar to those of Ouray and San Juan counties. Gold and silver are generally associated with iron pyrite, chalcopyrite, lead sulphide, and zinc blende. Before the advent of railroad transportation in 1890, ores carrying high values were the only ones mined to any extent. At the present time the main production from this section is derived from ores having a gross value of from $8 to $20 per ton. Mining operations are conducted on a large scale, the largest producers being equipped with expensive milling plants.[7]

San Juan county is noted for the number and continuity of its fissure veins. Mining practically began in 1870, and was prosecuted with varying success until the railroad reached Silverton in 1882. It has since developed into one of the most important mining sections of the state. Nearly one-fifth of the area of the county is held under mineral locations.

Summit county was one of the original subdivisions out of which has been carved a number of counties. Its mining history begins with 1859. The placer beds on the Blue river and its tributaries are credited with a production of many million dollars' worth of gold. Ten Mile mining district is also in this county. The ore deposits occur both as fissure and as "contact" veins, the predominating value being silver, though nearly all the lode veins carry a small percentage of gold. The gold product, on the whole, exceeds the silver on account of the product of the placer mines.[8]

The Cripple Creek district, located in Teller county, is at present the most productive gold district in the United States, although the discovery of gold in that district was not made until February, 1891. The gold product of Teller county in 1902 was 699,487 fine ounces,

[1] Report of the State Bureau of Mines, Colorado, 1901–2, pages 36 and 37.
[2] Ibid., pages 57 to 61.
[3] Ibid., page 72 ff.
[4] Ibid., page 81.
[5] Ibid., pages 92 to 97.
[6] Report of the State Bureau of Mines, Colorado, 1901–2, page 151.
[7] Ibid., pages 183 to 195.
[8] Ibid., pages 213 to 220.

valued at $13,996,421. This was 52.6 per cent of the gold product of the state, and 18.9 per cent of the entire gold product of the country. The numerous mines are, with a few exceptions, developed by shafts, a number of which have passed the 1,000-foot mark.

Coal.—The lignite beds of the upper Missouri were noticed by Lewis and Clark, 1803–4; those of the Laramie plains by Fremont, 1842; and those of the Raton mountain region by General Emory as early as 1848. Coal was first developed at Boulder in 1860,[1] although the first production from the state was not reported until 1864. The Marshall mines of Boulder county had already been worked for some years, and the coal was bringing from $12 to $15 a ton in Denver.[2] In 1872 production was reported from Weld county, and in 1873 from Las Animas and Fremont counties.

Coal is now reported from 18 counties, the heaviest producers being Las Animas, Huerfano, Boulder, Fremont, Pitkin, and Gunnison counties, in the order named. These counties produced over 90 per cent of the coal reported for 1902.

The state is rich in the variety of its coals, which range from lignite to anthracite. Lignites are mined in Arapahoe, Boulder, Douglas, El Paso, Jefferson, Larimer, and Weld counties; bituminous in Garfield, Gunnison, Huerfano, Las Animas, La Plata, Mesa, and Pitkin counties; semibituminous in Fremont, Garfield, Gunnison, and La Plata counties; and anthracite in Gunnison county.[3] For statistical purposes the Bureau of the Census and the Geological Survey have classed the entire production of the state as bituminous.

Table 4, compiled from the reports of the United States Geological Survey, shows the production of coal in Colorado from 1864 to 1902, inclusive.

TABLE 4.—*Annual production of coal, bituminous: 1864 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1864	500	1884	1,130,024
1865	1,200	1885	1,356,062
1866	6,400	1886	1,868,338
1867	17,000	1887	1,791,735
1868	10,500	1888	2,185,477
1869	8,000	1889	2,697,181
1870	13,500	1890	3,077,003
1871	15,600	1891	3,512,632
1872	68,540	1892	3,510,880
1873	69,997	1893	4,102,289
1874	77,372	1894	2,831,409
1875	98,838	1895	3,082,982
1876	117,666	1896	3,112,400
1877	160,000	1897	3,361,703
1878	200,630	1898	4,076,347
1879	322,732	1899	4,776,224
1880	437,005	1900	5,244,364
1881	706,744	1901	5,700,015
1882	1,061,479	1902	7,401,343
1883	1,229,593		

Iron ore.—The first iron manufacturing enterprise was that of a small charcoal furnace at Langford, Boulder county, which was put in blast in 1864, with the object of supplying pig iron for foundry purposes. It went out of blast in 1865 and was soon afterwards abandoned. The ore was obtained in the neighborhood. The owners of this furnace built a foundry at Denver in 1861, but removed it to Black Hawk in Gilpin county in 1862. March 1, 1878, a rolling mill to reroll rails was put in operation at Pueblo, but it was removed to Denver during the year. On September 7, 1881, the first large coke furnace was put in blast at Pueblo, and the Bessemer steel works, of the same place, were finished in 1882.[4]

The iron ore production of the state in 1902 amounted to 306,572 long tons, valued at $1,084,424, an average of $3.54 a ton. This high average value of Colorado iron ore is due to its silver contents, and to its availability for use as a fluxing medium when mixed with other gold and silver ores in the smelter.

In the production of iron ore is included 13,275 tons of manganiferous iron ore, valued at $52,371, which was used in the manufacture of spiegeleisen at the steel works.

The following table, compiled from the reports of the United States Geological Survey, shows the production of iron ore in Colorado from 1889 to 1902:

TABLE 5.—*Annual production of iron ore: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1889	109,136	1896	216,819
1890	114,275	1897	187,314
1891	110,942	1898	318,480
1892	141,769	1899	307,557
1893	171,670	1900	407,084
1894	250,199	1901	404,467
1895	240,937	1902	306,572

Petroleum.—The first indications of petroleum were found about 1859 at Oil Springs in Fremont county, some 10 miles northwest of Florence. In March, 1862, crude oil was collected from the springs by sinking shallow wells, and between 1862 and 1865 the oil collected was refined and most of it was transported by team to Pueblo, Denver, and Santa Fe. For some of this refined oil as high as $5 a gallon was realized. The advent of railroads rendered the industry unremunerative and it was abandoned. In 1881, while drilling a well for water near the coal mines at the town of Coal Creek, the drillers discovered oil at a depth of 1,260 feet. The discovery was followed up with varying success, no production being reported until 1887.[5]

The development of the Boulder field was begun near the close of 1901, and there was great activity throughout the state in 1902. The superior quality of the petroleum developed at Boulder led to a large amount of drilling in northern Colorado. Operations were active at Boulder, Fort Collins, and in the Florence field and to a lesser extent in Pueblo, Archuleta, Rio

[1] History of Nevada, Colorado, and Wyoming, by Hubert H. Bancroft, page 578, note 9.
[2] F. V. Hayden, Silliman's Journal, March, 1868.
[3] Biennial Report of the Inspector of Coal Mines, Colorado, 1899–1900, page 89 ff.
[4] Iron in All Ages, by James M. Swank, pages 343 and 344.
[5] Eleventh Census, Vol. XIX, page 482.

Blanco, and Routt counties and at Raton. The production of the Boulder pool in 1902 amounted to 11,800 barrels. It will be seen from Table 6 that the largest production, 824,000 barrels, was made in 1892, the average production since being but a little more than half that amount.

Table 6, compiled from the reports of the United States Geological Survey, shows the annual production of crude oil in Colorado from 1887 to 1902, inclusive.

TABLE 6.—*Annual production of petroleum: 1887 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
Total	6,852,926	1891	515,746
		1895	438,232
		1896	361,450
1887	76,295	1897	384,934
1888	297,612	1898	441,383
1889	316,476	1899	390,278
1890	368,842	1900	317,385
1891	665,482	1901	460,520
1892	824,000	1902	396,901
1893	594,390		

Sandstones and quartzites.—The state contains a variety of sandstones, which are now quite generally quarried. Reports for 1902 showed 51 quarries and 47 operators, distributed among Boulder, Delta, Douglas, Eagle, El Paso, Fremont, La Plata, Larimer, Las Animas, and Pueblo counties, the largest number being in Boulder county. The Red Beds yield building stones of a great variety of shades, texture, and strength. Numerous quarries, which furnish fine yellow and blue-gray stone, have been opened in Boulder county on the Cretaceous sandstones. In Fremont county there occurs a fine grayish or buff stone of Laramie age that closely resembles the Subcarboniferous stone of Berea, Ohio.[1]

Limestones and dolomites.—Limestone is quarried in 8 counties—Chaffee, El Paso, Fremont, Gunnison, Jefferson, La Plata, Pitkin, and Pueblo. A little more than three-fourths of the product is used for flux.

Copper.—The production of copper ore from mines operated for that mineral is comparatively small, the value of the product so reported being but $71,411 from 18 mines. There is, however, a large copper production by the smelters of the state, who purchase argentiferous copper ores and mattes in the open market.

Clay.—The clay sold by the miner, which is the only clay reported, is but a small part of the actual clay product of the state. It should be borne in mind that the clay which is manufactured by the producers was not taken into account in this inquiry. Clay valued at $67,434 was mined and sold as such by four establishments. The total value of brick and tile, and pottery, terra cotta, and fire clay products produced in the state in 1899 was $1,071,388. In 1900 the value of the same class of clay products was $1,200,519, and in 1901 it was $1,594,867, the state then ranking fourteenth in the value of these products. In 1902 the state ranked twelfth, though the value of the clay products had increased to $2,200,983.

Siliceous crystalline rocks.—Ten quarries of siliceous crystalline rocks were in operation in the counties of Boulder, Chaffee, Clear Creek, Fremont, Jefferson, Gunnison, and Larimer, and produced stone valued at $66,023—chiefly building stone. Fine gray granite occurs at Georgetown and Lawson, in Clear Creek county, and there are inexhaustible quantities of good material all through the mountains.[2]

Uranium and vanadium.—The only production of these metals in the United States was from three mines in Colorado—one each in Gilpin, Montrose, and San Miguel counties. The output amounted to 3,810 short tons of ore, valued at $48,125, the bulk of this production being contributed by the San Miguel county mine. The production of uranium in 1900 was reported as 153 short tons, carrying from 5 to 16 per cent of uranium oxide, and in 1901 it was 375 short tons.[3]

Lead and zinc.—The lead and zinc production in Colorado is practically all from the smelting of ores carrying precious metals. The nonargentiferous lead and zinc ore mined in 1902 amounted to only 1,636 short tons, of which 1,536 tons were zinc.

All other minerals.—The first production of Portland cement was reported for 1901 from one establishment in Fremont county. In 1902 two establishments were in operation; one of these quarried its raw material. As the other manufactured from purchased material, the statistics of its operation are not included in the report on mines and quarries.

Gypsum has been quarried to a small extent for a number of years, the bulk of the product being calcined into plaster of Paris. Numerous deposits of gypsum are known to exist in all the Rocky mountain territory. At the census of 1890 the beds that had so far been worked were in the neighborhood of Big Thompson, Larimer county, and Colorado Springs, El Paso county. Production of plaster of Paris was reported from the mill at Colorado Springs as early as 1879, when the output was 150 short tons. The production of 1902 was from one establishment near Loveland, Larimer county.

The natural gas produced in Colorado comes from the oil wells. In 1902 the output was valued at $1,900.

The precious stones reported for 1902 were smoky quartz and amazon stone. Smoky quartz occurs at and near Pikes Peak, where it is abundant in a coarse granite, associated with amazon stones—crystals of green feldspar—for which that locality is famous. It is also found at Mt. Antero, Chaffee county. One of

[1] Stones for Building and Decoration, by George P. Merrill, pages 132 to 135.

[2] Stones for Building and Decoration, page 53.

[3] United States Geological Survey, "Mineral Resources of the United States," 1900, page 265, and 1901, page 270.

the finest faceted stones in the world, measuring 3½ inches in length, exhibited at the Columbian Exposition, was from Mt. Antero. Aquamarines have also been found at Mt. Antero within recent years. Topazes have been found at Cheyenne mountain, Pikes Peak, and at Nathrop. Some fine rock crystal has been furnished by the state, especially from Mt. Antero. Amethyst has been reported from Cripple Creek and from localities in Park and Mineral counties. Turquoise is reported from the southern part of the state, and prosopite, a fluoride of alumina, occurs at Pikes Peak.

Tungsten ores, wolframite, and hubnerite have been found in quantity in San Juan, Boulder, Gilpin, Ouray, and Lake counties. In 1902 production was reported from three mines—two in Boulder county and one in San Juan. The only other producer in the United States was one mine in Connecticut. It is only within a few years that it has been known to exist in commercial quantities in Colorado. Shipments were reported in 1900 of 45½ short tons, carrying from 60 to 71 per cent of titanic acid.[1]

[1] United States Geological Survey, "Mineral Resources of the United States," 1900, page 258.

CONNECTICUT.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Connecticut for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Siliceous crystalline rocks.	Limestones and dolomites.	Sandstones and quartzites.	Feldspar.	Crystalline quartz.	Flint.	All other minerals.[1]
Number of mines or quarries	90	49	12	7	6	4	4	8
Number of operators	78	44	7	7	6	3	4	7
Salaried officials, clerks, etc.:								
Number	151	87	18	15	8	8	2	13
Salaries	$132,095	$75,682	$18,830	$13,554	$5,345	$6,030	$1,200	$11,454
Wage-earners:								
Average number	1,497	943	135	142	71	18	10	178
Wages	$808,772	$535,334	$66,765	$73,959	$33,672	$8,702	$1,895	$85,435
Miscellaneous expenses	$50,918	$31,859	$6,028	$6,881	$1,564	$1,450	$675	$5,461
Cost of supplies and materials	$236,075	$118,231	$61,346	$14,668	$10,677	$700	$1,965	$25,488
Value of product	$1,425,959	$812,141	$205,371	$128,579	$73,764	$32,075	$11,575	$162,454

[1] Includes operators as follows: Asbestos, 1; clay, 1; garnet, 2; iron ore, 1 (2 mines); marble, 1; and tungsten, 1.

The state ranked fortieth in mining in 1902 according to the value of its product. Its principal mineral products were nonmetallic. Connecticut, in early years, was a pioneer in mining enterprise, but later its mines, never very productive, have fallen largely into disuse. The first of the early colonists to turn his attention in the direction of mining seems to have been Governor Winthrop, who, from 1650 to 1660, engaged at intervals in examining the metalliferous indications of the Connecticut valley, in the vicinity of Haddam and Middletown. There is no reason to suppose that any actual mining was ever executed by him.[1]

The copper mines of Simsbury were discovered about 1705,[2] ruined a number of successive proprietors, and were finally made into a state prison, long since abandoned. In 1709 the first mining company organized in the United States was chartered to operate these mines. The material for the "Granby coppers," coined in 1737, and for other coins, including the first United States coinage, was obtained from Simsbury.[3] The finding of ore in this locality prompted the discovery of the Schuyler mine in New Jersey in 1719. A cobalt mine in Chatham was worked in 1762, and about the same time the Southampton lead mine was opened, but neither of these enterprises met with much success. In 1836 copper was extensively mined at Bristol, the workings being at this time among the most important in the United States. The Ore Hill iron mine of Salisbury in 1849 supplied 16 furnaces in Litchfield county with a fibrous and massive hematite, which furnished forge pig of the finest quality.[4] The most important silver-lead mine in the state was near Middletown. It was opened in 1852, although previously operated to some extent probably many years prior to the Revolutionary War.[5]

Minerals occurring in Connecticut but not reported in commercial quantities during 1902 are numerous. Barytes was mined in New Haven county as early as 1870, but none has since been reported. Bismuth is disseminated in small quantities through the quartz of Fairfield county. Bornite, green carbonate of copper, vitreous copper, copper pyrite, and native copper occur chiefly in Hartford, Litchfield, and New Haven counties. Emery and corundum are found near Litchfield,[6] graphite or plumbago is disseminated through rock in the same county, and glass sand occurs on the shores of Lake Quassapaug. Copper occurs in many forms throughout the state. A number of contact deposits in sandstone at junctures with gneiss were formerly worked, especially at Bristol.[7] Large deposits of infusorial earth and tripoli occur, but no production was reported for 1902. Indications of galena are abundant[8] throughout the state, but there are few localities where lead mining has been carried on to any

[1] Metallic Wealth of the United States, by J. D. Whitney, page xxii.
[2] Connecticut, by Alexander Johnston, page 3.
[3] Ibid., pages 3 and 4.
[4] Metallic Wealth of the United States, pages xxiii, xxiv, 315, and 463.
[5] Ibid., page 393.
[6] United States Geological Survey, "Mineral Resources of the United States," 1887, page 715.
[7] Ore Deposits of the United States, by James F. Kemp, page 158.
[8] Metallic Wealth of the United States, page 392.

extent. Manganese ore in small quantities is frequently found in connection with the iron ores of the Salisbury district.[1] Efforts have been made to locate this ore in sufficient quantities to pay for its separation from iron, but they have thus far proved futile. Mica is found near Branchville and New Milford, and molybdenum at Haddam in the gneiss quarries. Niccolite occurs in Middlesex and Fairfield counties, associated with smaltite or gray cobalt ore, which is disseminated in mica slate accompanied by galenite and sphalerite.

Precious stones—agate, beryl, and topaz—have been reported as found in the state. Pyrites, pyrrhotite, and chalcopyrite occur in various localities. Rutile occurs in Hartford, Litchfield, and Fairfield counties. Some silver is generally found in the galena of the Eastern states,[2] but the ores have never yet proved abundant enough to be important. Talc occurs with slate in gneiss near Bristol, Hartford county, and a silicate of zinc is found, in Fairfield county, in white limestone with galena and blende.[3]

The following table shows the value of the manufactured products of the state in 1900 based primarily upon the products of mining and quarrying in comparison with the total for all manufactures reported:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$352,824,106
Based upon products of mines or quarries:		
Chemicals and allied products	$852,860	
Clay, glass, and stone products	3,167,010	
Iron and steel and their products	61,079,340	
Metals and metal products, other than iron and steel	78,826,528	
Miscellaneous industries	14,445,102	
		158,370,840
All other		194,453,266

As shown in the above table, the product of mines and quarries was used as material in the manufacture of 44.9 per cent in value of the manufactures of Connecticut. Most of this mineral product was obtained from other states.

The value of the manufactured product reported for 1900 was $352,824,106, while the value of the product of mines and quarries in 1902 was $1,425,959. From these figures it will be seen that the production of mines and quarries represents only four-tenths of 1 per cent of the total value for the combined industries, and manufactures, 99.6 per cent. The manufacturing industries as reported in 1900 gave employment to 176,694 wage-earners who were paid $82,767,725 in wages; in 1902 there were employed at the mines and quarries 1,497 wage-earners who received $808,772 in wages. Of the combined totals, mines and quarries gave employment to eight-tenths of 1 per cent of the wage-earners and paid 1 per cent of the wages, while manufactures employed 99.2 per cent of the wage-earners and paid 99 per cent of the wages.

The following table, compiled from the reports of the United States Geological Survey, shows the value of the annual production of the principal minerals of the state from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Siliceous crystalline rocks.	Limestones and dolomites.	Sandstones and quartzites.	Feldspar.
1890	$1,061,202	$131,697	$920,061	(1)
1891	1,167,000	100,000	760,000	(1)
1892	700,000	95,000	650,000	(1)
1893	652,459	155,000	570,346	(1)
1894	504,390	204,414	322,934	(1)
1895	779,361	154,333	397,853	(1)
1896	791,325	138,945	426,029	$5,050
1897	616,215	178,410	364,604	24,875
1898	682,768	142,057	215,733	[2]12,020
1899	516,886	162,388	271,623	[2]49,495
1900	507,754	148,080	192,593	[2]68,300
1901	616,654	140,424	146,814	54,858
1902[3]	812,141	205,371	128,579	73,764

[1] Not reported.
[2] Includes value produced in New York in 1898 and 1900, and Maine in 1898.
[3] Census figures.

The principal mineral production in Connecticut is from quarries, siliceous crystalline rocks leading, although this industry has materially decreased since 1891. The production of sandstones and quartzites has also fallen off largely, but the production of limestones and dolomites increased from $131,697, in 1890, to $205,371, in 1902, or 55.9 per cent.

Siliceous crystalline rocks.—The production of siliceous crystalline rocks in 1902 was valued at $812,141. Of this amount, 43.2 per cent was stone sold in the rough or dressed for building purposes and 36.3 per cent was crushed rock for roads, railroad ballast, and concrete; the remainder being dressed for monumental purposes, made into paving blocks, or prepared for use as curbing, flagging, riprap, rubble, etc.

Extensive deposits of granite are found throughout the New England states, the Connecticut product being usually distinguished from other granites by a fine grain and light gray color.[4] The most important quarries in Connecticut are found bordering on Long Island sound, although a production was reported during 1902 in every county except Tolland.

At Millstone, New London county, is a quarry from which millstones were quarried for use in old-fashioned windmills a century and a half ago. The stone is rather dark colored and is now used chiefly for building, monumental work, and for paving blocks. Monumental stone is quarried only at Groton, the granite being fine grained, hard, and well adapted to this use. The Waterford granite is a fine grained biotite, gray in color,

[1] Eleventh Census, Report on Mineral Industries, page 297.
[2] Ore Deposits of the United States, page 201.
[3] United States Geological Survey, "Mineral Resources of the United States," 1887, pages 715 and 716.

[4] Tenth Census, Special Report on Building Stones, Vol. X, page 129.

and suitable for both monumental and building purposes. A considerable production was reported in 1902. A gray stone is also quarried near Oneco in Windham county.

At Leetes Island, New Haven county, a feldspathic pink gneiss, excellent for heavy construction and bridge work, is quarried. This stone was used in the foundation of the Bartholdi Statue of Liberty in New York harbor. The Stony Creek quarries produced large quantities of red granite, which was used chiefly for building purposes. The red or pink color of this stone is most attractive. At Ansonia and numerous other points there are quarries of more or less importance. There is a large quarry at Sachem Head, which, however, did not report any production during 1902.[1]

Limestones and dolomites.—The production of limestone during 1902 was valued at $205,371, an increase of 46.3 per cent over the production reported for 1901. All the Connecticut limestones are crystalline in texture[2] and comparatively free from admixture of clay or magnesia, and are therefore well adapted for burning into lime, for which purpose, except a very small amount reported as flux, the production of 1902 was wholly used. That limestones are not used in this state for roadmaking material is accounted for by the abundance of the harder and more permanent granitic rocks.

Sandstones and quartzites.—Third in importance among the mineral industries of Connecticut is the quarrying of sandstone, the value of the product for 1902 being $128,579. The quarries are found principally adjacent to the Connecticut river, at Portland, Middlesex county. A small production is also reported from Hartford and New Haven counties. This stone is sold chiefly in the rough and used for building purposes. It quarries easily, works well,[3] and possesses a very rich color, but sometimes does not weather well in the changeable climate of northern United States.

Feldspar.—Connecticut, in 1902, produced in value 29.5 per cent of the feldspar reported for the United States. It was quarried in Fairfield, Hartford, Litchfield, and Middlesex counties. It is obtained from pegmatitic dikes[4] occurring in gneisses and schists and is chiefly orthoclase. In some localities there are large masses of nearly pure spar, but generally the occurrence is an intergrowth of quartz and feldspar. The associated minerals are tourmaline, garnet, and beryl.

Crystalline quartz.—The crystalline quartz quarried during 1902 amounted to 10,400 short tons, and was valued at $32,075, or about three-fourths of the value reported for the entire United States. The mines are situated at New Milford, Roxbury, and Washington in Litchfield county, and at Southbury, New Haven county. Crystalline quartz is used in wood finishing, to prepare the surface of the wood for polishing, and in the stone cutting trade,[5] especially by the marble men, as an abrasive. It is also crushed and sized for use in the manufacture of sandpaper or pulverized for sale as tripoli.

Flint.—The flint production of Connecticut during 1902 was reported as 852 short tons of crude, valued at $1,775, and 960 short tons of ground, valued at $9,800, a total valuation of $11,575, which is somewhat less than was reported in 1901. The quarries are all located in Fairfield and Litchfield counties.

All other minerals.—A considerable amount of marble was quarried near East Canaan, Litchfield county, during 1902, and it was all used for building purposes. Deposits of serpentine[6] and verd antique marble occur in the vicinity of New Haven, but no quarrying was reported.

Iron ore of importance is mined in the extreme northwest corner of the state, near Salisbury, Litchfield county.[7] The ores are similar to those of Massachusetts. Statistics of the production, which is small, have been for some years consolidated with the production of other New England states and can not be shown separately for 1902 without disclosing the business of the only operator engaged in the mining. The Salisbury mines, two in number, are among the oldest in the country, and have been famous for the quality of their ore and the uses to which the iron made from it has been put.

One kaolin mine was reported in Litchfield county, statistics for which are included under "all other minerals" to avoid the disclosure of individual operations. In Litchfield county, in the vicinity of Roxbury, are also located 2 garnet quarries. A large portion of the product is used in the manufacture of sandpaper.

More than one-fifth of the entire asbestos production of the United States is mined in Litchfield county. During 1902 the asbestos produced in this state was chiefly in the crude form. Crushing the ore and separating it by sifting are the only processes thus far undertaken at the mine.

A small quantity of scheelite, which when refined assays about 79 per cent tungstic acid, was mined during 1902, near Longhill, Fairfield county. It occurs in a quartz vein between an amphibole gneiss and a bed of crystalline limestone.[8]

[1] United States Geological Survey, Nineteenth Annual Report, Part IV, continued, 1897–98, pages 232 to 234.
[2] Tenth Census, Special Report on Building Stones, Vol. X, page 107.
[3] Ibid., page 108.
[4] The Mineral Industry, 1898, Vol. VII, page 266.
[5] United States Geological Survey, "Mineral Resources of the United States," 1901, page 800.
[6] Tenth Census, Special Report on Building Stones, Vol. X, page 129.
[7] Metallic Wealth of the United States, page 402.
[8] The Mineral Industry, 1900, Vol. IX, page 658.

DELAWARE.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Delaware for 1902.

TABLE 1.—*Summary: 1902.*

	Total.	Siliceous crystalline rocks.	Clay.
Number of mines or quarries	12	6	6
Number of operators	12	6	6
Salaried officials, clerks, etc.:			
Number	29	16	13
Salaries	$28,047	$15,307	$12,740
Wage-earners:			
Average number	504	335	169
Wages	$222,622	$153,150	$69,472
Miscellaneous expenses	$39,278	$19,688	$19,590
Cost of supplies and materials	$15,361	$18,126	$27,235
Value of product	$448,467	$276,753	$171,714

The mineral wealth of the state consists chiefly of its deposits of granitic building stones, which have been extensively quarried, and clay deposits, which were among the first in the country to be developed on a commercial scale. While the state was not a producer in 1902 of feldspar, bog iron ore, greensand marl, limestone, and "blue rock," these minerals occur at various points and were mined in former years. Among the minerals occurring in the state which, as yet, have received little or no attention by miners are: Asbestos, amber, and serpentine.[1]

Certain manufacturing industries are closely allied to or are based on the mining industry, using as their raw material the product of the mine or quarry. The relative importance of these branches of manufacture, as indicated by the value of their products, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$45,387,630
Based upon products of mines or quarries:		
Iron and steel and their products	$9,233,012	
Clay, glass, and stone products	723,775	
Metals and metal products, other than iron and steel	275,367	
Chemicals and allied products	883,558	
Miscellaneous industries	1,509,955	
		12,625,667
All other		32,761,963

[1] United States Geological Survey, "Mineral Resources of the United States," 1887, page 718.

The total value of the products of the manufacturing industries, based on the products of mining, was, as shown by Table 2, $12,625,667, or 27.8 per cent of the total value of the product of all manufacturing industries in the state in 1900. During the same year there were employed in all branches of manufacture in the state 22,203 wage-earners, who were paid $9,259,661 in wages. In 1902 the mines and quarries of the state gave employment to 504 wage-earners, who received $222,622 in wages. Manufactures, therefore, gave employment to 97.8 per cent of the wage-earners and paid 97.7 per cent of the wages; mining employed 2.2 per cent of the wage-earners and paid 2.3 per cent of the wages.

Table 3 shows the annual production of siliceous crystalline rocks and clay.

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Siliceous crystalline rocks.	Clay.
1890	$211,194	(1)
1891	210,000	(1)
1892	250,000	(1)
1893	215,964	(1)
1894	173,805	(1)
1895	79,138	(1)
1896	67,775	(1)
1897	272,469	$99,411
1898	677,764	82,286
1899	1,039,349	71,742
1900	608,028	102,005
1901	671,204	112,883
1902[2]	276,753	171,714

[1] Not reported separately. [2] Census figures.

Siliceous crystalline rocks.—The granitic deposits of the state are confined, in the main, to a comparatively small belt or area adjacent to the city of Wilmington.[2] The rock is of a dark gray gneissoid character and has been used to a limited extent for building purposes, but has been more largely used in coarser construction work and in roadmaking.[3] This rock has been quarried for many years.

[2] The New International Encyclopedia, Vol. V, page 768.

[3] Stones for Building and Decoration, by George P. Merrill, page 55.

Clay.—The clays of Delaware constitute the major part of its mineral wealth. A large proportion of the workable deposits, comprising clays suitable for brick and terra cotta making and for china clay, occur in Newcastle county.[1] The clay product of chief importance, however, and that in the production of which the state holds a conspicuous place, is kaolin. The beginning of the industry of kaolin mining in Delaware is approximately coincident with that of the same industry just over the line in Pennsylvania, where it began in 1839.[2] For many years the kaolin deposits of these two states made up the total output of the country. While kaolin of excellent quality and of extensive occurrence has been mined at many different places, the present center of the industry of kaolin or china clay mining is in the vicinity of Hockessin, in Newcastle county. The industry of mining is supplemented in Delaware by the conversion of the raw kaolin into china clay, and the bulk of the state's product of this mineral is shipped in this form.

[1] The New International Encyclopedia, Vol. V, page 768.

[2] The Mineral Industry, 1898, Vol. VII, page 153 ff.

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FLORIDA.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Florida for 1902.

TABLE 1.—*Summary: 1902.*

	Total.	Phosphate rock.	Limestones and dolomites.	All other minerals.[1]
Number of mines or quarries	71	61	6	4
Number of operators	46	36	6	4
Salaried officials, clerks, etc.:				
Number	218	192	3	23
Salaries	$228,868	$206,108	$2,410	$20,350
Wage-earners:				
Average number	3,146	2,866	87	193
Wages	$1,082,030	$996,801	$28,054	$57,175
Contract work	$4,021			$4,021
Miscellaneous expenses	$304,142	$283,149	$2,208	$18,785
Cost of supplies and materials	$618,057	$542,322	$14,760	$60,906
Value of product	$2,943,806	$2,655,463	$63,571	$224,772

[1] Includes operators as follows: Clay, 2; fuller's earth, 2.

The state ranked thirty-fifth in 1902 in the value of products of mines and quarries, with a total of $2,943,806. The mining industry in the state is confined to nonmetallic minerals. Chief among these, both in extent and development, is phosphate rock. Also, in a relative sense, the state's product of fuller's earth is of importance and its wealth in clay deposits is worthy of note.

Other minerals found in the state but not commercially produced in 1902 are: Gypsum, a rather extensive bed of which has recently been discovered near Panasoffkee;[1] lignite or brown coal, deposits of which occur on the Suwanee river, and at one time were worked for fuel;[2] and hydraulic cement rock, of which a large deposit occurs near River Junction, extending for several miles along the left bank of the Apalachicola river southerly to Aspalaga, and comprising over 2,000 acres, with a thickness of at least 80 feet. Enough has been exposed to indicate that the deposit contains sufficient raw material to produce over two billion barrels of cement. The raw material is white, and the manufactured product is as white as the whitest marble.[3]

Development work in the state in 1902 was confined to phosphate rock, clay, and petroleum, cost $25,314, and was of interest chiefly because of the borings and testings made in Sumter county for petroleum.

[1] United States Geological Survey, Twentieth Annual Report, 1898–99, Part VI, page 662.
[2] Ibid., "Mineral Resources of the United States," 1882, page 675.
[3] Ibid., Twentieth Annual Report, 1898–99, Part VI, page 549 ff.

Certain manufacturing industries use as their raw material the product of the mine or quarry, and their relative importance, as indicated by value of products, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$36,810,233
Based upon products of mines or quarries:		
Chemicals and allied products	$500,239	
Clay, glass, and stone products	229,447	
Iron and steel and their products	320,507	
Metals and metal products, other than iron and steel	125,458	
Miscellaneous industries	981,716	
		2,157,366
All other		34,652,867

The total value of the products of manufacturing industries based on mining was, as shown by Table 2, $2,157,366, or 5.9 per cent of the total value of the products of all manufacturing industries in the state in 1900. During the same year there were employed in all branches of manufactures 34,230 wage-earners, who were paid $10,683,038 in wages. In 1902 the mines and quarries gave employment to 3,146 wage-earners, who received $1,082,030 in wages. Manufactures, therefore, employed 91.6 per cent of the wage-earners of the two industries and paid 90.8 per cent of the wages, while the mining industries employed 8.4 per cent of the wage-earners and paid 9.2 per cent of the wages.

In Table 3 is shown the value of the annual production, as compiled from the reports of the United States Geological Survey, of the principal minerals of the state from 1889 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Phosphate rock.	Limestone.	YEAR.	Phosphate rock.	Limestone.
1889	$32,800	(1)	1896	$1,547,353	$16,[illegible]
1890	338,190	(1)	1897	1,493,515	18,[illegible]
1891	703,013	(2)	1898	1,847,796	91,[illegible]
1892	1,418,418	(2)	1899	2,804,061	44,[illegible]
1893	1,979,056	$35,000	1900	2,983,312	128,[illegible]
1894	1,666,813	30,639	1901	3,169,473	51,[illegible]
1895	2,112,902	10,550	1902[3]	2,655,463	63,[illegible]

[1] Not reported separately. [2] No production. [3] Census figures.

Phosphate rock.—This mineral, which constitutes the state's most valuable resource, occurs principally in a belt extending from Lake Okeechobee on the south to the vicinity of Tallahassee on the north,[1] approximating 240 miles in length and averaging about 30 miles in width. Deposits of commercial value are not continuous throughout this large area, but are widely scattered. Four classes of phosphate rock have been produced. These, in the order of total values of product for the years 1888 to 1902, are: Hard rock, land pebble, river pebble, and soft rock.

The following table shows the product of phosphate rock by classes since its mining began in 1888:

TABLE 4.—*Annual production of phosphate rock by kinds: 1888 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	PRODUCTION (LONG TONS).				
	Total.	Hard rock.	Soft rock.	Land pebble.	River pebble.
Total	6,606,468	3,859,128	39,001	1,730,595	986,744
1888	3,000				3,000
1889	4,100				4,100
1890	46,501				46,501
1891	112,482	57,982	(1)	(1)	54,500
1892	287,343	155,908	6,710	21,905	102,820
1893	438,804	215,685	13,675	86,624	122,820
1894	527,653	326,461		98,885	102,307
1895	568,961	307,098	6,916	181,011	73,936
1896	495,199	296,811	400	97,936	100,052
1897	552,342	360,147	2,300	92,132	97,763
1898	600,894	366,810		155,084	79,000
1899	726,420	460,297		177,170	88,953
1900	706,248	424,977		221,468	59,803
1901	751,998	457,568		247,454	46,974
1902	785,430	429,384		350,991	5,055

[1] Included with hard rock.

Nodular amorphous phosphatic deposits in the state were found widely distributed many years ago. It was not believed at that time, however, that they were of sufficient importance either in quantity or quality to warrant their exploitation.[2] The industry of phosphate mining, which brought the state into world prominence, followed close upon the discovery in 1886,[3] on the Peace river, of phosphate rock of apparently high grade. By 1888[2] tentative operations were under way on this river and they met with such marked encouragement that many who had hitherto remained skeptically watching developments came into the field and the year 1889 saw two companies dredging the river bottom with modern and expensive equipment.[2] Thus the industry began in the state with the mining of river pebble.

At the close of 1888 Mr. Albert Vogt, living near Dunnellon, a village on the Withlacoochee river in Marion county, found fossil sharks' teeth in a white subsoil. Some of this white subsoil, being submitted to a chemist for analysis, was found to contain a large percentage of phosphate of lime. This deposit extended in a more or less "pockety" belt over a considerable district. Active explorations were begun and the known area of beds was rapidly enlarged.[3]

The mining of river pebble grew rapidly from the first, and when, in 1891, the period of speculation and development of the land deposits began to give way to the systematic production of this rock, the industry immediately took first rank. By the end of this year 215 companies had been formed to work the deposits, and the number was constantly increasing.[4]

In 1892 the state succeeded in tripling, as compared with the preceding year, its exports of phosphate rock, compelled consumers to acknowledge the industrial value of the product, and forced the majority of foreign producers from the field.[5] In 1894 the state, by exceeding the production of South Carolina, became the chief producer of phosphate rock in the world, with a product of 527,633 long tons; it has occupied this position ever since.

The hard rock phosphate is white or creamy, and varies in texture and structure. It is mined over a belt reaching from the vicinity of Bay City on the south to the vicinity of Albion on the north, and having an average width of about 10 miles with an area of about 900 square miles.

Land pebble is found in a number of localities in the peninsular portion of the state, the center of production being in Polk county. Between the Peace river and the Gulf its occurrence is general beneath a large part of the surface, and it is also found in varying quantities in many other places. It is essentially a mass of white phosphatic pebbles lying in a matrix of phosphatic clay or sand, usually of the two in combination. The matrix is easily disintegrated by water and the pebbles are washed out by appropriate machinery. The pebbles vary in size from grains to stones 1 inch in diameter, the average size being from one-quarter to one-half inch.

River pebble is found in bars in the rivers of southern Florida, the bulk of the production of this class of rock having been taken from the Peace river. Other rivers carrying the pebble are the Alafia, the two Manatees, and the Caloosahatchee. It has also been found in many other streams entering the Gulf and in Black creek, a tributary of the St. Johns. With these pebbles, the remains of vertebrate animals are often found. In color, the river pebbles are blue or black and in size they vary from 1 inch in diameter down to grains, usually finer as distance down the stream is gained.[6]

The soft rock phosphate occurs both as a deposit by itself and in deposits of hard rock, filling the spaces

[1] The New International Encyclopedia, Vol. VII, page 509.
[2] Phosphates of America, by Francis Wyatt, Ph. D., page 63.
[3] United States Geological Survey, "Mineral Resources of the United States," 1888, page 592.
[4] United States Geological Survey, "Mineral Resources of the United States," 1889 and 1890, page 454.
[5] The Mineral Industry, Vol. I, 1892, page 368.
[6] United States Geological Survey, "Mineral Resources of the United States," 1889 and 1890, page 453.

between the bowlders. It may be either clayey or sandy in its nature.[1]

Limestones and dolomites.—The production of limestone in the state has been limited to the last few years and the aggregate output is not large. It is divided about equally in use between building stone, paving, roadmaking, and jetties, and for burning into lime.[2] Limestone is the underlying rock throughout the state,[3] and its outcroppings in Dade, Washington, and Marion counties were the principal points of production in 1902.

All other minerals.—Clay mining in 1902 was confined to the two counties Lake and Putnam, although many valuable clay deposits have been found at various places in the state. Kaolin beds of superior quality occur in Citrus, Lee, and Hernando counties. In the vicinity of Okahumpka some fine specimens have been found of a clear, white quality, comparing favorably with the kaolin used in New Jersey in the manufacture of porcelain ware. At Bluffsprings, in Escambia county, occurs a bed of potters' clay from which a good quality of sewer pipe can be made.[4]

The great sedimentary kaolin deposits in the vicinity of Villa City, Lake county, on the Palalakaha creek, half way between St. Augustine and Tampa, are remarkably alike for their extent and quality. Prospecting has shown the clay to be some 30 feet in thickness and similar chemically to that of Limoges.[5] What are said to be the purest ball clays found in the United States occur at Edgar, near Leesburg.[6]

Fuller's earth includes a number of clay-like substances having strong absorbent qualities.[7] It is found in many shades of color varying from gray to dark green, turning to white on drying; some varieties are kaolinite and others are smectite.[8] For many years it was employed only as a detergent in fulling cloth, but with the increased production of cottonseed oil, it came to be used for clarifying such oil and also for clarifying lard oil and petroleum.[9] The utility of fuller's earth for this purpose was discovered in the United States.[10] For some years the supply had been drawn principally from England, but the new demand stimulated the search for commercial deposits in this country. In 1893, quite by accident, the first discovery of this useful earth in the United States occurred near Quincy, Fla. An effort to burn brick from a bed of clay failed, the material exfoliating instead of forming a coherent mass. An Alsatian cigarmaker called attention to the close resemblance of this peculiar clay to the German fuller's earth.[9] Investigation followed and the deposit proved to be fuller's earth of a very high grade. Since its discovery practically the entire output in the United States has come from this state. In addition to the deposits in the vicinity of Quincy, others have been found at Mt. Pleasant, Norway, River Junction, Ballards point, near Tampa, and at other points.[11] In 1897 a peculiar chocolate-brown earth was discovered near Ocala, which is claimed to be superior to all other American and to all English fuller's earths as a filtering and clarifying agent for oils.[12]

[1] United States Geological Survey, "Mineral Resources of the United States," 1889 and 1890, page 453.
[2] Ibid., Sixteenth Annual Report, 1894–95, Part IV, page 496.
[3] The New International Encyclopedia, Vol. VII, page 508.
[4] United States Geological Survey, "Mineral Resources of the United States," 1893, page 614.
[5] Ibid., 1891, page 507.
[6] Ibid., Seventeenth Annual Report, 1895–96, Part III, continued, page 845.
[7] United States Geological Survey, Seventeenth Annual Report, page 876.
[8] Dana's Mineralogy, 1892, page 695.
[9] United States Geological Survey, Twenty-first Annual Report, 1899–1900, Part VI, continued, page 590.
[10] Ibid., Twentieth Annual Report, 1898–99, Part VI, continued, page 741.
[11] Ibid., Seventeenth Annual Report, 1895–96, Part III, continued, page 877.
[12] The Mineral Industry, 1898, Vol. VII, page 271.

GEORGIA.

Table 1 is a summary of the statistics for the productive mines and quarries of the state of Georgia for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Siliceous crystalline rocks.	Marble.	Coal, bituminous.	Iron ore.	Gold and silver.	Limestones and dolomites.	Bauxite.	All other minerals.[1]
Number of mines or quarries	149	26	5	3	19	45	8	16	27
Number of operators	127	24	5	2	13	45	8	3	27
Salaried officials, clerks, etc.:									
Number	304	45	24	24	30	59	15	23	54
Salaries	$209,281	$34,536	$23,050	$20,326	$42,361	$20,508	$6,752	$19,355	$33,393
Wage-earners:									
Average number	2,820	724	310	168	688	334	152	93	351
Total wages	$1,085,047	$382,559	$105,709	$74,649	$229,138	$107,718	$42,516	$36,559	$106,199
Contract work	$122,619	.....	.....	$121,494	.....	$1,030	.....	$125	.....
Miscellaneous expenses	$231,145	$32,588	$68,557	$18,319	$76,022	$9,084	$3,348	$9,564	$12,463
Cost of supplies and materials	$566,067	$188,278	$77,205	$107,994	$64,032	$33,123	$17,905	$23,017	$52,713
Value of product	$3,117,358	$803,778	$660,517	$589,018	$452,717	$149,160	$111,589	$90,194	$251,995

[1] Includes operators as follows: Asbestos, 1; cement, 2; clay, 7; graphite, 2; infusorial earth, tripoli, and pumice (operator reported under talc and soapstone); manganese ore, 6; mica, 1; mineral pigments, crude, 4; sandstones and quartzites, 1; slate, 1; sulphur and pyrite, 1; talc and soapstone, 1.

The state ranked thirty-fourth in 1902 in the value of products of mines and quarries, with a total of $3,117,358. The scope of this branch of industry in the state is quite broad, nineteen different minerals contributing to the total. Gold and silver, in the production of which in former years the state was conspicuous, are still important products, though not commensurate with the abundant deposits of these metals. In recent years the state's most important mineral products have been granite and marble; the quality of the deposits of both these minerals is high and their quantity practically unlimited. From the bauxite deposits of the state more than three-fourths of the total output of the United States is drawn. The extensive occurrence of limestone, iron ore, and slate also add materially to the state's mineral wealth and promise much for future industrial activity.

In addition to the nineteen minerals produced commercially in 1902, the occurrence of many others has been definitely established. Some of these have been exploited to a limited extent, while with others development work has not passed beyond the incipient stage and still others remain untouched. Among the more important of these is copper ore, which before the Civil War was successfully mined in Fannin and Cherokee counties. Large quantities of high-grade ore have been taken from the mines of these counties and the deposits are undoubtedly of considerable economic importance. Copper ore deposits have also been discovered in Fulton, Paulding, Lumpkin, Haralson, Lincoln, and other counties in the northern part of the state. The most important form of the ore is the copper pyrites.[1]

Extensive deposits of corundum occur in many sections of northern Georgia, but chiefly in Rabun county on Laurel creek, where the first discovery of this mineral in the state occurred in 1871. Between 1880 and 1893 the deposits of this county, together with a deposit at Trackrock, in Union county, were extensively worked; their product was one of the main factors in the corundum trade of the country for abrasive purposes. The low prices prevailing for this mineral during the last few years are chiefly responsible for the mines remaining inactive. Corundum has also been found in Habersham and other counties.[2]

Of the precious stones, amethysts of good quality have been found in Rabun county; rubies and sapphires of small size have been obtained in connection with corundum mining, and green beryl, suitable for cutting, has also been found. Some good moonstones have been cut from the feldspar of Upson county.[3] Several diamonds have been found in Hall county, ranging in value up to $200.[4] Others have been found in Lumpkin, White, and Dawson counties.[5] Opal occurs in some of the clay beds of Washington and Bulloch counties.[5]

Serpentine, one of the most beautiful working stones

[1] Georgia, Historical and Industrial, page 140.
[2] Ibid., page 133.
[3] Ibid., page 66.
[4] Statistics of Georgia, by George White, page 307.
[5] The Commonwealth of Georgia, by J. T. Henderson, page 140.

of the state, occurs in commercial quantities in Cherokee county near Holly Springs, where it has been quarried to a limited extent. The stone is of a dark green color, mottled and streaked with white and black, admits of an excellent polish, and is very highly prized for ornamental purposes.[1] Other minerals are antimony, arsenic, barytes, bismuth, calcite, cyanite, epidote, fuller's earth, garnet, glauconite, gypsum, lazulite, lead, monazite, platinum, rutile, staurolite, tin, tourmaline, and zinc.[2]

Development work in the mineral deposits of the state in 1902 was confined to gold, silver, and copper, $32,657 being expended. Certain manufacturing industries are closely allied to or are based on the mining industry, using as their raw materials the product of the mine or quarry. The relative importance of these branches of manufacture, as indicated by the value of their products, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$106,654,527
Based upon products of mines or quarries:		
Chemicals and allied products	$3,549,632	
Clay, glass, and stone products	2,483,831	
Iron and steel and their products	4,100,101	
Metals and metal products, other than iron and steel	813,605	
Miscellaneous industries	2,971,110	
		13,918,279
All other		92,736,248

The total value of the products of these manufacturing industries based on mining was, as shown by Table 2, $13,918,279, or 13 per cent of the total value of the product of all manufacturing industries in the state in 1900. During the same year there were employed in all branches of manufactures in the state 83,842 wage-earners, who were paid $20,290,071 in wages. In 1902 there were employed in the mines and quarries of the state 2,820 wage-earners, who received $1,085,047 in wages. Of the combined figures for these two branches of industry, therefore, 96.7 per cent of the wage-earners, receiving 94.9 per cent of the wages, were employed in manufacturing, while 3.3 per cent of the wage-earners, receiving 5.1 per cent of the wages, were employed in mining.

Table 3, compiled from the reports of the United States Geological Survey, shows the value of the annual production of the principal minerals of the state from 1890 to 1902.

[1] Georgia, Historical and Industrial, page 135.
[2] The Commonwealth of Georgia, page 141.

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Siliceous crystalline rocks.	Marble.	Iron ore.	Gold and silver.[1]	Limestone and dolomite.
1890	$752,481	$196,250	[2]	$101,318	[2]
1891	790,000	275,000	[2]	80,622	[2]
1892	700,000	280,000	[3] $262,517	95,251	[2]
1893	476,387	261,666	[3] 203,682	100,375	$34,[illegible]
1894	511,804	724,385	[3] 166,228	99,095	32,0[illegible]
1895	508,481	689,220	[3] 250,116	128,520	12,0[illegible]
1896	274,734	617,380	[3] 150,018	151,776	29,6[illegible]
1897	436,000	598,076	[3] 166,704	160,076	32,0[illegible]
1898	339,311	656,808	[3] 129,468	129,246	57,8[illegible]
1899	411,344	742,551	[3] 235,343	113,517	29,7[illegible]
1900	380,434	631,241	[3] 446,354	[4] 116,948	54,4[illegible]
1901	761,646	936,549	[5] 258,227	[4] 124,740	85,6[illegible]
1902[6]	803,778	660,517	452,717	[4] 98,012	111,5[illegible]

[1] Estimates by Director of the Mint, value of the refined product; silver at coining value. The values given in Table 1 are the values at the mine.
[2] Not separately reported.
[3] Includes production from North Carolina.
[4] Silver at commercial value.
[5] Includes production from North Carolina and South Carolina.
[6] Census figures, except for gold and silver.

Siliceous crystalline rocks.—Georgia ranked eighth in the production of the rocks of this group in 1902. Granites and gneisses of excellent quality for building and monumental purposes, and in practically inexhaustible quantities, occur throughout the middle and northeastern parts of the state. One of the most interesting, and perhaps the largest, granite mass in the world is Stone mountain, located in Dekalb county, near Atlanta. This remarkable mountain of rock, whose barren summit attains an altitude of several hundred feet above the surrounding country, with a circumference at its base of 7 miles,[3] has long been the seat of a very important granite industry,[4] the first operations dating back to 1850.[5] The stone obtained from these quarries is a light colored muscovite granite possessing remarkable strength and quite free from all chemical and physical defects. The stone is extensively used as a building material, and is also largely employed in street improvement. There is probably no granite in the South more widely known and more generally used than that furnished by the Stone mountain quarries. Much of it is shipped beyond the borders of the state.[1]

Another granite, or rather granitoid gneiss, of almost as much economic importance as the Stone mountain granite itself, is the lithonia gneiss. This stone, which differs chiefly from the Stone mountain granite in being laminated, occurs in a considerable area in the eastern part of Dekalb county and in the contiguous parts of Rockdale and Gwinnett counties. The quarries on this belt are very extensive and furnish large quantities of

[3] Statistics of Georgia, page 207.
[4] Georgia, Historical and Industrial, page 134.
[5] Stones for Building and Decoration, by George P. Merrill, page 56.

stone for street improvement as well as for general building purposes. Georgia in 1902 ranked first among the states in the production of curbing, of which the greater part was drawn from the quarries on this belt. Granites and granitic gneisses similar to these occur in many other localities in the northern part of the state, but only at a few points have they been quarried to any considerable extent.[1]

In addition to the granites and granitoid gneisses mentioned there are other granites of superior quality which are admirably adapted to monumental purposes. These occur mainly in Elbert and Oglethorpe counties. They are fine grained biotite granites unusually free from injurious minerals and admit of a very brilliant polish. They are perhaps unsurpassed in the United States for decorative stonework, and it is only a question of time when the Georgia monumental granite industry will be of very great commercial value to the state.[1]

Marble.—Georgia ranked second among the states in 1902 in the production of marble. The state's prominence as a marble producer is remarkable, in view of the brief period over which the history of this industry extends. The commercial exploitation of the enormous marble resources has been entirely the work of the last two decades. The outcroppings of snowy rock in Pickens county were known to the Cherokee Indians, who formerly inhabited this region, and by them were worked to a limited extent and cut into bowls and various other forms. A good specimen of this handiwork may still be seen in the form of a large circular marble bowl, now used as a flower pot in a yard near the Piedmont quarries. It is remarkably well preserved, and is valued very highly by its present owner.[2]

The first systematic working of these outcroppings was by Mr. Fritz T. Simmons in 1840, in Longswamp valley near the village of Tate. At first all the work required in getting out and polishing the marble, which was then used exclusively for tombstones, was done by hand. About two years after Mr. Simmons had begun work he erected a mill with one gang of saws on the east bank of Longswamp creek, near Marble Hill post office. This was the first mill put up in the state for sawing marble. This mill was a somewhat primitive affair, but in principle it was identical with the best mills in use at the present day. A small product was turned out in a desultory way by this and similar mills in the vicinity during several years, but the local demand for tombstones was easily satisfied and existing conditions did not, therefore, encourage a rapid growth of the industry. In 1854 operators, who ten years before had opened a quarry 2 miles east of Jasper, renewed the work at that place. They erected a mill with four gangs of saws and continued fairly successful operations until the work was abandoned on account of the Civil War. The product of this mill was sold in the surrounding counties through agents, transportation being effected by wagons.[3] At the close of the war operations were again resumed and continued for about two years. Then followed a period of nearly twenty years during which the marble industry, in common with many others, was at a standstill.

In May, 1884, a company was organized with a capital of $1,500,000.[4] This date marks the beginning of a very important epoch in the history of the development of the marble industry on a commercial scale in Pickens county and the state. Prior to this date Georgia marble was practically unknown to the trade as a building or ornamental stone, and had even a very local use for tombstones, but on account of its exceptional quality and unlimited quantity, and the energy and business-like methods of the operators, it has found its way to all parts of the United States,[4] and even to foreign countries.[5] In many of the finest buildings in the country it has been used for building or ornamental purposes. Among these may be mentioned the capitols of Georgia, Rhode Island, Mississippi, and Minnesota; the United States Government building at Boston; St. Luke's Hospital, New York; and the Corcoran Art Gallery, Washington.[6]

The most valuable marbles of the state are those of the crystalline area, confined in the main to Pickens, Cherokee, Gilmer, and Fannin counties. These marbles occur in a narrow belt which runs parallel to the Atlanta, Knoxville and Northern Railway from near Canton, in Cherokee county, to the Georgia-North Carolina state line, a distance of more than 60 miles. The center of the marble industry of the state is in the vicinity of Tate, Pickens county, just north of the southern end of the belt, where the deposit attains a thickness of 200 feet.[7] The structure of the marble from the different quarries is essentially the same, but there is a marked variation in the color. Some of it is white, some bluish gray with dark blue spots, some with dark blue mottlings, useful for monumental work and interior decorations; others of a variety of shades, such as

[1] Georgia, Historical and Industrial, page 135.
[2] Geological Survey of Georgia, Bulletin No. 1, page 9.
[3] Ibid., pages 10 and 11.
[4] Geological Survey of Georgia, Bulletin No. 1, page 11.
[5] Georgia, Historical and Industrial, page 41.
[6] Ibid., pages 41 and 134.
[7] Geological Survey of Georgia, Bulletin No. 1, page 21 ff.

pink, salmon, rose, and dark green, thus producing rich effects, are especially adapted for wainscoting, panels, counters, table tops, etc.[1]

In addition to the marbles of the main belt there are also valuable deposits in the northwestern part of the state, especially in Whitfield county. These marbles belong to the same deposits that traverse East Tennessee, which are extensively quarried in the vicinity of Knoxville. The stone has a dark chocolate or light gray color and a rather fine texture. The light gray variety, which is always quite compact and highly crystalline, is traversed by dark zigzag lines that give to the polished surface a very pleasing effect. These marbles, though of great economic value for building purposes, have not as yet been extensively exploited.[2]

Iron ores.—The first iron furnace put into operation in the state was that erected in 1840 on Stamp creek, in Bartow county. Within the following twelve or fifteen years four others were put in blast in the same county. The remains of these old furnaces are still to be seen along Stamp creek and the Etowah river. They were small furnaces of the charcoal type and varied in capacity from 2 to 4 tons a day. The ore was taken from the banks in the vicinity or was picked up from the adjacent fields.[3] The industry, begun on this small scale in Bartow county, rapidly grew in importance and volume until at the opening of the Civil War it had spread to other counties in this immediate section, and with greatly enlarged and improved furnaces the state's output had increased many fold. The passing of the war left the furnaces in ruins, and it was not until 1870 that development of the iron ore deposits of the state was resumed. The Rising Fawn furnace, in Dade county, blowing in for the first time on June 18, 1875, was the first in the United States to use the Whitewell hot blast stove.[4] The industry, however, has never regained its former importance. Three or four modern plants have been manufacturing pig iron in Polk and Floyd counties from the high-grade deposits in the vicinity for a number of years,[5] but the bulk of the crude ore of the state is shipped to the furnaces of other states.[6]

The iron ores of Georgia constitute one of the most valuable of its various mineral products. The deposits, which are quite widely distributed throughout the northern part of the state, consist of the brown ores or limonite, magnetite, and hematite or red ores. The brown ores, which furnish the major portion of the present output, are mined in Bartow, Polk, and Floyd counties. The most abundant deposits of these ores occur in pockets or irregular deposits in the residual clays that have resulted from the weathering of an extensive magnesian limestone formation of the Lower Silurian age, known as the Knox dolomite. The average proportion of metallic iron in these ores runs between 48 and 50 per cent. They occur generally throughout the northwestern part of the state, and to a limited extent in other sections.

The red iron ore is mined in Walker and Chattooga counties.[7] Vast quantities occur in beds which outcrop in sandstone ridges that encircle the Coal Measures or extend parallel with their eastern and western limits.[7] The area underlaid by beds of workable thickness is not less than 350 square miles, and falls mainly within the counties of Dade, Catoosa, Walker, and Chattooga.[8]

The following table, compiled from reports of the United States Geological Survey, shows the output of iron ore from 1890 to 1902, inclusive:

TABLE 4.—*Annual production of iron ores: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1890	244,088	1897	[2]204,629
1891	250,755	1898	[2]160,083
1892	185,054	1899	236,748
1893	[1]186,015	1900	[2]336,186
1894	[2]174,694	1901	[3]215,599
1895	[2]272,014	1902	[2]364,800
1896	[2]175,331		

[1] Includes production from West Virginia.
[2] Includes production from North Carolina.
[3] Includes production from North Carolina and South Carolina.

Gold and silver.—Excepting early and half legendary Spanish working in and near the valley of the Coosa, the first gold mining in the state probably began in 1829. In that year, or shortly after, miners from the placer mines of Burke county, N. C., following the indications, went southward into Georgia, where they discovered gold on Dukes creek, in what is now White county. This discovery was followed in quick succession by others throughout Habersham and Lumpkin counties, and soon hundreds of miners were busily engaged on the various streams in this section in search of the yellow metal. In 1830 Governor Gilmer wrote to John McPherson Berrian, then Attorney-General of the United States, saying: "I am in doubt as to what ought to be done with the gold diggers. They, with their various attendants, foragers, and suppliers, make up between six and ten thousand persons. They occupy the country between the Chestatee and Etowah rivers, near the mountains, gold being found in the greatest quantity deposited in small streams which flow into those rivers."[9] The center of gold mining activity then, as now, was in Lumpkin county, in the vicinity of Dahlonega, which in the Cherokee language means "yellow money," and in the town of Auraria, 6 miles away, so named by John C. Calhoun, who owned a mine near by.[10]

[1] Georgia, Historical and Industrial, page 41.
[2] Ibid., page 134.
[3] Geological Survey of Georgia, Bulletin No. 10A, page 27.
[4] Iron in All Ages, by James M. Swank, page 280.
[5] Geological Survey of Georgia, Bulletin No. 10A, pages 27 and 28.
[6] Georgia, Historical and Industrial, page 62.
[7] The Commonwealth of Georgia, page 119.
[8] Ibid., page 118.
[9] Geological Survey of Georgia, Bulletin No. 4A, page 29.
[10] The Gold Mines, Scenery, and Climate of Georgia and the Carolinas, by R. C. Stone, page 20.

This region was then known as the Cherokee country, as it was occupied by the Cherokee tribe of Indians. The increasing strife and ill will between the Indians and the white miners, and among the white miners themselves who were quarreling and fighting over the Battle Branch and other gold discoveries, caused Governor Gilmer in June, 1831,[1] to issue a proclamation prohibiting gold mining in north Georgia. A detachment of United States troops was sent to enforce the proclamation. Two miles north of Auraria, or Knucklesville, as it was then called, there was still standing in 1878 the old station house in which General Scott and his troops were stationed to preserve the peace and enforce the law during these turbulent times.[2] Thus the mining industry was temporarily retarded, but the acquisition by the state of the Cherokee country about this time, and the removal of the Indians from it, gave the gold seekers full sway, and a period of great activity immediately ensued.[1] In 1831 the first deposit of gold from the placers of the state was made at the United States Mint.[1] The industry spread rapidly throughout the northern part of the state and the production of gold had reached such volume in 1838 that a branch of the United States Mint was established at Dahlonega. This mint continued in operation for twenty-three years and coined 1,381,784 pieces of gold, valued at $6,115,569. However, much of the product of the state during this period was sent to the Philadelphia and other mints, and the total yield exceeded materially the output of the Dahlonega mint.[3]

Mining activity in the state declined markedly on the discovery of gold in California and ceased almost entirely soon after the opening of the Civil War. As the placer deposits, that gave a basis for the greater part of the industry in its earlier stages, have been largely worked over, attention has been directed more and more in recent years to vein mining. According to the report of the Director of the United States Mint for the year 1882, "the work of the year in Georgia was eminently successful, both in its steady prosecution and increase. New mines were selected with judgment, carefully equipped, and the work for the most part managed with prudence and economy." As a result of the great progress of recent years in deep mining, through the introduction of methods for the economic working of refractory ores, the outlook for the industry in the state is quite promising.[4]

The value of gold and silver produced by the state since the discovery in 1829, as compiled from the reports of the Director of the United States Mint, is $17,105,253.

The gold deposits of the state belong to the Appalachian gold fields, an auriferous belt extending from Nova Scotia to Alabama. In Georgia the belt breaks up into a number of parallels having a northeast-southwest trend. The most important of these are the Dahlonega and the Hall county belts. The Dahlonega belt enters the state from North Carolina in the southwestern part of Rabun county, where valuable placer deposits have been worked at the Smith and Moore Girls mines. Farther to the southwest, in White county, the belt increases in width and the mines become more numerous. As it enters Lumpkin county it again increases in width, reaching its greatest development in the vicinity of Dahlonega. In Dawson county it becomes more or less broken, but upon entering Cherokee it again becomes regular and continues with but few interruptions to the Alabama line. The entire length of this belt is about 150 miles, while its width varies from 1 to 5 miles.

The Hall county gold belt lies some 10 miles east of the Dahlonega belt and parallels it for more than 100 miles, stopping short about 10 miles north of Atlanta. A third belt, which includes the Acworth, Villa Rica, and Bonner mines, traverses Cobb, Paulding, and Carroll counties. Still another belt includes some very important mines in Lincoln, Columbia, McDuffie, and Warren counties, and there are many isolated localities besides in which gold occurs in paying quantities.[5]

Limestones and dolomites.—Limestone suitable for lime, fluxing, and building materials exists in great abundance, especially in the northwestern part of the state. The most extensive of these calcareous formations is the Knox dolomite, a magnesian limestone of great thickness. This formation furnishes much of the lime used in the state as well as a large amount of stone for general building purposes. Other calcareous formations of scarcely less commercial importance are the Bangor and Chickamauga limestones. The Chickamauga stone has been extensively used in the last few years for the foundations of monuments in Chickamauga National Park.[6]

Coal, bituminous.—The coal fields of Georgia, which form the northern extension of the Warrior coal field of Alabama, and which were among the first in the country south of the Ohio river to be worked, are located in the northwestern part of the state, falling in the main within the counties of Dade, Walker, and Chattooga. For fifty years or more mining has been carried on in these fields, the greater part of the product at present coming from Dade and Walker counties.

The coal obtained from all the deposits in the state is an excellent quality of bituminous coal, well suited for coking and steam purposes.

Table 5, compiled from the reports of the United States Geological Survey, shows the annual production from 1884 to 1902, inclusive.

[1] Geological Survey of Georgia, Bulletin No. 4A, page 30.
[2] The Gold Mines, Scenery, and Climate of Georgia and the Carolinas, page 20.
[3] Geological Survey of Georgia, Bulletin No. 4A, page 31.
[4] Ibid., page 32.
[5] Georgia, Historical and Industrial, page 139 ff.
[6] Ibid., page 136.

TABLE 5.—*Annual production of coal, bituminous: 1884 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1884	150,000	1894	354,111
1885	150,000	1895	260,998
1886	223,000	1896	238,546
1887	313,715	1897	195,869
1888	180,000	1898	244,187
1889	225,934	1899	233,111
1890	228,337	1900	315,557
1891	171,000	1901	342,825
1892	215,498	1902	414,083
1893	372,740		

Bauxite.—The first discovery of bauxite in the United States occurred near Rome, Ga., in 1887, and the first bauxite production reported for the country came from the deposits at Hermitage, in Floyd county, in 1889.[1] Shortly after this date other mines were opened in Floyd, Bartow, and Polk counties, so that following close upon its discovery the mining of the bauxite in the state became a very important and lucrative industry. Georgia, until 1891 the only producer of bauxite, still contributes the greater part of this mineral to the market.

All other minerals.—Asbestos is rather widely distributed throughout the northern part of the state, although systematic investigation has been made of the deposits, and hence not much is known of their commercial value or extent. However, for many years the greater part of the supply of this mineral produced in the United States has come from the deposits of Georgia, the mine supplying the most of this being located on Sal mountain in White county.[1]

The industry of mining hydraulic cement rock in the state began in 1845, in Bartow county, above the Western and Atlantic Railroad. The deposits of the state are of excellent quality and are widely distributed over its northwestern part.[2]

The most valuable and extensive deposits of clay in the state are those of sedimentary origin. They occur in a belt several miles in width from Augusta to Columbus. Some of these clays have been used extensively in the manufacture of wall paper, while others are used in making porcelain, terra cotta, tiling, sewer pipe, pottery, etc. Dr. George E. Ladd, director of the Missouri School of Mines, speaking of the cretaceous fire clays of the state, says: "Some of these kaolins suitable for fire clays are more refractory than any of the noted fire clays of the United States." Fire clays also occur in commercial quantities at other points, and residual and alluvial clays, well suited to the manufacture of bricks and the cheaper grades of crockery, abound in every county in the northern part of the state.[3]

Graphite occurs in large quantities in many counties along the western margin of the crystalline area. It is quite abundant in Bartow county, where it is now mined and used in the crude state as a filler for commercial fertilizers.[4]

A light, porous, siliceous stone occurring in Murray, Chattooga, and other counties in northwest Georgia has been known locally for many years as tripoli. Though different from this mineral in origin it has similar uses in the arts.[5]

For many years the mining of manganese ore has been an important industry in the state. During several of the years since 1880 Georgia has been the chief producer of this valuable mineral in the United States, and since that time has contributed more than one-fifth of the total yield of the country.[6] The manganese ores of the state, like the brown iron ores, are confined chiefly to Bartow, Floyd, and Polk counties, the largest and most productive deposit so far located being near Cartersville in Bartow county.[7]

Mica is quite generally distributed throughout the northeastern part of the state, occurring in many places in commercial quantities.[4]

Ocher deposits of commercial value are of wide occurrence throughout the northwestern part of the state, generally associated with the brown iron ores. These ocher deposits, which are really only a pulverulent form of brown iron ore, are quite free from impurities and well suited for making linoleum and paint. The output of the ocher mines of the state, which is about one-fourth of the yield of the country, is shipped in the main to England, where it is used in the manufacture of linoleum.[7]

Pyrite in great abundance is widely distributed throughout the state, but exists in only a few localities in sufficient quantities to be of commercial importance. Valuable and extensive deposits occur in Lumpkin, Paulding, and Haralson counties, but no development on an extensive scale has yet been done.[8]

Sandstone has been extensively quarried in Catoosa county. This variety of sandstone has a dark brown color and resembles very closely the brown sandstone of the Connecticut valley. It makes a beautiful building material and appears to be quite durable. It is also found in great abundance in the mountain ranges of the northwestern part of the state. Other varieties of sandstone of a light color, and well adapted for building purposes, occur in Lookout, Sand, and Pigeon mountains.[9]

The roofing slates of Georgia occur in great quantities in the northwestern part of the state. The center of the slate quarrying industry in the state is at Rockmart, in Polk county, where the industry has been carried on for a great many years.[3]

Talc occurs in the northwestern part of the state in quantities of economic importance and has been mined in a number of places, especially in Fannin county.

[1] Georgia, Historical and Industrial, page 133.
[2] Ibid., page 136.
[3] Ibid., pages 136 and 137.
[4] Ibid., page 143.
[5] Georgia, Historical and Industrial, page 144.
[6] The United States Geological Survey, "Mineral Resources of the United States," 1902, page 135.
[7] Georgia, Historical and Industrial, page 130.
[8] Ibid., page 140.
[9] Ibid., page 135.

IDAHO.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Idaho for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Gold and silver.	Limestones and dolomites.	Sandstones and quartzites.	All other minerals.[1]
Number of mines or quarries	292	258	14	11	9
Number of operators	290	258	13	10	9
Salaried officials, clerks, etc.:					
Number	354	340	.....	1	13
Salaries	$576,690	$550,548	.....	$1,232	$24,910
Wage-earners:					
Average number	3,563	3,382	6	7	168
Total wages	$3,903,504	$3,698,345	$3,964	$1,655	$196,540
Contract work	$43,442	$41,642	.....	.....	$1,800
Miscellaneous expenses	$836,109	$814,670	$110	$615	$21,014
Cost of supplies and materials	$1,626,153	$1,605,696	$1,265	$352	$18,840
Value of product	$8,214,671	$8,177,267	$15,074	$13,777	$8,553

[1] Includes operators as follows: Coal, bituminous, 5; copper, 1; precious stones, 1; siliceous crystalline rocks, 2.

The state ranks fourth in the precious metals, the chief mining industry of the state, and is first in lead production, though the latter occurs as a by-product of gold and silver mining. Gold, silver, and lead mining overshadows all other mine and quarry interests, as the value of these products constituted over 99 per cent of the total mineral products of 1902. The other minerals mined commercially were limestones and dolomites, sandstones, bituminous coal, copper, precious stones, and siliceous crystalline rocks.

Other minerals found in the state, but not reported as mined or quarried in commercial quantities in 1902, are as follows: Antimony, a part of the small amount mined in this country having been furnished by Idaho in 1901 and previous years; marble, which has been quarried to a small extent in former years; mica, mined in former years to some extent in the Roberson mining district, near Moscow, Latah county, and opened up at several other localities;[1] monazite, said to have been found in the gold placers of Oro Fino; nickel ores, reported as occurring at the St. Joe mine, Blackbird, Lemhi county;[2] platinum, which occurs in gold placers of the state;[3] and tungsten ores.[4]

Development work was reported by 325 operators in the gold and silver industry. There were employed on development work 180 salaried officials, clerks, etc., who received $164,560 in salaries, and 852 wage-earners, who were paid $897,412 in wages. There was also paid to 254 employees $158,262 for work done by contract. The miscellaneous expenses amounted to $98,217, and the cost of supplies and materials to $405,058.

The following table shows the value of all manufactured products of this state for 1900 and the value of the products of the manufacturing industries based primarily upon the products of mines and quarries:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures	.....	$4,020,532
Based upon products of mines or quarries:		
Clay, glass, and stone products	$55,709	
Iron and steel and their products	64,272	
Metals and metal products, other than iron and steel	185,347	
Miscellaneous industries	91,448	
		396,776
All other	.....	3,623,756

The value of the products of manufactures utilizing mine and quarry products was 9.9 per cent of the value of all manufactures. Mines and quarries employed 3,563 wage-earners in 1902, who were paid $3,903,504 in wages. In 1900 manufacturers gave employment to 1,477 wage-earners, who received $862,088 as wages. Mines and quarries, therefore, employed 70.7 per cent of the wage-earners of the two industries and paid 81.9 per cent of the wages, and manufactures employed 29.3 per cent of the wage-earners and paid 18.1 per cent of the wages.

[1] United States Geological Survey, Twentieth Annual Report, 1898–99, Part VI, page 706.
[2] Ibid., "Mineral Resources of the United States," 1901, page 243.
[3] Ibid., page 231.
[4] Ibid., page 262.

The annual production since 1889 of the leading minerals of the state for which values are reported is shown in the following table:

TABLE 3.—*Value of annual production of principal minerals: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Gold.[1]	Silver.[1]	Limestone.	Sandstone.
1889	$2,000,000	$4,395,959	(2)	(2)
1890	1,850,000	4,783,838	$28,545	$2,490
1891	1,680,000	5,216,970	(2)	(2)
1892	1,721,364	4,475,087	5,000	3,000
1893	1,646,900	5,056,259	1,000	2,005
1894	2,308,775	4,879,966	5,315	10,529
1895	1,779,600	4,021,780	7,829	6,900
1896	2,155,300	6,658,457	5,662	16,060
1897	1,701,700	6,336,905	15,588	(2)
1898	1,716,900	6,560,065	3,080	(2)
1899	1,889,000	4,980,105	3,325	(2)
1900	1,724,700	[3] 3,986,042	34,587	438
1901	1,869,800	[3] 3,325,740	21,251	20,843
1902[4]	1,475,000	[3] 3,103,044	15,074	13,777

[1] Estimates of the Director of the Mint as value of the refined product; silver at coining value. The values given in Table 1 are the values at mine.
[2] Not reported separately.
[3] Commercial value.
[4] Census figures, except for gold and silver.

The mineral production at former census years was confined to gold and silver, with the exception of a small copper output in 1889. The gold and silver returns for the several census years, beginning with 1870, are as follows:

YEAR.	Gold and silver.	YEAR.	Gold and silver.
1870	$1,989,341	1880	$6,040,641
1880	2,480,000	1902	8,177,267

Gold.—Gold was found on the Pen d'Oreille river in 1852 by a French Canadian, but not in paying quantities. The mining growth of the state dates from the discovery of the Oro Fino placer mines in 1860.[1] Other discoveries soon followed. The mines at Florence at the head of Meadow creek were discovered in the fall of 1861; at Boise basin, a very rich placer district, in August, 1862; and at Owyhee in 1863. As in all new gold districts the first mining was placer, the location of the vein mines coming later. The Poorman, one of the famous vein mines of the state, was located in the summer of 1865. The gold and silver production of the state in 1866 was estimated at $17,000,000, but with the exhaustion of the rich placers it fell off rapidly. The following table, compiled from the reports of the Director of the Mint, gives the value of the annual production of gold and silver from 1866 to 1888, inclusive; for the subsequent years it will be found in Table 3.

[1] Report of J. Ross Browne in "Mineral Resources of the United States," 1868, page 517 ff.

TABLE 4.—*Value of annual production of gold and silver: 1866 to 1888.*[1]

[Estimates by the Director of the Mint.]

YEAR.[2]	Gold and silver.	YEAR.[2]	Gold and silver.
1866	$17,000,000	1872	$2,695,870
1867	6,500,000	1873	2,500,000
1868	7,000,000	1874	1,880,004
1869	7,000,000	1875	1,750,000
1870	6,000,000	1876	.....
1871	5,000,000		

YEAR.	Gold.	Silver.	YEAR.	Gold.	Silver.
1877	$1,500,000	$250,000	1883	$1,400,000	$2,100,000
1878	1,150,000	200,000	1884	1,250,000	2,720,000
1879	1,200,000	650,000	1885	1,800,000	3,500,000
1880	1,980,000	450,000	1886	1,800,000	3,600,000
1881	1,700,000	1,800,000	1887	1,900,000	3,000,000
1882	1,500,000	2,000,000	1888	2,400,000	3,000,000

[1] Silver at coining value.
[2] Figures prior to 1881 taken from The Mineral Industry, 1892, page 188.

The lowest point was reached in 1878, when the total gold and silver production was $1,350,000.

Lead.—Idaho leads all states and territories in lead, on account of the large deposits of argentiferous galenas of the Coeur d'Alene district, which has furnished the major part of the silver and lead product of the state since the first working of the Coeur d'Alene mines in 1886. With the exception of the year 1899, when the product of Coeur d'Alene was reduced by strikes, Idaho has been the first in lead production since 1896. In 1902 the state produced over 30 per cent of the lead product of the country.

Limestones and dolomites.—None of the quarry industries are extensively developed. There were 13 operators—8 individuals and 5 firms—engaged in working 14 limestone quarries in 1902. The value of the product ($15,074) shows the slight and local character of the industry. Of the product, $13,049 was used for lime and $2,025 for flux.

Sandstones and quartzites.—In the sandstone industry 10 operators—7 individuals, 2 firms, and 1 incorporated company—worked 11 quarries. The value of the product was $13,777, composed of building stone, rough, $7,823; dressed, $434; and rubble stone, $5,520.

Coal, bituminous.—Coal was mined in three counties, Lemhi, Fremont, and Boise, to a very small extent, the total production being 2,030 tons of a value of $5,180. The state is the least important of all the coal producing states.

All other minerals.—The state is not a large copper producer, the output for 1902 being less than a quarter of a million of pounds, but the mines of the Seven Devils district have shipped some high-grade ores, and the de-

velopment of copper mines at Mackey, in Custer county, and erection of furnaces, give promise of a material increase in the copper product.

Opals have been found at a number of points in the state and were produced in 1902 to a small extent from one locality in Owyhee county. In 1890 considerable development was commenced near Moscow, Latah county, where opal occurs in the trachyte rocks and production was continued for a year or two. The output for 1891 was estimated at $5,000. Other occurrences are at Opaline, Owyhee county; near Salmon, Lemhi county, where beautiful opal was found in trachyte bowlders and traced to the parent ledge; and at Panther creek, Lemhi county. Smoky quartz in large crystals, up to 4 and 5 inches in diameter, has been found at Brandy creek, in Lemhi county.

Although the state has an abundance of good building material in the granites and other siliceous crystalline rocks, the demand for it is still small. Two quarries were operated to a small extent.

ILLINOIS.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of Illinois for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Limestones and dolomites.	Cement.	Fluorspar.	Lead and zinc ore.	Clay.	Sandstones and quartzites.	Natural gas.[1]
Number of mines, quarries, and wells	1,116	875	160	6	5	14	8	18	30
Number of operators	1,013	789	150	6	5	14	7	18	24
Salaried officials, clerks, etc.:									
Number	1,869	1,510	284	50	9	12	2	2	.....
Salaries	$1,910,940	$1,564,832	$270,025	$59,259	$5,804	$9,120	$1,200	$1,200	.....
Wage-earners:									
Average number	40,523	36,617	3,178	488	71	104	42	22	1
Wages	$26,986,397	$24,876,201	$1,737,863	$261,926	$28,845	$51,565	$19,602	$10,295	$600
Contract work	$26,016	$24,699	.....	.....	.....	.....	.....	.....	$1,317
Miscellaneous expenses	$1,543,903	$1,258,686	$233,379	$35,621	$1,149	$11,079	$1,999	$1,946	$44
Cost of supplies and materials	$3,515,883	$2,834,444	$451,908	$185,881	$17,115	$20,464	$3,916	$1,955	$150
Value of product	$38,234,410	$33,945,910	$3,232,123	$769,251	$123,000	$90,619	$38,463	$32,200	$2,844

[1] Includes petroleum, 1 operator (2 wells).

The coal deposits underlie an extensive area and are part of the Central coal field, which includes Indiana and western Kentucky.[1] The lead mines of the Galena district have been in operation for nearly, if not quite, a century, but to-day more zinc than lead ore is produced. The Niagara limestone of Lemont and Joliet is a fine grained, workable stone, much in demand in the interior states. A good quality of sandstone is also found. Until quite recently the fluorspar mines in the southern part of the state were the only source of supply of this mineral in the United States. There are some petroleum and natural-gas wells, good clay is plentiful, and Portland cement is manufactured in large quantities.[2]

In addition to the minerals referred to in Table 1, iron ore and mineral pigments occur in the state, but were not produced in commercial quantities in 1902. The state ranked sixth in mines and quarries in 1902 according to value of product.

Table 2 presents the value of production of the manufacturing industries of this state, which are based primarily upon the products of mines and quarries, and also the value of all manufactured products in Illinois, as reported to the Twelfth Census.

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 292.

[2] King's Handbook of the United States, pages 206 and 207.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$1,259,730,168
Based upon products of mines or quarries:		
Chemicals and allied products	$9,928,333	
Clay, glass, and stone products	19,208,163	
Iron and steel and their products	160,189,237	
Metals and metal products, other than iron and steel	50,170,581	
Miscellaneous industries	57,436,587	
		296,932,901
All other		962,797,267

The value of the products of manufactures, based primarily upon minerals mined or quarried, as shown by the foregoing table, was $296,932,901, or 23.6 per cent of the total. The value of the total product of mines, quarries, and wells of Illinois in 1902, and manufactures in 1900, was $1,297,964,578, of which manufactures contributed 97 per cent and mines and quarries 3 per cent.

The Twelfth Census shows that on the average 395,110 wage-earners were engaged in manufactures in Illinois in 1900, and that $191,510,962 was paid in wages. The average number of wage-earners engaged in mining in 1902 was 40,523, and the wages paid amounted to $26,986,397. The two industries together

gave employment to 435,633 wage-earners during the year, and paid $218,497,359 in wages. Manufactures gave employment to 90.7 per cent of these wage-earners, and paid 87.6 per cent of the wages, while mining employed but 9.3 per cent of the wage-earners, and paid only 12.4 per cent of the wages.

The following table, compiled from the reports of the United States Geological Survey, shows the value of the production of the leading minerals, except for lead and zinc, for which values can not be obtained, from 1890 to 1902:

TABLE 3.—*Value of annual production of the principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Limestones and dolomites.	Portland cement.	Natural rock cement.	Fluorspar.
1890	$14,171,230	$2,190,607	(1)	[2] $292,784	$55,328
1891	14,237,074	2,030,000	(1)	[2] 276,931	78,330
1892	16,243,645	3,185,000	(1)	[2] 236,438	89,000
1893	17,827,595	2,305,000	(1)	153,039	84,000
1894	15,282,111	2,555,952	$540	133,880	47,500
1895	14,239,157	1,687,662	1,325	171,854	24,000
1896	15,809,736	1,261,359	5,250	217,731	[3] 52,000
1897	14,472,529	1,483,157	26,250	209,000	[3] 37,159
1898	14,567,598	1,421,072	(1)	220,680	(1)
1899	20,744,553	2,065,483	79,500	187,983	[3] 96,650
1900	26,927,185	1,881,151	300,552	129,446	[3] 94,500
1901	28,163,937	2,793,837	581,818	187,036	[3] 113,803
1902 [4]	33,945,910	3,232,123	769,251	(5)	123,000

[1] No production reported.
[2] Includes value of packages.
[3] Includes production from Kentucky.
[4] Census figures.
[5] Included in Portland cement.

Coal.—The bituminous coal deposits in Illinois underlie some 35,000 square miles, or about 63 per cent of the area of the state. The coal field extends from the northern boundary of Grundy county west to the Mississippi river, near Rock Island, and south along the Mississippi to the north line of Henderson county, where it leaves the river and inclines eastward to the southern part of Jackson county. Although the first discovery of coal in the United States was made in Illinois by Father Hennepin in 1679, near the present city of Ottawa, there is no probability that any mines were opened in that locality until long after coal mining had begun in the southern part of the state. The first record of coal mining in the state was in 1810, in Jackson county. In 1832 several boat loads were shipped from this locality to New Orleans, and in 1833, 6,000 tons were mined in St. Clair county and taken to St. Louis.[1] Since that date there has been a continual increase in the coal production.

In 1902 coal was mined in 54 counties, 41 of which showed an increase in production over 1901 and 7 a decrease, the remaining 6 counties not being reported in 1901. Sangamon, with an output of 4,172,722 tons, ranked first among the coal producing counties; St. Clair second, with 2,822,248; and Vermilion third, with 2,585,291 tons. Other large coal producing counties are Bureau, Grundy, Lasalle, Macoupin, Madison, and Williamson; each have a production exceeding 1,000,000 tons. Illinois ranked second among the coal producing states.

The 789 coal operators gave employment during 1902 to 36,617 wage-earners, or 90.4 per cent of all wage-earners engaged in mines and mining in the state during the year. They also paid in wages $24,876,201, or 92.2 per cent of all the wages paid in the mining industries of the state.

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of coal in Illinois since 1833:

TABLE 4.—*Annual production of coal, bituminous: 1833 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1833	6,000	1868	2,000,000
1834	7,500	1869	1,864,000
1835	8,000	1870	2,624,163
1836	10,000	1871	3,000,000
1837	12,500	1872	3,360,000
1838	14,000	1873	3,920,000
1839	15,938	1874	4,203,000
1840	10,968	1875	4,453,178
1841	35,000	1876	5,000,000
1842	58,000	1877	5,350,000
1843	75,000	1878	5,700,000
1844	120,000	1879	5,000,000
1845	150,000	1880	6,115,377
1846	105,000	1881	7,500,000
1847	180,000	1882	9,115,053
1848	200,000	1883	12,123,456
1849	260,000	1884	12,208,075
1850	300,000	1885	11,834,459
1851	320,000	1886	11,175,241
1852	340,000	1887	12,423,066
1853	375,000	1888	14,328,181
1854	385,000	1889	12,104,272
1855	400,000	1890	15,292,420
1856	410,000	1891	15,660,598
1857	450,000	1892	17,802,276
1858	490,000	1893	19,949,564
1859	530,000	1894	17,113,576
1860	568,000	1895	17,735,864
1861	670,000	1896	19,786,626
1862	780,000	1897	20,072,758
1863	800,000	1898	18,590,299
1864	1,000,000	1899	24,439,019
1865	1,260,000	1900	25,767,981
1866	1,580,000	1901	27,331,552
1867	1,800,000	1902	32,939,373

Limestones and dolomites.—Illinois ranked second among the limestone producing states, the products of its quarries in 1902 being valued at $3,232,123. The rocks represent most of the epochs of the Silurian, Devonian, and Carboniferous ages. A notable limestone is quarried in Will county, in the vicinity of Lemont and Joliet; it is a fine grained, light colored Niagara stone, soft and easily worked, taking readily a smooth surface, but no polish.[2]

Of the 160 producing quarries, 55 had a production valued in excess of $10,000, and only 7 produced stone valued in excess of $100,000. Cook county, with an output valued at $1,418,408, ranked first among the 30 limestone producing counties; Will county second, with a production valued at $485,268; and Kankakee county third, with $256,017.

[1] Illinois Bureau of Labor Statistics, Twenty-first Annual Coal Report, 1902, page 1.

[2] Stones for Building and Decoration, by George P. Merrill, page 297.

Cement.—A fine quality of magnesian limestone was discovered at Utica, Lasalle county, in 1838, during the construction of the Illinois and Michigan canal, and in the same year a factory was erected for the production of natural rock cement. This plant is still successfully operated. A second factory was built in 1869 at Lasalle, and has since been in continuous operation. The manufacture of Portland cement was first reported from Illinois in 1894, at Oglesby, Lasalle county.[1]

In 1902 there were 4 Portland cement plants in this state. Illinois ranked sixth among the states producing Portland cement at the time of this report.

The following figures from the reports of the United States Geological Survey show the production of cement in this state since 1894:

TABLE 5.—*Annual production of cement: 1894 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Portland cement (barrels).	Natural rock cement (barrels).
1894	300	446,267
1895	760	491,012
1896	3,000	544,326
1897	15,000	510,000
1898	(1)	630,228
1899	53,000	537,094
1900	240,442	369,276
1901	528,925	469,842
1902	767,781	607,820

[1] No production.

Fluorspar.—That this mineral was known long ago is proved by the discovery of fluorspar shaped into ornaments in some of the prehistoric mounds of southern Illinois. The earliest scientific mention of its occurrence was in 1819, which describes specimens obtained in the vicinity of Shawneetown. It was first discovered in Hardin county in 1839, and in 1842–43 mining was first actually commenced. The deposits of fluorspar and galena of Hardin county occur in the limestones which underlie the Coal Measures of the states bordering on the Ohio river.[2] Until 1898 the Hardin county mines near Rosiclare and those in Pope county supplied all the fluorspar produced in the United States,[3] but since 1900 Kentucky has led Illinois in the output of this mineral. A small quantity of fluorspar was produced in Pope county, Ill., in 1902.

The following figures from the reports of the United States Geological Survey show the production of fluorspar in Illinois since 1882, the figures since 1895 being combined with those for Kentucky:

TABLE 6.—*Annual production of fluorspar: 1882 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1882	4,000	1893	12,400
1883	4,000	1894	7,500
1884	4,000	1895	4,000
1885	5,000	1896	[1] 6,500
1886	6,000	1897	[1] 5,062
1887	5,000	1898	(2)
1888	6,000	1899	[1] 15,000
1889	9,500	1900	[1] 18,450
1890	8,250	1901	[1] 19,586
1891	10,044	1902	18,860
1892	12,250		

[1] Includes Kentucky. [2] No production reported.

Lead and zinc ore.—The lead bearing district in the northwestern corner of the state is entirely comprised within the limits of Jo Daviess and Stephenson counties.[4] This district forms a part of the upper Mississippi lead region, which occupies an area of some 3,000 square miles in Wisconsin, Iowa, and Illinois. Lead is supposed to have been observed at several points along the Mississippi river by Le Sueur in 1700, and the lead region of the upper Mississippi was located on a map published in France in 1752. Mining of lead ore in Illinois was probably not in active progress much before 1827,[5] the period of greatest production being from 1840 to 1850.[6] Galena, in Jo Daviess county, has always been the center of lead mining in Illinois, and up to the completion of the railroads was the natural outlet for the lead mined in Wisconsin. Zinc did not come into the market until 1860,[7] since which time its production has increased until it is now much greater than that of lead. In 1902 the production of zinc ore in Illinois amounted to 2,778 tons, while that of lead ore was only 792 tons.

Clay.—The state ranked thirteenth in the production of clay in 1902 according to value, producing 1.9 per cent of the total for the United States. The value of the clay produced by the 7 operators was $38,463.

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 792.
[2] Transactions of the American Institute of Mining Engineers, 1893, Vol. XXI, pages 31, 32, and 35.
[3] United States Geological Survey, "Mineral Resources of the United States," 1901, page 879.
[4] Geological Survey of Illinois, 1866, Vol. I, page 155.
[5] Iowa Geological Survey, Vol. VI, pages 15 and 18.
[6] Geological Survey of Illinois, 1866, Vol. I, page 156.
[7] Iowa Geological Survey, Vol. VI, page 18.

Sandstones and quartzites.—Carboniferous sandstones of light and dark brown color and good quality are found near Carbondale, Jackson county. The stone is of medium texture, works readily, and closely resembles some of the Connecticut brownstones.[1] The 18 sandstone quarries operating in Illinois in 1902 were located in Alexander, Carroll, Clay, Fulton, Henry, Jackson, Lee, St. Clair, Whiteside, and Union counties, and produced an output valued at $32,200.

[1] Stones for Building and Decoration, page 138.

Natural gas.—Natural gas was first discovered in Illinois in Champaign county in 1853. In later years it has been found in many other counties, but the wells generally have been shallow.[2] The natural gas of the state in 1902 came from the wells in Randolph and Bureau counties, the entire production being valued at only $1,844.

There were two petroleum wells in Illinois in 1902. The maximum production of petroleum in the state, 1,460 barrels, was recorded in 1889.

[2] United States Geological Survey, "Mineral Resources of the United States," 1902, page 759.

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INDIAN TERRITORY.

Table 1 is a summary of the statistics for the productive mines, quarries, and natural-gas and petroleum wells in Indian Territory for 1902.

TABLE 1.—*Summary: 1902.*

	Total.	Coal, bituminous.	Asphaltum and bituminous rock.	All other minerals.[1]
Number of mines, quarries, and wells	79	58	6	15
Number of operators	39	29	6	4
Salaried officials, clerks, etc.:				
Number	260	248	5	7
Salaries	$258,171	$240,581	$4,410	$8,180
Wage-earners:				
Average number	4,814	4,763	28	23
Wages	$3,183,822	$3,154,267	$13,185	$15,870
Contract work	$78,639	$56,610	$1,029	$21,000
Miscellaneous expenses	$366,332	$358,960	$2,213	$5,159
Cost of supplies and materials	$329,063	$320,664	$6,299	$2,100
Value of product	$4,321,380	$4,265,106	$11,754	$44,520

[1] Includes operators as follows: Natural gas, 1; petroleum, 2 (13 wells); and siliceous crystalline rocks, 1.

Investigations as to the geological conditions and formations of Indian Territory began as early as 1819[1] and have been continued from time to time during later years. In 1853 the geologist of the Pacific Railroad expedition, Jules Marcou, made an important reconnaissance of the southern part and gave to the public a better knowledge of the lithology and structure of coals in this vicinity.

Of the total mineral production for 1902 in Indian Territory, 98.7 per cent was coal, bituminous, and the remainder was asphaltum and bituminous rock, natural gas, petroleum, and siliceous crystalline rocks. Considerable development work, chiefly in coal mining, was carried on during the year, $167,261 being expended for this purpose. Copper and gold ores[2] are known to exist in the Wichita mountains, although they were not mined in commercial quantities in 1902. Sandstones and quartzites extend over a large portion of the territory,[1] and limestones and dolomites are found north of the Arkansas river. No sandstone or limestone production was reported during 1902.

The following table presents the value of the products of those manufacturing industries which are based primarily upon the products of mines and quarries and also the total value of the products of manufactures in Indian Territory in 1900:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$3,892,181
Based upon products of mines or quarries:		
Clay, glass, and stone products	$70,214	
Metals and metal products, other than iron and steel	54,544	
Miscellaneous industries	121,921	
		246,679
All other		3,645,502

The value of the output of the manufactures based primarily upon the products of mines and quarries, as shown in the above table, amounted to $246,679, or 6.3 per cent of the total value of the manufactured product of the territory for 1900, indicating that manufacturing in Indian Territory is but slightly dependent upon mineral industries for its raw or partially manufactured material.

In 1902 there were employed in mining and quarrying in Indian Territory an average number of 4,814 wage-earners who received the sum of $3,183,822 in wages. During the census year of 1900 there was an average number of 1,714 wage-earners engaged in manufactures in the territory, and they received $553,899 in wages. The combined manufacturing and mining industries gave employment to 6,528 wage-earners, who received $3,737,221 in wages. The mines and quarries employed 73.7 per cent of the total number of wage-earners and paid 85.2 per cent of the total wages, while the manufacturing industries employed 26.3 per cent of the total number of wage-earners and paid 14.8 per cent of the combined wages.

Coal, bituminous.—Coal mining is by far the most important mineral industry in Indian Territory. The coal fields occupy all of the area of the Creek nation and parts of the area of the Cherokee, Chickasaw, and Choctaw nations, a total of about 20,000 square miles.[3] These fields bear an intimate relation to the Coal Measures of Oklahoma, Kansas, Arkansas, and part of Texas.[4]

[1] A Geological Reconnaissance of the Coal Fields of Indian Territory, by Noah F. Drake, Ph. D., page 327.

[2] United States Geological Survey, "Mineral Resources of the United States," 1887, page 730.

[3] United States Geological Survey, Twenty-second Annual Report, 1900–1901, Part III, page 373.

[4] A Geological Reconnaissance of the Coal Fields of Indian Territory, page 360.

The development of coal deposits adjacent to McAlester, began in 1872,[1] where a coal suitable for coking was obtained. In 1881 operations were commenced in the vicinity of Savanna and Lehigh,[1] and in 1885 the first commercial coal production was reported in Indian Territory, amounting to 500,000 short tons.

The following table gives the annual production and value of bituminous coal mined in Indian Territory:

TABLE 3.—*Annual production of coal, bituminous: 1885 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Quantity (short tons).	Value.	YEAR.	Quantity (short tons).	Value.
1885	446,429	$750,000	1894	969,606	$1,541,293
1886	534,580	855,328	1895	1,211,185	1,737,254
1887	685,911	1,286,692	1896	1,366,646	1,918,115
1888	761,986	1,432,072	1897	1,336,380	1,787,358
1889	752,832	1,323,807	1898	1,381,466	1,827,638
1890	869,229	1,579,188	1899	1,537,427	2,199,785
1891	1,091,032	1,897,037	1900	1,922,208	2,788,124
1892	1,192,721	2,043,479	1901	2,421,781	3,915,268
1893	1,252,110	2,235,209	1902[1]	2,820,666	4,265,106

[1] Census figures.

The above table shows a steady increase in annual production, with the exception of the years 1889, 1894, and 1897, from the time of the first commercial mining operations up to 1902.

The coal belt is about 65 miles wide where it enters from Kansas near the northeast corner of Indian Territory. It extends southward through the territory and then eastward in an L-shaped formation into Arkansas. The southern branches of Coal Measures, reaching into Texas, are somewhat broken by a covering of Cretaceous deposits.

The coal seams vary considerably in thickness in the different portions of the territory, in some instances being too thin for profitable working. The coal deposits worked near Lehigh and Savanna[2] vary from 3 feet 11 inches to 4 feet 2 inches in thickness, while those of the McAlester district vary from 3 feet 6 inches to 4 feet.

The product of the Lehigh and Savanna mines is more especially adapted to steaming purposes[3] and both these coals are considerably utilized by railroads[4] while the McAlester product is a high-grade coke and gas coal remarkably free from sulphur and other impurities. The Savanna product somewhat resembles[3] that of the McAlester district, but the Lehigh coal, although of good steaming qualities, is not adapted for coking.

Asphaltum and bituminous rock.—The region of asphaltum and bituminous rock deposits in Indian Territory[5] is entirely south of the Canadian river and extends from the eastern to the western boundary of the territory.[6] The asphaltite of eastern Indian Territory is generally of a vein forming variety, jet black in color and brilliant in lustre, and of an exceeding brittleness.

One or two quarries were operated during 1895, but the experiment was not a complete success[7] owing to the hard and irregular formation of the asphaltic lime rock. Further developments have been more successful. In 1898 and 1899[8] new discoveries of asphaltic limestone and sandstone were made in the district adjacent to Dougherty and Davis, and a considerable production, chiefly of mastic, was reported. There were 6 quarries in operation during 1902 reporting a production valued at $11,754; in addition a considerable amount of development work was done by one company.

All other minerals.—One natural gas well was reported in the Creek nation and a considerable product was also obtained from an idle petroleum well in the same locality. As there was but one report, the statistics for natural gas production for Indian Territory can not be separately shown.

There were 13 petroleum wells reported by 2 companies near Bartlesville in the Osage nation and a large product was secured in 1902. Development work is being actively carried on in this vicinity.

One granite quarry was reported for the Chickasaw nation with a large production in 1902. The product is not shown separately, as to do so would disclose the operations of an individual establishment. The granite quarried in Indian Territory is not sold in the rough, but is dressed for building purposes and monumental work or prepared for curbing or concrete before it is placed on the market.

[1] United States Geological Survey, Twenty-second Annual Report, 1900–1901, Part III, page 386.
[2] Ibid., "Mineral Resources of the United States," 1887, page 244.
[3] Ibid., 1886, page 266.
[4] Ibid., 1883, page 45.
[5] United States Geological Survey, Twenty-second Annual Report, 1900–1901, Part I, page 262.
[6] Ibid., page 265.
[7] The Mineral Industry, 1895, Vol. IV, page 44.
[8] Ibid., 1898, Vol. VII, page 65.

INDIANA.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of Indiana for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Natural gas.	Petroleum.	Limestones and dolomites.	Cement.	Sandstones and quartzites.	All other minerals.[1]
Number of mines, quarries, and wells	16,825	339	6,861	9,439	160	9	9	8
Number of operators	3,909	288	880	2,567	156	7	9	7
Salaried employees:								
Number	1,662	637	580	108	266	65	6	.....
Salaries	$1,430,538	$580,492	$447,608	$138,536	$238,186	$71,166	$4,650	.....
Wage-earners:								
Average number	16,473	10,593	938	1,463	2,834	568	41	36
Wages	$10,729,767	$7,396,425	$586,860	$1,045,925	$1,399,829	$266,949	$19,567	$14,212
Contract work	$2,164,380	$26,603	$1,046,444	$1,091,333	.....	.....	.....	.....
Miscellaneous expenses	$3,387,668	$449,054	$1,399,355	$1,286,499	$196,907	$53,447	$1,706	$700
Cost of supplies and materials	$3,810,666	$729,104	$1,028,358	$1,126,627	$499,764	$120,168	$3,040	$3,605
Value of product	$28,224,700	$10,399,660	$7,081,344	$6,526,622	$2,865,691	$1,286,228	$37,593	$27,622

[1] Includes operators as follows: Clay, 2; oilstones, whetstones, and scythestones, 5 (6 mines); sulphur and pyrite (all data except value of product included with coal, bituminous).

The coals of this state, underlying 7,000 square miles or one-fifth the area of the state, are mostly bituminous, although some block coal is also mined. The petroleum area is steadily increasing, and the natural gas production places Indiana second among states reporting this product. No state possesses better stone for building purposes than Indiana. The production includes the Bedford limestones and the sandstones comprising the so-called conglomerate. Indiana is a large producer of whetstones, the Hindostan whetstone rock having been used for years. The clay deposits are very valuable, and are found in some form in every county. Quantities of white sand suitable for glassmaking occur in various localities. Limonite and siderite iron ore have been found in large quantities in several counties, but they are too siliceous to compete with the rich beds of hematite in other states. The marl deposits are being used more and more in the manufacture of cement.[1]

In addition to the productive mines, quarries, and wells referred to in Table 1, 12 operators reported active mines and wells but no production. These operators paid but $269 in wages during the year, practically all the work being done by contract. For such work $21,979 was paid. Miscellaneous expenses amounted to $6,417, and cost of supplies and materials to $9,118.

The following table shows the value of the products of the manufacturing industries, based primarily upon minerals mined and quarried, and also the total value of the products of all manufactures of Indiana, as reported to the Twelfth Census:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures	.....	$378,120,140
Based upon products of mines or quarries:		
Chemicals and allied products	$18,113,023	
Clay, glass, and stone products	22,843,090	
Iron and steel and their products	50,884,844	
Metals and metal products, other than iron and steel	4,523,881	
Miscellaneous industries	13,182,452	
	.....	109,547,290
All other	.....	268,572,850

The value of the products of manufactures, based primarily upon minerals mined and quarried, as shown by the foregoing table, is $109,547,290, or about 29 per cent of the total. The total value of the product of mines, quarries, and wells of Indiana in 1902 and manufactures in 1900 was $406,344,900, of which manufactures contributed 93.1 per cent and mines and quarries 6.9 per cent.

The average number of wage-earners reported by the Twelfth Census as engaged in manufacturing was 155,956, and the wages paid were $66,847,317. The average number of wage-earners engaged in mines and quarries in 1902 was 16,473, and the wages paid amounted to $10,729,767.

The two industries combined gave employment during the year to 172,429 wage-earners and paid $77,577,084

[1] Indiana Department of Geology and Natural Resources, Twentieth Annual Report, 1895, pages 16 to 20.

in wages. Manufactures gave employment to 90.4 per cent of the wage-earners and paid 86.2 per cent of the wages, while mines and quarries employed only 9.6 per cent of the wage-earners and paid 13.8 per cent of the wages.

The following table shows the value of the annual production of the leading minerals of the state, 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal.	Natural gas.	Petroleum.	Limestones and dolomites.	Portland cement.	Sandstones and quartzites.
1890	$3,259,233	$2,302,500	$32,462	$1,889,336	(1)	$43,983
1891	3,070,918	3,942,500	54,787	2,100,000	(1)	90,000
1892	3,620,582	4,716,000	260,620	1,800,000	(1)	80,000
1893	4,055,372	5,718,000	1,050,882	1,474,695	(1)	20,000
1894	3,295,034	5,437,000	1,774,260	1,203,108	(1)	22,120
1895	3,642,623	5,203,200	2,811,444	1,658,976	(1)	60 0 0
1896	3,261,737	5,043,635	2,954,411	1,058,499	(1)	32,817
1897	3,472,348	5,009,208	1,880,412	2,012,608	(1)	35,561
1898	3,994,918	5,060,969	2,214,322	1,686,572	(1)	45,342
1899	5,285,018	6,680,370	3,363,738	2,173,833	(1)	35,636
1900	6,687,137	7,254,539	4,693,983	2,344,818	$37,500	45,063
1901	7,017,143	6,954,566	4,822,826	2,993,186	240,242	28,334
1902[2]	10,399,660	7,081,344	6,526,622	2,865,691	[3]1,286,228	37,593

[1] No production. [2] Census figures. [3] Includes natural rock cement.

Coal.—The coal area is found in the western and southwestern part of the state, and ranges from 10 to 60 miles in width. The veins of workable thickness vary from 3 to 11 feet, but are in a few places from 25 to 28 feet thick.[1]

The Eastern Interior or Central coal field includes not only the bituminous coal areas of Indiana, but also those of Illinois and western Kentucky; in point of production it ranks second among the bituminous coal producing fields. Father Hennepin first found coal in this field in 1698 on the Illinois river, near Fort Crève-Cœur. This is the first mention of coal found in America. In 1804 coal was noted in the course of land surveys of Indiana, and its position marked on the maps. In 1811 coal dug at Fulton, Perry county, was used by Robert Fulton on the steamboat *Orleans*, and from 1830 to 1860 coal was shipped in a small way out of the state.[2] Since 1860 the mining of coal has steadily increased, and in 1902 Indiana ranked sixth among the bituminous coal producing states, with a total production of 9,446,424 short tons, of which 1,101,544 tons was block coal.

Of the 18 coal producing counties of Indiana in 1902, 13 show an increased production over 1901, the increase in Greene county, 719,164 short tons, being particularly noticeable. Greene county stands first, with a total production of 1,663,785 tons; Vigo second, with 1,652,798 tons; and Clay third, with 1,315,046 tons. Parke and Sullivan counties also contributed over 1,000,000 tons each.

Since 1870 the production of coal in Indiana has amounted to 96,060,655 short tons, as shown in the following table:

TABLE 4.—*Annual production of coal, bituminous: 1870 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
Total	96,060,655	1886	3,000,000
		1887	3,217,711
1870	490,414	1888	3,140,979
1871	600,000	1889	2,845,057
1872	896,000	1890	3,305,787
1873	1,000,000	1891	2,973,474
1874	812,000	1892	3,345,174
1875	800,000	1893	3,791,851
1876	950,000	1894	3,423,921
1877	1,000,000	1895	3,995,892
1878	1,000,000	1896	3,905,779
1879	1,196,490	1897	4,151,169
1880	1,500,000	1898	4,920,743
1881	1,771,536	1899	6,006,523
1882	1,976,470	1900	6,481,086
1883	2,560,000	1901	6,918,225
1884	2,260,000	1902	9,446,424
1885	2,375,000		

Natural gas.—Although the existence of natural gas in Indiana was known, it was not until after the Trenton rock gas field was opened at Findlay, Ohio, in 1884, that any great attention was given to its development.[3] The knowledge that large quantities of high pressure gas were stored within the Trenton limestone caused a rapid development in this industry. Twenty-six counties contributed to the production in 1902.

Petroleum.—The earliest production of petroleum in commercial quantities was first recorded in Vigo county in 1889.[4] The main Indiana oil field is a continuation of the Lima field in Ohio and extends from the Ohio-Indiana state line westward to Marion, Grant county, and from Warren, Huntington county, south to Hartford City, Blackford county. The greatest length of the field is about 45 miles and its extreme width about 20 miles.[5]

The following table compiled from the reports of the United States Geological Survey shows the annual production of petroleum in Indiana since 1889:

TABLE 5.—*Annual production of petroleum: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels (42 gallons).	YEAR.	Barrels (42 gallons).
Total	45,836,215	1895	4,386,132
		1896	4,080,792
1889	33,375	1897	4,122,356
1890	63,496	1898	3,730,907
1891	136,634	1899	3,848,182
1892	698,068	1900	4,874,392
1893	2,335,293	1901	5,757,086
1894	3,088,666	1902	7,480,896

[1] Indiana Department of Geology and Natural Resources, Twentieth Annual Report, 1895, page 8.

[2] United States Geological Survey, Twenty-second Annual Report, 1900–1901, Part III, page 294.

[3] United States Geological Survey, "Mineral Resources of the United States," 1902, page 642.

[4] Indiana Department of Geology and Natural Resources, Twenty-first Annual Report, 1896, page 48.

[5] Ibid., Twenty-fifth Annual Report, 1900, page 491.

Limestones and dolomites.—The limestones of Indiana, which are quarried for building purposes, belong either to the Upper Silurian or Subcarboniferous formations in the central and southern parts of the state. The most beautiful and valuable of the oolitic limestones found in Lawrence, Monroe, Owen, Crawford, Harrison, and Washington counties, is that known as "Bedford stone," found near Bedford, in Lawrence county. This rock is of fine, even texture, and is composed of small rounded grains compactly cemented together by crystalline lime or calcite. The stone is soft but tenacious, works readily in every direction, and is used more for carved work than any other domestic limestone.[1]

Of the 36 limestone producing counties of Indiana in 1902 only 6 had an output valued in excess of $100,000. Lawrence county ranked first with a production valued at $1,207,497, or about 42 per cent of the total for the state, which was $2,865,691. Monroe county ranked second and Decatur third.

Cement.—The first Portland cement plant in Indiana, and one among the first in the United States, was constructed at South Bend in 1877. In 1893 this plant was shut down and has not since been a successful producer. In 1900 a new plant was completed at Stroh, Lagrange county, which has since been an increasingly successful producer.[2] Late in the same year another plant was completed near Syracuse, Kosciusko county, but no production was reported until 1901. In 1902 the first production from the plant at Mitchell, in Lawrence county, was reported.[3] In 1900 the single Portland cement plant in Indiana produced 30,000 barrels. In 1901 the two plants produced 218,402 barrels, and in 1902 the three plants produced 536,706 barrels.[3]

Natural cement rock in Indiana was first noticed in Clark county during the construction of the Louisville and Shippingsport canal about 1826. Some time after 1832 a flouring mill, built at Clarksville, Ind., in that year, was changed into the first cement mill to be operated in the state.[4] In 1902 the six plants in Clark county produced 1,343,185 barrels of natural rock cement, valued at $657,984.

Sandstones and quartzites.—The Mansfield sandstone, coarse grained, and gray, yellow, red, brown, or variegated in color, is probably the most important sandstone in the state.[4] The value of the total output of sandstone in Indiana for 1902 was $37,593.

All other minerals.—The value of the clay produced by the two operators who reported, is included with that for other states in order to avoid disclosing individual operations.

The Hindostan whetstone of Orange county is said to have been first discovered in 1810 and the first quarry was opened in 1825.[4] The value of the finished product from the six quarries operated in 1902 was $16,950.

There was a small production of pyrite in Indiana in 1902, which was a by-product of coal mining.

[1] Stones for Building and Decoration, by George P. Merrill, pages 302 and 303.
[2] Indiana Department of Geology and Natural Resources, Twenty-fifth Annual Report, 1900, pages 24, 27, and 377.
[3] United States Geological Survey, "Mineral Resources of the United States," 1902, page 778.
[4] Indiana Department of Geology and Natural Resources, Twentieth Annual Report, pages 199 and 338.

IOWA.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Iowa for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Limestones and dolomites.	Gypsum.	Sandstones and quartzites.	Lead and zinc ore.
Number of mines or quarries	625	326	244	9	32	14
Number of operators	589	299	241	3	32	14
Salaried officials, clerks, etc.:						
Number	610	512	76	20	1	1
Salaries	$500,126	$436,828	$46,775	$15,883	$360	$280
Wage-earners:						
Average number	10,437	9,439	680	293	12	13
Wages	$6,791,161	$6,251,732	$357,249	$170,828	$5,586	$5,766
Contract work	$48,106	$48,046	$60			
Miscellaneous expenses	$373,252	$341,191	$22,518	$6,505	$527	$2,511
Cost of supplies and materials	$961,996	$841,506	$71,361	$47,683	$527	$919
Value of product	$9,676,424	$8,660,287	$649,984	$337,734	$15,061	$13,358

The bituminous coal deposits of Iowa underlie some 20,000 square miles in the southern half of the state and are a part of the Western Interior coal field. Over 10,000 wage-earners are now employed in the coal mines.[1] Large quantities of lead and zinc ore occur in the northeastern part of the state, around Dubuque, but at the present time these minerals are but little mined.[2] The gypsum deposits form one of the most valuable of Iowa's mineral resources.[3]

In addition to the minerals mentioned in Table 1 iron ore and mineral paints are found in Iowa, but these were not produced in commercial quantities in 1902.

Table 2 shows the value of the products of the manufacturing industries, based primarily upon minerals mined and quarried, and also the value of all manufactured products in Iowa, as reported at the Twelfth Census.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$164,617,877
Based upon products of mines or quarries:		
Chemicals and allied products	$342,707	
Clay, glass, and stone products	4,430,652	
Iron and steel and their products	6,198,884	
Metals and metal products, other than iron and steel	2,655,415	
Miscellaneous industries	6,964,093	
		20,591,751
All other		144,026,126

As shown in the foregoing table the value of the products of the manufacturing industries, based primarily upon minerals mined and quarried, was $20,591,751, or about 12.5 per cent of the total value of all manufactured products. The value of the output of the mines and quarries of Iowa for 1902 was $9,676,424, or 5.9 per cent of the total value of product of all manufacturing and mining industries.

The average number of wage-earners engaged in manufactures, as reported at the census of 1900, was 58,553, and the wages paid amounted to $23,931,680. The average number of wage-earners engaged in mining in 1902 was 10,437, and the wages paid were $6,791,161. The manufacturing and mining industries combined, therefore, gave employment during the year to 68,990 wage-earners and paid $30,722,841 in wages. Of these totals, manufactures employed 84.9 per cent of the wage-earners and paid 77.9 per cent of the wages, and mines and quarries employed 15.1 per cent of the wage-earners and paid 22.1 per cent of the wages.

The following table shows the value of the annual production of the principal minerals, 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Limestones and dolomites.	Gypsum.	Sandstones and quartzites.
1890	$4,995,739	$530,863	$47,850	$80,251
1891	4,807,999	499,000	58,095	50,000
1892	5,175,060	705,000	[1] 104,461	25,000
1893	5,110,460	547,000	55,538	18,347
1894	4,997,939	616,630	44,700	11,639
1895	4,982,102	449,501	36,600	6,575
1896	4,628,022	410,037	34,020	12,351
1897	5,219,503	480,572	64,900	14,771
1898	5,260,716	524,546	45,819	7,102
1899	6,897,338	785,576	296,220	24,348
1900	7,155,341	586,410	561,588	19,063
1901	7,822,805	777,484	[2] 629,336	14,341
1902[3]	8,660,287	649,984	337,734	15,061

[1] Includes production from Colorado, Ohio, Texas, and Utah.
[2] Includes production from Kansas and Texas.
[3] Census figures.

[1] King's Handbook of the United States, page 259.
[2] Iowa Geological Survey, Vol. VI, page 43.
[3] The Mineral Industry, 1895, Vol. IV, page 379.

Coal.—The area of the coal fields of Iowa is about 20,000 square miles, of which probably one-half is productive.[1] Coal has, without doubt, been mined since the earliest settlement of this area, but no production is recorded prior to 1840, and it was not until after 1852[2] that coal was mined for other than local use.

Of the 24 coal producing counties in 1902, Monroe was first, with 1,406,905 tons; Polk second, and Appanoose third. Other counties having a production in excess of 100,000 tons are Boone, Jasper, Keokuk, Lucas, Mahaska, Marion, Wapello, and Webster.

The figures in the following table are compiled from the reports of the United States Geological Survey, and show the annual production of coal in Iowa since 1840:

TABLE 4.—*Annual production of coal, bituminous: 1840 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.	YEAR.	Short tons.
Total.	107,596,226	1860	48,263	1882	3,920,000
		1861	50,000	1883	4,457,540
1840	360	1862	53,000	1884	4,370,566
1841	500	1863	57,000	1885	4,012,575
1842	750	1864	63,000	1886	4,315,779
1843	1,000	1865	69,574	1887	4,473,828
1844	2,500	1866	99,320	1888	4,952,440
1845	5,000	1867	150,000	1889	4,095,358
1846	6,500	1868	211,453	1890	4,027,739
1847	8,000	1869	295,105	1891	3,825,495
1848	10,000	1870	283,467	1892	3,918,491
1849	12,500	1871	300,000	1893	3,972,229
1850	15,000	1872	336,000	1894	3,967,253
1851	18,000	1873	392,000	1895	4,156,074
1852	20,000	1874	799,936	1896	3,954,028
1853	23,000	1875	1,231,547	1897	4,611,805
1854	25,000	1876	1,250,000	1898	4,618,842
1855	28,000	1877	1,300,000	1899	5,177,479
1856	30,000	1878	1,350,000	1900	5,202,930
1857	33,000	1879	1,400,000	1901	5,617,499
1858	37,500	1880	1,461,766	1902	5,904,766
1859	42,000	1881	2,500,000		

Limestones and dolomites.—Although limestones and dolomites abound in this state to the exclusion of almost all other varieties of building stone, but little of the material now quarried acquires more than a local reputation.[3] The quarries of the Stone City district in Jones county produce the well-known Anamosa limestone, which was first shipped to any distance in 1859.[4] This stone has found special favor for bridge masonry. Among the 45 counties in which limestone was quarried Jones county ranks first in the value of its output, Jackson county second, and Cedar county third.

Gypsum.—Although the occurrence of gypsum in Iowa has been known for many years, its extent and value has been recognized only recently. To-day it may be considered as forming one of the deposits of greatest value among Iowa's mineral resources.[5] An area of nearly 50 square miles, near Fort Dodge, in Webster county, is known to be covered by the gypsum beds, and this is probably one of the most valuable formations of the kind in the United States.[5] The total amount of available gypsum on the known area is more than 40,000,000,000 tons, and at the present rate of production the supply will last not less than 500,000 years.[5] Nearly the entire production is converted into stucco, or plaster of Paris.

The following table shows the production of gypsum in Iowa since 1889, the figures being compiled from the reports of the United States Geological Survey:

TABLE 5.—*Annual production of gypsum: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1889	21,784	1896	[illegible]
1890	20,900	1897	[illegible]
1891	31,385	1898	[illegible]
1892	12,000	1899	[illegible]
1893	21,447	1900	[illegible]
1894	17,906	1901	[illegible]
1895	25,700	1902	[illegible]

[1] Includes production from Kansas and Texas.

Sandstones and quartzites.—The 32 quarries operating in 1902 were located in Blackhawk, Cerro Gordo, Clayton, Clinton, Decatur, Des Moines, Fayette, Hardin, Jones, Keokuk, Lee, Marion, Scott, Tama, Van Buren, and Webster counties.

Lead and zinc ore.—The upper Mississippi lead and zinc region, comprising within its limits about 3,000 square miles,[6] embraces the southwest portion of Wisconsin, the northwest corner of Illinois, and the adjoining portion of Iowa, in the counties of Dubuque, Allamakee, and Clayton.

In 1700 Le Sueur is supposed to have observed lead at several points along the Mississippi river, and in 1744 the lead region of the upper Mississippi was located on a map published in France during that year. In 1788 the first mining of lead ore in Iowa was carried on by Julien Dubuque, who had obtained from the Indians a grant or lease of land for mining in what is now Dubuque county. Dubuque continued to develop his prospects until his death in 1810. The most productive period of the Dubuque mines was probably during the years 1835 to 1849.[7]

It was not until 1860[6] that zinc was produced commercially in Iowa. Since then its production has increased until it is greater than that of lead. In 1902 the 14 mines then in operation produced 186 tons of lead ore and 376 tons of zinc ore.

[1] United States Geological Survey, Twenty-second Annual Report, 1900–1901, Part III, page 340.
[2] Iowa Geological Survey, Vol. II, page 522.
[3] Stones for Building and Decoration, by George P. Merrill, page 304.
[4] The Mineral Industry, 1895, Vol. IV, page 565.
[5] The Mineral Industry, 1895, Vol. IV, pages 379 and 384.
[6] Iowa Geological Survey, Vol. VI, page 18.
[7] Ibid., pages 15 and 16.

KANSAS.

Table 1 is a summary of the statistics of the productive mines, quarries, and wells in the state of Kansas for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Natural gas.	Lead and zinc ore.	Limestones and dolomites.	Petroleum.	Sandstones and quartzites.	All other minerals.[1]
Number of mines, quarries, and wells	1,259	176	414	57	115	470	19	9
Number of operators	398	132	57	57	115	12	18	7
Salaried officials, clerks, etc.:								
Number	565	307	43	35	32	33	3	52
Salaries	$527,242	$345,162	$32,012	$21,143	$20,011	$31,664	$3,400	$73,850
Wage-earners:								
Average number	8,726	7,017	100	223	566	146	137	537
Wages	$5,680,593	$4,719,595	$65,952	$140,249	$288,347	$108,756	$67,260	$290,434
Contract work	$213,182	$3,644	$107,968	$922	$300	$99,467	.....	$881
Miscellaneous expenses	$767,069	$418,921	$40,109	$151,279	$24,378	$51,054	$5,790	$75,538
Cost of supplies and materials	$1,374,535	$596,501	$165,859	$84,313	$51,342	$296,821	$13,944	$165,755
Value of product	$10,700,285	$6,862,787	$824,431	$737,656	$670,536	$292,464	$105,509	$1,206,902

[1] Includes operators, as follows: Cement, 2; gypsum, 5 (7 quarries).

The coal mines of the state compare favorably with those of other coal producing states in the Mississippi valley and the yearly output is increasing. In zinc smelting Kansas ranks second among the states and its lead and zinc mines, although confined to but a few square miles in area, produce annually a large quantity of these ores. The fields of natural gas and petroleum are extensive and are being rapidly developed. The gypsum deposits are large and quantities of cement plasters are manufactured and shipped to all parts of the United States.[1] The manufacture of cement is also a growing industry.

In addition to the minerals referred to in Table 1, clay suitable for the manufacture of tiles, brick, and low-grade pottery, and barite are found in the state, but were not produced in commercial quantites in 1902.

The 18 operators reporting development work, distributed among the industries of natural gas, petroleum, lead and zinc, and coal (bituminous), gave employment during the year to 16 salaried officials, clerks, etc., who received $5,892 in salaries; and to 19 wage-earners, who were paid $16,463 in wages. They also paid $97,511 for work done by contract, which furnished employment to 78 employees. The miscellaneous expenses amounted to $10,956, and the cost of supplies and materials to $90,685.

Table 2 shows the value of the products of the manufacturing industries of the state, based primarily upon the products of mines and quarries, and also the value of all products manufactured in Kansas in 1900.

According to the following table, the value of the products of manufactures, based primarily upon minerals mined and quarried, amounted to $37,060,148, or 21.5 per cent of the total. The combined value of the product of mines and quarries in 1902 and of manufactures in 1900 was $182,829,683, of which manufactures contributed 94.1 per cent and mines and quarries 5.9 per cent.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.		Value of product.
All manufactures		$172,129,398
Based upon products of mines or quarries:		
Chemicals and allied products	$693,593	
Clay, glass, and stone products	1,810,335	
Iron and steel and their products	3,083,621	
Metals and metal products, other than iron and steel	26,696,884	
Miscellaneous industries	4,775,715	
		37,060,148
All other		135,069,250

The average number of wage-earners in Kansas engaged in manufacturing, as reported at the Twelfth Census, was 35,193, and the wages paid amounted to $16,317,689. In 1902 the average number of wage-earners reported as engaged in mining was 8,726, and the wages paid amounted to $5,680,593. The two industries together therefore gave employment to an average of 43,919 wage-earners during the year and paid $21,998,282 in wages. Manufactures, therefore, gave employment to 80.1 per cent of the wage-earners and paid 74.2 per cent of the wages, while mines and quarries furnished employment to but 19.9 per cent of the wage-earners and paid 25.8 per cent of the wages.

Table 3 shows the value of the annual production of the leading minerals of the state from 1890 to 1902.

[1] Mineral Resources of Kansas, 1897, page 6.

TABLE 3.—VALUE OF ANNUAL PRODUCTION OF PRINCIPAL MINERALS: 1890 TO 1902.

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Natural gas.	Lead and zinc.[1]	Limestones and dolomites.	Petroleum.	Sandstones and quartzites.	Cement.	Gypsum.
1890	$2,947,517	$12,000	$674,701	$478,822	(2)	$149,289	[3]$122,500	$72,[illegible]
1891	3,557,303	5,500	636,374	300,000	(2)	80,000	[3]94,000	161,[illegible]
1892	3,955,595	40,795	778,141	310,000	(2)	70,000	[3]77,000	195,1[illegible]
1893	3,375,740	50,000	667,103	175,173	(2)	24,761	21,000	181,7[illegible]
1894	4,178,998	86,000	686,052	241,039	$40,000	30,265	25,000	301,8[illegible]
1895	3,481,981	112,400	1,295,341	316,688	26,058	93,394	66,000	272,7[illegible]
1896	3,295,032	124,760	1,851,838	158,112	51,107	18,804	50,226	148,[illegible]
1897	3,602,326	105,700	2,255,133	208,889	32,439	20,953	[4]64,000	189,[illegible]
1898	3,703,014	174,640	2,347,029	305,605	35,990	19,528	120,000	191,[illegible]
1899	4,478,112	332,592	2,668,142	379,001	52,275	49,629	60,000	247,[illegible]
1900	5,454,691	356,900	1,479,233	389,466	69,142	55,178	158,400	150,[illegible]
1901	5,991,599	659,173	1,043,725	478,986	154,373	49,901	97,002	[5]629,[illegible]
1902[6]	6,862,787	824,431	737,656	670,536	292,464	105,509	[4]1,017,824	[5]807,[illegible]

[1] Statistics for 1890 to 1901, inclusive, from "Mineral Resources of Kansas," 1900 and 1901.
[2] Not separately reported.
[3] Includes production from Missouri.
[4] Includes production from Nebraska and Texas in 1897, and Missouri and South Dakota in 1902.
[5] Includes production from Iowa and Texas.
[6] Census figures, except for cement and gypsum.

Coal.—The Coal Measures of Kansas are in the eastern part of the state and cover about 20,000 square miles, of which 15,000 square miles are rated as productive. Of this area, however, only a small proportion is actually producing at this time.[1] The Kansas coal fields are a part of the Western field, which also includes the bituminous coal deposits of Missouri, Nebraska, Arkansas, Indian Territory, and Texas. The coals in the state occur in various shale beds, occupying all positions from the Cherokee shales at the base to the Osage shales more than 2,000 feet higher.[2]

Coal was first mined in the state in southeastern Cherokee county in 1866 by the early settlers of that locality. The coal beds then operated are now entirely abandoned as they were in the thinner and lower veins. Some years later the heavy beds of coal now so extensively mined in Cherokee and Crawford counties were discovered.[3]

The following table, compiled from the reports of the United States Geological Survey, "Mineral Resources of the United States," 1902, shows the annual production of coal in Kansas since 1869:

TABLE 4.—*Annual production of coal, bituminous: 1869 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1869	36,891	1886	1,400,000
1870	38,000	1887	1,596,879
1871	41,000	1888	1,850,000
1872	44,800	1889	2,221,043
1873	56,000	1890	2,259,922
1874	85,000	1891	2,716,705
1875	150,000	1892	3,007,276
1876	225,000	1893	2,652,546
1877	300,000	1894	3,388,251
1878	375,000	1895	2,926,870
1879	460,000	1896	2,884,801
1880	550,000	1897	3,054,012
1881	750,000	1898	3,406,555
1882	750,000	1899	3,852,267
1883	900,000	1900	4,467,870
1884	1,100,000	1901	4,900,528
1885	1,212,057	1902	5,266,065

[1] The University Geological Survey of Kansas, 1898, Vol. III, page 117.
[2] Ibid., page 140.
[3] Mineral Resources of Kansas, 1897, page 36.

The 175 coal mines operating in 1902 were located in Atchison, Bourbon, Cherokee, Cloud, Coffey, Crawford, Franklin, Jewell, Labette, Leavenworth, Linn, Osage, and Republic counties. The total output of these mines for that year was 5,266,065 tons, of which Crawford county produced 2,881,274, and Cherokee county 1,849,896.

Natural gas.—The area throughout which gas has been found in greater or less quantities is in the southeastern part of the state, and embraces the counties of Miami, Allen, Neosho, Crawford, Wilson, Montgomery, and Labette. It is found in the sandstones and the more porous beds of the Cherokee shales, which are at the base of the Kansas Coal Measures.[4]

Though gas had been found in prospecting for oil, and had been noticed escaping from springs even as early as 1864,[5] it was not until the completion of the "Acres well" at Iola, Allen county, in 1873 that the development of this industry really began.[6] In 1882 for the first time what could really be called a gas well was struck in Miami county, at Paola.[6] In 1893 a good well was found in Allen county. In 1899 gas was successfully applied to the reduction of zinc ore, and it also began to be used for lighting in many of the large towns in southeastern Kansas, and in the manufacture of brick and hydraulic cement.[4]

The value of the natural gas produced by the 414 wells flowing in 1902 was $824,431, an increase of $165,258, or 25.1 per cent, over 1901.

Lead and zinc ores.—These ores are at present mined only in the extreme southeastern corner of Cherokee county. All the lead and zinc ores shipped from Kansas have been mined in this area, scarcely equal to four miles square.[7]

The lead and zinc ores of southeastern Kansas, or

[4] United States Geological Survey, "Mineral Resources of the United States," 1902, page 649.
[5] Ibid., 1886, page 514.
[6] Mineral Resources of Kansas, 1897, page 45.
[7] Ibid., page 23.

Galena district, occur in the Mississippian or Subcarboniferous limestone formation, which has a wide exposure in southwest Missouri, northwest Arkansas, and southeast Kansas.[1]

The first discovery of lead ore was made in Cherokee county in April, 1876, although similar mines had been operated for several years at Joplin and Granby and adjacent points in Missouri. In the spring of 1877 a large body of pure lead ore was discovered. Great excitement ensued, and the narrow Short creek valley was soon a busy scene of activity. Two rival town companies came upon the scene, one of which, obtaining control of considerable land on the south side of the creek, named its town Galena, and the other, having control of the north side, called its town Empire City. At first everything was confusion, no records of the output of ore being made, but after a time order was established.[2] The total value of the output of the products of the mines of Galena-Empire City, at the mines, from 1876 to 1897, inclusive, has been estimated at from $25,000,000 to $26,000,000.[3]

The following table shows the quantity of lead and zinc ores mined in Cherokee county, Kansas, from 1886 to 1902, the figures, except for 1902, being compiled from Table IX of the Annual Bulletin on Mineral Resources of Kansas for 1897:

TABLE 5.—*Production of lead and zinc ores: 1886 to 1902.*

[Mineral Resources of Kansas, 1900 and 1901.]

YEAR.	Lead ore (short tons).	Zinc ore (short tons).	YEAR.	Lead ore (short tons).	Zinc ore (short tons).
1886	2,962	31,768	1895	12,538	41,282
1887	3,073	32,795	1896	14,062	62,232
1888	2,624	33,391	1897	15,135	59,451
1889	3,993	32,950	1898	7,918	74,852
1890	4,174	21,675	1899	6,723	64,708
1891	3,602	20,641	1900	4,938	46,501
1892	7,188	23,811	1901	5,238	33,978
1893	5,140	25,028	1902[1]	3,468	21,642
1894	5,817	28,670			

[1] Census figures.

Limestones and dolomites.—The limestones of the state quarried at present are, almost without exception, of the Carboniferous or Permian age and occur only in relatively thin beds, varying in thickness from a few inches to 8 or 10 feet. They are, as a rule, light in color, soft and porous, and incapable of receiving a polish that would fit them for any form of ornamental work.[4]

Of the 115 quarries operating in 1902 only 15 had a production exceeding $10,000 in value and but 1 over $100,000. Marion county led all other counties of the state in value of production, and Franklin was second.

Petroleum.—The existence of oil springs in Miami and Wyandotte counties had been learned by the earliest settlers of the state from the Indians. While wells were drilled in the early sixties near Paola, in Miami county, practically all prospecting ceased until after the Civil War. The years from about 1871 or 1872 to 1890 constitute a second distinct period in the development of the oil wells of the state. During this period wells were drilled in Miami and Allen counties. It was not, however, until the introduction of larger capital and better methods subsequent to 1890 that the real development of petroleum began in the state.[5]

The present productive petroleum field of Kansas is in the counties of Neosho, Allen, Chautauqua, Montgomery, and Woodson. Of these Neosho county ranks first and Allen county second in point of production.[6]

The following table shows the annual production of petroleum in Kansas since 1889. It is compiled from the reports of the United States Geological Survey:

TABLE 6.—*Annual production of petroleum: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
1889	500	1896	113,571
1890	1,200	1897	81,098
1891	1,400	1898	71,980
1892	(1)	1899	69,700
1893	18,000	1900	74,714
1894	40,000	1901	179,161
1895	44,430	1902	331,749

[1] Not reported.

Sandstones and quartzites.—Sandstones are said to occur in several counties in the southwestern part of Kansas, but few if any of these are of such a quality as to acquire other than a local market.[7]

The value of the output of the 19 quarries operated in 1902 was $105,509. Of this amount Bourbon and Phillips counties alone supplied $87,260, or 82.7 per cent. Elk, Labette, Montgomery, Neosho, Pawnee, Wilson, and Woodson counties also produced some sandstone.

All other minerals.—Natural rock cement was first manufactured in the state in 1868 at Fort Scott, Bourbon county, and has since been produced only in that locality.[8] In 1902 there were two plants producing natural rock cement located at Fort Scott, only one of which is

[1] Mineral Resources of Kansas, 1897, page 25.
[2] Ibid., pages 17 and 18.
[3] Ibid., page 31.
[4] Stones for Building and Decoration, by George P. Merrill, page 306.
[5] Mineral Resources of Kansas, 1897, pages 44 to 46.
[6] United States Geological Survey, "Mineral Resources of the United States," 1902, page 557.
[7] Stones for Building and Decoration, page 140.
[8] Mineral Resources of Kansas, 1897, page 66.

included in the census of mines and quarries, as the other purchased all the raw materials it used. The single Portland cement plant in the state, at Iola, in Allen county, began operations in 1900.[1] The statistics for the two plants embraced in the scope of the inquiry are included in "all other minerals" to avoid the disclosure of individual operations.

The gypsum deposits of the state early attracted the attention of geologists and prospectors, the first mention of them being made in 1864.[2] The deposits of gypsum near Blue Rapids, in Marshall county, were the first worked, the first mill being built in 1875.[3] Kansas is one of the leading states in the production of plaster of Paris and its practically inexhaustible deposits of gypsum will long be a source of supply.[4]

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 793.

[2] The University Geological Survey of Kansas, 1899, Vol. V, page 40.
[3] Ibid., page 51.
[4] Ibid., page 12.

KENTUCKY.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells of the state of Kentucky for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Limestones and dolomites.	Natural gas.	Petroleum.	Fluorspar.	Sandstones and quartzites.	All other minerals.[1]
Number of mines, quarries, and wells	1,142	523	70	117	392	14	9	17
Number of operators	665	503	69	19	39	10	9	16
Salaried officials, clerks, etc.:								
Number	854	593	68	32	63	31	16	51
Salaries	$666,360	$476,508	$48,405	$34,250	$44,376	$21,107	$10,270	$31,444
Wage-earners:								
Average number	10,654	9,077	774	50	79	193	166	315
Wages	$5,193,792	$4,522,207	$319,700	$27,660	$69,189	$79,107	$63,589	$112,440
Contract work	$224,923	$10,668	$900	$9,297	$194,462	$300	.....	$9,296
Miscellaneous expenses	$600,613	$285,702	$14,443	$112,794	$147,295	$22,328	$928	$17,033
Cost of supplies and materials	$1,207,771	$743,313	$54,809	$37,197	$227,822	$13,952	$10,165	$120,513
Value of products	$8,533,423	$6,666,967	$593,747	$365,611	$172,837	$143,410	$128,470	$462,381

[1] Includes operators as follows: Asphaltum and bituminous rock, 5; clay, 5; cement 1 (2 mines); iron ore, 3; lead and zinc ore, 1; oilstones, whetstones, and scythestones, 1.

With extensive coal deposits in both the eastern and western parts of the state, Kentucky ranks eighth among the coal producing states. In limestones and sandstones fit for structural, architectural, and sculptural purposes the state takes high rank. It has excellent iron ores, extensive deposits of superior clays, abundant stores of Chester marls, and notable deposits of fluorspar, carrying lead and zinc. The state also possesses large fields of natural gas and petroleum, and much asphalt rock. It has in abundance the raw materials for the manufacture of both natural-rock and Portland cement.[1]

In addition to the productive properties shown in Table 1, 58 operators reported active mines, quarries, and wells, but no production, in 1902, the work being confined to the development of the properties. These operators employed on an average 33 wage-earners and paid $25,693 in wages during the year. The salaried officials, clerks, etc., received $23,481; the contract work amounted to $185,733; the miscellaneous expenses to $22,857; and the cost of supplies and materials to $67,620.

The value of the products of the manufacturing industries of Kentucky, based primarily upon minerals mined and quarried, and also the value of all manufactured products of the state as reported at the census of 1900, is shown in Table 2.

[1] Report of the Inspector of Mines of Kentucky, 1901–2, page 299.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$154,166,365
Based upon products of mines or quarries:		
Chemicals and allied products	$698,030	
Clay, glass, and stone products	3,098,521	
Iron and steel and their products	12,232,657	
Metals and metal products, other than iron and steel	2,909,676	
Miscellaneous industries	6,265,904	
		25,204,788
All other		128,961,577

The value of the products of manufactures, based primarily upon minerals mined and quarried, as shown by the foregoing table, was $25,204,788, or 16.3 per cent of the total value for all manufactures in the state. The total value of the output of the mines, quarries, and wells of Kentucky, in 1902, was $8,533,423, or 5.5 per cent of the total value of product for all manufacturing and mining industries in the state.

The manufacturing industries of Kentucky were reported at the census of 1900 as employing on an average during that year 62,962 wage-earners, and as paying $22,434,185 in wages. The operators of the mines, quarries, and wells of the state reported that they gave employment to an average of 10,654 wage-earners during 1902, and paid $5,193,792 in wages. The two industries combined, therefore, gave employment to

73,616 wage-earners and paid $27,627,977 in wages. Manufactures, therefore, furnished employment to 85.5 per cent of the wage-earners and paid 81.2 per cent of the wages, while mining employed 14.5 per cent of the wage-earners and paid 18.8 per cent of the wages.

The following table shows the value of the annual production of the leading minerals of the state from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Limestones and dolomites.	Natural gas.	Petroleum.	Fluorspar.	Sandstones and quartzites.
1890	$2,472,119	$303,314	$30,000	$6,000	(1)	$117,940
1891	2,715,600	250,000	38,993	9,000	(1)	80,000
1892	2,771,238	275,000	43,175	16,400	(1)	65,000
1893	2,618,569	203,000	68,500	1,500	(1)	18,000
1894	2,749,932	113,934	89,200	450	(1)	27,868
1895	2,890,247	154,130	98,700	600	(1)	25,000
1896	2,684,306	135,967	99,000	924	(1)	(1)
1897	2,828,329	40,815	90,000	161	(1)	40,000
1898	3,084,551	83,960	103,133	2,784	[2]$63,050	72,525
1899	3,618,222	178,861	125,745	17,256	[2]96,650	119,982
1900	4,881,577	178,252	286,243	[3]46,782	[2]94,500	56,178
1901	5,213,076	199,567	270,871	[3]111,527	[2]113,803	108,259
1902[4]	6,666,967	593,747	365,611	172,837	143,410	128,470

[1] Not shown separately.
[2] Includes production from Illinois.
[3] Includes production from Tennessee.
[4] Census figures.

Coal.—There are two distinct coal fields in the state, the eastern, a part of the great Appalachian field and the western, a part of the Illinois or Central field. The two fields have an aggregate in Kentucky of 15,680 square miles of coal bearing measures, of which 11,180 square miles are in the eastern field and 4,500 in the western field.[1] A large part of each field is productive, and each contains from nine to twelve workable seams above the conglomerate sandstone series that lie at the base of the coal measures.[1] The eastern field has also from two to six beds included in the conglomerate series.[1] In 51 of the 53 counties in which coal occurs, workable beds are found.[1]

The existence of coal in Kentucky was undoubtedly known as early as 1770[2] and it was being mined in a small way in the western field from 1830 to 1840.[3] From 1840 to 1850 considerable coal was shipped down the Ohio river from Union and Hancock counties.[3] From 1850 to 1870 the state still produced but a few thousand tons, but in the latter year coal mining began on an extensive scale.[3] The first recorded coal production from the state was reported at the census of 1870.

In 1902 the 523 productive coal mines, located in 47 counties, produced 6,766,984 short tons, valued at $6,666,967. The net increase in production over 1901 amounted to 1,296,998 tons.[4] Hopkins county in the western field, with an output of 1,555,084 tons, ranked first in 1902 among the coal producing counties of the state; Muhlenberg in the same field, second; and Whitley county in the eastern field, third. The entire output of western Kentucky amounted to 3,761,606 tons in 1902, and that of eastern Kentucky to 3,005,378 tons.[5]

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of coal in the state since 1870:

TABLE 4.—*Annual production of coal, bituminous: 1870 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1870	168,654	1887	1,933,185
1871	259,000	1888	2,570,000
1872	380,800	1889	2,399,755
1873	300,000	1890	2,701,426
1874	360,000	1891	2,916,000
1875	500,000	1892	3,025,318
1876	650,000	1893	3,007,179
1877	850,000	1894	3,111,197
1878	900,000	1895	3,357,770
1879	1,000,000	1896	3,339,478
1880	1,000,000	1897	3,602,097
1881	1,100,000	1898	3,887,908
1882	1,300,000	1899	4,607,270
1883	1,650,000	1900	5,828,994
1884	1,550,000	1901	5,469,986
1885	1,600,000	1902	6,766,984
1886	1,550,000		

Limestones and dolomites.—The most valuable of the oolitic limestones of the state are found in Litchfield, Grayson county, and Princeton, Caldwell county.[6] The oolitic character is marked in these stones, and while a perfect surface can not always be produced, owing to the breaking away of the minute, rounded grains, in the better qualities, sharp edges and smooth surfaces are said to be acquired as readily as on the well-known stone of Bedford, Indiana.[6] The Bowling Green oolite, of Warren county, is of especial value as a building stone.[7] Handsome examples of the Lower Carboniferous limestones are to be found on the Rockcastle and Cumberland rivers, in the southeastern part of the state.[8]

Of the 70 quarries which were productive in 1902, but 21 reported an output in excess of $10,000, and of the 24 counties in which these productive limestone quarries were located, only 2, Jefferson and Jessamine, had a production valued at $100,000 or over. Warren county, with a production valued at $74,154, of which $44,500 was for building purposes, ranked third. The value of the limestone quarried in the state in 1902 was $593,747, which exceeds the amount for 1901 by $394,180.

[1] Report of the Inspector of Mines of Kentucky, 1901–2, page 305.
[2] One Hundred Years of American Commerce, Vol. I, page 178.
[3] United States Geological Survey, Twenty-second Annual Report, 1900–1901, Vol. III, page 294.
[4] United States Geological Survey, "Mineral Resources of the United States," 1902, page 301.
[5] Ibid., page 385.
[6] Stones for Building and Decoration, by George P. Merrill, page 308.
[7] United States Geological Survey, Sixteenth Annual Report, 1894–95, Part IV, page 506.
[8] Report of the Inspector of Mines of Kentucky, 1901–2, page 349.

Natural gas.—That the presence of natural gas in the state was early known may be seen from the description of the "Burning Spring," in Clay county, by Dr. D. D. Owen, in his report on the state survey for 1854 and 1855.[1] The first well which produced gas in any considerable quantity was drilled in 1863 near Brandenburg, in Meade county. In 1872 the gas from this well was used in making salt.[2] The search for natural gas was stimulated by the discoveries in 1885–86 in Ohio and Indiana.

The principal gas area thus far developed is in Martin county, in the eastern part of the state. The output of the 117 wells which supplied gas in 1902 was valued at $365,611, an increase of $94,740 over 1901.

Petroleum.—The existence of petroleum in Kentucky was undoubtedly known to the earliest settlers through the Indians, but the first known historical facts date from 1818 or 1819, when petroleum flowed so freely from a well dug in Wayne county for salt that it was abandoned for brine. In 1829 the famous American well was bored in Cumberland county near Burksville.[3]

Although operations in the south central oil district of the state have been carried on in a comparatively small way for many years, it has only been quite recently that the quest for oil has been prosecuted with vigor.[4] In 1902 the 392 productive wells, located in Barren, Bath, Clinton, Knox, Morgan, Rowan, Wayne, and Webster counties, produced 248,950 barrels, valued at $172,837. Wayne and Bath counties are the largest petroleum producing counties in the state.

The following figures from the reports of the United States Geological Survey show the annual production of petroleum in Kentucky since the earliest record. The difference between the Census figures and those of the Survey is caused by the fact that the former represent the petroleum produced and the latter the product marketed.

TABLE 5.—*Annual production of petroleum: 1882 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.[1]	YEAR.	Barrels.[1]
1882[2]	160,933	1893	3,000
1883	4,755	1894	1,500
1884	4,148	1895	1,500
1885	6,164	1896	1,680
1886	4,726	1897	322
1887	4,791	1898	5,508
1888	5,096	1899	18,280
1889	5,400	1900	62,259
1890	6,000	1901	137,259
1891	9,000	1902	185,331
1892	6,500		

[1] Includes production from Tennessee.
[2] Includes production previous to 1883.

Fluorspar.—This mineral is found in Crittenden, Livingston, and Caldwell counties associated with lead and zinc. The veins bearing fluorspar occupy fissures in the Carboniferous rocks, following the faultings that reach into the Coal Measures. The fluorite extends through the entire Genevieve group, excepting possibly the upper Chester.[5]

The ore deposits in the section of the state referred to have been known to settlers since early in the last century. The first attempt to mine them was made in Crittenden county by a company headed by President Andrew Jackson. Primitive attempts were also made at mining the ore deposits in Livingston county subsequent to the Civil War, and in 1878 nearly all mining in this district of western Kentucky had ceased. Up to 1878 lead only had been mined in this section, but the demand for fluorspar served to maintain a small interest in mining in the southern part of this district for a few years longer, when, owing to a slight drop in the value of this mineral and the cost of transportation, these mines became incapable of competing with the more favorably located mines on the other side of the Ohio river in Illinois.[6] Since 1898, however, interest in the fluorspar deposits of the state has been revived, and in 1902 Kentucky, with a production of 29,030 short tons of fluorspar from 14 mines in Crittenden, Fayette, and Livingston counties, was the largest producer of this mineral. The value of the state's output was $143,440.

Sandstones and quartzites.—One of the most valuable sandstones for structural purposes is quarried in Rowan county, and several of the sandstones of the Coal Measures are frequently quite good for bridge piers and foundations.[7] The 9 quarries productive in 1902 were located in Breathitt, Knox, Livingston, Rockcastle, Rowan, Warren, and Whitley counties, and had an output in that year valued at $128,470.

All other minerals.—Bitumens in Kentucky occur as impregnations of sandstones.[8] Fine examples are to be found in Breckinridge, Hardin, Grayson, and Logan counties, in western Kentucky, and in Carter county in the eastern part of the state.[9] In 1902 the state's production of bituminous sandstones amounted to 22,498 tons, valued at $68,704.

Fire clays of proved excellence are found in several counties of the eastern coal field and also in the western field. Pottery clays for ordinary use are abundant.[9] In 1902 Kentucky ranked fifteenth among the states in the value of its clay products, which amounted to $1,873,043.[10]

Natural cement rock was discovered in Kentucky in 1829, during the construction of the Louisville and

[1] Report of the Inspector of Mines of Kentucky, 1901–2, page 111.
[2] United States Geological Survey, "Mineral Resources of the United States," 1892, page 696.
[3] Tenth Census, Vol. X, page 8.
[4] Report of the Inspector of Mines of Kentucky, 1901–2, page 347.
[5] The Mineral Industry, 1893, Vol. II, page 310.
[6] Report of the Inspector of Mines of Kentucky, 1901–2, pages 350 to 352.
[7] Ibid., pages 348 and 349.
[8] United States Geological Survey, Twenty-second Annual Report, 1900–1901, Part I, page 240.
[9] Report of the Inspector of Mines of Kentucky, 1901–2, page 346.
[10] United States Geological Survey, "Mineral Resources of the United States," 1902, page 762.

Portland canal. The manufacture of Louisville cement was commenced in that year at Shippingport, a small suburb of Louisville. The growth of the industry has not been rapid. As but one cement factory quarried its own material in 1902, no figures can be given without disclosing individual operations. The product of Indiana and Kentucky combined was 1,727,146 barrels, valued at $869,163.[1]

That the presence of iron ores in Kentucky was early known is proved by reference made to them in an article written by Thomas Jefferson before the close of the Revolution. The first iron furnace was built in the state in 1791, in Bath county.[2] For a number of years after 1800 the iron industry of the state made rapid progress, and from about 1825 to 1860 was the period of its greatest activity.[3] Although iron ore is found in many counties, both in the eastern and western coal fields of the state, comparatively little mining has been done,[4] and in 1902 iron ore was mined only in Bath, Lyon, and Trigg counties. The total production amounted to 71,006 tons, valued at $86,169. Both brown and red hematite were mined.

The lead and zinc ore deposits in Crittenden county were first mined by a company headed by President Andrew Jackson.[5] Other primitive attempts were made in Livingston county subsequent to the Civil War, but in 1878 nearly all mining in these counties had ceased, owing to cost of transportation and a drop in the price of the ores. These mines are at present being worked principally for the associated mineral fluorspar.[6] As only one operator reported any production of lead and zinc ores in 1902, no figures can be given.

The sandstone used by the single operator reporting oilstones and whetstones comes from Hardin county. No figures can be given without disclosing individual operations.

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, pages 783 and 793.
[2] Iron in All Ages, by James M. Swank, page 282.
[3] Ibid., pages 285 and 286.
[4] Report of the Inspector of Mines of Kentucky, 1901–2, pages 339 and 340.
[5] Report of the Inspector of Mines of Kentucky, 1901–2, pages 351 and 352.
[6] Ibid., pages 350, 351, and 352.

LOUISIANA.

Table 1 is a summary of the statistics for the productive mines and wells in the state of Louisiana for 1902.

TABLE 1.—*Summary: 1902.*

	All minerals.[1]
Number of mines and wells	8
Number of operators	3
Salaried officials, clerks, etc.:	
Number	8
Salaries	$7,533
Wage-earners:	
Average number	61
Wages	$31,444
Contract work	$105,858
Miscellaneous expenses	$25,820
Cost of supplies and materials	$7,354
Value of product	$270,327

[1] Includes operators as follows: Petroleum, 2 (7 wells); sulphur and pyrite, 1.

A few minerals of the state which were not produced in 1902, but which occur in sufficient quantities for commercial operations, call for mention. Among them are the sandstones of the hills of the northern part of the state and along the Grand Gulf. Only the latter, however, are of economic value, and these have been quarried extensively for riprap, jetty work, and railroad ballast. Limestones, which occur in beds of limited extent and as concretions, are also found in the state. The outcroppings have been used to some extent for lime, and the concretions have been used for the same purpose and also for road material and for cement.[1] Lignite, which has had only a limited local use for blacksmithing purposes, has been found. Gypsum occurs in several places, especially along the Ouachita river and in association with the sulphur deposits near Lake Charles, the gypsum in these deposits being of exceptional purity.[2]

Development work of considerable importance was carried on during the year, the total expenditure being $92,442. This outlay was confined to well boring and other expense incident to the development of the oil industry.

Petroleum.—Dr. William M. Carpenter, in his Geological Survey of Louisiana (1839), makes the statement that "in the lowlands bordering on the Calcasieu river there are numerous springs of petroleum." It was while boring for petroleum in this region that the discovery of the great sulphur deposit was made. One of the wells sunk here yields a small quantity of petroleum, which some years ago was collected and barreled. Prospecting wells have also been sunk on Belle Isle and in other localities in the state.[3]

Early in 1901 development work was started near Jennings, Welsh, Lake Charles, Sulphur, and a few other places in adjoining parishes. The Jennings Oil Company, drilling in Arcadia parish, 87 miles east of Beaumont, Tex., and about 190 miles west of New Orleans, on the line of the Southern Pacific Railroad, succeeded in finding oil in paying quantities. The company now has two good wells each producing from 2,000 to 2,500 barrels each per day. The Southern Oil Company early in 1902 completed a good well about 100 feet from the Jennings well No. 1, and both companies are making extensive preparations for handling their output.[3]

Sulphur.—There is a very large deposit of this mineral about 13 miles from Lake Charles in Calcasieu parish.[4] In 1868 the Louisiana Oil Company, while sinking a well at this point, struck at a depth of 443 feet a very extensive bed of almost pure sulphur, the analysis showing 99.93 per cent. During 1869 and 1870 other borings showed the average thickness of the deposit to be about 100 feet. Numerous attempts have since been made to exploit it, but the depth of the deposit below the surface and the beds of water-bearing sands which overlie it render mining operations difficult. In 1895 operations were begun with the Frash system, invented by Mr. Herman Frash, of Cleveland, Ohio, and by the use of this method a considerable product was taken from the deposit. The principle of the "air lift" pump was applied in 1896, and by this means a product of 265 tons a day was secured. The production from the mines in 1895 was about 800 tons; in 1896, 4,200 tons; and in 1897, 1,000 tons. Shortly afterwards the mines were closed, as their operation under the adverse conditions was too expensive to leave a reasonable margin of profit,[5] but work of a developing and experimental character ensued for some years, during which period the details of a chemical process for recovering the sulphur were being worked out. Operations, under the new method of mining, were resumed in 1900, and the mine has been a consistent producer since that time.

[1] Geological Survey of Louisiana, 1899, Part V, page 130 ff.
[2] Ibid., page 137.
[3] United States Geological Survey, "Mineral Resources of the United States," 1901, page 564.
[4] Ibid., 1882, page 687.
[5] Geological Survey of Louisiana, 1899, Part V, page 126 ff.

MAINE.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Maine for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Siliceous crystalline rocks.	Limestones and dolomites.	Slate.	All other minerals.[1]
Number of mines or quarries	135	110	11	7	[illegible]
Number of operators	141	103	11	7	[illegible]
Salaried officials, clerks, etc.:					
Number	208	163	16	22	7
Salaries	$193,814	$158,516	$13,236	$16,999	$5,063
Wage-earners:					
Average number	3,684	2,832	591	217	44
Wages	$2,284,789	$1,867,200	$288,512	$110,818	$18,259
Miscellaneous expenses	$121,556	$66,413	$37,613	$13,496	$4,034
Cost of supplies and materials	$476,964	$217,548	$226,694	$27,329	$5,393
Value of product	$3,656,134	$2,659,450	$745,132	$206,558	$44,994

[1] Includes operators as follows: Feldspar, 5; flint (operator reported under feldspar); mica, 2; precious stones, 13 (no mines).

As shown in the above table, quarrying is the chief mineral occupation in Maine. The value of siliceous crystalline rocks quarried during the year represents 72.7 per cent of the entire mineral production in the state, and limestone and slate are second and third, respectively, in value of production.

A number of minerals occur, for which no production was reported during 1902, although they were previously mined to a considerable extent. Barytes occurs sparingly in Hancock county. Clay has been mined to some extent, and beds of copper in Washington and Hancock counties have been worked with considerable success. Gold alloyed with platinum has been placer mined in Franklin county; it also occurs with metallic bismuth in Hancock county. Infusorial earth and tripoli are found in Hancock county, in pond bottoms near the coast. Iron ores are found in Aroostook, Washington, Piscataquis, Hancock, Knox, Cumberland, and Oxford counties. Graphite and lead occur in many localities throughout the state. Lead is charged with silver to such an extent that it has been said that "systematic mining might pay" in the districts where it occurs. Manganese is found in Knox, Hancock, Piscataquis, York, and Aroostook counties; marl occurs in the northern part of the state; and ocher may be obtained in Androscoggin and Cumberland counties. Molybdenum sulphide is found in Washington and Hancock counties and pyrite occurs in many localities, but chiefly in Hancock county. Sandstone, silica sand, native silver, talc and soapstone, and zinc blende are other minerals not mined, though found here and there through the state.[1]

[1] United States Geological Survey, "Mineral Resources of the United States," 1887, pages 736 to 739.

Table 2 presents the total value of the products for all manufacturing industries in 1900 together with the totals for those based upon the product of mines or quarries.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$127,361,[illegible]
Based upon products of mines or quarries:		
Chemicals and allied products	$143,631	
Clay, glass, and stone products	4,440,993	
Iron and steel and their products	8,869,968	
Metals and metal products, other than iron and steel	912,701	
Miscellaneous industries	4,891,144	
		14,258,436
All other		113,102,[illegible]

As shown in the above table, manufactures based primarily upon the products of mines and quarries constitute 11.2 per cent of the total product of all manufactures reported for the state at the census of 1900. The product reported during 1902 by the mines and quarries in the state is valued at $3,656,134, which amount is only 2.8 per cent of the combined value of the products of the manufacturing and mining industries, while manufactures represent 97.2 per cent of this total.

During the census year of 1900 the manufacturing industries of Maine gave employment to an average number of 74,816 wage-earners, who received $28,527,84[illegible] in wages. The operators of the mines and quarries in 1902 employed an average of 3,684 wage-earners, and paid $2,284,789 in wages. The combined industries therefore employed 78,500 wage-earners, who received $30,812,638 in wages. Manufacturing gave employ-

ment to 95.3 per cent of the wage-earners and paid 92.6 per cent of the wages, while mines and quarries gave employment to 4.7 per cent of the wage-earners and paid 7.4 per cent of the wages.

The annual production of siliceous crystalline rocks, limestones and dolomites, and slate is given in Table 3 as compiled from the reports of the United States Geological Survey.

TABLE 3.—*Annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Siliceous crystalline rocks.	Limestones and dolomites.	Slate.
1890	$2,225,839	$1,523,499	$219,500
1891	2,200,000	1,200,000	250,000
1892	2,800,000	1,600,000	250,000
1893	1,274,954	1,175,000	139,200
1894	1,551,036	810,089	146,838
1895	1,400,000	700,000	140,154
1896	1,195,491	608,077	124,086
1897	1,115,327	742,877	201,117
1898	1,032,621	1,283,468	199,237
1899	1,321,082	1,028,375	181,766
1900	1,568,573	691,312	177,842
1901	2,703,116	715,272	202,326
1902[1]	2,659,450	746,192	206,558

[1] Census figures.

The above table shows that the production of siliceous crystalline rocks during 1901 was the greatest of any year during the decade, and that the production for 1902 was but slightly less. The production of limestones during 1902 was less than half that reported in 1890, although an increase is shown over both 1901 and 1900. The production of slate in 1902 was greater than for any year since 1892. In that year and in 1891 the maximum production for the thirteen years was reported.

Siliceous crystalline rocks.—The state of Maine, during 1901, held first rank as a producer of granite in the United States, but in 1902 it was second to Massachusetts. The production during 1902 was valued at $2,659,450, of which amount $1,921,020 was the value of stone utilized for building purposes. The stone converted into paving blocks was valued at $354,530; and that for monumental purposes at $208,141. Lesser amounts for stone utilized as curbing, flagging, riprap, rubble, crushed stone, and for other purposes were reported, the total being $175,759.

The rocky coast of Maine and adjacent islands furnish immense quantities of granite rock of an excellent color and quality, and the convenient location of the deposits to navigable waters appealed long ago to the enterprising New England business men. The first successful attempt at quarrying in Maine is said to have been in 1825; and in 1836 and 1837 there was considerable activity in the stone industry of the state. In 1837 thirty acts of incorporation were granted by the legislature to quarry companies.[1]

[1] Stones for Building and Decoration, by George P. Merrill, pages 3 to 5.

The Vinalhaven quarries on Penobscot bay were first operated in 1850, and the product being well adapted for ornamental and building purposes has been extensively used all over the country. The quarries at Mt. Waldo, near Frankfort, were opened in 1853. The stone has been largely used in the building of forts on the coast, as well as for ornamental and other purposes, and has been shipped as far south as Mobile and New Orleans. In this section of the state are found some of the most extensive quarries in operation in the country. The granite for the United States Treasury building at Washington, D. C., was obtained from Dix island in Knox county. The Hallowell quarries in Kennebec county furnish one of the best working granites, and many prominent buildings and monuments have been constructed wholly or in part of this stone. Among these may be mentioned the New York state capitol at Albany, N. Y., the Maine state capitol at Augusta, the old Tombs prison, New York city, and the statue on the Pilgrims Monument at Plymouth, Mass. Many other localities are rich in deposits of siliceous crystalline rocks, and quarrying operations were reported during 1902 in 13 of the 16 counties of the state.[2]

Limestones and dolomites.—Limestone is abundant in Maine, especially in the southeastern part of the state. The entire product during 1902, reported from Knox county, was valued at $745,132, and was practically all burned into lime.[3] This stone is not commonly utilized for building, as its colors, blue and blue-black, veined with white, are poorly adapted for such purpose.[4]

The lime industry in Knox county dates back to the year 1733, when Samuel Waldo experimented upon the limestone of this locality, and, finding it of satisfactory quality, erected a kiln and prepared lime for the Boston market. The first cargo of lime shipped to New York was in 1823, and sold at $2 per cask. In 1888 the market price was about 97 cents per cask,[5] while in 1902 the price is reported at from 60 to 75 cents per barrel, when prepared for shipment.

Slate.—The production of slate is chiefly in Piscataquis county, although a small quantity has been reported near Waterville, in Kennebec county. The value of slate quarried in the state during 1902 was $206,558. Of the total quantity quarried, 26,468 squares, valued at $143,832, were used for roofing.[6]

Slate was discovered by Welsh farmers near Brownville, and a quarry in this vicinity was opened by A. H. Morrill as early as 1846. In 1870 slate quarrying

[2] Stones for Building and Decoration, pages 56 to 66.
[3] United States Geological Survey, "Mineral Resources of the United States," 1902, pages 698 and 699.
[4] Stones for Building and Decoration, page 309.
[5] Report on Industrial and Labor Statistics of Maine, 1889, pages 59 to 63.
[6] United States Geological Survey, "Mineral Resources of the United States," 1885, page 398.

began at Monson,[1] and these quarries are still the most important in the state. In color the slates are distinctively slate-blue to blue-black, resembling those of Pennsylvania. The best grades are generally of smooth homogeneous texture, strong, durable, handsome, and holding a uniform color on the roof.[2]

All other minerals.—The feldspar obtained in Maine is considered the best in the United States. Feldspar quarrying near Auburn in Androscoggin county began in 1896. The spar occurs in pockets rather than in a continuous vein; the product obtained is pure and remarkably white.[3] The occurrence of this mineral is noted at other localities, quarrying being reported at Hebron, in Oxford county, and near Georgetown and Topsham, in Sagadahoc county, during 1902. The production of a considerable quantity of flint is reported with that of feldspar in Androscoggin and Sagadahoc counties.

No mining operations are reported for precious stones in the state of Maine, but a number of important finds were reported to dealers. Tourmaline and beryl of a considerable value were discovered during 1902 in Oxford county. In the same county two mica mines were reported during the year, but separate statistics can not be given without disclosing the operations of individual establishments.

[1] Report on Industrial and Labor Statistics of Maine, 1889, page 72.
[2] The Mineral Industry, 1897, Vol. VI, pages 593 and 594.
[3] Ibid., 1898, Vol. VII, pages 261 and 266.

MARYLAND.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Maryland for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Siliceous crystalline rocks.	Limestones and dolomites.	Cement.	Slate.	Flint.	Iron ore.	Sandstones and quartzites.	All other minerals.[1]
Number of mines or quarries	232	44	17	102	4	6	6	29	5	19
Number of operators	209	30	13	100	4	6	5	28	5	18
Salaried officials, clerks, etc.:										
Number	398	210	65	53	22	10	14	5	2	17
Salaries	$465,065	$315,791	$67,925	$31,289	$17,227	$4,520	$11,080	$1,010	$1,148	$14,775
Wage-earners:										
Average number	6,826	4,936	817	430	170	145	65	76	12	175
Wages	$4,323,939	$3,468,117	$435,372	$159,793	$74,677	$72,170	$21,383	$22,949	$5,391	$64,675
Contract work	$8,499	$8,499								
Miscellaneous expenses	$443,170	$312,198	$43,856	$20,811	$17,914	$5,523	$9,572	$12,814	$51	$20,901
Cost of supplies and materials	$859,755	$510,092	$107,435	$135,560	$51,879	$18,078	$8,627	$2,639	$1,152	$24,293
Value of product	$7,313,712	$5,579,869	$758,203	$153,030	$150,080	$118,084	$56,551	$46,911	$15,405	$134,079

[1] Includes operators as follows: Clay, 6; feldspar, 2 (3 mines); gold and silver, 1; infusorial earth, tripoli, and pumice, 1; marble, 2; mineral pigments, crude, 4; talc and soapstone, 2.

Coal mining is by far the most important mineral industry in the state, which ranked eleventh among the states in 1902 in the output of this mineral. The Cumberland coal field, which has been sending its high-grade steam coal into the market for nearly three-quarters of a century, and from which the entire coal product of Maryland is obtained, is the nearest to tide water of all the bituminous coal fields which supply the great coal markets of the northern Atlantic seaboard. The coal beds of the state are so situated as to yield a practically unlimited increase in production should the trade of the seaboard markets demand it.[1] Quarrying, with a product distributed, in the order of importance, among siliceous crystalline rocks, limestones and dolomites, and slate, constitutes also an important branch of the mineral industry of the state.

The minerals of known occurrence in the state, that were not commercially produced in 1902, are as follows: Asbestos, chrome, cobalt, copper ore, lead ores, graphite, gypsum, lignite, manganese, marl, molybdenum, nickel ores, quartz, serpentine, and zinc ores.

Development work during the year was confined to gold and silver and copper ore, with no return in product.

The relative importance of certain manufacturing industries of the state closely allied to, or based upon, the mining industry, since they use as their raw material the product of the mine and quarry, is shown in Table 2, as indicated by the value of their product.

[1] United States Geological Survey, Sixteenth Annual Report, page 132 ff.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$242,552,990
Based upon products of mines or quarries:		
Chemicals and allied products	$11,646,196	
Clay, glass, and stone products	5,110,578	
Iron and steel and their products	20,248,863	
Metals and metal products, other than iron and steel	33,174,693	
Miscellaneous industries	10,118,618	
		80,298,888
All other		162,254,102

The total value of the products of the manufacturing industries based on mining, as shown by Table 2, was $80,298,888, or 33.1 per cent of the total value of the product of all manufacturing industries in the state in 1900. During the same year there were employed in all branches of manufacture in the state 108,325 wage-earners, who received $38,748,551 in wages. In 1902 there were employed in the mines and quarries of the state 6,826 wage-earners, who received $4,323,939 in wages. Of the combined figures for these two branches of industry, therefore, 94.1 per cent of the wage-earners, receiving 89.9 per cent of the wages, were employed in manufacturing, while 5.9 per cent of the wage-earners, receiving 10.1 per cent of the wages, were employed in mining.

Table 3 shows the value of the annual production of the principal minerals of the state from 1890 to 1902.

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Siliceous crystalline rocks.	Limestones and dolomites.	Cement.	Slate.
1890	$2,899,572	$447,489	$164,860	$203,785	$110,008
1891	3,082,515	450,000	150,000	187,855	125,425
1892	3,063,580	450,000	200,000	[1]220,991	116,500
1893	3,267,317	200,855	(2)	[1]125,554	37,884
1894	2,687,270	308,966	350,000	[1]136,000	153,068
1895	3,160,592	276,020	200,000	[1]116,700	60,357
1896	3,299,928	251,109	264,278	[1]125,175	72,142
1897	3,363,996	247,948	181,637	118,400	53,939
1898	3,582,257	317,258	433,653	118,989	82,240
1899	3,667,056	423,823	235,225	144,800	93,595
1900	3,927,381	486,822	317,207	134,028	128,673
1901	5,046,491	613,356	382,381	175,665	105,798
1902[3]	5,579,869	758,203	453,030	150,680	118,084

[1] Includes production from West Virginia.
[2] Not reported.
[3] Census figures.

Coal.—Some authorities place the discovery of coal in Maryland in the year 1801 at a point 6 miles northeast of Baltimore, and Benjamin Henfrey as the discoverer.[1] The first well authenticated discovery was made in 1804, at a point in Allegany county near the present site of Frostburg, by a Mr. Riser.[2] Various openings were made in the deposits from time to time, and they were worked on a small scale, chiefly for local use, for more than a quarter of a century. In 1830 the industry reached its second stage of development, when the first eastern shipment of coal was made from the old Neff mine. This first cargo was loaded at Cumberland and boated down the Potomac to Washington. For a decade or more the output of coal was confined to a very limited market, on account of the expensive and ineffective transportation facilities. The exceptional quality of Cumberland coal soon began to attract the attention of users at greater distances, and its mining, from the first shipment over the Baltimore and Ohio Railroad, in 1842, developed rapidly, and before long became the most important factor in the mineral industry of the state. The total shipments from the Cumberland region in this first year were 1,708 long tons. The annual output grew in the decade ending in 1852 to 334,178 long tons, and in 1860 it had increased to 788,909 long tons. During the earlier years of the Civil War the industry suffered a slight decline, but recovered in 1863, and at the end of the next decade, in 1872, the output exceeded 2,000,000 tons. The output remained at about this figure during the next ten years. The general industrial activity of the decade from 1882 to 1892 was shared by the coal mining industry in the Cumberland region, and the production again increased rapidly, reaching its maximum in 1891, when the state's output was 3,831,251 short tons.[3]

Table 4 shows the annual coal production, in short tons, from 1842 to 1902:

[1] Iron in All Ages, by James M. Swank, page 470.
[2] Maryland Geological Survey, Allegany county, page 167.
[3] United States Geological Survey, Sixteenth Annual Report, page 132 ff.

TABLE 4.—*Annual production of coal, bituminous: 1842 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.	YEAR.	Short tons.
1842	2,104	1863	877,313	1883	2,156,[illegible]
1843	12,421	1864	755,761	1884	2,765,[illegible]
1844	18,345	1865	1,025,208	1885	2,831,[illegible]
1845	30,372	1866	1,217,668	1886	2,517,[illegible]
1846	36,707	1867	1,381,429	1887	3,278,[illegible]
1847	65,222	1868	1,529,879	1888	3,479,[illegible]
1848	98,032	1869	2,216,300	1889	2,939,[illegible]
1849	175,497	1870	2,005,760	1890	3,357,[illegible]
1850	212,517	1871	2,670,338	1891	3,831,[illegible]
1851	317,460	1872	2,647,156	1892	3,419,[illegible]
1852	411,707	1873	3,198,911	1893	3,716,[illegible]
1853	657,862	1874	2,899,392	1894	3,501,[illegible]
1854	812,727	1875	2,808,018	1895	3,915,[illegible]
1855	735,137	1876	2,126,873	1896	4,143,[illegible]
1856	817,659	1877	1,939,575	1897	4,442,[illegible]
1857	654,017	1878	2,068,926	1898	4,674,[illegible]
1858	722,686	1879	2,132,233	1899	4,807,[illegible]
1859	833,349	1880	2,549,731	1900	4,024,[illegible]
1860	907,177	1881	2,677,378	1901	5,113,[illegible]
1861	287,073	1882	1,555,445	1902	5,271,[illegible]
1862	346,201				

The coal deposits of the state are confined to western Allegany and Garrett counties and form a part of a long, narrow, detached coal field, lying on the extreme fringe of the great Appalachian coal basin. This wedge shaped strip, beginning just north of the Pennsylvania line and extending across Maryland into West Virginia, is known as the "Cumberland field." In some respects it is one of the most important in the United States.[3]

Maryland's share of these economic coal deposits is known by various names, among which are the "Frostburg basin" and the "Georges Creek basin." It is situated in an elevated trough to the west of the town of Cumberland, between two parallel ridges, known as Davis and Savage mountains, which are less than 4 miles apart. There are five workable coal seams, ranging in thickness from 14 feet in the "Big Vein" down to 3 feet in the vein of the Bayou formation.[4] The bulk of the state's coal production is mined in Allegany county, though the number and extent of workable seams in Garrett county afford much promise for future exploitation there.

The state's coal product comprises two distinct classes or varieties. That known as bituminous contains a high proportion of volatile gases and less than 70 per cent of carbon, and is especially valuable for the manufacture of coke and gas. This variety is not extensively mined at present. The other class, known as semi-bituminous, has no superior as a steam coal, and constitutes the bulk of the output of the mines of the state.

Siliceous crystalline rocks.—Granite quarrying in the state began in Cecil county in 1816.[5] During 1816 and 1817 a bridge was built across the Susquehanna river at the present site of Port Deposit. Stone for the construction of abutments was quarried near the present site of the extensive McClenahan quarries in Cecil county. The exceptional qualities of the stone soon came to be recognized, and after the completion of the bridge, further and extensive exploitation of the granite

[4] Geological Survey of Maryland, Vol. I, page 219 ff.
[5] Geological Survey of Maryland, Cecil county, page 196 ff.

in the vicinity was carried on. A very important industry has flourished there since. The Port Deposit granite is of a gneissoid character, light bluish gray in color, and eminently strong and durable.[1]

The occurrence of granite and gneissoid rocks in the state is confined within the area known as the Piedmont plateau, a broad belt extending from Cecil and Harford counties on the northeast to Montgomery county and the Potomac river on the southwest. Within this area is an abundance of excellent building material, though quarry development has not yet been rapid. In the vicinity of Ellicott City occurs a dark gray granite which is rendered porphyritic by the presence of ill-defined crystals of pink feldspar. This has been quarried since an early period in the state's history and has been extensively used for building purposes, especially in Baltimore. One of the best granites in the state for most of the uses which granite serves occurs within a small area in the southwestern corner of Baltimore county, near Woodstock. This rock has been extensively quarried with few interruptions since 1832–33. Among the many important buildings in the construction of which it has been used as material are the Capitol, Patent Office, old Post Office, and Library of Congress in Washington.[2] The stone is of medium texture and of dark gray color. Another granite which is remarkably free from defects, and which is well adapted to monumental as well as to general structural purposes, is found near Guilford, in Howard county. This stone is of moderately fine and uniform grain and of a light gray color. Large quantities of dark gray gneiss for local use in rough building work is quarried in the immediate vicinity of Baltimore.[3]

Limestones and dolomites.—Of the carbonate of lime deposits in the state, the limestones, as distinguished from the marbles, occur generally throughout the western part, or the Appalachian region, and in the form of limestone conglomerate or "Potomac marble" in the Frederick valley.

The blue limestones are in demand locally for building purposes. On weathering, this stone changes its color rapidly. The limestone of the Frederick valley is known as "calico rock" or "Potomac marble" and was used for the columns in the construction of the old Hall of Representatives in Washington. A good exposure of this rock is at Washington Junction, and its occurrence extends northward along the base of the Catoctin mountains.[4] Buckeystown, in Frederick county; Cockeysville, in Baltimore county, and Baltimore have long been important points in the manufacture of lime.[5]

[1] Stones for Building and Decoration, by George P. Merrill, page 66 ff.
[2] Geological Survey of Maryland, Vol. I, page 206 ff.
[3] Stones for Building and Decoration, page 67 ff.
[4] Geological Survey of Maryland, Vol. I, page 209 ff.
[5] The United States Geological Survey, "Mineral Resources of the United States," 1887, page 533.

Cement.—The industry of hydraulic cement manufacture is one of considerable relative importance in the state. The greater part of the state's output comes from the limestones in the vicinity of Cumberland and Hancock and from the Shenandoah limestones of the Hagerstown valley near Sharpsburg. The cement produced is of excellent quality, and the demand for it extends beyond the state.[6] The following table shows the annual production of cement since 1890:

TABLE 5.—*Annual production of cement: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
1890	223,269	1897	296,000
1891	204,900	1898	297,475
1892	[1]262,092	1899	362,000
1893	[1]231,600	1900	335,070
1894	[1]279,000	1901	351,329
1895	[1]242,000	1902	409,200
1896	[1]271,500		

[1] Includes production from West Virginia.

Slate.—Since Revolutionary times the slate deposits of the Peach Bottom region in Harford county have been worked for a roofing material, and the exceptional quality of these slates is strongly evidenced by the fact that after a hundred years' exposure they show almost no change. The area in which they occur is a narrow zone beginning near Pylesville, on the Baltimore and Lehigh Railway, and running into York and Lancaster counties, Pennsylvania.[7]

Flint.—Maryland is a very important contributor to the aggregate output of flint and quartz, commercially known as flint in the United States. In 1902, 6 of the 19 active quarries in the United States were located within the state, and 49.2 per cent, or about one-half of the output of ground flint in the country came from these quarries. Important centers for the production of flint and quartz are Darlington and Conowingo.[8]

Iron ores.—The iron industry in Maryland, whose development began in the early days of the colonial period, was for more than a century one of the most important factors in the prosperity of the state. The first recorded notice taken of the iron ores of Maryland and Virginia by the early settlers was in 1608, when Capt. John Smith sent 2 barrels of iron ore specimens to England for examination. Nothing is known of the result of this examination. About one hundred years later the first recorded operations were inaugurated by some Welsh miners in the vicinity of Iron Hill and Elkton. The extent of these operations is not known, but in the development of the iron ores of this same region in the nineteenth century, "the miners employed in the ore pit on Iron Hill came upon one of the galleries made by the Welsh miners and

[6] Geological Survey of Maryland, Vol. I, page 213 ff.
[7] Ibid., page 211.
[8] United States Geological Survey, Seventeenth Annual Report, pages 838 and 846.

discovered a rude shovel and pick and a small tallow candle, the wick of which was made of flaxen yarn. The candle, though probably a century old, was in a good state of preservation, but the shovel and pick were so badly rusted that the former could be readily picked to pieces with the thumb and finger."[1]

The first iron works in Maryland were probably erected in Cecil county at the head of Chesapeake bay. It is probable, also, that the bloomery built at North East, on North East river, before 1716 formed the pioneer iron enterprise of that character. Scrivenor, in his "History of the Iron Trade," published in 1841, says that in 1718 Maryland and Virginia exported "3 tons and 7 cwt." of bar iron to England, and, since Virginia had no forges at that date, the shipment must have come from the works of Maryland.

The era of systematic iron production in the state was opened by the organization in 1722 of the Principio Company, which in that year began the construction of a furnace at the mouth of Principio creek. Shortly after the organization of the company Mr. John England, of Bristol, England, who proved to be one of the most intelligent, enterprising, and successful of the early American ironmasters, became its general manager. He built the first furnace and the first forge in the state. The enterprise grew rapidly and soon its production of iron had reached a scale of commercial importance. About 1725 Augustine and Lawrence Washington, the father and half-brother of the first President,[2] became interested in the company, which soon outranked all others in the manufacture of pig and bar iron from its three furnaces and two forges in Maryland and one furnace in Virginia. For fifty years it was the most important of colonial iron enterprises, contributing one-half to the total exports of pig iron from the colonies to England up to the Revolution.[3] The marked success of this company brought others into the field for the exploitation of the iron deposits of the state, and by 1761 the industry had attained a flourishing condition. This is indicated in a report made by the governor to the effect that there were 18 furnaces and 10 forges in the state which made 2,500 tons of pig iron a year.[4] During the middle and latter part of the eighteenth century and the early part of the nineteenth, the industry of iron manufacture spread to other sections of the state and many furnaces were built, but nearly all of these were later abandoned. One of the most notable of these was the Catoctin furnace at Frederick, which was built in 1774, and furnished guns and projectiles to the Continental Army during the Revolution.

In recent years several modern furnaces have been built in the vicinity of Baltimore. By far the largest of these is at Sparrows Point, which plant, however, uses only ores obtained from sources outside the state.

Since the discovery of extensive deposits of higher grade ores in other sections of the country, notably in Michigan, Pennsylvania, and Alabama, the industry of iron ore mining in the state has rapidly declined until now the great iron using industries of the state depend to only an inconsiderable extent upon local ores.[5]

Sandstones and quartzites.—The quarrying of sandstones and quartzites in the state has continued in a more or less systematic way from the building of the old Potomac canal around the Great Falls of the Potomac, in 1774, when Seneca sandstone was used in the construction of two locks, down to the present time. This red Seneca sandstone has long been highly regarded alike for its durability, for the ease with which it can be worked, and for its beautiful colors. It entered largely into the construction of the Smithsonian Institution at Washington. Other occurrences of sandstone that have been exploited, and for which there is a greater or less demand, are in Harford county in the Catoctin and Blue Ridge mountains, and in Allegany county.

All other minerals.—Another factor of the mineral wealth of Maryland is found in the clay deposits, which are widely distributed and in many cases possess characteristics that render them of exceptional economic importance.

The first plant constructed in the United States for the manufacture of fire brick was that built in 1841 at Mt. Savage in Allegany county. The main fire clay deposits of the state lie near the bottom of the Coal Measures, the beds ranging from 8 to 20 feet in thickness. Their exploitation has been a characteristic industry of the state for more than fifty years, and the brick made from them are considered the best in the country. The clay deposits of the state that are most extensively exploited at present are those comprised in the Columbia and Patapsco formations. The center of their manufacture into terra cotta work and pottery is Baltimore.[6] The kaolin deposits of Cecil county, which are a continuation of the Delaware deposits, have been extensively mined for use in the manufacture of white ware for many years.[7]

Feldspar occurs at a number of places in the state, but was produced commercially in 1902 from only three mines located in Baltimore, Cecil, and Harford counties.

The discovery of gold occurred in Maryland in 1849, near Sandy Spring, in Montgomery county, and most of the mines subsequently opened lie along the southern boundary of this county in the vicinity of the Great Falls of the Potomac. The known occurrences of gold in the state are confined to the Piedmont plateau, and are in quartz veins. Some very rich specimens have

[1] Maryland Geological Survey, Cecil county, page 218 ff.
[2] Maryland Geological Survey, Vol. I, page 45 ff.
[3] Iron in All Ages, page 240 ff.
[4] Maryland Geological Survey, Vol. I, page 50.
[5] Maryland Geological Survey, Vol. I, page 218 ff.
[6] Ibid., page 214 ff.
[7] Maryland Geological Survey, Cecil county, page 211 ff.

been found in this region, but the deposits of the metal are not sufficiently even to render its mining profitable.[1]

Infusorial earth has been produced in greater quantities in Maryland than in any other state in the country. The deposits occur at the base of the Chesapeake formation, and in parts of Calvert and Charles counties attain a thickness of 30 or 40 feet. The beds have been extensively worked in the vicinity of the mouth of Lyon's creek on the Patuxent river and at Pope's creek on the Potomac.[2]

The industry of marble quarrying in the state dates probably from 1815, when material for use in the Washington Monument at Baltimore was taken from the deposits at Cockeysville in Baltimore county. This point continues to be the important marble producing center of the state. The 26-foot monoliths in the National Capitol were taken in 1859–61 from what is now known as the Beaver Dam quarry. Though there are numerous occurrences of marble deposits, those which have been developed sufficiently to demonstrate their economic importance are limited to what is known as the Green Spring valley, extending east and west at a distance of from 12 to 20 miles north of Baltimore. In this belt are located the two quarries mentioned. The stone is a white dolomite of medium texture, strong and durable. Small lenses of compact crystalline marble occur in Carroll and Frederick counties. Also at Texas occurs a coarsely crystalline white limestone, sometimes known as alum marble, which is extensively quarried, mainly for quicklime and flux, though it was used in constructing the lower 150 feet of the Washington Monument in Washington.[3]

Ores from which mineral paints are made are of quite common occurrence in the state and have been worked at many points. In former years large quantities were obtained from the brown ore deposits in Frederick county and also in Carroll and Harford counties. The Patapsco formation in Anne Arundel and Prince George counties carries easily worked deposits of a fine and highly ferruginous clay. This belt at present is the principal seat of the industry of mineral pigment production in the state.[4]

Soapstone occurs in several counties, especially Carroll, Harford, and Montgomery, where it has been mined at various times. The most extensive deposits are in Carroll county, in a northwesterly direction from Marriottsville.[4]

[1] Maryland Geological Survey, Vol. I, page 221 ff.
[2] Ibid., page 222.
[3] Stones for Building and Decoration, page 213 ff.
[4] Maryland Geological Survey, Vol. I, page 227.

MASSACHUSETTS.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Massachusetts for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Siliceous crystalline rocks.	Sandstones and quartzites.	Limestones and dolomites.	Marble.	All other minerals.[1]
Number of mines or quarries	251	204	19	11	8	9
Number of operators	234	194	16	8	8	9
Salaried officials, clerks, etc.:						
Number	360	279	35	17	13	16
Salaries	$309,978	$248,512	$25,530	$12,606	$12,468	$10,856
Wage-earners:						
Average number	4,242	3,395	342	203	130	172
Wages	$2,525,405	$2,045,340	$222,977	$99,740	$72,730	$84,618
Contract work	$1,853					$1,853
Miscellaneous expenses	$273,791	$211,745	$35,440	$10,192	$7,837	$8,577
Cost of supplies and materials	$762,835	$509,702	$59,486	$133,609	$18,324	$41,214
Value of product	$4,671,855	$3,451,397	$487,366	$339,349	$165,489	$228,254

[1] Includes operators as follows: Asbestos, 1; clay, 1; corundum and emery, 1; feldspar (operator reported under flint); flint, 1; graphite, 1; infusorial earth, tripoli, and pumice, 1; iron ore, 1; sulphur and pyrite, 1; talc and soapstone, 1.

The principal mineral industry of Massachusetts is quarrying, and as shown in Table 1, the value of siliceous crystalline rocks quarried in 1902 represents 73.9 per cent, or nearly three-fourths of the entire mineral production of the state. Massachusetts granite was the first to be systematically produced in the United States, and the state continues to lead in that production.[1] Sandstone, limestone, and marble are also quarried in considerable quantities, and the statistics for these operations are given separately in the table.

Among the minerals listed in the group of "all other minerals" are two of great importance. More than half of the emery produced in the United States is mined by one operator in Massachusetts, and a large proportion of the sulphur and pyrite production is also contributed by this state. Although these are of great importance, the statistics can not be shown separately because to do so would disclose the reports of individual operators.

A number of minerals for which no commercial production was reported in 1902 are known to occur in the state. Among these the following may be mentioned: Barytes, which occurs chiefly as gangue, with lead and copper, in Hampshire and Franklin counties; a very hard anthracite coal in Bristol, Plymouth, and Norfolk counties, which can not be mined profitably; chalcopyrite found in pyrite vein in Franklin county;[2] fuller's earth and garnet found in Worcester county, and garnet also in Framingham, Middlesex county; native gold found in small quantities in Middlesex, Norfolk, and Plymouth counties; deposits of stone suitable for use as millstones or whetstones in Hampshire, Norfolk, and Berkshire counties; lead ore found in Essex, Hampshire, Middlesex, and Worcester counties; manganese in small beds in Hampshire, Berkshire, and Franklin counties; ocher in Berkshire and Worcester counties; amber, agate, amethyst, beryl, jasper, jade, smoky quartz, and topaz are precious stones that have been reported in the state; quartz sand found in Berkshire, Essex, and Franklin counties; quarries of slate for local use, operated in Worcester and Middlesex counties; sphalerite or zinc blende occurring with galena in Franklin and Hampshire counties and at the Newburyport lead mines in Essex county, where operations were carried on before 1878.[3]

The relative importance of manufacturing industries closely allied to, or based upon the mining industry, using as their raw material the product of the mine or quarry, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$1,035,198,989
Based upon products of mines or quarries:		
Chemicals and allied products	$6,091,402	
Clay, glass, and stone products	12,763,947	
Iron and steel and their products	97,735,863	
Metals and metal products, other than iron and steel	29,232,650	
Miscellaneous industries	51,107,117	
		196,930,979
All other		838,268,010

[1] Stones for Building and Decoration, by George P. Merrill, pages 2 and 3.

[2] The United States Geological Survey, "Mineral Resources of the United States," 1887, pages 742 to 744.

[3] The United States Geological Survey, "Mineral Resources of the United States," 1887, page 745.

From the foregoing table it will be seen that 19 per cent of the total manufactured product of the state was based primarily upon the products of mines and quarries. The total product of manufactures as reported at the census of 1900 was $1,035,198,989; there were employed 497,448 wage-earners, who received $228,240,442 in wages. The product of mines and quarries in the state during 1902 was valued at $4,671,855, and there were reported as engaged in this production 4,242 wage-earners, to whom was paid the sum of $2,525,405 in wages.

Therefore the value of the product of mines and quarries was but four-tenths of 1 per cent of the combined product of mineral and manufacturing industries, 99.6 per cent of the total being contributed by manufactures. There were engaged in mining and quarrying eight-tenths of 1 per cent of the total number of wage-earners, and these received 1.1 per cent of the total wages. The manufacturing industries employed 99.2 per cent of the total wage-earners, and paid 98.9 per cent of the total wages.

The following table shows the value of the annual production of the principal minerals of the state from 1890 to 1902, inclusive:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Siliceous crystalline rocks.	Sandstones and quartzites.	Limestones and dolomites.	Marble.
1890	$2,503,503	$649,097	$119,978	(1)
1891	2,600,000	400,000	100,000	(1)
1892	2,200,000	400,000	200,000	$100,000
1893	1,631,204	223,348	156,528	(1)
1894	1,995,830	160,231	195,982	(1)
1895	1,918,894	339,487	75,000	2,000
1896	1,656,973	304,361	118,622	83,904
1897	1,736,069	194,084	126,508	79,721
1898	1,650,508	91,287	174,822	38,210
1899	1,798,294	131,877	168,147	59,416
1900	1,698,605	153,427	209,359	130,735
1901	2,216,258	247,310	244,039	126,546
1902[2]	3,451,397	487,366	339,349	105,189

[1] Not reported. [2] Census figures.

The production of 1902, according to Table 3, increased over that of 1901 in all the industries presented. The production of siliceous crystalline rocks, as well as that of limestones and dolomites, during 1902 was greater than that reported during any year of the thirteen years shown in the table.

Siliceous crystalline rocks.—The Massachusetts production of siliceous crystalline rocks during 1902 was valued at $3,451,397, which is greater than the amount reported for any other state in the Union. Thirty-nine per cent of this value, or $1,347,214, was used for dressed stone for building and monumental work; 27.1 per cent, or $936,413, was for stone sold in the rough, and the remainder was for paving purposes, crushed stone, riprap, etc., in the order named.

In a strictly scientific sense, most of the siliceous crystalline rocks of Massachusetts are not granites, but granitites or gneisses.

The granitites differ from granite proper in the absence of white mica, while gneisses are crystalline rocks which possess a more or less well-marked banding, usually due to the arrangement of the micas in defined planes.[1]

Although granite bowlders were used in construction as early as 1650,[2] it was not until the early part of the nineteenth century that quarrying was prosecuted to any considerable extent in Massachusetts. In 1810 the Boston court-house, in 1814 the New South church, and in 1818–19 the first stone block in Boston were constructed of stone introduced by canal from Chelmsford, 30 miles distant. The quarries of Quincy, in Norfolk county, were opened about 1820, and the history of systematic siliceous crystalline rock quarrying in New England begins at this time.[3]

The stone obtained from this locality is coarse grained and very hard and in color generally a dark blue-gray. It is classed as a hornblende pyroxene, and although the brittle pyroxene makes the production of a perfect surface somewhat difficult, it is still used extensively for finished as well as for rough work. Its suitability for interior decoration may be seen in the polished stairways and pillars of the Philadelphia city buildings. The Quincy stone was first brought into prominence in 1825 through its use in the construction of the famous Bunker Hill Monument at Charlestown, and what is claimed to be one of the first railroads in the United States was built a distance of 3 miles from these granite quarries to the Neponset river in 1826.[4]

Probably the Gloucester quarries at Bay View, in Essex county, were the next to be worked, being opened in 1824. The rock obtained is hornblendic with considerable black mica or annite, coarse in texture, and greenish or gray in color. It is hard and tough, and being very durable, it is eminently suitable for building and ornamental work. A number of other quarrying localities were opened in Essex county, chiefly at Rockport in 1830. The stone quarried resembles the Gloucester type and may be obtained in massive blocks.[5] The stone quarried at Chester, Hampden county, is clear gray or bluish gray of medium shade; it is homogeneous and of fine, even grain.[6]

At Dedham, Norfolk county, there is produced an epidote granite of fine grain and light pink, tinged with green, in color, and at Brockton, Milford, and North Easton a light pink variety of coarse biotite is quarried.

The stone obtained at Milford, Worcester county, possesses a more or less plainly marked banding, which increases its beauty without any depreciation of its strength or usefulness. At Monson, Hampden county, a characteristic gneiss is quarried and in a number of

[1] The Mineral Industry, 1898, Vol. VII, page 637.
[2] Stones for Building and Decoration, pages 1 and 2.
[3] One Hundred Years of American Commerce, Vol. I, page 189.
[4] Harper's Encyclopedia, Vol. IX, page 404.
[5] Stones for Building and Decoration, pages 68 to 72.
[6] United States Geological Survey, Eighteenth Annual Report, page 965.

other localities siliceous crystalline rocks may be found.[1] Quarrying operations have proved very successful in Massachusetts, as the largest deposits are adjacent to navigable water, which renders shipment convenient and comparatively inexpensive.

Sandstones and quartzites.—The sandstone and quartzite production of Massachusetts during 1902 was valued at $487,366. More than one-half of the amount quarried was used in roadmaking and the rest, with the exception of a small amount reported as rubble, was sold principally in the rough or dressed condition for building purposes. In the vicinity of East Longmeadow, Hampden county, are found the principal sandstone quarries, and some of the earliest quarrying operations have been reported in this locality. Sandstone of several colors, fine grained and of a massive type, is obtained, and is used chiefly for building purposes.[2] Geologically speaking, this sandstone locality is a northward continuation of the Connecticut brownstone deposit, extending into Massachusetts as far north as Northampton. This stone is of a Triassic variety and is soft and easily worked.[3]

A number of quarries in and about Boston, principally municipal in ownership, yield a so-called pudding stone; this is a rough and durable stone suitable for roadmaking, concrete, etc., but generally too coarse for ornamental work.[3] These conglomerates in Roxbury, Suffolk county, came into use about 1840, and have been utilized somewhat in building construction and for the rustic masonry work of the Boston system of parkways.

Limestones and dolomites.—Massachusetts limestones and dolomites are obtained entirely in Berkshire county; the production during 1902 was valued at $339,349. They occupy a belt along the Housatonic river and are of the same age as those of Rutland valley, Vt., to which stones they bear a close resemblance.[4]

Marble.—The production of marble in Massachusetts for 1902 was valued at $165,489 and quarrying operations were chiefly reported in Berkshire county. In composition the marble ranges from marble proper to dolomites, or to varieties carrying a high percentage of magnesium carbonate.[2] At Egremont quarries was obtained the marble for the Corinthian columns of Girard College in Philadelphia about 1835. In 1838 the Sheffield, and in 1852 the Lee quarries were opened. Stone from the latter was used in the extension of the Capitol at Washington, D. C. The marbles are all white or gray, of medium fine grained texture, and are better adapted for building than for decoration. They often contain white tremolite crystals which weather out on exposure, leaving the rock with a rough pitted surface, as may be noticed in the exterior walls of the Capitol, where this marble has been used.[5]

All other minerals.—A small quantity of asbestos was found associated with the talc produced in the state in 1902.

A fire clay was mined near Gay Head, in Dukes county. It generally burns to a white or cream, except the red variety, which burns blue, and upon application of greater heat changes to an iron brown.

Emery was discovered in Chester, Hampden county, in 1864; two years later corundum crystals were also found, and soon thereafter began the first actual mining of emery and corundum in America. In 1902 most of the emery produced in the United States came from this locality. In 1871 the occurrence of corundum in vermiculites with asbestos in olivine rocks, and very similar to the south Appalachian deposit, was discovered at Pelham.[6]

Flint and feldspar were both obtained from a quarry near Huntington, in Hampden county, and the product obtained is ground and screened before being placed on the market. Flint is the principal stone quarried, and in 1902 nearly one-tenth of the total production of the United States was reported from Massachusetts.

A small amount of graphite was mined during 1902, near Sturbridge, in Worcester county. An infusorial earth was mined in Middlesex county.

Iron ore was discovered near Lynn soon after its settlement in 1629, and in 1643 the first iron foundry established in America was located at what is now Saugus Center, in the vicinity of Lynn. This locality furnished most of the iron used in the colony prior to 1671 and the mines were operated at intervals after that time until 1688 when they seem to have been abandoned. The second iron enterprise undertaken in New England was at Braintree, about 10 miles south of Boston. Iron ore was mined there in the early part of 1652,[7] but operations were suspended in the following year on account of the scarcity of ore. Massachusetts was the chief iron center of the continent for a hundred years after its settlement in 1620. During this time bog ore was mined, mostly in the eastern counties. The rich brown hematite ores of western Massachusetts were developed in 1750 and the first furnace was built at Lenox, in Berkshire county, in 1765.[8] This county was the only producer of iron ore in the state during 1902.

The only pyrite mines in Massachusetts are located in Franklin county and were opened in June, 1882. The mineral is an almost pure iron pyrite and the width and continuity of the ore vein, as well as its great length, depth, and purity, make it one of the most remarkable deposits ever known.[9]

Talc is mined in Berkshire county in the vicinity of Dalton. About one-half the product is used by foundries and the balance is prepared as talcum powder or is used as an ingredient of paint..

[1] Stones for Building and Decoration, pages 68 to 72.
[2] The Mineral Industry, 1898, Vol. VII, page 639.
[3] Stones for Building and Decoration, page 143.
[4] The Mineral Industry, 1898, Vol. VII, pages 639 and 640.
[5] Stones for Building and Decoration, page 215.
[6] Transactions of the American Institute of Mining Engineers, Vol. XXV, page 857.
[7] Iron in All Ages, by James M. Swank, pages 108 to 113.
[8] Ibid., pages 120 to 122.
[9] United States Geological Survey, "Mineral Resources of the United States," 1885, page 503.

MICHIGAN.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of Michigan for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Iron ore.	Copper ore.	Cement.	Coal, bituminous.	Limestones and dolomites.	Gypsum.	All other minerals.[1]
Number of mines, quarries, and wells	203	80	20	11	31	30	6	25
Number of operators	146	41	20	10	30	29	4	12
Salaried officials, clerks, etc.:								
Number	1,585	750	419	102	99	62	127	26
Salaries	$1,840,132	$775,914	$598,076	$131,131	$87,780	$49,264	$171,245	$26,722
Wage-earners:								
Average number	31,951	14,456	13,887	988	1,445	665	359	201
Wages	$20,103,616	$9,132,703	$8,744,892	$535,570	$1,075,805	$325,379	$176,607	$112,660
Contract work	$77,947	$57,382	$11,725	.....	$7,500	.....	.....	$440
Miscellaneous expenses	$3,869,461	$3,004,384	$473,501	$170,477	$106,414	$36,464	$44,716	$33,506
Cost of supplies and materials	$9,341,409	$3,661,194	$4,688,419	$704,237	$82,448	$89,089	$88,634	$26,788
Value of product	$50,157,358	$26,695,860	$18,247,207	$2,134,396	$1,653,192	$357,072	$459,621	$310,010

[1] Includes operators as follows: Clay, 1; graphite, 2; petroleum, 1 (13 wells); sandstones and quartzites, 8 (9 quarries); sandstones and quartzites includes all data for grindstones and pulpstones, and for oilstones, whetstones, and scythestones.

The mineral resources of Michigan are extensive and varied. The iron ore deposits of the Upper Peninsula along the shores of Lake Superior are extensive, and the annual production is enormous. The copper mines of the state are among the richest in the world, and the celebrated Calumet and Hecla mine is claimed to be the most profitable copper mine known. Although coal underlies some 6,700 square miles of the state's area, it is of inferior quality and not pure enough for smelting purposes. The Huron grindstones have been quarried for many years, and Michigan ranks second in their production in the United States, Ohio being first. Valuable deposits of gypsum occur, which, in the vicinity of Grand Rapids and Alabaster, are extensively quarried and used in the manufacture of stucco. The Lake Superior region also produces gold, silver, agate, sardonyx, chalcedony, cornelian, jasper, and opals, as well as roofing slate, freestone, marble, and limestone.[1] Among other minerals to be found are fire clay, marble, ochers, freestones, slates, limestones, and glass sand.[2]

In addition to the minerals mentioned in the foregoing table, the following minerals found in Michigan were not produced in commercial quantities in 1902: Amethysts, barytes, copper pyrites, gold, granite, manganese ores, ocher, serpentine rock, slate, and strontium ore.

The 17 operators who reported active mines and quarries with no production in 1902 were engaged principally in developing copper and iron deposits. These operators employed during the year an average of 353 wage-earners and paid $222,215 in wages; the salaried officials, clerks, etc., received $69,967; the miscellaneous expenses amounted to $103,887, and the cost of supplies and materials to $201,656.

The value of the products of the manufacturing industries of the state, based primarily upon minerals mined or quarried, as reported at the census of 1900, is shown in the following table, which also shows the total value of the products of all manufactures in Michigan for the same year:

TABLE 2.—*Manufactures based primarily on the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$356,944,082
Based upon products of mines or quarries:		
Chemicals and allied products	$7,201,387	
Clay, glass, and stone products	4,325,273	
Iron and steel and their products	34,071,223	
Metals and metal products, other than iron and steel	25,556,939	
Miscellaneous industries	12,576,108	
		83,730,930
All other		273,213,152

From the above table it will be seen that the total value of the products of manufactures in Michigan, based primarily upon minerals mined or quarried, was $83,730,930, or 23.5 per cent of the total. The total value of the output of the mines, quarries, and wells in 1902 was $50,157,358, or 12.3 per cent of the total value of the product of all manufacturing and mining industries.

The average number of wage-earners engaged in the manufacturing industries in 1900 was 162,355, and the total wages paid amounted to $66,467,867. The aver-

[1] King's Handbook of the United States, pages 410 and 411.
[2] Ibid., page 407.

age number engaged in mining in 1902 was 31,951, and their total wages amounted to $20,103,616. The total number of wage-earners, therefore, employed in mining and manufacturing industries was 194,306, and they received in wages $86,571,483. Of this total, manufactures employed 83.6 per cent of the wage-earners and paid 76.8 per cent of the wages. The wage-earners employed in mining industries constituted 16.4 per cent of the total number employed and received 23.2 per cent of the total wages paid.

Table 3, compiled from the reports of the United States Geological Survey, shows the value of the annual production of the principal minerals in Michigan from 1890 to 1902, except copper ore, values for which can not be obtained.

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Iron ore.	Cement.	Coal, bituminous.	Limestones and dolomites.	Gypsum.
1890	(1)	(1)	$149,195	$85,952	$192,099
1891	(1)	(1)	133,387	75,000	223,725
1892	$16,587,521	(1)	121,314	95,000	306,527
1893	8,611,192	(1)	82,462	53,282	303,921
1894	5,844,995	(1)	103,949	336,287	189,620
1895	8,403,958	(1)	180,016	424,589	174,007
1896	10,143,918	$7,000	150,631	109,427	146,424
1897	8,347,615	26,250	325,416	215,177	193,576
1898	10,308,807	134,760	462,711	271,523	204,310
1899	13,707,899	513,849	870,152	371,210	283,537
1900	28,859,650	830,940	1,259,683	425,636	285,119
1901	21,735,592	1,128,290	1,753,064	565,931	267,243
1902[2]	26,695,860	2,134,396	1,053,192	657,072	459,021

[1] Not reported separately. [2] Census figures.

Iron ore.—The existence of iron ore deposits on the southern border of Lake Superior was known to white Indian traders as early as 1830. Their commercial value, however, was not realized until 1844. In 1845 the celebrated Jackson mine in the Marquette district was located and the first forge was built. The first iron was made in this region during the following year.[1] The first iron ore shipped from the Marquette mines for commercial purposes was in 1853, and since that time there has been a steady increase in the output. In 1877 the first shipment of ore was made from the Menominee district and in 1884 from the Gogebic district. The yearly production of the Michigan iron ore mines has increased from 948,553 long tons in 1872 to 11,135,215 tons in 1902. From 1890 to 1900 Michigan ranked first among the iron ore producing states, but since that time it has ranked second, Minnesota being first. By far the greatest quantity of Michigan iron ore is of the red hematite variety, although magnetite is produced to some extent.

The following table, compiled from the reports of the United States Geological Survey, shows the practically steady increase in the iron ore production in this state from 1854 to the present time:

[1] Iron in All Ages, by James M. Swank, page 321.

TABLE 4.—*Annual production of iron ore: 1854 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.	YEAR.	Long tons.
Previous to 1854	75,083	1870	859,507	1887	3,934,339
1854	3,000	1871	813,984	1888	4,113,803
1855	1,449	1872	948,553	1889	5,856,169
1856	6,790	1873	1,195,234	1890	7,141,656
1857	25,646	1874	899,934	1891	6,127,001
1858	22,876	1875	881,166	1892	7,543,544
1859	68,832	1876	993,311	1893	4,668,324
1860	114,410	1877	1,025,129	1894	4,419,074
1861	49,909	1878	1,127,583	1895	5,812,444
1862	124,169	1879	1,420,745	1896	5,706,736
1863	203,055	1880	1,948,334	1897	6,087,463
1864	247,059	1881	2,125,729	1898	7,346,846
1865	193,758	1882	2,656,933	1899	9,146,157
1866	296,713	1883	2,518,048	1900	9,926,727
1867	565,504	1884	2,225,146	1901	9,654,067
1868	510,522	1885	2,205,190	1902	11,135,215
1869	639,097	1886	3,179,511		

Copper ore.—The existence of native copper on the southern shore of Lake Superior was first made known by the Jesuit missionaries early in the seventeenth century. Other explorers found copper in that locality in the succeeding century, and in 1770 Capt. Jonathan Carver, of London, published a book, telling of the rich deposits of copper in the Lake Superior region. This led to the formation of a copper mining company in London. During the winter of 1771–72, this company sent over from England a party of miners who conducted operations along the Ontonagon river. The attempt failed, however, and nothing further was done at copper mining for seventy years.[2]

Throughout the entire copper region numerous excavations have been found. It is believed these were made at a very remote period, for the purpose of securing copper. Some of this mine work is on an extensive scale, attaining, in one instance, a depth of 50 feet in the solid rock.[3]

The formation carrying the cupriferous lodes and veins of the Lake Superior district is composed of old lava flows, supplemented by beds of conglomerate which have been formed by the deposition of rocks, broken from adjacent shores, upon old sea beds. This belt of rocks, named after the Keweenaw peninsula, where it predominates, is of considerable extent. It forms a trough or synclinal, the southern edge of which outcrops on the Keweenaw peninsula, and to the westward along the southern shore of the lake.[4]

The discoveries of Dr. Douglas Houghton led to the exploitation of the Lake Superior district, now among the most valuable and productive copper fields in the world. The first copper in any considerable quantity was taken from what was later known as the Cliff mine, in Keweenaw county, in 1846. About 1847 the Minnesota mine, in Ontonagon county, was opened. The mine was closed in 1870, after having paid dividends of

[2] The Copper Handbook, by Horace J. Stevens, Vol. III, page 109.

[3] Metallic Wealth of the United States, by J. D. Whitney, page 250.

[4] The Copper Handbook, Vol. III, page 106.

$1,820,000 from 17,352 tons 668 pounds of copper produced. The mine has recently been reopened. The famous Calumet and Hecla mine, producing about 8 per cent of the copper output of the world, was opened in 1866. Up to 1903 this mine had contributed about 55 per cent of the total copper production of Michigan.[1]

The now practically abandoned mines on Isle Royal were probably worked long before the arrival of the white man, but the earliest historic explorations were contemporary with those in Keweenaw and Ontonagon counties. Several mines were located and worked to some extent until 1883. At the present time new explorations are being made in this region.[2]

The output of copper from ore mined in Houghton, Keweenaw, and Ontonagon counties was 76,385 long tons in 1902, or 26.8 per cent of the total production for the United States. From 1847 to 1887 Michigan ranked first among the copper producing states, but since that time, with the single exception of 1891, Montana has ranked first and Michigan second. In 1901 Michigan contributed 13.4 per cent of the world's production of copper.

The following table compiled from the reports of the United States Geological Survey, shows the annual production of copper in the United States and in Michigan from 1845 to 1902, and the percentage of Michigan's output to that of the United States:

TABLE 5.—*Annual production of copper in the United States and in Michigan, with per cent of total: 1845 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	PRODUCTION (LONG TONS).			YEAR.	PRODUCTION (LONG TONS).		
	United States.	Michigan.	Per cent of total.		United States.	Michigan.	Per cent of total.
1845	100	12	12.0	1874	17,500	15,327	87.6
1846	150	26	17.3	1875	18,000	16,089	89.4
1847	300	213	71.0	1876	19,000	17,085	89.9
1848	500	461	92.2	1877	21,000	17,422	83.0
1849	700	672	96.0	1878	21,500	17,719	82.4
1850	650	572	88.0	1879	23,000	19,129	83.2
1851	900	779	86.6	1880	27,000	22,204	82.2
1852	1,100	792	72.0	1881	32,000	24,363	76.1
1853	2,000	1,297	64.9	1882	40,467	25,439	62.9
1854	2,250	1,819	80.8	1883	51,674	26,653	51.6
1855	3,000	2,593	86.4	1884	64,708	30,961	47.8
1856	4,000	3,666	91.7	1885	74,052	32,209	43.5
1857	4,800	4,255	88.6	1886	70,430	36,124	51.3
1858	5,500	4,088	74.3	1887	81,017	33,941	41.9
1859	6,300	3,985	63.3	1888	101,054	38,604	38.2
1860	7,200	5,388	74.8	1889	101,239	39,364	38.7
1861	7,500	6,713	89.5	1890	115,966	45,273	38.9
1862	9,000	6,065	67.4	1891	126,839	50,992	40.2
1863	8,500	5,797	68.2	1892	154,018	54,999	35.7
1864	8,000	5,576	69.7	1893	147,033	50,270	34.2
1865	8,500	6,410	75.4	1894	158,120	51,061	32.3
1866	8,900	6,138	69.0	1895	169,917	57,737	34.0
1867	10,000	7,824	78.2	1896	205,384	64,078	31.2
1868	11,600	9,346	80.6	1897	220,571	64,858	29.4
1869	12,500	11,886	95.1	1898	235,050	66,291	28.2
1870	12,600	10,992	87.2	1899	253,870	65,803	25.9
1871	13,000	11,942	91.9	1900	270,588	64,938	24.0
1872	12,500	10,961	87.7	1901	268,782	69,772	25.9
1873	15,500	13,433	86.7	1902[1]	285,283	76,385	26.8

[1] Census figures.

Cement.—The history of the Portland cement industry in this state begins with the year 1872, when a plant was built near Kalamazoo and operated until abandoned in 1882. No further steps in the development of this industry were taken until 1896 and 1897, when a plant was erected at Union City. This was the beginning of the recent period of rapid and extensive development of the cement industry in Michigan.

The raw materials entering into the composition of the Portland cement thus far made in Michigan are limestone, marl, shale, clay, and gypsum, all of which abound in the state.[3]

Table 6, compiled from the reports of the United States Geological Survey, shows the increase in product of the Portland cement industry in the state from 1896 to 1902.

TABLE 6.—*Annual production of Portland cement: 1896 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
1896	4,000	1900	664,750
1897	15,000	1901	1,025,718
1898	77,000	1902[1]	1,577,006
1899	312,566		

[1] Census figures.

Coal.—The industry of coal mining in Michigan began in 1835 in Jackson county. This was followed in 1838 by operations on the Grand Ledge, in Ingham and Clinton counties. In 1878 coal was mined in the Owosso district in Shiawassee county, and this field has been worked continuously since that year. Successful operations first began in the Saginaw district and in Bay county in 1895. The large proportion of the product of the smaller mines finds a ready local market, while much of the output from the larger ones goes into Wisconsin, Minnesota, and the Dakotas.[4]

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of coal in the state from 1868 to 1902:

TABLE 7.—*Annual production of coal, bituminous: 1868 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1868	28,000	1886	60,434
1869	29,980	1887	71,461
1870	31,528	1888	81,407
1871	32,000	1889	67,431
1872	33,600	1890	74,977
1873	50,000	1891	80,307
1874	58,000	1892	77,990
1875	62,500	1893	45,979
1876	66,000	1894	70,022
1877	69,197	1895	112,322
1878	85,322	1896	92,882
1879	82,015	1897	223,592
1880	129,053	1898	315,722
1881	130,130	1899	624,708
1882	135,389	1900	849,475
1883	71,296	1901	1,241,241
1884	96,712	1902	964,718
1885	45,178		

Limestones and dolomites.—The value of the product of the 30 quarries operating in 1902, which are located in the counties of Alpena, Charlevoix, Chippewa, Delta, Emmet, Huron, Kent, Monroe, Schoolcraft,

[1] The Copper Handbook, Vol. III, pages 108, 109, 227, and 383.
[2] Geological Survey of Michigan, Vol. VI, page 22.
[3] United States Geological Survey, 1900–1901, Part III, page 635.
[4] Ibid., page 324 ff.

and Wayne, was $657,072 while in 1901 it amounted to $565,931.

Gypsum.—Table 8, compiled from the reports of the United States Geological Survey, shows the annual production of gypsum in the state from 1868 to 1902.

TABLE 8.—*Annual production of gypsum: 1868 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1868	34,082	1886	52,369
1869	36,174	1887	54,310
1870	38,364	1888	51,682
1871	48,428	1889	131,767
1872	52,501	1890	74,877
1873	57,340	1891	79,700
1874	51,493	1892	139,557
1875	36,187	1893	124,590
1876	48,789	1894	79,958
1877	48,250	1895	66,519
1878	47,252	1896	67,634
1879	51,278	1897	94,874
1880	65,470	1898	93,181
1881	50,105	1899	144,776
1882	58,096	1900	129,654
1883	63,397	1901	185,150
1884	51,389	1902[1]	208,563
1885	40,419		

[1] Census figures.

In 1827 an Indian trapper brought a specimen of gypsum which he had picked up on Plaster creek, to the mission located on the present site of Grand Rapids. Little attention, however, was paid to the mining of gypsum until 1838, when Dr. Douglas Houghton, the state geologist, called attention to the deposits. In 1841 the first gypsum mill was built on Plaster creek, in Kent county, and in 1862 the Alabaster quarry and mill in Iosco county were opened.[1] In its ground, uncalcined state gypsum is used as land plaster for fertilizing purposes, but the greater part of the gypsum produced is calcined into plaster of Paris. The total value of gypsum produced in 1901 was $267,243, of which $208,549 was the value of plaster of Paris and $10,708 that of land plaster. In 1902 the total value was $459,621; the value of product calcined into wall plaster and plaster of Paris was $372,821 and that ground into land plaster, $16,340.

All other minerals.—Extensive beds of Potsdam sandstone occur in the northern part of the Upper Peninsula and furnish the best quality of building material found in the state. The stone is of medium fineness of texture and of a light brownish red color, often curiously spotted or mottled with gray, and is known locally as "raindrop stone."[2] The total value of the stone produced by the 9 quarries which operated in 1902 was $188,073, while in 1901 it was $290,575. The principal quarries are located in Baraga, Houghton, Keweenaw, Ottawa, and Marquette counties.

The largest grindstone quarries in the state were opened in 1838 at Grindstone city, Huron county. The Huron grindstone is a very fine grit, soft and wet when fresh, but growing hard and dry upon exposure.[3] In the production of grindstones Michigan is second among the states, Ohio standing first.

The graphite mines are located in Baraga county, the 13 petroleum wells in St. Clair county, and a small quantity of clay is produced in Ontonagon county.

[1] Report of the State Board of Geological Survey of Michigan, 1902, page 4 ff.

[2] Stones for Building and Decoration, by George P. Merrill, page 144.

[3] King's Handbook of the United States, page 407.

MINNESOTA.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Minnesota for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Iron ore.	Limestones and dolomites.[1]	Sandstones and quartzites.	Siliceous crystalline rocks.	Precious stones.
Number of mines or quarries	176	59	77	13	27	.....
Number of operators	255	31	76	12	26	110
Salaried officials, clerks, etc.:						
Number	675	529	92	18	36	.....
Salaries	$577,336	$430,994	$86,969	$18,654	$40,719	.....
Wage-earners:						
Average number	9,760	8,256	785	305	414	.....
Wages	$6,391,184	$5,376,933	$481,561	$215,068	$317,622	.....
Contract work	$330,244	$238,244	$1,000	.....	.....	.....
Miscellaneous expenses	$1,242,851	$1,134,526	$50,380	$45,740	$12,028	$180
Cost of supplies and materials	$2,868,340	$2,699,115	$103,794	$13,158	$52,273	.....
Value of product	$25,729,545	$23,989,227	$905,857	$347,472	$478,989	$8,000

[1] Includes cement, 2.

By far the most important mineral found in the state is iron ore, Minnesota ranking first in the production of this mineral. The building stones of the state are of excellent quality and of great variety. Natural-rock cement has been manufactured near Mankato for many years, and the famous red pipestone is found in Pipestone county.

In addition to the minerals enumerated in Table 1 the following, which are known to occur in Minnesota, were not produced in commercial quantities during 1902: Feldspar, jasper, molybdenum, reported as occurring in quantities near Portage, Aitkin county, and slate.

In 1902 there were 15 operators, exclusive of those referred to in Table 1, who reported active mines but no production, the work being confined to the care and development of the properties. These operators employed an average of 117 wage-earners and paid $73,700 in wages during the year. The miscellaneous expenses amounted to $2,346 and the cost of supplies and materials to $66,310.

The value of the products of the manufacturing industries of the state, based primarily upon the products of mines and quarries, is shown in the following table, which also shows the total value of products for all manufactures in Minnesota:

TABLE 2.—*Manufactures based primarily upon products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures	.....	$262,655,881
Based upon products of mines or quarries:		
Chemicals and allied products	$365,101	
Clay, glass, and stone products	3,521,708	
Iron and steel and their products	8,483,678	
Metals and metal products, other than iron and steel	3,210,436	
Miscellaneous industries	12,862,474	
		28,443,297
All other	.....	234,212,584

From the figures in Table 2 it will be seen that the total value of the products of manufactures in 1900, based primarily upon minerals mined or quarried, amounted to $28,443,297, or 10.8 per cent of the total of all manufactures. The total value of the output of the mines and quarries of Minnesota in 1902 was $25,729,545, or 8.9 per cent of the total value of the products of all mining and manufacturing industries in the state.

According to the census of 1900 the average number of wage-earners engaged in the manufacturing industries was 77,234, and the total wages paid amounted to $35,484,825. The average number engaged in mining and quarrying in Minnesota in 1902 was 9,760, and the total wages paid amounted to $6,391,184. The manufacturing and mining industries combined, therefore, gave employment to 86,994 wage-earners and paid $41,876,009 in wages. Of these totals, manufactures employed 88.8 per cent of the wage-earners and paid 84.7 per cent of the wages. Mines and quarries gave employment to 11.2 per cent of the wage-earners and paid 15.3 per cent of the wages.

The following table presents the value of the output of the leading minerals of this state from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Iron ore.	Limestones and dolomites.	Siliceous crystalline rocks.	Sandstones and quartzites.
1890	(1)	$613,247	$356,782	$181,979
1891	(1)	600,000	(1)	200,000
1892	$3,090,942	600,000	360,000	175,000
1893	2,321,204	208,088	270,296	80,296
1894	2,165,802	291,263	153,936	8,415
1895	2,803,452	218,733	148,596	74,700
1896	5,286,664	228,992	155,297	202,900
1897	4,029,077	286,397	92,412	158,057
1898	4,659,649	345,685	79,309	175,810
1899	9,924,853	496,462	159,459	294,615
1900	24,384,393	441,554	221,684	267,000
1901	15,335,513	522,778	260,105	246,685
1902[2]	23,989,227	905,857	478,989	347,472

[1] Not reported. [2] Census figures.

Iron ore.—The Minnesota iron mines thus far developed are in the Mesabi and Vermilion ranges in St. Louis county, and lie about 100 miles north of Duluth. They are about 20 miles apart and extend in an easterly and westerly direction, with the ore deposits scattered along the ranges in groups at irregular intervals; and thus, besides being very narrow, as compared with their length, the ore belts are composed of nonproductive reaches for miles, with occasional groups of rich mines. The ore, confined to red hematite variety, is soft, sometimes yielding 67 per cent of iron, and so low in phosphorus as to come within the Bessemer limit.

The occurrence of iron ore of the azotic system in northern Minnesota was first mentioned in 1850, but no particular importance was ascribed to this ore.[1] H. H. Eames, state geologist of Minnesota in 1865 and 1866, was the first to observe and report iron ore on both the Vermilion and Mesabi ranges and to consider it of any value.[1]

The first iron ore was shipped from the Vermilion range in 1884 and from the Mesabi range in 1892. The total production for 1884 amounted to 62,122 tons. In 1889, with a production of 864,508 tons, the state ranked fifth among the iron ore producing states, while in 1902, with a production of 15,137,650 tons, it ranked first; Michigan second, with 11,135,215 tons; and Alabama third, with 3,574,474 tons. With the exception of Great Britain and the German Empire no country in the world has reached so great a production in any year as Minnesota. Much the greater part of the ore produced goes to furnaces in Pennsylvania, New York, and Ohio, comparatively little being consumed in the state.

The state has adopted the system of leasing its iron lands, and a royalty of 25 cents per ton is imposed on all iron ore mined and shipped from state lands. To the end of the fiscal year ending July 31, 1902, the state had received in royalties on iron ore actually shipped a total sum of $332,119.02.[2]

The following table shows the yearly production of iron ore in Minnesota from 1884 to 1902, inclusive, the figures being taken from the reports of the United States Geological Survey:

TABLE 4.—*Annual production of iron ore: 1884 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1884	62,122	1894	2,968,463
1885	227,075	1895	3,866,453
1886	307,948	1896	4,283,880
1887	394,910	1897	5,601,429
1888	511,953	1898	5,963,509
1889	864,508	1899	8,161,289
1890	891,910	1900	9,834,399
1891	945,105	1901	11,109,537
1892	1,255,465	1902	15,137,650
1893	1,499,927		

[1] Geological and Natural History Survey of Minnesota, Vol. IV., page 583.

[2] Report of State Auditor, 1901–2.

Limestones and dolomites.—The state has extensive deposits of Lower Silurian limestones and dolomites. At present the only ones quarried are located in the counties of Blue Earth, Brown, Dakota, Dodge, Goodhue, Hennepin, Houston, Lesueur, Nicollet, Olmsted, Ramsey, Rice, Washington, and Winona. During 1902, 77 quarries were operated, the value of their product being $905,857, while in 1901 the value of the product from the operating quarries was $522,778. Kasota stone, or pink limestone, which is found in the quarries at Kasota and Mendota, Lesueur county, is much admired and highly valued. Other limestones quarried are usually buff, light blue, or drab in color.

The two cement producing operators, data concerning whose plants are included with limestones and dolomites, manufactured nothing but natural rock cement.

Sandstones and quartzites.—The 13 quarries operating in 1902, in the counties of Carlton, Lac qui Parle, and Pine, produced a product valued at $347,472, while the product of the quarries operated in 1901 amounted to $246,685. The red sandstones of Fond du Lac are the most valuable in the state and closely resemble the Connecticut brownstone, though harder and firmer. These quarries were not operated during the year covered by this report.

Granites.—More than half the state is underlaid by the crystalline class of rocks to which granite belongs. There are large exposures of granite in the northern part of the state which are practically of little value because of their inaccessibility. Those in the southern and western part are of more importance. The first quarry was operated in 1868 in Sherburne county. Minnesota granites are both red and gray in color and vary as to fineness of their grain.[3]

The value of the product from the 27 granite quarries operating in 1902 was $478,989. These quarries were located in Benton, Bigstone, Lac qui Parle, Redwood, Renville, St. Louis, Sherburne, and Stearns counties.

Precious stones.—The value of the catlinite, or red pipestone, quarried in Pipestone county in 1902 was $2,000. This is found nowhere else in the world; is blood red, easily carved, and susceptible of a dull polish. It is famous on account of its earlier use by the Indians for pipes and ornaments.[4]

The value of the output of chlorastrolite, a nonhomogeneous metal found along the shores of Lake Superior, was $4,000; that of agate, found in the sand and gravel around the city of St. Paul, $1,000, and that of mesolite, $1,000.

[3] Stones for Building and Decoration, by George P. Merrill, page 72.

[4] King's Handbook of the United States, page 427.

MISSISSIPPI.

There was no mining on a commercial scale in Mississippi in 1902. The clay deposits, which are widely distributed, have been utilized to some extent for brick.[1] Gypsum, probably the most important deposit of which is located near Cato in Rankin county, has been worked in former years, as have also the gypseous marls, for local use only, of southern Carroll, Attala, Leake, Holmes, northern Madison, Hinds, Rankin, and Scott counties. There was also some development in former years of the hydraulic limestone outcroppings at points in Tishomingo county.[2] Marls and phosphates are found extensively in many counties of the state, and they have been worked to some extent to supply local needs.[1] These phosphates and marls are of great value, and there appears no reason why they should not be developed on a commercial scale.[3]

[1] The New International Encyclopedia, Vol. XII, page 397.
[2] The United States Geological Survey, "Mineral Resources of the United States," 1882, page 698.
[3] Ibid., 1886, page 618.

Sandstones of gray and light buff color occur in Jefferson, Rankin, and Tishomingo counties. This stone, samples of which were exhibited at the New Orleans exposition in 1884–85, is fine grained but rather soft and friable and of doubtful durability as a building stone.[4] Common limestone suitable for local use is found in many sections of the state.[5]

Coal has been found in the vicinity of Alexander, but no production of this mineral has been reported.[6]

Carbonate of iron ores occur over a considerable area in the northern part of the state, and surface conditions indicate that their commercial exploitation is practicable.[7]

[4] Stones for Building and Decoration, by George P. Merrill, page 146 ff.
[5] The Universal Cyclopedia, Vol. 8, page 169.
[6] The United States Geological Survey, "Mineral Resources of the United States," 1891, page 260.
[7] Ibid., 1887, page 48 ff.

MISSOURI.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of Missouri for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Lead and zinc ore.	Coal, bituminous.	Limestones and dolomites.	Siliceous crystalline rocks.	Clay.	Iron ore.	All other minerals.[1]
Number of mines, quarries, and wells	1,045	374	384	142	11	25	34	75
Number of operators	973	374	345	136	9	25	27	57
Salaried officials, clerks, etc.:								
Number	1,438	777	420	155	16	20	15	35
Salaries	$1,233,811	$727,021	$325,147	$129,291	$11,614	$10,115	$14,766	$15,857
Wage-earners:								
Average number	15,351	6,612	6,501	1,434	179	120	148	357
Wages	$8,757,367	$3,691,923	$3,927,158	$752,178	$104,624	$66,169	$57,475	$157,840
Contract work	$172,514	$105,877	$42,031	$14,595	.....	$77	$500	$9,434
Miscellaneous expenses	$2,118,436	$1,768,458	$250,078	$51,506	$8,256	$11,704	$3,373	$25,061
Cost of supplies and materials	$2,859,018	$2,189,461	$304,821	$262,222	$92,104	$11,123	$26,052	$33,235
Value of product	$20,284,656	$12,555,580	$5,374,642	$1,697,139	$157,708	$134,862	$106,379	$258,346

[1] Includes operators as follows: Barytes, 28 (34 mines); cement, 1; infusorial earth, tripoli, and pumice, 2; mineral pigments, crude, 2; natural gas, 9 (13 wells); nickel and cobalt, 1; petroleum, 2 (10 wells); sandstones and quartzites, 10; sulphur and pyrite, 2.

In the production of zinc Missouri ranks first, the mines in the far southwestern portion of the state yielding a large annual output, and in the central, southeastern, and southwestern parts of the state lead is found in great quantities. Bituminous and cannel coal underlie some 26,000 square miles of the area of the state, being a continuation of the Iowa Coal Measures. The iron fields in the southeastern part of the state produce the red and brown hematite varieties of ore. Quarries of brown, red, and buff sandstone; white, red, and colored marble, hydraulic and Portland cement, rock slate, gypsum and limestone also exist.[1] By virtue of its extensive clay deposits the state ranked seventh in 1902 among the states in the value of its product of clay. Over one-half the output of barytes in the United States is quarried in Missouri.

In addition to the minerals shown in the foregoing table the following minerals are found in this state, but were not produced in commercial quantities in 1902: Gold, gypsum, manganese ore, marble, mica, sandstone, slate, and silver.

In 1902 there were 27 operators who reported active mines but no production, the work being confined to the care and development of the properties. These operators employed an average of 67 wage-earners and paid $43,213 in wages during the year. The salaried officials, clerks, etc., received $10,220, the contract work amounted to $12,149, the miscellaneous expenses to $3,225, and the cost of supplies and materials to $22,352.

[1] King's Handbook of the United States, page 149.

The value of the products of the manufacturing industries of Missouri in 1900, based primarily upon the products of mines and quarries, is shown in the following table, which also shows the total value of all manufactured products in the state, as reported at the Twelfth Census:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$385,492,784
Based upon products of mines or quarries:		
Chemicals and allied products	$6,364,080	
Clay, glass, and stone products	8,533,017	
Iron and steel and their products	27,183,664	
Metals and metal products, other than iron and steel	15,876,274	
Miscellaneous industries	23,002,140	
		80,959,175
All others		304,533,609

From the foregoing table it will be seen that the value of the products of the manufacturing industries, based primarily upon the products of mines and quarries, was $80,959,175, or 21 per cent of the total manufactures reported for 1900. The value of the output of the productive mines, quarries, and wells in Missouri for 1902 was $20,284,656, or 5 per cent of the combined value of the mineral products of 1902 and the manufactured products of 1900.

The Twelfth Census reported the average number of wage-earners engaged in manufactures in Missouri as 134,975 and the wages paid as $60,719,428. The average number engaged in mining in 1902 was 15,351, and the wages paid amounted to $8,757,367. Employ-

ment was therefore given by the two industries to 150,326 wage-earners, who received $69,476,795 in wages. Of these totals, manufactures employed 89.8 per cent of the wage-earners and paid 87.4 per cent of the wages, while mining gave employment to only 10.2 per cent of the wage-earners and paid 12.6 per cent of the wages.

The following table shows the value of the annual production of the principal minerals except lead ore, separate values for which can be obtained only for 1900 and 1901, when the production amounted to $3,726,202 and $4,849,595, respectively:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Zinc ore.[1]	Coal, bituminous.	Limestones and dolomites.	Siliceous crystalline rocks.	Iron ore.	Clay.
1890	$2,256,583	$3,382,858	$1,859,960	$500,642	$561,041	(2)
1891	2,673,063	3,283,242	1,400,000	400,000	(2)	(2)
1892	2,862,475	3,369,659	1,400,000	325,000	237,827	(2)
1893	2,245,028	3,562,757	861,563	388,803	160,532	(2)
1894	1,337,910	2,634,564	578,802	298,757	105,235	(2)
1895	1,707,665	2,651,612	897,318	128,987	16,968	(2)
1896	1,831,856	2,518,194	802,968	107,710	12,800	(2)
1897	1,706,948	2,887,884	1,018,202	97,857	600	$201,001
1898	2,927,321	2,871,296	735,275	78,423	[3]123,345	238,982
1899	5,974,624	3,591,945	977,399	151,688	42,203	375,400
1900	5,711,631	4,280,328	1,070,343	139,103	62,745	247,204
1901	5,308,671	4,707,164	1,362,272	95,806	33,742	295,333
1902	7,052,819	5,374,642	1,697,139	157,708	106,379	134,862

[1] Values taken from the Fifteenth Annual Report of State Mine Inspector.
[2] Not reported separately.
[3] Includes value of accumulated ores.

Lead and zinc ore.—The principal lead and zinc ore producing districts of Missouri are the southeastern, central, and southwestern. In the southeastern district, including the counties of Jefferson, Madison, St. Francois, and Washington, where lead alone is produced, the ores occur in the older Paleozoic limestones and have very little zinc associated with them. They are disseminated in small grains through the solid limestone, and to distinguish between them and the concentrated ores of the southwest they are called disseminated ores.[1] In the central district but little has been done toward developing lead ore mining. In the southwestern region, commonly known as the Joplin district, which extends into the adjoining corners of Arkansas, Indian Territory, and Kansas, the lead ores occur in connection with zinc, and are found in crevices and cavities in irregular deposits, but at the present time the production of zinc ore in this district is far greater than that of lead.

In 1705 an expedition prepared by the governor of Louisiana ascended as far north as the mouth of the Kansas river in search of precious metals.[2] The celebrated Mine La Motte was discovered in 1715 by M. de la Motte Cadillac.[3] In 1719 the Sieur de Lochon commenced mining on the Meramec river, but with little success.[2] In June, 1721, Sieur Renault, superintendent of the Meramec mines, discovered the mine Renault, which he continued to work until 1742.[2] Work was not again resumed here until the nineteenth century. In 1763 Francis Burton discovered the rich mines now known as the Potosi mines.[2] The first regular shaft was sunk in the Meramec or southeastern district in 1798,[2] and this district has since continued to be a large producer of lead ore.

The lead and zinc ore deposits of southwestern Missouri were discovered in 1851,[4] since which time they have been continuously worked, with the exception of an interruption during the Civil War. In 1872[4] the zinc ore, associated with the lead found in this district, began to attract attention, and has now become more important than the lead ore.

In 1902, only lead ore was produced in Douglas, Franklin, Madison, Miller, Morgan, and St. Francois counties; only zinc ore was produced in Howell, Ozark, and Wright counties; and both ores were produced in Benton, Cole, Greene, Jasper, Jefferson, Lawrence, Moniteau, Newton, and Washington counties.

St. Francois county is the largest producer of lead ore in Missouri; in 1902 its output was 83,401 short tons, valued at $3,584,307, about 67 per cent of the total lead ore production of the state for 1902. Of the 8 operators in this county, 7 had each an output valued in excess of $100,000 and 1 in excess of $1,000,000. Jasper and Newton counties are also very large producers of lead and zinc ores, 39 mines each exceeding $50,000 in value of output.

The following table shows the annual production of lead and zinc ores in Missouri to the present time:

TABLE 4.—*Annual production of lead and zinc ore: 1873 to 1902.*

YEAR.	Zinc ore (short tons).[1]	Lead ore (short tons).[2]	YEAR.	Zinc ore (short tons).[1]	Lead ore (short tons).[2]
1873	960	13,840	1888	61,550	22,610
1874	5,100	15,160	1889	82,357	31,590
1875	3,600	16,480	1890	100,248	28,840
1876	11,300	22,550	1891	123,752	31,000
1877	10,000	24,680	1892	131,488	32,260
1878	12,000	23,112	1893	108,591	(3)
1879	20,000	22,386	1894	89,150	(3)
1880	27,500	24,850	1895	101,294	(3)
1881	35,500	25,630	1896	92,754	(3)
1882	34,900	28,870	1897	93,148	(3)
1883	35,700	18,390	1898	139,668	(3)
1884	43,200	14,330	1899	181,430	(3)
1885	42,200	20,916	1900	186,293	[4]78,538
1886	48,400	22,780	1901	224,074	[4]109,376
1887	57,300	16,720	1902[4]	240,057	124,537

[1] Figures from Annual Report State Mine Inspector, 1901, pages 15 and 169.
[2] Figures to 1893 from The Mineral Industry, Vol. II, 1893, page 387.
[3] Not reported separately.
[4] Census figures.

Coal.—The Coal Measures of Missouri, comprising an area of about 22,995 square miles,[5] are part of the Western Interior coal field, which also includes Iowa, Kansas,

[1] The Mineral Industry, 1894, Vol. III, page 405.
[2] Geological Survey of Missouri, 1873–74, Vol. 1, pages 11 and 12.
[3] Sixteenth Annual Report, State Mine Inspector of Missouri, 1902, page 146.
[4] The Mineral Industry, 1893, Vol. II, page 388.
[5] Geological Survey of Missouri, 1872, Part II, page 5.

and Nebraska. Some cannel coal is mined, but the bituminous greatly predominates.

It is probable that very little coal was mined in Missouri before 1840,[1] when the earliest reports of production were made. As the state suffers from the disadvantage of being surrounded by other coal producing states whose product can be mined more cheaply, it has to depend very largely upon local markets, and any increased production should therefore be considered as indicating a growth in local population and industry.

Coal production was reported in 1902 from 33 counties, with a total of 384 mines. Macon county produced the greatest quantity, 1,064,726 short tons; Lafayette was next with a production of 543,801 short tons, and Randolph third with 424,167 short tons.

The following table, from the 1902 report of the United States Geological Survey, shows the annual coal production in the state to date:

TABLE 5.—*Annual production of coal, bituminous: 1840 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

Year.	Short tons.	Year.	Short tons.	Year.	Short tons.
1840	9,971	1861	300,000	1882	2,240,000
1841	12,000	1862	320,000	1883	2,520,000
1842	15,000	1863	360,000	1884	2,800,000
1843	25,000	1864	375,000	1885	3,080,000
1844	35,000	1865	420,000	1886	1,800,000
1845	50,000	1866	450,000	1887	3,209,916
1846	68,000	1867	500,000	1888	3,909,967
1847	80,000	1868	541,000	1889	2,557,823
1848	85,000	1869	550,000	1890	2,735,221
1849	90,000	1870	696,562	1891	2,674,606
1850	100,000	1871	725,000	1892	2,733,949
1851	125,000	1872	784,000	1893	2,807,442
1852	140,000	1873	784,000	1894	2,245,039
1853	160,000	1874	789,080	1895	2,372,393
1854	175,000	1875	840,000	1896	2,331,542
1855	185,000	1876	1,008,000	1897	2,665,626
1856	200,000	1877	1,008,000	1898	2,688,321
1857	220,000	1878	1,008,000	1899	3,026,814
1858	240,000	1879	1,008,000	1900	3,540,103
1859	260,000	1880	1,680,000	1901	3,802,088
1860	280,000	1881	1,960,000	1902	3,890,154

Limestones and dolomites.—It is probable that underlying 25,000 square miles of this state there are good deposits of limestone,[2] but in 1902, of the 142 quarries in operation, only 47 had a value of product severally in excess of $10,000. The product of the largest quarries located in St. Louis county are light drab in color, and are extensively used in building.

Missouri is sixth in rank among the limestone producing states, the value of the production for 1902 being $1,697,139, an increase over 1901 of $334,867.[3]

Siliceous crystalline rocks.—Although there are almost inexhaustible quantities of granite in the northern part of Iron and Madison counties and the southern portion of St. Francois, only a few quarries are worked systematically.[2] The 11 quarries operated in 1902, all in St. Francois, Wayne, Iron, and Madison counties, produced gray and red granites of various shades. The value of the output in 1902 was $157,708; a gain of $61,902 over 1901.

Clay.—Missouri ranks seventh among the states in the value of the products of clay, which in 1902 amounted to $5,166,414. Of this, $1,832,118, or about 35 per cent, was the value of the common brick produced. The value of the raw clay produced in 1902 was $134,862.[4]

Iron ore.—There are three distinct iron ore fields in Missouri, known as the Iron Mountain, the Southwestern, and the Southeastern districts. Of these the Iron Mountain district is the most important. The first iron ore in Missouri was probably mined about 1816, in which year a small furnace for smelting iron was erected near Stouts creek, in Iron county. In 1845 the Iron Mountain and Pilot Knob region was developed.[5] Over 3,000,000 long tons of ore have been taken from Iron Mountain since its development.

The following table, compiled from the reports of the United States Geological Survey, shows the annual output of the Missouri iron mines since 1884:

TABLE 6.—*Annual production of iron ore: 1884 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1884	283,225	1894	81,926
1885	169,162	1895	12,512
1886	379,776	1896	4,535
1887	427,785	1897	600
1888	217,931	1898	[1]205,347
1889	265,718	1899	22,720
1890	181,690	1900	41,866
1891	106,949	1901	14,280
1892	118,494	1902	66,308
1893	77,863		

[1] Includes accumulated ores.

All other minerals.—The barytes mined in the state is associated for the most part with limestone, and even where this has become decomposed to some depth, leaving a residual clay-like material, the barytes has not altered. The value of the 31,334 short tons produced in 1902 by the 34 mines was $104,677. The total production for the United States amounted to 61,668 short tons, valued at $203,154.

Portland cement was first produced in Missouri in 1902, but no separate figures for either the production or the value can be shown without exposing individual operations.

The so-called "tripoli," found in Newton county, was mined by two operators in 1902. This material, which is evidently residual silica, is especially adapted for fil-

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 308.

[2] Stones for Building and Decoration, by George P. Merrill, pages 74 and 313.

[3] United States Geological Survey, "Mineral Resources of the United States," 1902, pages 696 to 699.

[4] United States Geological Survey, "Mineral Resources of the United States," 1902, page 719.

[5] Geological Survey of Missouri, 1873–74, Vol. 1, pages 15 and 16.

tering purposes and can readily be cut into any desired shape.[1] The quarries were first opened in 1872.[2]

The mineral pigments, crude, produced in the state in 1902, came from quarries located in Cape Girardeau and Ozark counties.

The 13 gas wells are in Bates, Cass, and Jackson counties. The value of the gas produced in 1902 was $2,154, while in 1889 it was $35,687.

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 881.
[2] Fifteenth Annual Report Missouri State Lead and Zinc Mine Inspector, 1901, page 164.

The only nickel and cobalt produced in the United States during 1902, except a little from North Carolina and Oregon, were as by-products from Mine La Motte, a celebrated lead mine in Madison county. The 20 tons of matte containing these metals yielded 5,748 pounds of metallic nickel and 3,730 pounds of cobalt oxide.

The 10 productive petroleum wells in 1902 were in Bates and Jackson counties.

The 2 pyrite mines were located in Crawford and Phelps counties.

MONTANA.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Montana for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Copper.	Gold and silver.	Coal, bituminous.	Precious stones.	Limestones and dolomites.	Sandstones and quartzites.	Siliceous crystalline rocks.	All other minerals.[1]
Number of mines or quarries	281	27	176	37	3	10	8	3	17
Number of operators	271	27	176	34	3	10	8	3	10
Salaried officials, clerks, etc.:									
Number	571	310	185	61	2	4	2	1	6
Salaries	$912,477	$494,415	$318,020	$80,674	$1,730	$4,091	$3,900	$1,420	$8,227
Wage-earners:									
Average number	10,589	6,388	2,278	1,587	39	91	57	21	78
Wages	$11,812,150	$7,339,773	$2,688,052	$1,516,043	$43,664	$70,078	$52,117	$26,488	$75,935
Contract work	$64,636	$40,975	$19,161	$1,000					$3,500
Miscellaneous expenses	$893,258	$456,108	$310,145	$118,693	$830	$829	$3,882	$278	$2,493
Cost of supplies and materials	$5,007,102	$3,049,127	$1,069,300	$283,930	$5,920	$8,035	$6,810	$2,583	$32,397
Value of product	$28,265,085	$20,563,363	$4,688,636	$2,443,447	$116,000	$104,725	$85,152	$77,050	$187,822

[1] Includes operators as follows: Corundum and emery, 1; flint, 1; graphite, 1 (8 mines); grindstones and pulpstones (operator reported under sandstones and quartzites); gypsum, 2; iron ore, 3; manganese ore, 1; marble, 1.

Foremost among the minerals in Montana is copper, in the production of which the state leads the world. Millions of dollars worth of gold and silver have been mined since the discovery of gold in the state in 1852. Bituminous coal in large quantities is found along the Missouri and Yellowstone rivers.[1]

Deposits of iron ore, of lead and zinc ores, of graphite and of manganese ore have been found in the state, and have been mined to a greater or less extent. The rocks of the state include granites, sandstones, marbles, and limestones in great abundance and variety. Corundum, flint, quicksilver, tin, platinum, tungsten, and stones suitable for grindstones are also found, and the Montana sapphire is well known among the precious stones.

Of the total value of the product of the mines and quarries in the state in 1902 copper ore contributed 72.8 per cent, more than four times the value of any other mineral produced.

Besides those shown in Table 1, the following minerals occur in the state, but were not commercially produced in 1902: Tin, tungsten, cinnabar, lead and zinc ores, platinum, molybdenum, clay, petroleum, and magnesia.

In addition to the active mines and quarries shown in the foregoing table, 128 operators reported development work in 129 mines and quarries, distributed as follows: Gold and silver, 126; bituminous coal, corundum and emery, and marble, 1 each. The operators employed 77 salaried officials, clerks, etc., who received $83,099, and 520 wage-earners who were paid $592,626 in wages. Contract work amounting to $65,797 gave employment to 810 employees. The total amount expended for miscellaneous expenses was $37,397, and the cost of supplies and materials was $275,796.

The value of the products of the manufacturing industries of the state in 1900, based primarily upon the products of mines and quarries, is shown in the following table, which also shows the total value of products for all manufactures in Montana:

TABLE 2.—*Manufactures based primarily upon the product of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$57,075,824
Based upon products of mines or quarries:		
Clay, glass, and stone products	$498,046	
Iron and steel and their products	1,198,309	
Metals and metal products, other than iron and steel	41,865,685	
Miscellaneous industries	1,929,032	
		45,491,072
All other		11,584,752

The total product of the industries based primarily upon the products of mines and quarries constituted 79.7 per cent of all manufacturing industries of the state in 1900. The value of the product of mines and quarries in 1902 and manufactures in 1900 amounted to $85,340,909; manufactures contributing 66.9 per cent and mines and quarries 33.1 per cent of the combined value. Manufactures in 1900 and mines and quarries in 1902 gave employment to 20,656 wage-earners and paid $19,782,036 in wages, mines and quarries employing 51 per cent of the wage-earners and paying 59.7 per cent of the wages, manufactures giving employment to 49 per cent of the wage-earners and paying 40.3 per cent of the wages.

[1] King's Handbook of the United States, page 516.

Table 3, compiled from the reports of the United States Geological Survey, shows the value of the annual production of gold, silver, coal, limestones and dolomites, and sandstones and quartzites in Montana since 1890. Values for copper ore can not be obtained.

TABLE 3.—*Value of annual production of certain minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Gold.[1]	Silver.[1]	Coal, bituminous.	Limestones and dolomites.	Sandstones and quartzites.
1890	$3,339,000	$20,363,636	$1,252,492	$24,964	$31,648
1891	2,890,000	21,139,394	1,228,630	(2)	35,000
1892	2,891,386	24,615,822	1,330,847	6,000	35,000
1893	3,576,000	21,858,780	1,772,116	4,100	42,300
1894	3,868,429	17,634,220	1,887,390	92,970	16,500
1895	4,101,400	22,715,600	2,850,906	95,121	31,069
1896	4,324,700	21,640,404	2,279,672	83,927	3,250
1897	4,373,400	20,257,487	2,897,408	37,300	25,644
1898	5,126,900	19,144,663	2,324,207	63,196	3,683
1899	4,760,100	20,810,990	2,347,757	113,718	26,160
1900	4,698,000	[3]8,801,148	2,713,707	141,093	59,630
1901	4,744,100	[3]7,879,020	2,009,316	143,866	58,439
1902[4]	4,373,600	[3]7,019,214	2,443,447	104,725	85,152

[1] Estimates by the Director of the Mint, value of the refined product; silver at coining value. The values given in Table 1 are the values at the mine.
[2] Not reported separately.
[3] Commercial value.
[4] Census figures.

Copper ore.—The city of Butte dates from the discovery in 1864 of placer mines in the Missoula gulch. The placers were in no way remarkable, being duplicated elsewhere in neighboring camps. Following the exhaustion of the auriferous gravels, came the discovery and working of silver bearing ledges in the hills, but these did not add materially to the fame of the district. The Anaconda mine and others of the great properties were bought, developed, and worked with a view to their silver values.[1]

The opening of the Anaconda as a copper mine dates from 1882. At that time the dark red and brown quartz, developed for its gold and silver values, carried only traces of copper, and it was while preparing to mill this ore that the main shaft then being sunk entered the rich copper ledge at a depth of about 300 feet. This led to other discoveries.[1]

In 1870 the Lake Superior region produced 87.2 per cent of the copper product of the country. In 1875 the Lake product constituted 89.4 per cent, and in 1880 it was over 82.2 per cent. In 1882 Montana commenced to produce and advanced steadily and rapidly until in 1887 its copper output exceeded that of the Lake Superior mines. Since that date, with the single exception of 1891, it has held first place not only among the states and territories, but as the largest copper producing district in the world.

The following table shows the annual production of copper in Montana from 1883 to 1902:

[1] Bancroft's History of the Pacific States, page 589 ff.

TABLE 4.—*Annual production of copper: 1883 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1883	11,011	1893	69,290
1884	19,250	1894	81,729
1885	30,267	1895	84,900
1886	25,362	1896	99,071
1887	35,133	1897	102,807
1888	43,704	1898	92,041
1889	43,849	1899	100,503
1890	50,437	1900	120,865
1891	50,028	1901	102,621
1892	72,860	1902	128,975

The output for 1902 was 26,354 long tons in excess of that for 1901, an increase of over 25 per cent; but the 1901 output shows a decrease of 18,244 long tons from the product of 1900, and the 1902 product only exceeds that of 1900, the greatest up to that time, by 8,110 long tons.

Gold and silver.—Although the presence of gold in this section was probably known to the missionaries, they had other motives than the gathering of precious treasures. The discovery of gold is, therefore, apparently due to Francois Finlay, a French half-breed, who had worked in the placers of California, and when returning to the vicinity of his former home, discovered fine float gold on Gold creek, in Deerlodge county, on the western slope of the Rocky mountains. He did little more than prospect the locality.[2]

Subsequently, in May, 1858, James and Granville Stuart, Thomas Adams, and Reese Anderson prospected in Gold creek, finding dirt or gravel that showed as high as 10 cents to the pan. They were forced to abandon the work, however, because of trouble with the Indians and lack of tools and provisions. In the summer of 1860 three small sluice boxes, roughly hewed out of green timber, were operated on Gold creek by Henry Thomas. This was the first actual mining in Montana. Stuart and his party had removed to the vicinity of Fort Bridger, where they lived as traders until 1860, when they returned to investigate the affluents to the valley of the Deerlodge. They prospected during 1861 and found several favorable localities, but it was not until 1862, after receiving from Wallawalla, Wash., 425 miles distant, tools and lumber, that the first string of 10 sluices was set up and worked. They had communicated the news of their discovery to a relative at Pikes Peak, as Colorado was then called, and about the 20th of June, 1862, miners began to arrive at Deerlodge in considerable numbers. The newcomers discovered the placers at Pikes Peak gulch, Pioneer gulch, etc., and from this time the immigration of gold seekers rapidly increased.[3]

[2] Mineral Resources of the United States East of the Rocky Mountains, by James W. Taylor, 1868, pages 39 and 40.
[3] Ibid., pages 39 to 51.

Alder gulch, in Madison county, was discovered in the spring of 1863 by William Fairweather, one of a party of prospectors from Bannock city. The first pan of earth yielded $1.75. Being without provisions, the party hurried back to Bannock city, and returning with friends the gulch was staked off on the 6th and 7th of June, 1863. Within less than two years Alder gulch contained five thriving towns, besides Virginia City, an incorporated city of nearly 10,000 inhabitants. This was the richest and largest "find" ever worked in Montana, and probably in the world, being nearly 20 miles in length and uniformly productive throughout the greater portion. At the head of the gulch the gold was coarse, and many nuggets were picked up varying in value from $200 to $800.[1]

The discovery of Last Chance gulch, near the site of the present city of Helena, in the summer of 1864 was the next of importance. In that summer a party of five or six men are said to have taken from one of the bars in Confederate gulch about 1,400 pounds of gold dust of a value of nearly $300,000.

In addition to the foregoing there were numerous rich diggings found both east and west of the main range. The location and working of vein mines dates from 1864. The Oro Cache lead in the summit district of Alder gulch was discovered early in that year, and work was begun on December 1 of the same year. The Whitlatch Union lead, sometimes called the Owyhee, was discovered in the winter of 1864, and work was begun the succeeding spring.[1]

The following table, compiled from various sources, shows the value of the annual gold and silver production in Montana from 1862 to 1889. The production for the subsequent years has already been given in Table 3.

TABLE 5.—*Value of annual production of gold and silver: 1862 to 1889.*

YEAR.	Gold and silver.[1]	YEAR.	Gold.	Silver.
1862	$600,000	1877	$3,200,000	$750,000
1863	8,000,000	1878	2,260,511	1,660,635
1864	16,000,000	1879	2,500,000	2,225,000
1865	18,000,000	1880	1,805,767	2,905,068
1866	17,500,000	1881	2,330,000	2,630,000
1867	12,000,000	1882	2,550,000	4,370,000
1868	15,000,000	1883	1,800,000	6,000,000
1869	9,000,000	1884	2,170,000	7,000,000
1870	9,100,000	1885	3,300,000	10,060,000
1871	8,050,000	1886	4,425,000	12,400,000
1872	6,068,339	1887	5,230,000	15,500,000
1873	5,178,047	1888	4,200,000	17,000,000
1874	3,844,722	1889	3,500,000	19,393,989
1875	3,573,600			
1876	[2]			

[1] From 1862 to 1867, inclusive, compiled from "Mineral Resources of the United States East of the Rocky Mountains," by James W. Taylor, 1868, page 52; 1868 to 1879, inclusive, from "The Mineral Industry," 1892, page 188; and 1880 to 1889, inclusive, from United States Geological Survey, "Mineral Resources of the United States," 1892, page 75.
[2] Not reported.

Coal, bituminous.—The occurrence of good steam coal accessible to the Northern Pacific system was a question of importance in the development of the mining and manufacturing interests of the Northwest. A vast amount of lignite was known and in places worked, but was so poor in quality that coal was brought from Pittsburg to mix with it. In 1881 true bituminous was known to occur in but two places in Montana, one near Bozeman canyon and the other on the summit of Mullens Pass. In that year, taking these occurrences as clews, the Bozeman outcroppings were traced several miles. Another outcrop was found for 24 miles, south of Wilkeson through the forests of the Cascade mountains, and several other less important bituminous fields were discovered. The bituminous coal field north of the forty-fifth parallel is on the west flank of the Cascade and the east flank of the Rocky mountains, the few occurrences between these ranges being insignificant.

The great plains for miles away from the mountains are underlaid with beds of lignite of inferior quality, often attaining a thickness of 7 or 8 feet. As the mountains are approached the lignite, as a rule, disappears, giving place to true bituminous, and frequently a good coking coal, though the seams are of less thickness than the lignite.[2]

The production of coal in the Bozeman field began in January, 1883, and operators in the Gardiner field, along the Yellowstone, in Gallatin county, reported their first production the same year.[3]

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of coal in Montana from 1883 to 1902:

TABLE 6.—*Annual production of coal, bituminous: 1883 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1883	19,795	1893	892,309
1884	80,376	1894	927,395
1885	86,440	1895	1,504,193
1886	49,843	1896	1,543,445
1887	10,202	1897	1,647,882
1888	41,467	1898	1,479,893
1889	363,301	1899	1,496,451
1890	517,477	1900	1,661,775
1891	541,861	1901	1,396,081
1892	564,648	1902	1,560,823

The total value of the coal product of the state in 1902 was $2,443,447, the largest value being shown for Cascade county, followed by Carbon, Park, Gallatin, Choteau, and Fergus, in the order named. Production is also reported for Deerlodge and Meagher counties, their combined product being valued at $2,012.

Precious stones.—The only systematic mining that has been undertaken for sapphires is in Montana. Sapphires were first found in this state by miners who were washing the gravels of the bars on the Missouri river for gold. These were first described in 1873, but actual mining did not begin until 1891. These bars are located from 12 to 18 miles northeast of Helena and

[1] Mineral Resources of the United States East of the Rocky Mountains, 1868, pages 39 to 51.

[2] Tenth Census, Vol. XV, pages 691 and 692.
[3] United States Geological Survey, "Mineral Resources of the United States," 1883, page 53.

have been followed from Canyon Ferry to American bar, a distance of about 12 miles. Sapphires are also found in the gravel of Maple gulch, about 1 mile above Emerald bar, the intermediate gravels being barren. These stones are for the most part of a pale green or greenish yellow color, with an occasional pink and yellow, while those approaching a red or blue color are extremely rare. Sapphire has also been found at Rock creek, Cottonwood creek, and Yogo gulch. From these deposits stones of deeper color have been obtained, those from Rock and Cottonwood creeks ranging from red to blue, and those from Yogo gulch being all blue.[1] Smoky quartz has also been found at Three Mile gulch, near Helena. A gigantic crystal weighing 93½ pounds was found on Clear creek, in Jefferson county. Montana is the chief western source of supply for the amethyst. In 1895 a crystal weighing 12 pounds was found on Granite creek, and in 1900 remarkable discoveries were made in Jefferson county about 22 miles southeast of Butte. The amethyst in this locality occurs in fine crystals curiously mingled with quartz. The amethyst itself is free from foreign substances, though occasionally parts of the same crystals are composed of tourmaline.

Besides those already named, beryl, aquamarine, garnet, chrysoberyl, white topaz, opal, agate, and moss agate are frequently found in the gold bearing gulch soils.[2]

Limestones and dolomites.—Though the occurrence of limestone is known in almost every one of the 26 counties and the Crow reservation, only 8 reported the quarrying of limestone in 1902. The largest product was shown for Cascade county and the second largest for Jefferson county, their entire production being used as blast furnace flux. Lewis and Clarke county was third, where about one-fourth of the production was used for building, more than one-half for blast furnace flux, and the remainder for flagging. Powell county was fourth, the entire production being burned into lime. The fifth county in value of product is Flathead, followed by Park, Sweet Grass, and Yellowstone in the order named. Of the total production in the state, $88,000 was used for flux; $8,775 for lime burned; $6,375 for building purposes; and the remainder for flagging and rubble.

Sandstones and quartzites.—A fine light gray sandstone, somewhat resembling the Berea, Ohio, stone, occurs in considerable abundance in Rocky canyon, Gallatin county, the formation permitting the removal of large blocks which work readily when first removed, but harden on exposure. A compact, red quartzite, found near Salesville, in the same county, and a fine, very light stone quarried near Dillon, in Beaverhead county, are coming into use.[3] Sandstone also forms one of the strata of the Coal Measures of Montana, often cleaving the coal seam and sometimes attaining a thickness of 50 feet.[4]

In 1902 Yellowstone county showed the largest production, $62,162. The amount used for building purposes was $54,430, of which $51,638 was the value of dressed stone. The other counties reporting were Cascade and Flathead.

Siliceous crystalline rocks.—A fine grained light gray granite occurs in Lewis and Clarke county, and a coarse hornblende-mica granite is found in the copper region near Butte. This latter rock is of good quality, but requires careful selection, as those portions in close proximity to the ore veins are charged with pyrite, which oxidizes on exposure. There is abundance of granite in the state, but for lack of a market quarrying is not extensive.[5] Two of the three quarries reporting in 1902 were located in Lewis and Clarke county, and the third in Jefferson county, the total output being valued at $77,050. Almost the entire production from Lewis and Clarke county was dressed for building purposes. Of the total production the value of stone for building purposes amounted to $32,600, and that used for riprap to $43,800.

All other minerals.—The property of the Montana Corundum Company, consisting of four claims and the mineral rights in 3,000 acres of land, was located in 1901. The ground upon which the corundum was discovered has been used as a stock range for nearly thirty years, and no doubt in the last ten years hundreds of people have passed over the "float" crystals without stopping to inquire their nature. A farmer and prospector exhibited, in the winter of 1900–1901, to a druggist from Hoopston, Ill., a crystal and a pocketknife, the blade of which gave evidence of the hardness of the crystal found. The druggist recognized the mineral, and after a careful search of the vicinity where the crystal was found definitely located the vein. A shaft 85 feet deep was sunk, from the bottom of which a drift was run along the vein—to the west 165 feet and to the east 72 feet. The vein thus far developed measures from 26 to 48 inches between the walls, with a pay streak varying from 14 to 42 inches in width. Numerous shafts, surface crosscuts, and pits have prospected the vein for a distance of over 1½ miles.[6]

In 1902 one flint quarry was reported as in operation near Basin, in Jefferson county, the entire production being sold crude as a flux in metallurgical operations.

[1] Bureau of Agriculture, Eighth Biennial Report, 1902, "Labor and Industry of Montana," pages 312 to 320.
[2] History of the Pacific States, by Hubert H. Bancroft, Vol. XXVI, page 598.
[3] Stones for Building and Decoration, by George P. Merrill, page 148.
[4] Bureau of Agriculture, "Labor and Industry of Montana," 1901–2, page 376 ff.
[5] Stones for Building and Decoration, page 75.
[6] Bureau of Agriculture, Eighth Biennial Report, "Labor and Industry of Montana," page 443.

Prior to 1887 a deposit of graphite was discovered in Van Camps canyon, 18 miles from Dillon, but it was not systematically developed until 1901. The vein is a true fissure, and varies in width from 12 inches to a few feet. The ore has been tested and declared equal to the best grades imported from Ceylon.[1]

The sandstone quarries at Columbus, Yellowstone county, reported a portion of their product as manufactured into grindstones. It is a fine even-grained sandstone, and produces an article equal to the well-known Berea grindstone.[2]

Gypsum was discovered in 1893, in Carbon county, 8 miles from Bridger, the nearest railroad station, which is 29 miles from Billings on the main line of the Northern Pacific. Active development began in 1894, and in spite of the long haul by wagon the gypsum has been placed in successful competition with the eastern product. The deposit, from 2 to 10 feet thick, lies almost flat, about 30 feet below the surface of the ground. In 1900 another quarry was opened in Cascade county; the gypsum vein is about 16 feet thick and lies flat under several feet of limestone. The mill of this plant is located on a branch of the Montana Central Railway; the mine being directly back and up the hill, gravity is largely helpful in handling the rock.[3]

The work of the Northern Transcontinental Survey proved the existence of extensive deposits of iron ore in the mountain region of Montana. Notable among these is a mass of magnetic ore on East Boulder creek, Gallatin county, and on Cable mountain in Deerlodge county. The ore from the latter locality will average from 55 to 60 per cent metallic iron, is low in phosphorus and sulphur and practically free from titanium.[4]

In previous years the state has been comparatively unimportant as far as the production of manganese ore is concerned. In 1902, 9,000 tons of ore were mined, and stocked at the mines, from two deposits in Jefferson county. Analysis of the ore is said to show 45 per cent and over of manganese. It would also be valuable as a flux.[5]

About 5 miles southwest of the city of Helena a vast ledge of marble containing several grades of this mineral has been located.

[1] Bureau of Agriculture, Eighth Biennial Report, "Labor and Industry of Montana," page 467.
[2] Ibid., page 465.
[3] Bureau of Agriculture, Eighth Biennial Report, "Labor and Industry of Montana," page 461.
[4] Tenth Census, Vol. XV, page 472.
[5] United States Geological Survey, "Mineral Resources of the United States," 1902, page 141.

NEBRASKA.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Nebraska for 1902.

TABLE 1.—*Summary: 1902.*

	All minerals.[1]
Number of mines or quarries	36
Number of operators	35
Salaried officials, clerks, etc.:	
Number	12
Salaries	$8,001
Wage-earners:	
Average number	178
Wages	$95,935
Miscellaneous expenses	$2,790
Cost of supplies and materials	$11,173
Value of product	$148,391

[1] Includes operators as follows: Infusorial earth, tripoli, and pumice, 1 (2 quarries); limestones and dolomites, 33; sandstones and quartzites, 1.

Of chief importance among the natural resources of Nebraska are its rocks of various kinds and qualities. Sandstone, chalk rock, limestone, and magnesia rock abound. Fire and mineral clays are of extensive occurrence in the northern counties, and a fuller's earth of superior quality was discovered in Cherry county a few years ago.[1] Bituminous and lignite coal underlie the eastern counties and the valley of the Republican river.

These beds furnish fuel for local use, but up to the present time the deposits have not been worked commercially.[2]

Table 2 shows the value of the products of the manufacturing industries of Nebraska, based primarily upon minerals mined and quarried, as well as the value of all manufactured products of the state, as reported at the census of 1900.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$143,990,102
Based upon products of mines or quarries:		
Chemicals and allied products	$954,849	
Clay, glass, and stone products	1,365,120	
Iron and steel and their products	1,012,286	
Metals and metal products, other than iron and steel	24,671,289	
Miscellaneous industries	4,097,761	
		32,101,255
All other		111,888,847

From the foregoing table it will be seen that the value of the products of manufactures, based primarily upon minerals mined and quarried, was $32,101,246, or 22.3 per cent of the total. The value of the output of the mines and quarries of Nebraska in 1902 was $148,391, or about one-tenth of 1 per cent of the value of all its manufactured products in 1900.

The average number of wage-earners engaged in manufactures in Nebraska in 1900, as reported at the Twelfth Census, was 24,461, and the wages paid them amounted to $11,570,688. The average number of wage-earners engaged in mining and quarrying in 1902 was 178, and the wages paid them amounted to $95,935. The combined figures give 24,639, as the number of wage-earners, and $11,666,623 as the wages paid in the combined industries. Manufactures employed 99.3 per cent of the wage-earners, and paid 99.2 per cent of the wages; while mines and quarries employed only seven-tenths of 1 per cent of the wage-earners and paid eight-tenths of 1 per cent of the wages.

Limestones and dolomites.—The carboniferous limestone of this state is suitable for building, as is also the siliceous limestone found in Sarpy county.[3]

The 33 quarries operating in 1902, all of them in Cass, Cheyenne, Furnas, Gage, Greeley, Johnson, Nemaha, Sarpy, and Thayer counties, had an output valued at $145,473. Of this amount $69,330 was reported from Cass county, $34,237 from Gage, and $22,795 from Nemaha.

The following table, compiled from the reports of the United States Geological Survey, shows the annual value of limestone quarried in Nebraska from 1890 to 1902:

TABLE 3.—*Value of annual production of limestones and dolomites: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Value.	YEAR.	Value.
1890	$207,019	1897	$42,359
1891	175,000	1898	78,493
1892	180,000	1899	125,017
1893	158,927	1900	107,305
1894	8,228	1901	154,717
1895	7,376	1902[1]	145,473
1896	10,655		

[1] Census figures.

The production of the two pumice quarries and of the single sandstone quarry can not be shown without disclosing individual operations.

[1] Nebraska's Resources, by George W. Hervey, page 6.
[2] King's Handbook of the United States, page 526.
[3] Stones for Building and Decoration, by George P. Merrill, page 315.

NEVADA.

Table 1 is a summary of the statistics for the productive mines and quarries in Nevada for 1902.

TABLE 1.—*Summary: 1902.*

	Total.	Gold and silver.	Sandstones and quartzites.	All other minerals.[1]
Number of mines or quarries	114	104	3	7
Number of operators	121	104	3	14
Salaried officials, clerks, etc.:				
Number	146	136	.....	10
Salaries	$222,098	$210,838	.....	$11,260
Wage-earners:				
Average number	1,132	1,075	2	55
Wages	$1,205,565	$1,162,337	$1,583	$41,645
Contract work	$7,944	$7,944	.....	.....
Miscellaneous expenses	$177,355	$172,206	$351	$4,798
Cost of supplies and materials	$923,457	$599,928	$250	$23,279
Value of product	$3,518,430	$3,409,348	$6,115	$102,967

[1] Includes operators as follows: Borax, 1; copper ore, 1; gypsum, 1; limestones and dolomites, 1; precious stones, 8 (1 mine); siliceous crystalline rocks, 1; sulphur and pyrite, 1.

The discovery and development of mineral deposits, especially that of the Comstock lode, is responsible for the settlement and indeed the very existence of Nevada, and the history of mining is therefore to a great extent the history of the state.[1] Until the news of precious metal discoveries and the consequent influx of prospectors, Nevada was largely a desert wilderness, invaded only by missionaries and a few dauntless exploring parties. The early history is to a certain extent identified with that of Utah, Arizona, portions of Colorado, Wyoming, Oregon, and northern California,[2] and it was not until March 2, 1861, that the confines were fully established and Nevada took position as a recognized territory, advancing to statehood October 31, 1864.

Certain minerals occur in considerable quantities in various portions of the state, for which no commercial production was shown for 1902. Among the most important of these are barytes (heavy spar), found in Humboldt county; coal in the form of lignite, in Esmeralda county; cinnabar, the ore containing quicksilver, near Steamboat, in Washoe county; graphite or plumbago and magnetic iron ore (magnetite), in Humboldt county; iron ore (hematite), in Elko and Churchill counties; iron sulphuret (pyrite), in Lander and many other counties; cerussite (lead carbonate) and galenite, in Eureka county; pyrolusite or manganese dioxide, at Dun Glen and near Golconda, in Humboldt county; and roofing slate, in Esmeralda county.

In addition to the productive mines and quarries in Table 1, development work, confined to gold and silver, was reported by 82 operators. During 1902 these operators employed 574 wage-earners and paid $656,169 in wages. The 142 salaried officials, clerks, etc., received $181,172; the contract work amounted to $27,133; the miscellaneous expenses to $70,435; and the cost of supplies and materials to $454,077.

The manufacturing industries of a state depend somewhat upon the character of its mineral deposits, some of the most important manufactured products being based primarily upon materials obtained in mines and quarries. The following table will illustrate the extent to which this is true of Nevada:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures	.....	$1,643,675
Based upon products of mines or quarries:		
Chemicals and allied products	$20,950	
Clay, glass, and stone products	52,350	
Metals and metal products, other than iron and steel	108,184	
Miscellaneous	139,876	
		321,360
All other	.....	1,322,315

As shown in Table 2, the manufactured products based upon the product of mines and quarries form about one-fifth of the entire product of manufactures reported in 1900. During the same year there were employed in all branches of manufactures in the state 601 wage-earners, who were paid $416,732 in wages. In 1902 there were employed in the mines and quarries of the state 1,132 wage-earners, who received $1,205,565 in wages. Comparing these two branches of industry, it is disclosed that 34.7 per cent of the wage-earners of the combined industries, receiving 25.7 per cent of the wages, were employed in manufacturing, while 65.3 per cent of the wage-earners, receiving 74.3 per cent of the wages, were employed in mining.

Gold and silver.—In 1902 Nye county was first in precious metal production, the Tonapah mining district taking rank as the principal mining center of the state. Storey county is second in importance with its famous

[1] History of Nevada, by Hubert H. Bancroft, page 92.
[2] Ibid., page 66.

Comstock lode, while Lincoln county, which stood first in gold and silver production in 1901, has now dropped to third place. Eureka and Elko counties are respectively fourth and fifth in rank and both show an increased production, still retaining their former relative positions among the gold and silver counties of the state. In the order of their reported production may also be mentioned Lyon, White Pine, Lander, Washoe, Humboldt, Esmeralda, Ormsby, Churchill, and Douglas counties.[1]

The following table, compiled from the reports of the Director of the United States Mint, shows the annual production of gold and silver from 1890 to 1902:

TABLE 3.—*Annual production of gold and silver: 1890 to 1902.*

[Reports of the Director of the Mint.]

YEAR.	GOLD.[1]		SILVER.[1]	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Coining value.
1890	135,450	$2,800,000	4,450,000	$5,753,535
1891	99,169	2,050,000	3,520,000	4,551,111
1892	76,021	1,571,500	2,244,000	2,901,333
1893	46,367	958,500	1,561,300	2,018,651
1894	55,042	1,137,819	1,035,151	1,338,377
1895	75,088	1,552,200	956,200	1,236,200
1896	119,404	2,468,300	1,048,700	1,355,895
1897	143,983	2,976,400	1,228,900	1,588,881
1898	144,859	2,994,500	805,000	1,040,898
1899	107,343	2,219,000	843,400	1,090,457
1900	97,050	2,006,200	1,358,700	[2]842,394
1901	143,374	2,963,800	1,812,500	[2]1,087,500
1902	140,059	2,895,300	8,746,200	[2]1,985,486

[1] Estimates of the Director of the Mint for refined product. The values given in Table 1 are the values at the mine.
[2] Commercial value.

As seen from Table 3, the production of gold during 1898 was greater than that of any other year shown, and the product during 1897, 1898, and 1901 was slightly more than that reported for 1902. Both the quantity and value of silver produced in 1902 were greater than for any other year since 1890, in which year and in earlier years a larger production is reported. The smallest production of gold was reported in 1893 and of silver in 1898.

Gold was discovered in Nevada in Gold canyon, near Dayton, by Abner Blackburn, in July, 1849.[2] In the same year an immigrant named Hardin discovered silver in the Black Rock range, in Humboldt county.[3] Other placer and quartz mines were located in various parts of what is now Nevada, but Gold Canyon was the only district worked prior to 1857. The Comstock lode of gold and silver ore was discovered June 11, 1859, and from this time on the mining interests of Nevada have been a matter of brilliant history.[4]

The gold hunters, working up the ravines from Gold canyon and Six Mile canyon, in 1859 came across what is known as the "Comstock lode," so named for Henry Comstock, one of the claim locators. This famous channel of silver and gold ore is about 3 or 4 miles long and a quarter of a mile wide, and extends nearly north and south along the eastern slope of Mt. Davidson, principally in Storey county, at a distance of about 20 miles from the California boundary. At first the ore in the Comstock lode was worked for gold alone, but later the black metallic substance occurring so persistently in connection with the gold was discovered to be a rich sulphuret of silver.[5]

From that time on until 1877 this locality was increasingly productive. During the bonanza years—1873 to 1877—the value of the ore produced each month ranged from about $2,000,000 to $3,000,000.

The following table, compiled from the reports of the Director of the Mint, shows the quantity and value of the annual production of gold and silver from the Comstock lode district from 1859 to 1902:

TABLE 4.—*Annual production of gold and silver in the Comstock lode district: 1859 to 1902.*

[Reports of the Director of the Mint.]

YEAR.	TOTAL.		Silver.	Gold.
	Quantity (tons of ore).	Value.		
1859		$30,000.00		$30,000.00
1860	10,000	750,000.00	$200,000.00	550,000.00
1861	140,000	3,500,000.00	1,000,000.00	2,500,000.00
1862	250,000	7,000,000.00	2,350,000.00	4,650,000.00
1863	450,000	12,400,000.00	7,460,000.00	4,940,000.00
1864	680,450	16,000,000.00	9,600,000.00	6,400,000.00
1865	430,745	15,833,720.00	9,700,232.00	6,133,488.00
1866	640,282	14,907,895.00	8,944,737.00	5,963,158.00
1867	402,176	13,738,608.00	8,243,164.80	5,495,443.20
1868	300,560	8,479,769.00	5,087,861.40	3,391,907.60
1869	279,584	7,405,578.00	4,443,346.80	2,962,231.20
1870	238,967	8,704,325.40	5,222,595.24	3,481,730.16
1871	400,718	10,249,528.65	6,149,717.19	4,099,811.46
1872	384,668	12,236,399.65	7,341,839.79	4,894,559.86
1873	448,301	21,671,980.53	13,003,187.13	8,668,793.40
1874	520,742	22,476,785.15	13,486,071.09	8,990,714.06
1875	546,425	25,825,521.54	15,495,312.92	10,330,208.62
1876	598,818	31,618,000.20	18,971,196.12	12,647,464.08
1877	562,519	36,301,536.70	21,780,922.02	14,520,614.68
1878	272,909	19,661,394.11	11,796,836.47	7,864,557.64
1879	178,276	7,003,485.82	4,202,091.49	2,801,394.33
1880	172,399	5,129,015.00	3,077,409.00	2,051,606.00
1881	76,049	1,075,620.00	645,372.00	430,248.00
1882	90,181	1,743,404.00	1,046,078.40	697,325.60
1883	125,914	2,006,348.83	1,203,809.29	802,539.54
1884	188,369	2,838,752.00	1,577,488.40	1,261,313.60
1885	226,147	3,144,602.29	1,415,071.04	1,729,531.25
1886	238,780	3,736,218.46	1,681,298.31	2,054,920.15
1887	223,682	4,611,230.63	2,030,053.78	2,481,176.85
1888	271,152	7,627,267.73	4,458,058.66	3,169,209.07
1889	286,144	5,949,923.27	3,358,949.95	2,590,973.32
1890	286,075	4,980,872.59	2,988,523.56	1,992,349.03
1891	188,647	3,462,142.55	2,071,285.53	1,380,857.02
1892	133,678	2,173,247.63	1,130,088.77	1,043,158.86
1893	109,780	1,872,104.24	748,841.70	1,123,262.54
1894	97,049	1,281,467.72	512,587.09	768,880.63
1895	63,558	914,789.47	365,915.79	548,873.68
1896	39,240	567,088.93	226,835.57	340,253.36
1897	17,850	373,014.39	149,205.76	223,808.63
1898	10,706	205,039.81	82,015.92	123,023.89
1899	6,780	171,677.90	68,671.16	103,006.74
1900	35,300	700,865.26	319,441.70	381,423.56
1901	56,577	1,267,509.00	521,032.00	746,477.00
1902	96,490	1,280,975.55	495,944.96	785,030.59
Total	10,851,748	352,798,425.00	204,653,039.80	148,145,385.20
Total mill tailings		18,449,863.16		
Grand total		371,248,288.16		

From 1877 to 1900 a decreasing production indicated that the rich ore body was probably becoming exhausted. The increased production shown for 1901 and 1902 is largely due to the introduction of improved electrical machinery.

[1] Annual Report of the Director of the Mint, 1902, page 152.
[2] Harper's Encyclopedia, Vol. IX, page 434.
[3] History of Nevada, page 103.
[4] Ibid., pages 94 and 95.
[5] Report of the Director of the Mint, 1900, page 155

The Sutro tunnel, projected by Adolph Sutro in 1869 and finished in 1879, is nearly 4 miles long, extending from the low hills bordering Carson river valley westward to the Comstock lode. The chief objects of the tunnel were to improve the drainage and ventilation and facilitate the working of the Comstock lode, and for this service all the mining companies pay a royalty. This tunnel has been principally valuable in drainage, and without it certain of the deep workings of the lode could not have been operated successfully on account of the flooding of the lower levels of the mines.

Quartz and porphyry are generally the accompanying vein matter met with in the Comstock lode, the gangue carrying the precious metals being quartz and the inclosing walls a diorite or syenite on the west and on the east a porphyrite or trachyte formation, seamed with quartz and clay. The ore obtained, both gold and silver, is free milling and is not refractory with foreign mineral complications.[1]

The rich deposit of precious metals in the Tonapah mining district in the north central portion of Nye county, near Mt. Oddie, was discovered in April, 1900, by James L. Butler, and in August of the same year he located the eight claims now forming the regular Tonapah group. A plan of leasing the ground in small sections on a 25 per cent royalty was adopted by Mr. Butler and a considerable quantity of ore was extracted on this basis.[2]

The following table, compiled from the reports of the Director of the Mint, shows the quantity of the production of ore, and the value of its precious metal contents, in the Tonapah district for 1901 and 1902:

TABLE 5.—*Annual production of gold and silver in the Tonapah district: 1901 and 1902.*

[Reports of the Director of the Mint.]

YEAR.	TOTAL.		Silver.[1]	Gold.
	Quantity (tons of ore).	Value.		
1901	2,594	$576,146	$374,110	$202,036
1902	11,258	1,798,129	1,234,271	558,858

[1] Commercial value.

Prior to January, 1902, the work done was altogether individual, but in that year a systematic development of the property was begun by a Philadelphia syndicate which had purchased the Tonapah mines. Several shafts have been started and the deep workings show an improvement both in the quantity and quality of ore.[3]

The mining industry was considerably hampered by inadequate transportation facilities during these years. Food, supplies, and even drinking water had to be carted to the camp from other localities and the ore transported 60 miles to the nearest railroad.[4] A railroad is now being built to the mines.

The Mizpah ledge has received the greatest amount of attention, although the surface indications point to rich deposits awaiting development in other of the fifteen ledges thus far discovered in this group. The chutes in which the ore is found are sometimes from 6 to 8 feet and even more in thickness, and pitch to an angle of about 35°. The gangue substance is quartz and the ore a fine grained black sulphuret, containing much chloride of silver and small amounts of iron and manganese. There is no free gold.[4]

Sandstones and quartzites.—The commercial production of sandstone in 1902, reported only in Nye county, amounted to $6,115, of which $2,383 was sold in the rough for building purposes and $3,657 for rubble.

All other minerals.—A considerable quantity of sulphur was produced in Humboldt county during 1902. Operations were reported by one company only and the statistics are therefore not shown separately.

The only precious stone reported as produced in the state in commercial quantities during 1902 was turquoise, found principally in Lincoln county. Only one company is regularly engaged in mining gems, but numerous miscellaneous findings are reported to the small dealers.

The state's production of gypsum in 1902 was all mined in Lyon county and is reported by one company.

Borax deposits occur in Esmeralda and Churchill counties, only the former reporting a production in 1902. The borax obtained in Esmeralda county was treated by boiling, evaporation, and crystallization before being placed on the market.

Deposits of limestone predominate in the mountains of Nevada and are marked by overflows of basaltic trap rock and trachytic lavas.[5] The production during 1902 was reported from Lyon county, near Dayton.

Granite was quarried in Washoe county during 1902, and the production was sold for building and monumental purposes and for curbing.

Copper occurs in fissure veins with gold, silver, and lead, chiefly in the form of sulphide, carbonate, or oxide. A small amount was produced in 1902, all of which was subjected to the smelting process before being marketed.

[1] Report of the Director of the Mint, 1900, page 154.
[2] Ibid., 1901, pages 172 and 173.
[3] Ibid., 1901, page 174.
[4] Ibid., 1901, page 175.
[5] History of Nevada, page 7.

NEW HAMPSHIRE.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of New Hampshire for 1902.

TABLE 1.—*Summary: 1902.*

	Total.	Siliceous crystalline rocks.	All other minerals.[1]
Number of mines or quarries	56	51	5
Number of operators	62	49	13
Salaried officials, clerks, etc.:			
Number	92	87	5
Salaries	$68,971	$65,648	$3,323
Wage-earners:			
Average number	1,253	1,219	34
Wages	$806,494	$791,196	$15,298
Miscellaneous expenses	$26,993	$26,719	$274
Cost of supplies and materials	$134,128	$132,122	$2,006
Value of product	$1,176,312	$1,147,097	$29,215

[1] Includes operators as follows: Infusorial earth, tripoli, and pumice, 1; mica, 2; oilstones, whetstones, and scythestones (2 mines, operator reported in Arkansas); precious stones, 10 (no mines).

The value of the mineral production for the state in 1902, $1,176,312, is only two-tenths of 1 per cent of the total value of all minerals mined or quarried in the United States during the year. Of the 50 states and territories from which mining operations were reported, New Hampshire ranked 41. The state produced in commercial quantities only five classes of minerals. These were, in the order of their importance, siliceous crystalline rocks, including granite, trap rock, and similar stones; mica; infusorial earth, tripoli, and pumice; oilstones, whetstones, and scythestones; and precious stones.

The value of the output of siliceous crystalline rocks for the state during 1902 was $1,147,097. This production consisted of building stone, rough and dressed, valued at $619,916; of stone for monumental purposes, valued at $346,735; of stone converted into paving blocks, valued at $101,548; and of stone for a variety of other purposes, valued at $78,898.[1]

In addition to the minerals named above, others occur in greater or less abundance, but were not mined in commercial quantities. The more important are clay, monazite, copper ore, and talc and soapstone.[2] Monazite has been identified with the granites in many localities, but nowhere in sufficient quantities or purity to warrant its exploitation.[3] Talc has been mined in small quantities in connection with other minerals.[4]

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, pages 678 and 679.
[2] Ibid., 1901, pages 160 and 711.
[3] Ibid., 1901, page 950.
[4] Ibid., 1900, page 777.

The following table shows the value of the products of manufactures in 1900, based upon the products of mines and quarries, compared with the value of products of all manufactures:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$118,709,308
Based upon products of mines or quarries:		
Clay, glass, and stone products	$2,080,657	
Iron and steel and their products	4,164,207	
Metals and metal products, other than iron and steel	956,330	
Miscellaneous[1]	3,422,200	
		10,623,394
All other		108,085,914

[1] Includes the products of 1 producer of chemicals and allied products in order to avoid disclosing its operations.

This table shows that the value of all manufactures for New Hampshire in 1900 was $118,709,308, and that the value of manufactured products based primarily on the products of mines and quarries was $10,623,394, or 8.9 per cent of the total. Tables 1 and 2 also show that the combined value of manufactures for 1900 and of mineral products for 1902 was $119,885,620. Of this amount, manufactures contributed 99 per cent and mines and quarries 1 per cent.

During 1902 there were employed in mines and quarries 1,253 wage-earners, who received $806,494 in wages. The census of 1900 reported 70,419 wage-earners employed in manufactures, at wages amounting to $27,620,247. On the basis of these figures, wage-earners engaged in manufactures constituted 98.3 per cent of the total number, and their wages amounted to 97.2 per cent of the total wages. It follows, therefore, that the wage-earners employed in mining industries constituted only 1.7 per cent of the total number employed and that they received 2.8 per cent of the wages.

Siliceous crystalline rocks.—Granite is found in every section of the state in quantities practically inexhaustible.[5] New Hampshire is one of the most mountainous of the New England states. The White mountains, extending through the upper half of the state, are practically solid granite. As early as 1623 stone was used for building construction;[6] and judging from the fact that the first settlement was made in the vicinity of prominent granite deposits, it is reasonable to suppose

[5] Report of New Hampshire Bureau of Labor, Vol. VI, 1901–2, page 16.
[6] History of New Hampshire, by J. N. McClintock, page 29.

that this stone was used. The old state prison, erected at Concord in 1812, and the statehouse, built in the same city in 1816–19, were built of this granite, quarried in the immediate vicinity.[1] The admirable state of preservation of these buildings is evidence of the excellent quality of the stone. The New Hampshire granite is known to commerce as the muscovite-biotite granite, and is considered one of the most valuable in the United States. In texture it is as fine as many marbles, and is remarkable for the wonderful ease with which it can be worked. The Library of Congress at Washington is built of this stone.[1]

In the production of siliceous crystalline rocks, New Hampshire ranked fourth.[2] The total production of this stone in the United States for 1902 was valued at $18,257,944. New Hampshire contributed a product valued at $1,147,097, or 6.3 per cent.

The mineral industries of the state, according to Table 1, employed 1,253 wage-earners, with aggregate wages of $806,494. The wage-earners employed in the production of siliceous crystalline rocks numbered 1,219, or 97.3 per cent of the total, and their wages amounted to $791,196, or 98.2 per cent of the total.

The following table, compiled from the reports of the United States Geological Survey, shows the value of the annual production of siliceous crystalline rocks since 1887:

TABLE 3.—*Value of annual production of siliceous crystalline rocks: 1887 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Value.	YEAR.	Value.
1887	$195,000	1895	$480,000
1888	104,800	1896	497,966
1889	727,531	1897	641,691
1890	727,531	1898	683,595
1891	750,000	1899	802,636
1892	725,000	1900	870,046
1893	442,424	1901	935,494
1894	724,702	1902 [1]	1,147,097

[1] Census figures.

It will be observed that, while there has been a steady increase in value of products since 1895, previous to that date the industry experienced many fluctuations. The year 1902 was the first in which the value of the output exceeded $1,000,000.

All other minerals.—Infusorial earth and tripoli are produced in New Hampshire in small quantities. During 1902 the only deposit that was worked was on Troy mountain, in Cheshire county. The material, after it is mined, is calcined, bolted, and manufactured at Keene, by the producers of the raw material, into cleaning powders and polishers.

During 1902 Cheshire county was the only producer of mica in commercial quantities, and was credited with two operators. Mica mines have been uncovered and worked at Grafton, Grafton county; at Danbury, Merrimack county; and at Alstead, in Cheshire county. The Ruggles mine, which up to 1889 had been a constant producer since 1803, at one time contributing four-fifths of the domestic mica, was idle during 1902. While the value of the state's production of mica in 1902 was not large, the state nevertheless ranked fourth, as the entire value of the output of mica in the United States amounted to only $118,849.

The quarrying of various stones for manufacture into oilstones, whetstones, and scythestones has been an important industry in New Hampshire ever since Isaac Pike discovered a superior grit for scythestones in Grafton county in 1823.[3] The company formed to exploit the deposits now owns and operates quarries in New Hampshire, Vermont, Indiana, Massachusetts, Ohio, and Arkansas, and has mills for cutting, smoothing, and mounting the stones. Special stones of many kinds are put upon the market, and the industry shows a steady growth.[4]

During the census year there were discovered and sold a small number of beryl gems, classified as precious stones. These were all found in Grafton county and were not in any case the result of systematic search or mining.

[1] Stones for Building and Decoration, by George P. Merrill, pages 76 and 77.
[2] United States Geological Survey, "Mineral Resources of the United States," 1902, page 675.
[3] The Mineral Industry, 1892, Vol. I, page 463.
[4] Report of the Bureau of Labor of New Hampshire, Vol. VI, page 19 ff.

NEW JERSEY.

Table 1 is a summary of statistics for the productive mines and quarries in the state of New Jersey for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Iron ore.	Siliceous crystalline rocks.	Clay.	Sandstones and quartzites.	Limestones and dolomites.	All other minerals.[1]
Number of mines or quarries	162	15	49	34	22	27	15
Number of operators	151	9	46	34	22	25	15
Salaried officials, clerks, etc.:							
Number	420	138	92	35	28	15	112
Salaries	$957,000	$101,870	$64,508	$26,044	$17,847	$11,301	$135,430
Wage-earners:							
Average number	5,645	1,660	947	702	418	187	1,731
Wages	$2,658,727	$773,286	$433,166	$293,232	$232,480	$80,654	$845,909
Contract work	$10,770	$10,770					
Miscellaneous expenses	$303,669	$30,114	$53,135	$19,403	$18,352	$7,833	$174,832
Cost of supplies and materials	$2,236,964	$420,231	$161,562	$67,476	$36,080	$23,044	$1,515,571
Value of product	$6,605,402	$1,228,664	$918,474	$612,721	$406,726	$188,050	$3,220,167

[1] Includes operators as follows: Cement, 2; lead and zinc ore, 1; marl, 10; slate, 1; talc and soapstone, 1.

The mineral wealth of New Jersey constitutes one of its greatest resources, and since the earliest days of its history has exerted a marked influence over its general industrial development. The most extensively utilized of the state's diversified mineral deposits is its clay, the exploitation of which has brought New Jersey into national prominence. Doubtless an important factor in their extensive development is their geographical occurrence. While brick clays are found in almost every section, nearly all the rich clays are in Middlesex county close to the navigable coast waters and the Raritan river.[1]

The metalliferous ores are mainly limited to those of iron, zinc, and copper. Lead and silver occur, and although the former has been worked, it is now abandoned, and the latter has not been found in sufficient quantities to warrant mining. The occurrence of the ores of arsenic and nickel is chiefly of mineralogical importance; no deposits or veins of workable extent have been discovered.[2]

The state from its earliest history has been an important producer of high-grade iron ore. The ore is of the magnetic variety and has a higher value per ton than that produced in any other state.[3] In 1902 the output comprised over 26 per cent of the total yield of magnetic iron ore in the country.[4] Zinc mining in the United States had its inception in New Jersey,[5] and for many years the bulk of the zinc ore mined was drawn from its deposits. The state's output of Portland cement in 1902 was approximately one-eighth of the total yield of the country. The sand deposits of southern New Jersey are of a quality that makes them valuable in the manufacture of glass, and they have been utilized for this purpose since pre-Revolutionary times.[6] The state also possesses valuable deposits of granite and sandstone that have been extensively exploited, especially during recent years. The greater part of the granite product is of crushed stone, in the output of which New Jersey exceeded every other state in 1902. Other minerals produced commercially in 1902 are marl, slate, and talc and soapstone.

In addition to these, the range of mineral deposits in the state comprises, among those of known occurrence, though not mined in 1902, the following: Asbestos, barytes, coal (bituminous), copper ores, galena, garnet, infusorial earth, magnesia hydrate and carbonate, marble, mica, plumbago, phosphate rock, sapphire, serpentine, and silver.[7]

The total expenditure for development work in 1902 was $275,950. Of this amount, $272,250 was applied to developing the cement industry. The remainder, $3,700, was expended in the development of gold and silver and iron ore deposits. Work of an experimental character was also prosecuted in connection with copper ores.

The following table shows the value of the products of manufacturing industries closely allied to or based

[1] The New International Encyclopedia, Vol. XII, pages 1045 and 1046.
[2] Geological Survey of New Jersey, 1900, page xxv.
[3] United States Geological Survey, "Mineral Resources of the United States," 1902, pages 43 and 67.
[4] The New International Encyclopedia, Vol. XII, page 1045 ff.
[5] Production and Properties of Zinc, by Walter R. Ingalls, page 13.
[6] The New International Encyclopedia, Vol. XII, page 1046.
[7] United States Geological Survey, "Mineral Resources of the United States," 1887, page 760 ff.

upon the mining industry in 1900, using as their raw material the product of the mine and quarry:

TABLE 2.—*Manufactures based primarily upon the product of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$611,748,933
Based upon the products of mines or quarries:		
Chemicals and allied products	$49,607,740	
Clay, glass, and stone products	22,767,027	
Iron and steel and their products	76,832,967	
Metals and metal products, other than iron and steel	91,855,743	
Miscellaneous industries	25,489,243	
		266,552,720
All other		345,196,213

The total value of products of the manufacturing industries based on mining was, as shown by Table 2, $266,552,720, or 43.6 per cent of the total value of the product of all manufacturing industries in the state in 1900. There were employed in all branches of manufacture in 1902, 241,582 wage-earners, who were paid $110,088,605 in wages. In 1902 the mines and quarries of the state gave employment to 5,645 wage-earners, who received $2,658,727 in wages. Comparing the figures for these two branches of industry, it is disclosed that 97.7 per cent of the wage-earners, receiving 97.6 per cent of the wages, were employed in manufacturing, while 2.3 per cent of the wage-earners, receiving 2.4 per cent of the wages, were employed in mining.

The following table shows the value of the annual production of the principal minerals in the state, 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Iron ore.	Siliceous crystalline rocks.	Clay.	Sandstones and quartzites.	Limestones and dolomites.
1890	$1,341,548	$425,673	(1)	$597,309	$129,662
1891	525,612	400,000	(1)	400,000	100,000
1892	1,388,875	400,000	(1)	350,000	180,000
1893	909,458	373,147	(1)	267,514	149,416
1894	508,056	310,965	(1)	217,941	193,523
1895	612,671	151,343	(1)	111,823	150,000
1896	528,759	204,323	(1)	126,534	134,213
1897	491,838	561,782	$258,976	190,976	141,646
1898	654,148	753,513	390,872	257,217	146,611
1899	814,920	779,822	440,874	147,768	153,025
1900	956,711	1,170,555	467,881	198,234	170,006
1901	918,011	894,167	594,894	244,512	809,798
1902 [2]	1,228,664	948,474	612,721	406,726	188,650

[1] Not reported separately. [2] Census figures.

Iron ore.—The first recorded exploitation of the iron ores of New Jersey occurred in 1674 at Tinton Falls, near the town of Shrewsbury, in Monmouth county. The pioneer in the industry in the state was Henry Leonard, who came from the village of Rowley, in Massachusetts, to New Jersey and established the iron manufacture in that state. Bog ore was used in the first furnace. For more than a third of a century the industry of iron manufacture in the state, which grew rapidly from the start, was confined to the working of bog ore. Large quantities of iron were made from this ore at one time, and the industry of its mining and manufacture spread throughout southern and southwestern New Jersey and was for more than a century and a half an important factor in the industrial development of this part of the state. "Jersey pines" furnished the fuel for the furnaces and bloomeries, and oyster shells supplied the fluxing material.

The passing of bog ore mining was approximately coincident with the supplanting of charcoal as a fuel by anthracite coal, which took place about 1840.

The rich deposits of magnetite in northern New Jersey were discovered at an early day, and about 1710 settlements were made on Whippany river, in Morris county, for the purpose of smelting the iron ores in the neighborhood. Probably the first forge erected for the working of these magnetic ore deposits, which for almost two hundred years have been mined continuously, was located at a point about 4 miles northeast of Morristown. The celebrated Succasunna iron ore mine is near the place where the first forge was built. It was here that the pioneers in the industry obtained their ore, which was carried to the works in leather bags on pack horses; the bar iron was carried on horseback over the Orange mountains to Newark. Other forges were soon built in Morristown and some in Essex county, all of which for a long time and with the same crude methods of transportation drew their ore from the same source. The ores were free to all until the tract embracing the Dickerson mine was taken up on account of its minerals by John Reading in 1713 or 1714. The deposit has long been known as the "Dickerson mine," from one of the early governors, who was subsequently a United States Senator. On March 10, 1714, William Penn, by a warrant from the council of proprietors, acquired title to one of the richest iron ore mines in New Jersey. This tract was situated in Essex county, then Hunterdon, and was the site of what later was known as the celebrated Andover mine. The products of this mine were for many years carried on pack horses and in carts down the valley of the Musconetcong to a place on the Delaware called Durham, and thence transported by boat to Philadelphia.

For some years after the beginning of the eighteenth century New Jersey was the only colony outside of New England engaged in the manufacture of iron, and this was largely confined to its bloomeries. Not much progress was made in establishing the industry until about the middle of the eighteenth century; but from about 1740 to the Revolution many blast furnaces and other iron works were erected, and the iron industry, though hampered to some extent by restrictions imposed by England, was exceedingly active. The patriotic cause was afterwards greatly indebted for much of its iron and steel, so necessary to secure its success, to the enterprises built up between 1740 and 1770 within the borders of New Jersey. The old Oxford furnace, in

Warren county, built by Jonathan Robeson in 1742, is, according to tradition, the first one blown by a water blast. In 1880 it was still in operation, sharing with the Cornwall furnace in Pennsylvania the distinction of being the oldest furnace in the United States then in active operation.[1]

In 1790 the total production of iron ore in New Jersey was 10,000 tons. Forty years later it had increased to 20,000 tons, and in 1855 had reached a total of 100,000 tons. The output increased rapidly for almost two decades thereafter and in 1873 amounted to 665,000 tons. During the succeeding three or four years there was a marked decrease, the output in 1876 dropping to 285,000 tons. Then ensued another period of rapid increase, which continued throughout the remaining years of the decade, the maximum output in the history of the state, nearly 1,000,000 tons, being reached in 1882. During the next ten years the annual production remained steady, with only slight variations, at an average of about 500,000 tons. Between 1893 and 1897 the production reached the lowest figures since 1864, with a minimum output for the period of 257,235 tons in 1897.[2] The increase which was shown in 1898 has grown rapidly during each year since, closing with an output of 441,879[3] tons in 1902. This is a gratifying yield in view of the shortage of anthracite coal during the closing months of the year, which tended to retard the work of blast furnaces, and thus indirectly to affect the output of the mines.[3]

The iron ore producing district of New Jersey is a continuation of the ridge of Archean rock which, beginning in Putnam county, N. Y., extends southwest across Orange county, N. Y., and the Hudson river and, traversing northern New Jersey, runs out in Pennsylvania. Lenses of magnetic ore occur throughout its entire length. In New Jersey these are not as large as in the Adirondacks, but they are more regularly distributed. Four courses or mine belts are recognized in the state—the Ramapo, the Passaic, the Musconetcong, and the Pequest—in order from east to west.[4] Mining operations, which began in Morris county, have extended until at present they are widely distributed over the belt, the principal points of production being at Mt. Pleasant and Hibernia.[5]

The following table shows the annual production, in long tons, of iron ore from 1890 to 1902:

[1] Iron in All Ages, by James M. Swank, page 146 ff.
[2] Geological Survey of New Jersey, 1902, pages 115 and 142 ff.
[3] United States Geological Survey, "Mineral Resources of the United States," 1902, page 43.
[4] The Ore Deposits of the United States, by James F. Kemp, page 123 ff.
[5] Geological Survey of New Jersey, 1902, page 119.

TABLE 4.—*Annual production of iron ore: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1890	495,808	1897	254,235
1891	525,612	1898	275,438
1892	465,455	1899	256,185
1893	356,160	1900	344,247
1894	277,483	1901	401,989
1895	282,433	1902	441,879
1896	264,999		

Siliceous crystalline rocks.—The rocks of this character have not been quarried extensively until within the last five or six years. The increase began in 1898, when the value of the output was nearly 50 per cent greater than that of 1897.[6] The maximum was reached in 1900, New Jersey then standing third among the states in the production of stones of this classification, with an output valued at more than $1,000,000.[7] The production has remained close to this figure since. The bulk of the state's yield of this classification consists of trappean rocks used principally as road materials.[8]

The belt within which occur all the granitic and gneissoid rocks enters New Jersey from New York near the Ramapo river, in Bergen county, and traverses the state in a southwesterly direction. The greatest width of the belt is less than 20 miles, while it is less than half that width at its southern extremity. Comparatively few quarries are worked throughout this area, though in many places the rocks are so situated that their exploitation is practicable at a relatively low cost. From the quarries at Dover, in Morris county, large quantities of stone for railroad construction have been taken. A good quality of granite of fine grain and even texture occurs in the Vernon valley along the eastern foot of Pochuck mountain.[8]

Clay.—The valuable clay beds of New Jersey have been known and exploited for more than a century; but their extensive occurrence and great importance to the state and the country have been understood and fully appreciated for only a comparatively short time.

The first recorded instance of clay mining in the state was in the banks of South Amboy. The clay was used in making stoneware at Van Wickle's pottery at Oldbridge, now Herbertsville, about 1800. In 1802 a second pottery was built at Sayreville, on the Raritan, and began the manufacture of stoneware from the same clay banks at South Amboy.

[6] United States Geological Survey, Twentieth Annual Report, Part VI, continued, page 279.
[7] Ibid., "Mineral Resources of the United States," 1900, page 665.
[8] Stones for Building and Decoration, by George P. Merrill, page 77 ff.

The famous fire clays of the state were first exploited after the War of 1812, probably about 1816. At about this date G. W. Price carried to Boston a boat load of fire clay, dug at Woodbridge, from the afterwards celebrated banks, and manufactured it into fire brick. Jacob Felt, about 1820, mined and carried to Boston another shipment consisting of 50 tons, for which he paid 25 cents per ton in the ground. From this beginning the mining and shipping of these clays to the same point continued for many years. In 1835 they were used in Philadelphia by Howell & Bros. in the manufacture of wall paper.

The industry of fire brick manufacture within the state had its inception in 1833, Mr. J. R. Watson, of Perth Amboy, building and operating the first plant. By this time the clay deposits were beginning to attract some attention. The Gazetteer of New Jersey stated in an issue of 1833 that "extensive beds of white pipe clay, composed principally of alumina, and infusible, have been observed between Woodbridge and Amboy." In 1840 Professor Rogers published in his final report on the Geology of New Jersey the results of a cursory examination made by him of the clay deposits, especially in the vicinity of Woodbridge, but these researches disclosed only a fraction of the full importance of the beds. During the following fifteen years the scope of the clay working industries was materially broadened. The progress is indicated by the following quotation from the State Geological Report of 1855: "Clay for making 50,000,000 fire bricks was taken out during the year from the pits at Woodbridge, Perth Amboy, and South Amboy; 2,000 tons were sold for facing paper hangings; 2,000 tons for making alum, and a considerable quantity for making fine pottery at Jersey City, Trenton, and Green Point. About 10,000 tons of stoneware clay were needed to supply the demand." Eighteen years later, in 1873, the industry of clay mining had grown to such an extent that 265,000 tons of fire clay were dug annually and sent into the market for making fire brick, fine pottery, sewer pipe, terra cotta ware, retorts, crucibles, facing for wall paper, alum, etc. The average price per ton received at that time was about $3.50.

At the same time 20,000 tons of stoneware clay were mined in the vicinity of South Amboy. This was shipped to all parts of the United States and supplied the material for the bulk of the stoneware used in the country. It brought an average price of $4 per ton.

The manufacture of fine earthenware was begun in the state in the latter fifties. In 1868 these products were turned out from 12 potteries in Trenton, and reached for the year an aggregate value of $1,500,000.

The abundance of the New Jersey clays, their superior quality, and convenience to market have made them almost essential to the successful prosecution of some of the great industries of the country.[1]

The clay wealth of the state comprises a great diversity of varieties, with characteristics that fit them for the manufacture of all the principal clay products. Except for the common brick clay of the state, which is widely distributed, the clay deposits are confined within comparatively narrow limits. The more valuable clays occur in three geographical groups. The most important is in Middlesex county, east of New Brunswick, and extends to Staten Island sound and Raritan bay. Its northern limit is a line parallel with the Pennsylvania Railroad from New Brunswick to Rahway and about 2 miles south of it, the Cheesequake creek forming its southern boundary. The district comprises an area of 68 square miles. It is within this district that the noted Woodbridge and Amboy clays, kaolins, and fire sands occur.

The second district is an extension of the first across the state and along the Delaware river southwest to Salem county, where it crosses the river and appears again in Delaware. The Trenton, Florence, and Pensauken creek clays occur in it.

The third district or group of clay deposits is within the area lying to the south and southeast of the Greensand-marl belt. The more important deposits occurring in this region are those at Conrad, in Gloucester county, and at Wheatland, in Ocean county. Of these three groups of clay deposits those of the Middlesex district are by far the most important, being superior in quality and yielding an aggregate product many times larger than that of the rest of the state combined.[2]

Clay mining as a distinct industry disassociated from the manufacture of clay products has reached a fuller development in New Jersey than elsewhere in the country, this state, in 1902, contributing almost 34 per cent of the total product of the United States.[3]

Sandstones and quartzites.—Sandstone has been quarried in New Jersey from an early date, especially in Bergen, Passaic, and Essex counties, for building purposes, and for monuments and tombstones, and has proved thoroughly durable. For many years the sandstones of New Jersey, being of finer texture and less laminated than those of Connecticut, and consequently of superior quality, have been extensively used

[1] Geological Survey of New Jersey, 1878, page 1 ff.
[2] Transactions of the American Institute of Mining Engineers, Vol. VI, page 177 ff.
[3] United States Geological Survey, "Mineral Resources of the United States," 1902, page 748.

in New York and neighboring cities as a building material.[1] Among the many notable structures built of this stone may be mentioned Trinity church, New York city.[2]

The most extensively worked stone quarries in the state are those in the belt of red or brown sandstone which extends from the New York line in a general southwesterly direction across the state to the Delaware river,[1] comprising an area of 1,540 square miles.[2]

The principal quarrying points in the belt are in various towns of Passaic, Essex, Hunterdon, and Mercer counties. The stone, like that of Connecticut, is a granitic sandstone, cemented by iron oxides, silica, and carbonate of lime, and varying in color from light brownish gray to reddish brown. The fine grained, dark brown variety is most in demand.[1]

Limestones and dolomites.—The limestones of the state are widely distributed and have been used for many years in the production of lime and cement.[3] In former years quarrying on an extensive scale was prosecuted in the outcrops of Devonian limestone at Lower Harmony, in Warren county. This limestone, known in the market as marble, was of a grayish hue and in places banded, owing to alternate lines of light and dark minerals. It was worked mainly for the Pennsylvania market. A very beautiful limestone, known commercially as "Rose Crystal Marble," has been quarried to some extent on a subordinate ridge of the Jenny Jump mountain range, in the same county. There also occurs in association with the dolomites at Montville a beautiful deep green and oil yellow, often translucent, serpentine, but it has not as yet been quarried except for cabinet specimens.[4]

All other minerals.—Among the mineral products in the output of which New Jersey takes high rank, is Portland cement. This industry has had its inception and remarkable development practically within the last decade. Although there is an abundance of limestone in the state, it was thought for many years, in fact until quite recently, that very little, if any, of it was adapted to the manufacture of cement. Indeed, this was the opinion expressed by the state geologist in 1868, formed after an exhaustive study of the various limestones of the state.[3]

Prior to 1892 the production of Portland cement in the state was not recorded by the United States Geological Survey. Beginning in 1892 with a reported output of 20,000 barrels, it increased during the following year by 300 per cent to 60,000 barrels. The rapid growth of the industry continued through all the succeeding years of the decade, until in 1902 the total yield was 2,152,158 barrels, or more than 100 times the output of 1892. The following table shows the annual production of Portland cement since 1892:

[1] Stones for Building and Decoration, page 149.
[2] King's Handbook of the United States, page 556.
[3] Geology of New Jersey, 1868, page 387.
[4] Stones for Building and Decoration, pages 217 and 365.

TABLE 5.—*Annual production of Portland cement: 1892 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
1892	20,000	1898	587,163
1893	60,000	1899	892,167
1894	72,223	1900	1,169,212
1895	155,000	1901	1,612,000
1896	247,100	1902	2,152,158
1897	430,335		

The raw materials used in the manufacture of Portland cement occur in many localities in Sussex and Warren counties, and to a limited extent in Hunterdon county. The areas of principal importance are in the Kittatinny valley and in some of the inter-Highland valleys.[5]

Zinc ore mining in the United States began in Sussex county, N. J., in 1838. The ore, which was of the red variety, was taken to the Government arsenal at Washington, where it was reduced, and the zinc used in the brass designs of the standard of weights and measures ordered by Congress. The process used, however, was too costly to permit commercial production of the metal.[6] In 1848 the New Jersey Zinc Company was organized and erected at Newark an extensive plant for the reduction of the metal. By 1852 the industry had made considerable headway, 860 tons of metallic zinc being produced. In 1853 the output increased to 1,440 tons, and for some years the state was the only producer of zinc in the country.[7]

The zinc deposits of the state occur in Sussex county on a range of hills which commences near Sparta and extends in a southerly direction through Stirling to Franklin.[8] The points of principal production have been Ogdensburg and Franklin.[8]

The marls of New Jersey have been dug for use as fertilizers since the early history of the state. The marl, or Greensand region, is in the southern part of the state, and is comprised within a belt from 6 to 15 miles in width, extending from the ocean below Sandy Hook across the state to the Delaware.[9]

The quarrying of roofing slate in New Jersey dates from about 1823, when it is believed the first quarry was opened by Mr. Evans, near the Delaware Water-gap. The slate deposits of the state are extensive and occur mainly within a belt entering the state from Pennsylvania and extending entirely across the northern part of the state to the New York state line, and along the northwestern border of Kittatinny valley for a distance of about 35 miles.[10]

The state's production of soapstone in 1902 was obtained from Warren county.

[5] Geological Survey of New Jersey, 1900, page 30.
[6] Production and Properties of Zinc, page 13.
[7] Metallic Wealth of the United States, by J. D. Whitney, page 348 ff.
[8] Ibid., page 348.
[9] Geology of New Jersey, 1868, page 261.
[10] Ibid., page 518.

NEW MEXICO.

Table 1 is a summary of the statistics of the productive mines and quarries of the territory of New Mexico for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Gold and silver.	Copper.	Precious stones.	Sandstones and quartzites.	All other minerals.[1]
Number of mines or quarries	161	30	91	17	8	7	8
Number of operators	207	25	91	17	60	7	7
Salaried officials, clerks, etc.:							
Number	175	68	75	24	3	.....	5
Salaries	$209,569	$85,599	$80,390	$32,120	$5,160	.....	$6,300
Wage-earners:							
Average number	2,275	1,489	519	164	36	8	109
Wages	$1,046,833	$1,027,460	$409,779	$128,483	$22,087	$6,515	$52,509
Contract work	$48,381	$5,770	$32,945	$10,266	.....	.....	.....
Miscellaneous expenses	$140,055	$68,990	$34,110	$26,858	$1,900	$536	$12,661
Cost of supplies and materials	$497,949	$166,513	$256,816	$49,408	$2,480	$370	$32,362
Value of product	$2,686,473	$1,500,230	$677,168	$271,270	$61,600	$12,201	$173,914

[1] Includes operators as follows: Graphite, 1; iron ore, 1 (2 mines); lead and zinc, 1; marble, 2; mica, 1; phosphate rock, 1.

Doctor Wizlizenus, writing in 1847, gives a concise presentation of the mineral resources of New Mexico. "In Spanish times several rich mines were worked at Avo, at Cerrillos, and in the Nambe mountains, but none at present. Copper is found in abundance throughout the country, but principally at La Tijera, Jemez, Abiquiu, Guadalupita, etc.; iron, though also abundantly found, is entirely overlooked. Coal has been discovered in different localities, as in the Raton mountains, near the village of Jemez, southwest of Santa Fe, and near, but south of, Placer mountain. Gypsum, both common and selenite, is found in large quantities, extensive layers of it existing in the mountains near Algodones, on the Rio Grande, and in the neighborhood of the celebrated salinas. It is used as common lime for whitewashing, and the crystalline or selenite instead of window glass. About 100 miles south-southeast of Santa Fe, on the high table-land between the Rio Grande and Pecos, are some extensive salt lakes, or salinas, from which all the salt (muriate of soda) used in New Mexico is procured."[1] Very little mining was done by the Americans for many years after their occupation of the territory.[2]

Aside from the minerals commercially produced in 1902, deposits of alum and sulphate of alumina, cinnabar, molybdenum, tungsten, vanadium, and serpentine are known to occur in the territory.

In addition to the productive mining there were 159 operators engaged in developing 159 mines and wells, of the following character: Gold and silver, 156; petroleum, 2; and coal, 1. They gave employment to 358 wage-earners, who were paid $270,896 in wages. Other expenses were contract work, $73,128; miscellaneous expenses, $34,125; and the cost of supplies and materials, $128,488.

The following table shows the value of the products of all the manufacturing industries of the territory, as reported at the census of 1900, and the products of the manufacturing industries which chiefly utilize, as raw materials, the products of mines and quarries:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures	.....	$5,605,795
Based upon the products of mines or quarries:		
Clay, glass, and stone products	$114,698	
Iron and steel and their products	65,546	
Metals and metal products, other than iron and steel	1,160,995	
Miscellaneous industries	556,247	
	.....	1,837,486
All other	.....	3,768,309

The manufactured products thus based upon the products of mines and quarries constitute 32.7 per cent of the total value. The value of the mineral production of the territory in 1902 was $2,686,473, or 32.4 per cent of the value of the combined product of manufac-

[1] Mineral Resources of the United States, by Browne and Taylor, 1867, page 325.

[2] History of the Pacific Coast States, by Hubert H. Bancroft, Vol. XII, page 748.

tures and mines and quarries of the territory. Mines and quarries in 1902 employed 2,275 wage-earners, who were paid $1,646,833 in wages. In 1900 manufactures gave employment to 2,600 wage-earners, who were paid $1,350,586; therefore manufactures gave employment to 53.3 per cent of the wage-earners and paid 45.1 per cent of the wages, while mines and quarries gave employment to but 46.7 per cent of the wage-earners and paid 54.9 per cent of the wages.

The following table, compiled from reports of the United States Geological Survey, shows, with the exception of copper ore, values for which can not be obtained, the value of the annual production of the principal minerals of the territory from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Gold.[1]	Silver.[1]	Sandstones and quartzites.
1890	$504,390	$850,000	$1,680,808	$186,804
1891	779,018	905,000	1,713,131	50,000
1892	1,074,601	950,000	1,521,390	20,000
1893	979,044	913,100	592,679	4,922
1894	935,857	829,519	276,764	300
1895	1,072,520	492,200	898,320	2,700
1896	930,381	475,800	889,277	(2)
1897	991,611	356,500	697,535	(2)
1898	1,344,750	539,000	549,883	3,500
1899	1,461,865	584,100	650,731	1,829
1900	1,776,170	832,900	[3]269,266	2,500
1901	1,546,652	688,400	[3]338,040	(2)
1902[4]	1,500,230	531,100	[3]242,316	12,291

[1] Estimates of the Director of the Mint, value of refined product, silver at coining value. The values given in Table 1 are the values at the mine.
[2] Not reported separately.
[3] Commercial value.
[4] Census figures except for gold and silver.

Coal, bituminous.—The production of coal in New Mexico was first reported for 1882, when it amounted to 157,092 short tons. It was then mined in Raton, Cerillas, Gallup, Monero, and San Pedro counties, which represent the present counties of Colfax, Santa Fe, McKinley, and Rio Arriba. In addition to these counties coal is now mined in Lincoln, San Juan, San Miguel, and Socorro counties. McKinley and Colfax counties are the heaviest producers, their product being over 74 per cent of the total tonnage of the territory. The coals range from lignite to anthracite, considerable quantities of the latter being found associated with bituminous coal in the Cerillos district.

The following table, compiled from reports of the United States Geological Survey, shows the annual production of coal from 1882 to 1902:

TABLE 4.—*Annual production of coal, bituminous: 1882 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1882	157,092	1893	665,094
1883	211,347	1894	597,196
1884	220,557	1895	720,654
1885	306,202	1896	622,626
1886	271,285	1897	716,981
1887	508,034	1898	992,288
1888	626,665	1899	1,050,714
1889	486,943	1900	1,299,299
1890	375,777	1901	1,080,546
1891	462,828	1902	1,048,763
1892	661,330		

Gold and silver.—The Old Placer gold mines, 30 miles southwest of Santa Fe, were discovered in 1828, and were worked to a considerable extent by the Mexicans in the early days. The New Placer gold mines were discovered in 1839.[1] Silver was discovered at Georgetown in 1872.[2] The rich Lake Valley silver mines commenced producing in 1881. The "Bridal Chamber" at Lake Valley, a cavern in the limestone lined with rich silver ores, was one of the most remarkable ore deposits ever found. It was here that Governor Safford offered $50,000 for the ore he could extract unaided in ten hours.[3]

The decade 1880 to 1889 witnessed a large increase in the gold and silver production, as shown by the following table, compiled from the reports of the Director of the Mint:

TABLE 5.—*Annual production of gold and silver: 1880 to 1889.*

[Reports of the Director of the Mint.]

YEAR.	Gold.	Silver.[1]	YEAR.	Gold.	Silver.[1]
1880	$49,354	$372,337	1885	$800,000	$3,000,000
1881	185,000	275,000	1886	400,000	2,300,000
1882	150,000	1,800,000	1887	500,000	2,300,000
1883	280,000	2,845,000	1888	602,000	1,200,000
1884	300,000	3,000,000	1889	1,000,000	1,461,010

[1] Coining value.

Copper.—Two copper mines were extensively worked before the Civil War—the Santa Rita and the Hanover—turning out about 12 tons of copper per week and employing jointly about 500 hands.[4] The Santa Rita mines, near Silver City, were discovered by Lieutenant-Colonel Carrisco in 1800,[5] and were extensively worked for copper, much of it native, before the Gadsden Purchase.[6]

TABLE 6.—*Annual production of copper: 1882 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Pounds.	YEAR.	Pounds.
1882	869,498	1893	280,742
1883	828,511	1894	81,884
1884	59,450	1895	148,719
1885	79,889	1896	2,701,664
1886	558,385	1897	701,892
1887	283,664	1898	1,592,871
1888	1,631,271	1899	3,935,441
1889	3,686,187	1900	4,169,400
1890	850,034	1901	9,629,884
1891	1,293,197	1902	6,614,961
1892	1,188,796		

Precious stones.—The production classified as precious stones consists of turquoise, from Grant and Otero counties, and garnets, from McKinley county. The value of the turquoise product in 1902 was $51,100, of which $47,600 was from the mines of Grant county and $3,500 from Otero county. The garnets from McKinley county were found by individuals, and were not from any regularly operated mine.

[1] Harper's Encyclopedia, Vol. IX, page 449.
[2] The Mineral Industry, 1892, Vol. I, page 229.
[3] History of the Pacific Coast States, Vol. XII, page 755.
[4] Mineral Resources of the United States, 1867, page 325.
[5] Harper's Encyclopedia, Vol. IX, page 448.
[6] The Mineral Industry, 1894, Vol. III, page 247.

The most interesting of the ancient turquoise workings are in the Chalchuitl mountain ("Chalchuitl" is the Indian name for turquoise). The entire hill is undermined by caves, and there are two immense open cuts, the larger being over 300 feet across and 200 feet or more in depth. According to tradition, a great rock slide occurred here in 1680 that buried some twenty-five Indians. The requisition of the Spaniards on the neighboring pueblo of San Marcos for more Indians to take the place of those entombed led to a general uprising, that resulted in driving the Spaniards out of the country.

Modern turquoise mining in New Mexico has been developed since the census of 1890. There are three districts where turquoise is produced—the ancient turquoise mines in the Cerrillos mining district, 18 miles south of Santa Fe, a locality in the vicinity of Cow Springs mountain and Burros, and the mines opened a few years ago in the Jarilla district, in Otero county. In opening the old workings of the ancient mines stone hammers and pottery in considerable quantities were found.[1]

For the decade from 1890 to 1900 the total output of the largest turquoise mine at Cerrillos amounted to more than $2,000,000 in value. A single stone has been sold for as much as $3,000.

Pyrope garnets, sometimes called Arizona rubies, are found on the Navajo reservation. An interesting variety of green semiopal has been discovered in Taos county.

Sandstones and quartzites.—Sandstone quarries are operated in Bernalillo, Colfax, and San Miguel counties, chiefly for building stone. In the vicinity of Las Vegas, Hot Springs, and Albuquerque occur beds of light gray, brown, and pink sandstone of fine texture.[2]

[1] Report of the Governor of New Mexico, 1901, page 405.
[2] Stones for Building and Decoration, by George P. Merrill, page 149.

All other minerals.—Amorphous graphite is found in the Raton mountains. The total graphite production of the territory was refined graphite from one establishment, an incorporated company, operating in Colfax county.

One individual operator worked two iron mines in 1902 in Grant county. The deposits of iron ore in the territory are numerous, extending from the Raton mountains to the Placer and Sandia mountains. Ore of excellent quality is found near Las Vegas. At the Hanover copper mine there is a heavy supply of iron ore, partly magnetic and partly a red hematite. On the Rio Puerco, associated with coal, occur frequent bands of iron ore. East of the Gallinas range and about 30 miles west of Socorro, in Socorro county, there is a large tract of land covered with iron nodules that have been shipped in large quantities for use as flux in smelters. Good iron ore occurs also in the Santa Rita, Burros, and other ranges in the southern part of the territory.[3]

Marble was quarried in 1902 at two quarries in Otero county. Near the Rio Puerco station of the Atlantic and Pacific Railroad, in Valencia county, are deposits of travertine, or stalagmitic matter, thus far exploited only in a preliminary way. The stone varies in color from almost white to almost black, and from translucent to opaque. The better varieties show, when polished, a silky luster and a radiated fibrous structure.[4] White and black marble occurs in the White Oaks district, Lincoln county.

Mica was obtained from one mine in Taos county. It has also been worked to some extent in the Cribbenville district, Rio Arriba county.[5] Phosphate rock was reported for the first time as mined to a small extent in Luna county.

[3] United States Geological Survey, "Mineral Resources of the United States," 1883, page 285.
[4] Stones for Building and Decoration, page 274.
[5] The Mineral Industry, 1898, Vol. VII, page 510.

NEW YORK.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in New York state for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Cement.	Limestones and dolomites.	Petroleum.	Sandstones and quartzites.	Iron ore.	Siliceous crystalline rocks.	Talc and soapstone.
Number of mines, quarries, and wells	9,768	21	181	8,443	377	15	22	4
Number of operators	2,921	20	178	2,123	364	13	22	4
Salaried officials, clerks, etc.:								
Number	701	141	174	69	86	62	47	29
Salaries	$788,382	$160,282	$166,459	$92,116	$67,463	$65,231	$42,942	$19,654
Wage-earners:								
Average number	9,560	2,459	2,422	408	1,284	965	655	163
Wages	$5,099,753	$1,203,313	$1,214,742	$296,718	$785,694	$432,039	$357,329	$83,080
Contract work	$355,113	$4,450		$272,759				
Miscellaneous expenses	$1,276,232	$310,772	$142,206	$259,740	$104,493	$199,587	$20,157	$38,786
Cost of supplies and materials	$3,002,554	$1,374,040	$451,876	$440,004	$108,159	$293,050	$94,299	$15,253
Value of product	$13,350,421	$3,056,589	$2,503,536	$1,530,852	$1,408,699	$1,362,987	$651,014	$615,350

	Marble.	Natural gas.	Gypsum.	Slate.	Garnet.	Graphite.	Corundum and emery.	Buhrstones and millstones.	All other minerals.[1]
Number of mines, quarries, and wells	14	612	17	11	3	3	3	22	20
Number of operators	13	108	15	11	3	3	3	22	19
Salaried officials, clerks, etc.:									
Number	34	76	22	17	7	7	5	5	10
Salaries	$40,634	$63,015	$32,600	$14,645	$6,050	$6,627	$2,349	$3,740	$4,576
Wage-earners:									
Average number	469	121	214	120	83	71	9	59	52
Wages	$332,086	$84,476	$100,996	$69,561	$47,003	$35,583	$4,446	$28,021	$23,981
Contract work		$77,904							
Miscellaneous expenses	$31,283	$127,530	$14,081	$8,429	$3,200	$1,124	$2,171	$849	$2,824
Cost of supplies and materials	$100,705	$39,929	$31,175	$16,225	$8,200	$19,543	$2,675	$1,489	$4,541
Value of product	$577,298	$346,471	$259,170	$120,718	$97,600	$77,437	$44,625	$39,570	$52,505

[1] Includes operators as follows: Clay, 7 (8 mines); crystalline quartz, 1; feldspar, 1; flint, 2; infusorial earth, tripoli, and pumice, 1; lead and zinc ore, 1; mineral pigments, crude, 5; sulphur and pyrite, 1.

The mineral resources of the state are varied, 23 different minerals contributing to the state's output in 1902. Among the various branches of the mining industry in the state the manufacture of cement is foremost. Both natural rock and Portland cement are produced in large quantities; and New York has led the states for many years in the production of natural rock cement. The greater part of the crystalline graphite production in the United States comes from the mines at Ticonderoga, in Essex county, where the mineral has been mined for nearly a century. The gypsum deposits of the state are extensive, and in gypsum mining New York ranks fourth. The glass sand found in the state occurs in a form sufficiently disintegrated to require no further crushing before using it in the manufacture of glass.[1] The corundum and emery mines near Peekskill are among the largest producers of these abrasive materials in the United States, and in the production of garnet for abrasive purposes the state ranks high. Most of the buhrstones made in the United States are from the quarries of the state along the eastern slopes of the Appalachian mountains. The state for many years has been a large producer of fibrous talc, most of which is used in paper making. Extensive deposits of clays are widely scattered and many of them are capable of being used in the manufacture of terra cotta, roofing tile, and the coarser grades of pottery.[2] Natural gas is also found over a very large area of the state. It was first used as a source of light and heat at Fredonia, Chautauqua county, in 1821.[3] The oil territory in New York is a continuation of the Bradford, Pa., field and has been more or less productive since 1865.[4] With the exception of Pennsylvania, New York state is the largest producer of the magnetite variety of iron ore, which

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 1010.

[2] New York State Museum, Bulletin No. 12, page 98.

[3] United States Geological Survey, "Mineral Resources of the United States," 1902, page 648.

[4] New York State Museum, Bulletin No. 15, page 558.

abounds in the Highlands of the Hudson and in the Adirondack region, where the ore has been mined for over a century in the Lake Champlain valley.[1] Iron ores of both the red and brown hematite variety are also mined in the state, and in a number of localities ore of the hematite variety is found suitable for metallic paint, and is also used for coloring matter in making mortar.

The numerous quarries of the state produce annually large and valuable quantities of fine stones, among which are included the granite of the Adirondack region, the sandstones of Potsdam and Medina, the bluestone of the Hudson valley, the shell limestone of Lockport, the black marble of Glens Falls, the red marble of Warwick, the verd antique of Moriah, the roofing slate of Washington, Rensselaer, and Columbia counties, and the white marble of Westchester.[2]

Other minerals mined or quarried in the state in greater or less quantities are crystalline quartz, feldspar, flint, infusorial earth, lead and zinc ore, and sienna.

The following minerals also occur in the state, but were not produced in commercial quantities in 1902: Barytes, chrysoberyl, copper, fluorite, ilmenite, manganese, molybdenum, monazite, nickel, pyrope, rutile, serpentine, strontium ore, whetstones, mica, tourmaline, and sulphur and pyrite.

In addition to the productive mines, quarries, and wells shown in Table 1, 6 operators reported mines and quarries having no production, the work done during 1902 being confined to development and care. These operators gave employment to 96 wage-earners on an average during the year and paid $50,403 in wages. The 11 salaried officials, clerks, etc., received $16,569; the contract work amounted to only $500; the miscellaneous expenses were $6,131; and the cost of supplies and materials was $2,164.

The following table shows the value of the products of manufacturing industries based primarily upon minerals mined or quarried, as well as the value of all manufactured products of the state as reported at the census of 1900:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$2,175,726,900
Based upon products of mines or quarries:		
Chemicals and allied products	$58,870,600	
Clay, glass, and stone products	42,594,874	
Iron and steel and their products	157,050,481	
Metals and metal products, other than iron and steel	93,341,219	
Miscellaneous industries	140,844,342	
		492,701,525
All other		1,683,025,375

The value of the manufactured products, based primarily upon minerals mined and quarried, as shown by the foregoing table, amounted to $492,701,525, or 22.6 per cent of the total value of all manufactures in the state as reported for 1900. The value of the output of the mines, quarries, and wells of the state in 1902, $13,350,421, was six-tenths of 1 per cent of the total value of all the manufactures of 1900, and the products of mining and quarrying in 1902.

The wage-earners employed during the census year 1900 by the manufacturing industries of New York state numbered 849,056, and the wages paid amounted to $408,855,652. The operators of the mines, quarries, and wells of the state reported that they employed, during 1902, 9,560 wage-earners and paid $5,099,753 in wages. Manufactures and mining together gave employment during the year to 858,616 wage-earners and paid $413,955,405 in wages. Manufactures, therefore, employed 98.9 per cent of the wage-earners and paid 98.8 per cent of the wages, and mines and quarries gave employment to but 1.1 per cent of the wage-earners and paid 1.2 per cent of the wages.

The following table presents the value of the annual production of the leading minerals of the state from 1890 to 1902:

[1] New York State Museum, Bulletin No. 15, pages 529 to 535.
[2] King's Handbook of the United States, page 589.

TABLE 3.—VALUE OF ANNUAL PRODUCTION OF PRINCIPAL MINERALS: 1890 TO 1902.

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	CEMENT.[1]		Limestones and dolomites.	Petroleum.	Sandstones and quartzites.	Iron ore.	Siliceous crystalline rocks.	Talc and soapstone.	Marble.	Natural gas.	Gypsum.	Slate.
	Portland.	Natural rock.										
1890	$140,000	$2,985,513	$1,708,830	(2)	$702,419	(2)	$222,773	$389,196	$354,197	$552,000	$73,093	$126,603
1891	190,250	3,046,279	1,200,000	$1,061,970	500,000	(2)	225,000	493,068	380,000	280,000	58,571	176,000
1892	279,000	3,074,781	1,200,000	708,297	450,000	$2,379,267	200,000	472,485	380,000	216,000	61,100	210,000
1893	287,725	2,805,387	1,103,529	660,000	415,318	1,222,034	181,449	403,436	206,926	210,000	65,392	204,982
1894	205,231	1,974,463	1,378,851	790,464	450,992	396,456	140,618	485,060	501,585	249,000	60,262	44,542
1895	278,810	2,285,094	1,043,182	1,240,468	415,644	598,313	68,474	370,897	207,828	241,530	59,321	91,875
1896	443,175	2,423,891	1,591,966	1,420,653	223,175	780,932	161,167	399,443	484,160	256,000	32,812	82,492
1897	600,197	2,123,771	1,697,780	1,005,736	544,514	642,838	422,216	396,986	354,631	200,076	78,684	53,799
1898	970,126	2,065,658	1,533,936	1,098,284	566,133	350,999	516,847	411,430	342,072	229,078	81,969	48,694
1899	708,579	2,813,500	1,545,699	1,708,926	1,218,053	1,241,985	306,711	438,150	338,816	294,593	105,533	76,675
1900	582,290	2,045,451	1,730,102	1,759,501	1,467,496	1,103,817	446,171	499,500	332,518	335,367	150,588	62,755
1901	617,228	1,117,066	1,738,716	1,460,008	1,331,327	1,006,231	489,828	483,600	379,159	293,282	241,660	100,966
1902[3]	(4)	3,656,589	2,503,536	1,530,852	1,408,699	1,302,987	651,014	615,350	377,298	346,471	259,170	126,718

[1] Values of Portland cement previous to 1894, and of natural rock cement previous to 1893 include cost of packages.
[2] Value not reported.
[3] Census figures.
[4] Included in natural rock cement.

Cement.—New York, which leads the states in the manufacture of the Rosendale, or natural rock cement, is also the state in which the industry in this country was first established. Natural-cement rock was first discovered in this country about 1818 at or near Chittenango, Madison county, N. Y., and was first used in the construction of the Erie canal.[1] In 1823, when the Ulster county section of the Delaware and Hudson canal was under construction, hydraulic-cement rock was discovered near Rosendale.[2] In 1825 a rock similar to the Chittenango variety was discovered at Highfalls, in Ulster county, and the first crushing mill was erected there in 1826. In 1828 a mill was built at Rosendale, in Ulster county. This locality soon became the leading center for this industry, and has so remained.[3] Extensive works were also erected at Whiteport and at other places in the vicinity.

Upon the completion of the canal activity in the manufacture of cement greatly declined, but upon the reopening of the old Snyder mill interest revived and the natural rock cement was made for the general market. Since 1839, when an exceptionally high grade of cement rock was found at Akron, in Erie county, an increasing industry has been maintained in that region.[3]

Certain strata of limestone were found near South Rondout, Ulster county, that are well adapted to the manufacture of Portland cement, and suitable clay for its production was also found near Phoenicia, in the same county.

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of both Portland and natural rock cement from 1890 to 1902:

TABLE 4.—*Annual production of cement: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Portland (barrels).	Natural rock (barrels).	YEAR.	Portland (barrels).	Natural rock (barrels).
1890	65,000	3,766,756	1897	394,398	4,259,186
1891	87,000	3,931,306	1898	554,358	4,157,917
1892	124,000	3,780,687	1899	472,386	4,689,167
1893	137,096	3,597,758	1900	465,832	3,409,085
1894	117,275	3,446,330	1901	617,228	2,234,131
1895	159,320	3,939,727	1902	1,156,807	3,577,340
1896	260,787	4,181,918			

In 1902 a total of 21 plants in the state were making cement, 11 of which manufacturing natural rock cement only, 8 making Portland cement only, and 2 making both. The total output was 4,734,147 barrels, valued at $3,656,589. Of this output 3,577,340 barrels were natural rock cement and 1,156,807 Portland cement. Ulster county alone produced 2,730,750 barrels of natural rock cement, or 76.3 per cent of the total for the state.

Limestones and dolomites.—The limestones in the state that furnish building stone belong to the following named formations: Calciferous, which may be traced along the Mohawk valley, in Herkimer, Montgomery, and Oneida counties; the Chazy, seen in Clinton county in its typical development and in the Champlain valley; the Trenton, found in Montgomery, Fulton, Herkimer, Oneida, Lewis, Jefferson, St. Lawrence, Hamilton, Clinton, Essex, Warren, and Saratoga counties; the Niagara, which has its greatest development near the Niagara river; the Lower Helderberg, found in the Rondout valley and in Ulster, Greene, Herkimer, and Otsego counties; the Upper Helderberg, found in Onondaga, Cayuga, Seneca, Monroe, Genesee, Erie, and Ulster counties; and the Tully, found in Onondaga county. A stratum of Lower Silurian limestone, 60 to 70 feet in thickness, is extensively worked for ornamental and building purposes at Greenport, Columbia county. It is a stone of medium texture, semicrystalline, highly fossiliferous, of a water-blue or gray color, and has been known as "coal-shell marble." In various towns in Montgomery county a gray or blue-gray semicrystalline limestone is quarried for building material.[4] The Onondaga gray limestone is well developed and is extensively quarried in Onondaga county. The Upper Helderberg beds at Auburn, Cayuga county, have furnished gray and blue-gray magnesian limestone since 1810, when the first quarry was opened. The Lockport gray limestone has been quarried in Niagara county along the Erie canal since 1825.[5]

The 181 quarries from which a production was reported in 1902 were located in 34 counties, and had an aggregate output valued at $2,503,536, New York thus taking fifth place among the states in the production of limestone. The increase over 1901 amounted to $764,820. The value of the limestone quarried for building purposes in 1902 amounted to $480,141.

Petroleum.—The occurrence of petroleum in New York state was first recorded by a Jesuit missionary who visited the oil spring at Cuba, Allegany county, in 1627. The Indians valued the oil from this spring for its supposed curative powers when externally applied, and it became widely known as "Seneca oil."[6] The oil territory in the state is a continuation of the Bradford field of Pennsylvania, and almost all the developed territory in the state is contained in Cattaraugus and Allegany counties, in the southwestern part of the state. The first drilling was done at Limestone, in Cattaraugus county, in 1865. In 1881 a well was drilled at

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, pages 797 to 799.
[2] The Mineral Industry, 1897, Vol. VI, page 92.
[3] United States Geological Survey, "Mineral Resources of the United States," 1902, page 799.
[4] Stones for Building and Decoration, by George P. Merrill, pages 315 to 318.
[5] New York State Museum, Bulletin No. 15, pages 443 to 447.
[6] Ibid., pages 557 and 558.

Petrolia, in Allegany county, and a year later another was drilled at Richburg, in the same county. The oil varies in color from light yellow to almost black, although the dark green oil is by far the most abundant.[1]

In 1902 there were 8,443 producing wells, with an output of 1,119,730 barrels, valued at $1,530,852. This was a decrease in production of 86,888 barrels as compared with 1901.

The following table, compiled from the reports of the United States Geological Survey, shows the annual petroleum production of the state from 1891 to 1902:

TABLE 5.—*Annual production of petroleum: 1891 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
1891	1,585,030	1897	1,279,155
1892	1,273,343	1898	1,205,250
1893	1,031,391	1899	1,320,909
1894	942,431	1900	1,300,925
1895	912,948	1901	1,206,618
1896	1,205,220	1902	1,119,730

Sandstones and quartzites.—The principal sandstones quarried in New York state may be divided into three groups, belonging respectively to three distinct geological horizons, and each group having its peculiar characteristics.[2]

The first group, popularly known as "bluestone," belongs to the Hamilton period of the Devonian formations. The stones are fine grained, compact, dark blue-gray stones, very strong and durable.[3] The area in which bluestone is quarried in the state extends from the west shore of the Hudson river, in Albany, Greene, and Ulster counties, in a southwesterly direction to the Delaware river, through Delaware and Sullivan counties. There is also a small isolated region of production in Chenango county.[3]

The second group belongs to the Medina period of the Upper Silurian formations. The stones are largely siliceous, of coarser, more distinctly granular texture than the bluestone, and are gray or red in color. Quarries of Medina sandstone are found in Oswego, Oneida, Cayuga, Wayne, Monroe, Orleans, and Niagara counties. The stone has been quarried at Lockport, in Niagara county, since 1824.[4] This stone has a wide use for street paving, in place of the usual granite or trap blocks.[2]

The third group belongs to the Potsdam period of the Cambrian formations, the oldest formation in which sandstone is quarried for building purposes in the state. The Potsdam sandstone is quarried in Jefferson, Franklin, Essex, Washington, and St. Lawrence counties. The most extensive openings are near Potsdam, in St. Lawrence county, the stone being hard, compact, and even grained, and pink to red in color. Some of it has a laminated structure and striped appearance. It is an excellent building stone, and is widely known and esteemed for its beauty and durability.[5]

The value of the sandstone quarried in the state in 1902 at the 377 productive quarries amounted to $1,408,699, an increase over 1901 of $77,372. The value of the stone quarried for building purposes amounted to $550,039; for paving, $264,858; for curbing, $272,831; and for flagstones, $230,158. The productive quarries were located in 31 counties; Orleans ranking first in value of product.

Iron ore.—Albany, Cayuga, Clinton, Columbia, Dutchess, Essex, Franklin, Herkimer, Jefferson, Lewis, Madison, Oneida, Onondaga, Orange, Putnam, Richmond, Rockland, St. Lawrence, Saratoga, Warren, Washington, Wayne, and Westchester counties are known to contain one or more of the varieties of iron ore found in the state, and in most of these counties iron ore has been mined at one time or another.[6]

Although iron ore was found in various places by the Dutch during their rule from 1614 to 1664, no known effort was made by them to manufacture iron, and it is not probable that any mining of iron ore of consequence was then attempted. The first known ironworks in the state were established in Columbia county, near the Connecticut line, about 1740, but the ore was mainly obtained from the Salisbury mine in Litchfield county, Connecticut.

With the discovery of the celebrated Sterling mine, near Monroe, in Orange county, in 1750, and the building of a furnace in that locality in the succeeding year, iron ore mining in New York state may be said to have really begun.[7] The Forest-of-Dean mine, 5 miles west of Fort Montgomery, in Orange county, was discovered about the same time.[8]

Historic interest attaches to the Sterling group of mines, not only because here was probably the first iron mine opened in the state but also because the anchors for the United States frigate *Constitution*, and the great iron chain suspended across the Hudson river at West Point in 1778 to prevent the passage of the British vessels, were made at the Sterling Iron Works from ores produced at these mines.[7]

The Maltby mine, near Millerton, in Dutchess county, opened in 1750, has produced a large amount of ore, and much of it was smelted in a furnace on the property.[9] The Armenia mine, in Dutchess county, opened about 1760, was still worked in 1902. During the Revolution the ore from this mine was used for mak-

[1] New York State Museum, Bulletin No. 15, pages 557 and 558.
[2] Stones for Building and Decoration, pages 150 to 153.
[3] New York State Museum, Bulletin No. 15, page 411.
[4] Ibid., page 400.
[5] Ibid., pages 383 and 384.
[6] Mineralogy of New York, 1842, by Lewis C. Beck, pages 5 to 35.
[7] Iron in All Ages, by James M. Swank, pages 136 and 140.
[8] New York State Museum, Bulletin No. 7, page 6.
[9] Ibid., page 58.

ing guns.[1] The output from the Dutchess county iron ore mines at the present time is comparatively small.

Iron ore was mined and furnaces were erected in Westchester county before the close of the eighteenth century, and iron mines were also worked in Putnam county about the same time.[1] The Tilly Foster mine is located near Brewster, in Putnam county. Neither Westchester nor Putnam county reported production in 1902.

About 1800 the celebrated Champlain iron district, comprising the counties of Essex, Clinton, and Franklin, was developed,[1] one of the oldest openings in Essex county being the Castaline bed, near Elizabethtown.[2] The output during the earlier years of the development was small, aggregating but a few thousand tons, but it increased rapidly after 1840, and in 1868 the town of Moriah alone produced 230,000 tons.[3] With the further development of the Port Henry and Chateaugay mines this district was and is to-day the leading iron ore producing district in the state.[4]

The Caledonia mine at Rossie, St. Lawrence county, was opened in 1812, the Kearney in 1825, and the Keene in 1837. These mines produced ore of the red hematite variety.[5] The Old Sterling mine, near Antwerp, in Jefferson county, first opened in 1836, is another mine that produces red hematite ore.[6] This mine was in operation in 1902.

The Clinton, or fossil, ores have been found in Herkimer, Oneida, Madison, Cayuga, Wayne, and Monroe counties, but very little mining has been done except in the towns of Clinton, in Oneida county, and Ontario, in Wayne county. The first lease for digging Clinton ore was given in 1797.[7]

In 1902 there were 15 productive iron mines in the state, in Clinton, Dutchess, Essex, Herkimer, Jefferson, Lewis, Oneida, Orange, St. Lawrence, and Wayne counties. The total production was 555,321 long tons, valued at $1,362,987. Essex county alone produced 324,731 tons. Magnetic ore was produced in Essex, Clinton, Herkimer, Lewis, and Orange counties; red hematite in Jefferson and St. Lawrence counties; fossil in Wayne and Oneida counties; and brown hematite in Dutchess county.

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of iron ore in New York state from 1884 to 1902:

[1] Iron in All Ages, pages 141 and 142.
[2] New York State Museum, Bulletin No. 7, pages 34 and 35.
[3] Ibid., page 9.
[4] Ibid., pages 9 and 33.
[5] Ibid., page 47.
[6] Ibid., page 45.
[7] Ibid., pages 11 and 12.

TABLE 6.—*Annual production of iron ore: 1884 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.[1]	YEAR.	Long tons.
1884	651,228	1894	242,759
1885	471,261	1895	307,256
1886	690,480	1896	385,477
1887	919,754	1897	335,725
1888	738,902	1898	179,951
1889	1,247,537	1899	443,790
1890	1,253,393	1900	441,485
1891	1,017,216	1901	420,218
1892	891,099	1902	555,321
1893	534,122		

[1] Quantities reported for the first five years represent the output of the leading districts.

Siliceous crystalline rocks.—Although massive crystalline rocks are of common occurrence in the state, they do not outcrop over extensive areas, excepting in the Adirondacks and in the Highlands of the Hudson. Gneissic rocks have been quarried at many points within the city limits of New York. In Westchester county there are belts of gneiss and mica schist. Granite quarries have been opened in Putnam, Orange, and Rockland counties.[8]

Probably the most important of the true granites of the state for monumental work is the red variety quarried in various places on Grindstone Island, Jefferson county, in the St. Lawrence river. The stone is deep red and coarsely crystalline, taking a high lustrous polish.[9]

In 1902 granite was quarried in Clinton, Fulton, Herkimer, Jefferson, Orange, Putnam, Richmond, Rockland, St. Lawrence, and Westchester counties. The 22 productive quarries had an output valued at $651,014, of which Westchester county was credited with $302,526. The value of the granite, both rough and dressed, quarried for building purposes was $307,453, and of that dressed for monumental work was $7,180.

Talc and soapstone.—The fine deposits of soapstone in the vicinity of Gouverneur, in St. Lawrence county, attracted the attention of a mineralogist prospecting in that county during the seventies. Later, attention was directed to the rich deposits of foliated talc in the town of Fowler, but it was found that the material was not suitable for the uses contemplated. About this time workmen engaged in roadmaking in the vicinity of Gouverneur found a large vein of fibrous talc, the first of this variety discovered which, when pulverized, was found to be a suitable material for weighting and finishing paper. Prospecting was carried on, new mines were opened, and new mills erected, and by 1893 every

[8] New York State Museum, Bulletin No. 15, page 374.
[9] Stones for Building and Decoration, pages 78 and 79.

available water privilege from Talcville down the Oswegatchie to a point below Gouverneur was occupied by a milling establishment devoted to the production of pulverized talc.[1]

All the mines that have been developed are found on a comparatively narrow ridge, about 7 miles long, the most valuable deposits being in the immediate vicinity of Talcville. Here the best beds are of unknown depth and extent. In most of the mines to the south of Talcville the fibrous material is too largely mixed with the foliated talc to be valuable. At the Freeman mine active operations are carried on 300 or 400 feet below the surface, the deposit being of vein form and having well-defined granitic walls. The material as it comes out in the form of slabs is easily split in the direction of the fiber, but is quite refractory across the grain. The slabs have a pure, pale, sea-green tint, while the manufactured product is snow-white. The principal use of fibrous talc is in filling and weighting paper, but it is also used as an adulterant in certain drugs and as a mixer in cheap grades of soap.[1]

In 1902 there were 4 productive mines in St. Lawrence county, the total output being 71,100 short tons, valued at $615,350.

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of fibrous talc in the state from 1880 to 1902:

TABLE 7.—*Annual production of talc and soapstone: 1880 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1880	4,210	1892	41,925
1881	5,000	1893	35,861
1882	6,000	1894	39,906
1883	6,000	1895	39,240
1884	10,000	1896	46,089
1885	10,000	1897	57,009
1886	12,000	1898	54,356
1887	15,000	1899	54,655
1888	20,000	1900	63,500
1889	23,746	1901	69,200
1890	41,354	1902	71,100
1891	53,054		

Marble.—Crystalline limestones occur in New York city and in Westchester county, in the Highlands of the Hudson, and in the Adirondack region. Quarries opened in Westchester, Putnam, and Dutchess counties have yielded a large amount of fine white marble.

Marble has been taken from quarries at Tuckahoe, in Westchester county, since 1820.[2] The stone is pure white in color and somewhat irregular in quality, but the better grades are highly esteemed for architectural purposes and have been used in some of the finest buildings in New York city.[3]

The Gouverneur marble, in St. Lawrence county, is a very coursely crystalline light gray magnesian limestone, which although too coarse for carved work is suitable for massive structures. It is also used largely for monuments, as well as for building and ornamental work, because it retains a good surface and polish and is believed to be durable.[3]

In the Lower Silurian formation at Plattsburg and Chazy, in Clinton county, two excellent varieties of colored marbles occur, which are commercially known as "Lepanto" and "French gray." The French gray has been used more extensively, with the possible exception of the Tennessee marble, than any other domestic marble for mantels, table tops, tiling, and general interior decorative work.[3]

At Glens Falls, in Warren county, there is an extensive deposit of dark blue-black magnesian limestone, certain strata of which furnish the finest varieties of black marble at present quarried in this country. The stone is very fine grained and compact, and when polished is a deep, lustrous black in color, though the uniformity of the color is sometimes broken by the presence of a small white fossil.

A beautiful coarsely crystalline marble of a carmine-red color, sometimes slightly mottled or veined with white, is found at Warwick, in Orange county. This stone has been but little used, and the supply reported is small.

A peculiar granular stone, consisting of an intimate mixture of serpentine, dolomite, and calcite, interspersed with small flecks of phlogopite, has been quarried at Moriah and Port Henry, in Essex county, under the name of ophite marble. This stone is nearly free from the numerous dry seams and joints that prove so objectionable in most serpentines, and it can be obtained in sound blocks of fair size. The stone polishes well and is said to be durable. A stone of the same general nature has been quarried near Thurman,[4] in Warren county, and it occurs elsewhere in the same county.

The largest and most valuable deposit of serpentine in the state is at Gouverneur, Fowler, and Edwards, in St. Lawrence county. The rock is massive and sound and remarkably free from the defects usually developed in rocks of this class. Near Pitcairn, in the same county, there is a fine deposit of serpentine of the variety commonly called precious, and serpentine, from almost black to nearly white, forms the main range of hills on Staten Island.[5]

The producing marble quarries of the state in 1902 numbered 14, and were located in Clinton, Columbia, Dutchess, St. Lawrence, Warren, and Westchester counties. The value of the marble quarried amounted to $577,298, an increase over 1901 of $198,139. Of the total, $267,013 was the value of the marble dressed for

[1] The Mineral Industry, 1893, Vol. II, pages 603 to 606.
[2] New York State Museum, Bulletin No. 15, pages 425 to 432.
[3] Stones for Building and Decoration, pages 218 to 220.
[4] Stones for Building and Decoration, page 367.
[5] Ibid., page 368.

building, while that dressed for monumental work was valued at $143,080.

Natural gas.—Over a very large area in the western part of the state natural gas is found in a number of different sandstones and limestones. Along the southern shores of Lake Ontario and Lake Erie are scattered a vast number of small wells, each furnishing gas to from one to four families.

In 1902 there were 612 productive gas wells in the state, producing an output valued at $346,471, an increase of $53,199 over 1901.

Gypsum.—The gypsum deposits extend in a narrow belt through the central part of the state in Madison, Onondaga, Cayuga, Ontario, Monroe, Livingston, and Genesee counties. The bed near Union Springs, in Cayuga county, was first opened in 1828.[1] In a number of places the industry is only of local importance, the product being used exclusively for land plaster, but there are some large plants which produce principally wall plaster.

In 1902 the 17 productive plants produced 95,318 short tons, of which 60,184 was calcined into wall plaster and plaster of Paris. The entire product was valued at $259,170; that calcined into wall plaster at $200,236. The state ranked fourth among the states in the production of this mineral.

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of gypsum in New York state from 1889 to 1902:

TABLE 8.—*Annual production of gypsum: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1889	52,608	1896	23,325
1890	32,903	1897	33,440
1891	30,135	1898	31,655
1892	32,894	1899	52,149
1893	36,126	1900	58,890
1894	31,798	1901	119,565
1895	33,587	1902[1]	110,364

[1] Census reports 95,318 tons of gypsum products.

Slate.—Roofing slate has been found in many localities in the state and quarries have been opened in Orange, Dutchess, Columbia, Rensselaer, and Washington counties. The only productive slate quarries, however, are in a narrow belt lying entirely within Washington county. The stone varies in color from red and purple to green and is of excellent quality.[2]

The 11 quarries productive in 1902, all in Washington county, had an output valued at $126,718—an increase of $25,758 over 1901.

Garnet.—This mineral is found in Warren county, on the borders of the Adirondack region, and in Essex and St. Lawrence counties. The entire deposits in Warren county appear to be of the common variety, almandine. It occurs in a formation of crystalline limestone and in gneissic rocks which adjoin or are intercalated with the crystalline limestone. Commercially this mineral is classified as massive garnet, shell garnet—the most valuable for industrial purposes on account of its purity—and pocket garnet.[3] The garnet is used almost exclusively in the manufacture of sandpaper, or garnet paper, which is used for abrasive purposes by manufacturers of boots and shoes and by wood manufacturers.

In 1902 garnet was mined commercially in Essex, Warren, and St. Lawrence counties, but the work done in St. Lawrence county was more or less experimental. The total production for the state in 1902 was 2,760 tons, valued at $97,600. As the total output of garnet in the United States for 1902 was 3,926 tons, valued at $132,820, New York state produced 73.5 per cent in value of the entire product shown for the country.

Graphite.—Deposits of graphite are known to exist throughout the Adirondack region, but the mining of crystalline graphite in this portion of the state has been practically confined to a comparatively small section in the southeast portion of Essex county and in the northeast part of Warren county.[4] There are also occurrences of graphite in Dutchess county and several tons have been obtained from them.[5]

The material in the mines near Ticonderoga, in Essex county, is in a vein of the purest foliated graphite, several inches in width. The folia often have a radiated arrangement and are of considerable size. The gangue is calcareous spar, which sometimes exhibits large and perfect cleavages. At Johnsburg, in Warren county, the mineral occurs in irregular shaped masses, weighing from 1 to 20 pounds, in a vein of quartz.[5]

Early in the last century, after the accidental discovery in 1815 of a deposit at Ticonderoga, in Essex county, graphite mining was carried on, in a primitive manner, by the farmers owning the land, and the material, ground with considerable magnetic iron ore, was used for stove blacking.[4]

In 1830 the invention of the lead pencil aroused increased interest in the Essex county mines. New openings were made in the mountain side and pencil leads were made from the crude graphite in the vicinity of the mines. In 1863 the American Graphite Company acquired these properties, an extensive mill was erected, and the industry increased so rapidly that the annual production reached 500 tons in 1869. Subsequently the same company acquired the Warren county properties.[4]

In 1902 the three productive mines of the state,

[1] New York State Museum, Twentieth Report of the State Geologist, 1900, page r180.

[2] New York State Museum, Bulletin No. 15, pages 421 and 422.

[3] New York State Museum, Bulletin No. 15, pages 553 and 554.

[4] Private Historical Notes on the Graphite Deposits of Essex and Warren Counties, New York, by H. P. Whitlock, under the direction of Mr. F. J. H. Merrill, geologist of New York state.

[5] Mineralogy of New York, pages 97 and 98.

located in Essex and Warren counties, produced 1,375 tons of crystalline graphite, valued at $77,437. As the total quantity of this mineral mined in the United States in 1902 was 1,983 short tons, the contribution of New York state was 69.3 per cent of the whole.

Corundum and emery.—The emery mines of the state are located in Westchester county, near Peekskill. In most cases they are abandoned iron mines, emery not having been recognized when iron ore was being mined in this region. As the emery outcrops on the hillsides, the mines are usually shallow openings or quarries.[1]

The output of the 3 mines productive in 1902 was 2,886 tons, or 67.9 per cent of the production of corundum and emery for the United States. The value of the New York emery was $44,625.

Buhrstones and millstones.—In the United States the millstone varies from a sandstone to a quartz conglomerate. The rock from which it is made occurs along the eastern slopes of the Appalachian mountains from New York to North Carolina and is known by various names. In New York state it is called "Esopus stone" and is found in Ulster county, in the Oneida conglomerate. Millstones are now used extensively for grinding the coarser cereals, mineral paint ores, fertilizers, cement rock, barytes, and other minerals. Before the introduction of the roller process in milling, millstones were used principally in grinding wheat.

The 22 operators of the state reported for 1902 a production of 5,158 stones, valued at $39,570. All the quarries from which the rock was taken were in Ulster county. As the value of the buhrstones and millstones made in the United States in 1902 was $59,808, New York state alone furnished 66.2 per cent of this amount.

All other minerals.—Deposits of clay occur in nearly every county in the state, but the most important are those of the Hudson valley. This region is probably the most active brickmaking region in the world. In 1902 its operators produced 782,932,000 common brick, or 73.7 per cent of the total output of common brick reported for the state. The production was exceeded by only two states. New York ranked fifth among the states in 1902 in the value of its products of clay, which amounted to $8,414,113. The value of the clay mined and sold by the 7 operators in 1902 was $14,535.[2]

The crystalline quartz mined in Dutchess county in 1902 was used as a wood filler. No statistics can be shown for the single operator of the state without disclosing individual operations. The single productive feldspar mine of the state in 1902 was near Bedford, in Westchester county. The two productive flint mines in the state in 1902 were both in Westchester county. The deposit of infusorial earth of White Lake at Wilmurt, in Herkimer county, is dug from the bottom of the lake, which covers about 4 acres, and has a thickness of from 2 to 30 feet, being covered by about 4 feet of water.[3] As early as 1740 lead ore is said to have been mined in Dutchess county, and in both Columbia and St. Lawrence counties it was mined early in the last century. The presence of both lead and zinc was known in many other localities throughout the state, and much money was expended in the exploitation of this industry.[4] Only one mine, in St. Lawrence county, was productive in 1902. Under the classification "mineral pigments, crude," are the statistics for the production of ores used in the manufacture of mineral paints. Such ores were produced during 1902 in Cattaraugus, Rensselaer, and Washington counties, but the entire output of the 5 mines was only 1,261 tons, valued at $4,251. The single productive pyrite mine in the state in 1902 was located in St. Lawrence county.

[1] New York State Museum, Nineteenth Report of the State Geologist, 1899, pages *r*153 and *r*154.

[2] United States Geological Survey, "Mineral Resources of the United States," 1902, pages 729, 748, and 769.

[3] New York State Museum, Bulletin No. 15, pages 555 and 556.

[4] Mineralogy of New York, pages 45 to 52.

NORTH CAROLINA.

Table 1 is a summary of the statistics for the productive mines and quarries of the state of North Carolina for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Siliceous crystalline rocks.	Talc and soapstone.	Gold and silver.	Mica.	Monazite.	Barytes.	All other minerals.[1]
Number of mines or quarries	126	30	6	15	28	23	5	19
Number of operators	137	27	6	15	26	22	5	36
Salaried officials, clerks, etc.:								
Number	120	31	12	21	4	3	13	36
Salaries	$84,244	$23,578	$7,710	$18,267	$1,411	$2,100	$5,401	$25,757
Wage-earners:								
Average number	1,556	615	62	203	50	88	34	504
Wages	$517,765	$222,868	$21,416	$66,822	$15,160	$25,318	$9,914	$156,267
Contract work	$9,000						$1,000	$8,000
Miscellaneous expenses	$76,842	$16,463	$27,081	$10,238	$2,952	$2,083	$5,886	$11,239
Cost of supplies and materials	$118,782	$42,881	$12,447	$26,490	$3,124	$256	$2,740	$30,844
Value of products	$927,376	$338,750	$88,962	$71,287	$71,148	$64,160	$44,130	$248,939

[1] Includes operators as follows: Buhrstones and millstones (operator reported under siliceous crystalline rocks); clay, 3; coal, bituminous, 1; copper ore, 2; garnet, 1; graphite, 2; iron ore, 3; limestones and dolomites, 4; precious stones, 18 (1 mine); sandstones and quartzites, 2.

The state ranked forty-second in 1902 in the value of products of mines and quarries, with a total of $927,376. This small product (less than one-eighth of 1 per cent of the total for the United States) should not be taken, however, as a measure of the state's relative importance in quantity and diversity of mineral resources. The minerals contributing to this total and arranged in the order of values were siliceous crystalline rocks, talc and soapstone, clay, gold and silver, mica, monazite, iron ore, barytes, bituminous coal, copper ore, limestones and dolomites, garnet, precious stones, sandstones and quartzites, buhrstones and millstones, and graphite.

It will be noted that the production of gold and silver in 1902 was exceeded in value by that of siliceous crystalline rocks and talc and soapstone, and almost equaled by that of mica and monazite. Also that copper and iron ore occupy relatively minor positions, while no yield of zinc ore was reported. These facts suggest the changing character of the state's mineral product and the somewhat checkered and interesting nature of its mining history.

A number of minerals occurring in the state in commercial quantities were not produced in 1902. Asbestos has been found on Tryon mountain, Polk county, about 1½ miles west of Skyuka. It is of the amphibole variety and occurs in what is apparently a series of pockets, which have been traced across the country for nearly a mile. One pocket that was opened measured nearly 100 feet in width. It is of fair quality, and large masses have been taken out in which the fiber was from 10 to 15 inches long. The chromite mines of Yancey county give indications of containing large deposits, and there is a promising deposit on Dark Ridge creek, in Jackson county. Another property recently developed is on Big Ivy creek, Buncombe county, 16 miles northwest from Asheville. Several veins of the black oxide of manganese of considerable extent have been found. Oil shale exists in great thickness in connection with the coal beds and yields a large percentage of oil.[1] Phosphatic deposits were first systematically examined and studied in 1884 by the state survey. They were found to be of two classes. The first class consists of amorphous nodules, occurring in small quantities in Sampson, Pender, Onslow, Duplin, Columbus, and New Hanover counties.[2] These are of little value commercially. The other class is that of the phosphatic conglomerates found in beds of from 1 to 6 feet thick, and located principally in New Hanover and Pender counties. While the percentage of phosphate of lime in these conglomerates does not average over 10 to 20 per cent, they have been ground by several companies for local consumption.[2] Grains of platinum have been discovered among the sands of gold washings in Rutherford and Burke counties, and

[1] Handbook of North Carolina, by L. L. Polk, page 129.
[2] Eleventh Census, Report on Mineral Industries, page 690.

also near Burnsville, in Yancey county.[1] Nickel minerals in small quantities are associated with many of the basic manganesium rocks. Genthite and garnierite have been found, but thus far they have not been discovered in sufficient quantity to make them a commercial source of nickel. A deposit of nickel ore averaging 1.5 per cent of the metal is located near Morganton, Burke county. Pyrite, which is one of the most common minerals in the state, is found especially in the counties of Catawba, Gaston, Chatham, Union, and Mecklenburg.[2]

Other minerals which have been found are: Epidote, ilmenite, manganese ore, manganiferous iron ore, marble, rutilated quartz, rutile, sperrylite, tungsten, uranium, and vanadium.

In addition to the productive mines and quarries of the state, extensive development work was carried on during 1902 on 29 nonproductive mines and quarries, the total outlay in this line amounting to $200,915. Most of this expenditure was applied to the development of gold and silver deposits, phosphate rock and clay sharing the remainder in the order named.

The relative importance of those manufacturing industries which are closely allied to or based upon the mining industry, using as their raw material the product of the mine or quarry, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$94,919,663
Based upon products of mines or quarries:		
Chemicals and allied products	$1,501,024	
Clay, glass, and stone products	1,162,061	
Iron and steel, and their products	1,611,504	
Metals and metal products, other than iron and steel	243,836	
Miscellaneous industries	1,261,978	
		5,780,403
All other		89,139,260

As shown by Table 2, the total value of the products of the manufacturing industries based primarily on mines and quarries was $5,780,403, or 6.1 per cent of the product of all manufacturing industries in the state in 1900.

During the same year there were employed in all branches of manufacture in the state 70,570 wage-earners, who were paid $13,868,430 in wages. In 1902 there were employed in the mines and quarries of the state 1,556 wage-earners, who received $517,765 in wages. On the basis of these figures it is seen that 97.8 per cent of the wage-earners of the combined industries, receiving 96.4 per cent of the wages, were employed in manufacturing, while 2.2 per cent of the wage-earners, receiving 3.6 per cent of the wages, were employed in mining.

[1] The Minerals and Mineral Localities of North Carolina, by F. A. Genth and W. C. Kerr, page 12.
[2] Geology of North Carolina, by W. C. Kerr, Vol. I, page 58.

The following table, compiled from the reports of the United States Geological Survey, shows the value of the annual production from 1890 to 1902 for the leading minerals of the state for which comparable figures are available:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Siliceous crystalline rocks.	Gold and silver.[1]	Talc and soapstone.	Monazite.
1890	$146,627	$126,397	(2)	(3)
1891	(2)	101,477	(2)	(3)
1892	150,000	90,196	(2)	(3)
1893	122,707	70,505	(2)	[4] $7,600
1894	108,993	52,927	(2)	[4] 36,193
1895	75,000	54,720	(2)	[4] 137,150
1896	40,017	44,946	(2)	[4] 1,500
1897	59,236	34,988	(2)	[4] 1,980
1898	79,969	84,905	$27,320	[4] 13,542
1899	255,544	31,888	31,880	[4] 20,000
1900	257,962	[5] 35,444	75,308	[4] 48,805
1901	261,288	[5] 67,680	77,824	[4] 59,262
1902[6]	338,750	[5] 101,777	88,962	64,160

[1] Estimates of the Director of the Mint for the refined product; silver at coining value. The values given in Table 1 are the values at the mine.
[2] Not reported separately.
[3] No production.
[4] Includes production from South Carolina.
[5] Silver at commercial value.
[6] Census figures, except for gold and silver.

Siliceous crystalline rocks.—Granite and gneiss are among the commonest rocks of the state, being found in all sections except the coastward region. The principal producing counties where good grades of building granites are found are Gaston, Iredell, Rowan, Surry, and Wilkes.[3]

Talc and soapstone.—Talc is a very common mineral in North Carolina, both in the form of the impure greenish massive or slaty rock (potstone), used for monuments and for chimney and furnace hearths and linings, and in the form of a pure massive white steatite. The product for the year 1902 was reported from Cherokee, Moore, and Swain counties, and constituted 7.8 per cent of the total product of the United States. The most extensive beds of this mineral are found in Cherokee and Macon counties in immediate association with the marble range along the Nantahala, Valley, and Nottely rivers.[4]

Clay.—Many varieties of clay of varying value are found at many points in the state, especially in Guilford, Chatham, Wake, Harnett, Robeson, Lenoir, and Jackson counties.[5] In Jackson county extensive beds of kaolin of high grade have been found, and the total clay product of the state for 1902 came from this county.

Gold and silver.—Gold was the principal product of the mines of this state for nearly three-fourths of a century. It is widely distributed, but its principal field is the eastern slope of the Blue Ridge. Silver, on the whole, is a rare mineral in North Carolina. It has been obtained in considerable quantities at Silver Hill, in

[3] Geology of North Carolina, Vol. I, page 271 ff.
[4] Ibid., page 298.
[5] Ibid., page 296.

Davidson county. Other counties in which silver has been found and in some instances mined with indifferent success are Burke, Caldwell, Wilkes, Gaston, Cabarrus, Union, Montgomery, McDowell, Madison, Johnston, Cherokee, and Surry.[1]

From the earliest days of placer gold mining in 1799 on the tributaries of the Pedee down to the decade immediately preceding the Civil War, North Carolina ranked as a mining state of the first importance. The bulk of the mining done in the state during this period was gold mining, and from 1804 to 1827 all the gold produced in the United States, amounting to $110,000, came from the mines of this state.[2] That part of the product of the gold mines of the state which was deposited in the United States Mint and its branches between 1804 and 1866 amounted to nearly $10,000,000.

After the working out of the principal placer deposits, and when the progress in quartz mining had reached the point where, owing to the fineness of the gold and the increasingly refractory character of the ores as the water level was reached, further profitable prosecution of mining with the crude machinery then in use had become a problem of doubtful solution, a decline took place in mining activity. This decline was greatly accentuated by the discovery in California in 1848 of rich placer deposits and by the beginning in 1851 of quartz mining in the same state, where high-grade, free-milling ores had been found in great abundance. Finally, the advent of the Civil War and the discontinuance of the branches of the United States Mint at Charlotte, N. C., and Dahlonega, Ga., brought to a practical close this long and interesting period of mining activity in the state's history.

Since 1866 mining for gold has been carried on in the state in a somewhat desultory way, and in later years other minerals and other sections of the state have claimed attention. The mineral wealth of the state is by no means confined to the eastern slope of the Blue Ridge—the principal gold belt. West of that range, between Smoky mountains and the Blue Ridge, and from the upper water of the French Broad river westward, there is a rich mining field.

Mica.—Mica is found in a half dozen or more counties in the state, most of which lie west of the Blue Ridge. The most noted localities are in Mitchell and Yancey counties on the waters of the Nolichucky between the Black mountain and the Roan. In this basin are a great many enormous ledges of granite from which the marketable mica is obtained.[3]

Modern mica mining in the state dates from 1870, since which time North Carolina has produced a very important percentage of the total yield of this mineral in the United States. In 1870 the entire reported product of the country was from this state. In 1880 it was 48.3 per cent; in 1890, 13.3 per cent; and in 1902, 59.9 per cent of the total.

There is one point of unusual interest connected with the history of mica mining in this state. The industry is not really a new one, but has only been revived. The present workings are continually cutting into ancient shafts and tunnels, and hundreds of spurs and ridges of the mountains, especially all over Mitchell county, are found to be honeycombed with extensive ancient workings of which no one knows the date or history. In one locality open pits 40 to 50 feet wide by 75 to 100 feet long, filled up to 15 or 20 feet of depth, are disposed along the sloping crest of a long terminal ridge or spur of a neighboring mountain. The excavated earth is piled in huge heaps about the margins of the pits and the whole overgrown with the heaviest forest trees—oak and chestnut—some of them 3 feet and more in diameter, and some of the largest, belonging to a former generation of forest growth, fallen and decayed.[3] It would thus appear that not less than three hundred years have passed since these pioneer toilers wrote in the unmistakable language of pits and tunnels the first chapter of the history of mining in the state. These old workings were at one time thought to be abandoned Spanish silver mines. There is no appearance, however, of a silver vein and no explanation of the object of these extensive works other than that they were for the purpose of obtaining the large plates of mica or crystals of cyanite, both of which abound in the coarse granite rock. It is known that mica was of common occurrence in the tumuli of the Mound Builders, among the utensils and ornaments which such primitive people were in the habit of burying with their dead. Many cut forms similar to those found in the mounds have been discovered among the rubbish and refuse heaps about and in these old pits. These facts reveal, therefore, the purpose and probable date of these ancient workings and show them to have been contemporary with the extensive copper mining operations of Lake Superior.[4]

Monazite.—The total product of monazite mining in the United States reported in 1902 came from the state of North Carolina. While the existence of monazite in commercial quantities in this state was first established in 1879, by Mr. W. E. Hidden, of New York, who, in the interest of Thomas A. Edison, the inventor, inspected the gold placers on a hunt for platinum, the first recorded product of monazite mining in the state was in 1887, and came from the Brindleton district, in Burke county.[5]

Iron ore.—The first recorded discovery of iron ore in North America occurred in the year 1585, in North

[1] The Minerals and Mineral Localities of North Carolina, page 12, and Geology of North Carolina, Vol. I, page 288 ff.
[2] United States Geological Survey, Sixteenth Annual Report, Part III, page 256.
[3] Geology of North Carolina, Vol. I, page 299.
[4] Geology of North Carolina, Vol. I, page 301.
[5] Minerals and Mineral Localities of North Carolina, pages 89 and 90.

Carolina. It was made by an expedition fitted out by Sir Walter Raleigh, and commanded by Ralph Lane, and which attempted to plant an English colony on Roanoke Island. The ore was found near the coast, and although the importance of the discovery was fully realized, no attempt was made to utilize it, as the colonists were then on a search for gold. It was many years after that a permanent settlement was made, and the industry of iron mining and manufacture was well under way in many other colonies before its beginning here.[1] Iron ores of high grade and in large quantities have been found in many sections of the state, and at different periods during the last hundred and twenty-five years the production of iron in the state was an industry of relatively marked importance. The ranges of iron ore deposits are widely distributed, but in the main fall within the following counties: Chatham, Orange, Guilford, Gaston, Lincoln, Catawba, Yadkin, Surry, Stokes, Mitchell, Ashe, Madison, Cherokee, and Johnston.[2] The product of the state is still small. That reported for 1902 came from Johnston, Madison, and Mitchell counties.

Barytes.—The commercial production of barytes in North Carolina, first noted at the census of 1889, is confined chiefly to Madison county, though deposits have also been found in Gaston, Orange, Cabarrus, and Union counties.[3] For the year 1902 the production of barytes was $44,130, or 21.7 per cent of the total product of the United States.

All other minerals.—Deposits of bituminous coal exist in the state in Stokes and Rockingham counties, in the valley of the Deep river. Coal has also been found in Chatham and Moore counties.[4] No statistics can be shown without disclosing individual operations.

Copper ore is found in many places in the state, the principal variety being chalcopyrite, or copper pyrites. Before the Civil War the industry of copper mining had made considerable headway. Many of the gold veins are associated with pyritic ores, practically all the old copper mines of the central part of the state having been worked first for gold. The general character of these mines was that at about water level the so-called "brown gold ores" were replaced by quartz richly charged with iron pyrites more or less mixed with copper pyrites, the latter increasing as the mine deepens, and in many places becoming the only or the predominating ores, and forming a regular copper vein. Perhaps the most valuable deposits of copper in the state are in Ashe, Alleghany, and Watauga counties; the most remarkable vein in this range is at Ore Knob, in the southeast corner of Ashe county, near the top of the Blue Ridge.[5]

Abrasive garnet is widely distributed through the state, and is a regular constituent of many of the mica and hornblende slates. Large crystals of a brownish red color are frequently met with in the mica mines of Mitchell and Yancey counties. The product of the North Carolina garnet mines has obtained the highest price in the market, $60 per ton. The total product of the state for 1902 was from Jackson county.

Graphite occurs in many localities in the state. The largest beds are in Wake county. Others occur in Lincoln, Cleveland, Catawba, Alexander, Stokes, Wilkes, Person, and Yancey counties.[6]

Limestones though not abundant are found in more than twenty counties, and distributed throughout the state. Those in the eastern part are a shell conglomerate, valuable both for building purposes and for the manufacture of lime. Those of the middle and western section are frequently crystalline, and in several counties, especially in Cherokee and Macon, constitute a very good marble.

Precious stones have been picked up at many places in the central and western part of the state. Among these have been a half dozen or more diamonds. The first one was found in 1843 by Dr. M. F. Stephenson, of Gainesville, Ga., at the ford of Brindleton creek, in Burke county, and was worth about $100.[7] Garnet crystals of great beauty and perfection and of various colors are found in Burke, Caldwell, and Catawba counties.[8] A peculiar green garnet has been found in the Covee valley, for which the name rhodolite has been generally adopted. Many emerald matrix specimens have been found at Crab Tree mountain in Mitchell county. Mining for amethyst has met with considerable success at Tesnaty, on the creek of that name, in Smith Bridge township, Mitchell county, where a large vein occurs in an altered pegmatite. Crystals are found from one-half to 3 inches in length, and in color they are light and dark, the dark spots often being of the deepest, richest purple. No finer amethysts have been found in the United States. Several thousand dollars worth of stones were sold from the first development work. A very interesting new form of moonstone has been found near Bakersville. The well-known occurrence of pink and red ruby corundum in a green amphibole

[1] Iron in All Ages, by James M. Swank, page 102 ff.
[2] Geology of North Carolina, Vol. I, page 218 ff.
[3] The Minerals and Mineral Localities of North Carolina, page 83.
[4] United States Geological Survey, Sixteenth Annual Report, Part IV, page 153.
[5] Geology of North Carolina, Vol. I, page 271 ff.
[6] Ibid., page 296.
[7] Ibid., page 57 of Appendix.
[8] The Minerals and Mineral Localities of North Carolina, page 47 ff.

(smaragdite) at Buck creek, Clay county, has been utilized as a new semiprecious stone. Pieces are selected in which the bright spots of red or pink ruby are inclosed in the bright green matrix. The stone is being introduced under the name of ruby matrix.

Sandstone of a superior quality has long been quarried in the state. It is found in two narrow zones, one lying along the valley of the Dan river, near and almost parallel to the northern boundary of the state, and the other lying in a northeast and southwest direction, nearly across the eastern side of the middle division of the state.[1] In many places it is of such character as to be well adapted to the purposes of millstones. Conglomerates, which are associated with the sandstone, have been made into excellent millstones, occasionally of such quality as to be almost equal to the French buhrstone. The rocks have been quarried for millstones in Anson, Moore, Madison, Person, Montgomery, and Rowan counties.[2] The total product of the state in 1902 was from Rowan county.

[1] Geology of North Carolina, Vol. I, page 304.
[2] Ibid., page 35.

NORTH DAKOTA.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of North Dakota for 1902.

TABLE 1.—*Summary: 1902.*

	All minerals.[1]
Number of mines or quarries	48
Number of operators	48
Salaried officials, clerks, etc.:	
Number	52
Salaries	$43,980
Wage-earners:	
Average number	298
Wages	$196,534
Contract work	$2,795
Miscellaneous expenses	$23,012
Cost of supplies and materials	$88,867
Value of product	$334,967

[1] Includes operators as follows: Cement, 1; and coal, bituminous, 47.

The lignite coal area of this state is of very great extent, equal to at least half the area of Ohio.[1] Although known for some time the coal fields are of only recent development. Some cement of good quality is manufactured.

There is also every reason to believe that large sandstone quarries will in time be developed, since there are a number of suitable locations only awaiting a sufficient demand to justify extensive development. Granite and gneiss are also found throughout the eastern half of the state, except in the Red river valley, but are not quarried in commercial quantities. The clay fields in the state are wholly undeveloped.[2]

The value of the products of the manufacturing industries of North Dakota, based primarily upon minerals mined and quarried as well as the value of all manufactured products of the state as reported at the Twelfth Census are presented in the following table:

[1] Geological Survey of North Dakota, Second Biennial Report, 1902, page 35.

[2] Ibid., pages 28 to 32.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$9,183,114
Based upon products of mines or quarries:		
Clay, glass, and stone products	$198,224	
Iron and steel and their products	103,511	
Metals and metal products, other than iron and steel	167,864	
Miscellaneous industries	874,560	
		1,344,159
All other		7,838,955

Table 2 shows that the value of products of manufactures of North Dakota in 1900, based primarily upon minerals mined and quarried, was $1,344,159, or 14.6 per cent of the total. The value of the output of the mines and quarries of the state in 1902 was $334,967, or 3.5 per cent of the combined value of products of manufacturing and mining in North Dakota.

The average number of wage-earners engaged in manufactures in North Dakota as reported at the Twelfth Census was 2,398, and the wages paid amounted to $1,222,472. The average number of wage-earners engaged in mining and quarrying in the state in 1902 was 298, and the wages paid were $196,534. The total number of wage-earners, therefore, employed in mining and manufacturing industries was 2,696, and their wages amounted to $1,419,006. On the basis of these figures, those engaged in manufactures constitute 88.9 per cent of the total number of wage-earners, while their wages amount to 86.1 per cent of the total paid. The wage-earners employed in mining industries constitute 11.1 per cent of the total number employed, and they received 13.8 per cent of the wages paid.

Coal.—Lignite coal in North Dakota underlies an area of 28,620 square miles. This area is a part of the

so-called Rocky mountain coal field, which also includes the coal areas of Montana, Wyoming, Utah, Colorado, New Mexico, Idaho, and Nevada.[1] The earliest production of coal worthy of statistical notice was produced in 1884.[1] The North Dakota variety does not stand transportation well, and consequently can not compete with bituminous coal, except when the latter is high priced. To be sold at a profit, therefore, North Dakota coal must at present find a comparatively local market.[1]

In 1902 the mines of the 47 operators reporting were located in Burleigh, McLean, Morton, Stark, and Ward counties. The total output was 226,511 short tons. Ward county produced 93,786 tons of this amount.

The following figures taken from the reports of the United States Geological Survey show the quantity and value of the coal mined in the state since 1884:

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 402.

TABLE 3.—*Annual production of coal, bituminous: 1884 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	Value.	YEAR.	Short tons.	Value.
1884	35,000	(1)	1894	42,015	$47,049
1885	25,000	$91,000	1895	38,997	41,646
1886	25,955	41,277	1896	78,050	84,908
1887	21,470	32,205	1897	77,246	88,803
1888	34,000	119,000	1898	83,895	93,691
1889	28,907	41,431	1899	98,809	117,500
1890	30,000	42,000	1900	129,883	158,348
1891	30,000	42,000	1901	166,601	214,151
1892	40,725	39,250	1902	226,511	325,967
1893	49,630	56,250			

[1] Not reported.

Cement.—No data relative to the single cement plant in the state can be shown without disclosing individual operations. However, it may be said that the plant has been erected about five years and has been a successful though not a very large producer. The plant is located at Pembina, on the Tongue river.[2]

[2] United States Geological Survey, "Mineral Resources of the United States," 1902, page 802.

OHIO.

Table 1 is a summary of statistics for the productive mines, quarries, and wells in the state of Ohio for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Petroleum.	Limestones and dolomites.	Natural gas.	Sandstones and quartzites.[1]	Cement.	Grindstones and pulpstones.	All other minerals.[2]
Number of mines, quarries, and wells	44,934	648	42,483	259	1,352	115	7	7	63
Number of operators	11,338	513	10,002	249	417	91	7	7	52
Salaried officials, clerks, etc.:									
Number	2,530	1,314	450	205	241	200	49	22	49
Salaries	$2,551,083	$1,222,966	$629,369	$155,451	$221,837	$218,590	$57,838	$10,792	$34,240
Wage-earners:									
Average number	37,173	25,903	4,017	3,065	699	2,363	375	189	552
Wages	$23,222,080	$16,693,464	$2,915,787	$1,454,328	$441,581	$1,171,674	$227,548	$64,288	$254,010
Contract work	$2,701,557	$46,818	$2,212,923	$7,276	$433,026				$1,514
Miscellaneous expenses	$7,711,026	$1,619,451	$4,896,861	$139,648	$491,223	$437,827	$71,829	$9,982	$44,205
Cost of supplies and materials	$10,126,452	$2,082,788	$5,504,792	$560,402	$1,139,201	$526,521	$231,322	$19,777	$61,789
Value of product	$57,186,922	$26,953,789	$20,767,359	$3,204,998	$2,355,458	$2,078,754	$714,551	$560,412	$561,601

[1] Includes operating expenses for the production of grindstones and pulpstones, valued at $399,726.
[2] Includes operators as follows: Clay, 31; gypsum (operator reported in Michigan); iron ore, 9; oilstones, whetstones, and scythestones, 1; phosphate rock, 1; silica sand, 7; sulphur and pyrite, 3.

The coal fields of Ohio are extensive and have been yielding over 10,000,000 tons annually since 1889. The petroleum and natural-gas output is very large, a number of the most productive wells in the country being found in this state. Some of Ohio's building stones are among the finest in the United States, and find a ready market. Practically the entire output of grindstones and all the pulpstones produced in this country come from this state. To supply its extensive iron and steel industries Ohio depends on other states for the necessary iron ore, as its own deposits are not rich either in quantity or quality. Ohio is one of the leading states in the manufacture of Portland cement, and has long been a producer of natural rock cement. Sandstone abounds and when crushed and screened is used in glassmaking and for other purposes. Large and valuable deposits of clay aid in giving the state its leading position in the clay working industries.

In addition to the minerals referred to in Table 1, strontium ore is found at Put in Bay, Ottawa county, but none has been produced in commercial quantities since 1897.

The operators reporting active mines and wells, but no production, gave employment to 204 wage-earners and paid $122,722 in wages during 1902. The cost of supplies and materials amounted to $27,912, and of contract work to $14,174.

The relative importance of manufacturing industries closely allied to or based upon the mining industry, using as their raw material the product of the mine or quarry, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$832,438,113
Based upon products of mines or quarries:		
Chemicals and allied products	$18,795,206	
Clay, glass, and stone products	20,680,884	
Iron and steel and their products	255,219,520	
Metals and metal products, other than iron and steel	16,451,954	
Miscellaneous industries	27,722,917	
		347,820,571
All other		484,617,542

From the foregoing table it will be seen that the value of the products of manufactures based primarily upon minerals mined and quarried was $347,820,571, or 41.8 per cent of the total. The value of the output of the mines, quarries, and wells of Ohio for 1902 was $57,186,922, or 6.9 per cent of the total value of all manufacturing and mining products for the state.

The Twelfth Census reported the average number of wage-earners engaged in manufactures in Ohio as 345,869 and the wages paid as $153,955,330. The average number of wage-earners engaged in mining in 1902

was 37,173, and the wages paid were $23,222,680. The manufacturing and mining industries combined gave employment to 383,042 wage-earners and paid $177,178,010 in wages. Manufactures employed 90.2 per cent of the wage-earners and paid 87 per cent of the wages, while mining employed 9.8 per cent of the wage-earners and paid 13 per cent of the total wages.

The following table, compiled from the reports of the United States Geological Survey, shows the value of the annual production of the principal minerals of this state from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Petroleum.	Limestones and dolomites.	Natural gas.	Sandstones and quartzites.	Cement.
1890	$10,783,171	$5,644,105	$1,514,934	$4,684,300	$3,046,656	$49,000
1891	12,106,115	5,576,705	1,250,000	3,076,325	3,200,000	82,000
1892	12,722,745	6,239,039	2,025,000	2,136,000	3,300,000	108,500
1893	12,351,139	8,124,342	1,848,063	1,510,000	2,201,932	85,500
1894	9,841,723	9,206,293	1,733,477	1,276,100	1,777,034	144,425
1895	10,618,477	16,399,242	1,568,713	1,255,700	1,449,659	239,221
1896	10,253,461	17,693,438	1,399,412	1,172,400	1,679,265	267,892
1897	9,535,409	11,232,998	1,486,550	1,171,777	1,600,058	256,291
1898	12,027,336	12,205,210	1,673,160	1,488,308	1,494,746	465,276
1899	14,361,903	20,960,304	1,793,604	1,866,271	1,775,642	721,473
1900	19,292,246	24,091,601	1,969,387	2,178,234	2,233,596	667,769
1901	20,928,158	20,533,571	2,606,502	2,147,215	2,576,723	758,837
1902[1]	26,953,789	20,757,359	3,204,998	2,365,458	2,078,754	714,551

[1] Census figures.

Coal.—The coal fields of Ohio underlie between 10,000 and 12,000 square miles of the state area, and are located in some thirty counties in the eastern and southeastern portion of the state. They belong to the northern Appalachian system, which also includes the coal areas contained in western Pennsylvania, Maryland, Virginia, West Virginia, and eastern Kentucky. The coals are all of the bituminous variety and are known in general terms as block, gas, cannel coal, etc., and by special names indicating the producing localities. At what period the deposits first became known is uncertain, but they were known to exist certainly as early as 1770.[1] Although some coal was undoubtedly produced prior to 1828,[2] when the first recorded shipment was made, the first production recorded was in 1838. The history of the output was not kept with any accuracy before 1872.

Of the 29 coal producing counties in Ohio in 1902, 9 had a production of 1,000,000 tons or over, and of the 648 mines 2 had an output of 1,000,000 tons or over, and 51 an output of 100,000 tons or over. The largest coal producing counties were Athens, Belmont, Guernsey, Hocking, Jackson, Jefferson, Perry, Stark, and Tuscarawas. Ohio ranked second in quantity of product among the coal states until 1883, when Illinois outranked it; in 1896 West Virginia ranked third, Ohio taking fourth place. This place it still held in 1902, although in value of coal produced it ranked third.

The following table shows the annual production of coal in Ohio from 1838 to 1902. The figures for many of the years prior to 1872 are estimates.

TABLE 4.—*Annual production of coal, bituminous: 1838 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1838	119,952	1871	4,000,000
1839	125,000	1872	5,315,294
1840	140,535	1873	4,550,028
1841	160,000	1874	3,267,585
1842	225,000	1875	4,864,259
1843	280,000	1876	3,500,000
1844	340,000	1877	5,250,000
1845	390,000	1878	5,500,000
1846	420,000	1879	6,000,000
1847	480,000	1880	7,000,000
1848	540,000	1881	8,225,000
1849	600,000	1882	9,450,000
1850	640,000	1883	8,220,429
1851	670,000	1884	7,640,062
1852	700,000	1885	7,816,179
1853	760,000	1886	8,435,211
1854	800,000	1887	10,300,708
1855	890,000	1888	10,910,951
1856	930,000	1889	9,976,787
1857	975,000	1890	11,494,506
1858	1,000,000	1891	12,868,688
1859	1,060,000	1892	13,562,927
1860	1,133,596	1893	13,253,646
1861	1,150,000	1894	11,909,856
1862	1,200,000	1895	13,355,806
1863	1,204,581	1896	12,875,202
1864	1,815,622	1897	12,196,942
1865	1,536,218	1898	14,516,867
1866	1,887,424	1899	16,500,270
1867	2,092,334	1900	18,988,150
1868	2,475,844	1901	20,943,807
1869	2,461,986	1902	23,519,894
1870	2,830,559		

Petroleum.—As early as 1814 petroleum was obtained in brine wells, but it was not until after Drake's discovery on Oil creek, Pa., in 1859, that the oil region in the southeastern part of Ohio began to attract attention.[3] The Trenton rock, or Lima district, in the northwestern part of the state, did not receive any serious consideration until 1885, when the great Cincinnati arch began to be looked upon as a probable factor in the crude petroleum field.[4] The Trenton rock petroleum comes from a limestone instead of a sandstone formation, is dark in color, and contains a considerable quantity of sulphureted hydrogen, making it rather refractory for refining purposes. The Lima district, extending through Wood, Hancock, Allen, Sandusky, Auglaize, Mercer, Van Wert, Lucas, Wyandot, and Ottawa counties, has been one of the largest producers in the United States, and in 1902 its production was about 75 per cent of the petroleum produced in Ohio.

Since 1895 Ohio has ranked first among the petroleum producing states. In 1902 its 42,483 wells had an output of 21,014,231 barrels, or nearly 24 per cent of the entire production of the United States for that year. While Ohio's petroleum output for 1902 was less than that for 1901, the product sold at an increase in price averaging 4 cents per barrel.

[1] One Hundred Years of American Commerce, Vol. I, page 178.
[2] United States Geological Survey, Twenty-second Annual Report, Part III, page 216.
[3] Tenth Census, Vol. X, page 12.
[4] United States Geological Survey, "Petroleum Bulletin," 1902, page 90.

The following table shows the annual production of petroleum in Ohio from the beginning of operations until the close of 1902:

TABLE 5.—*Annual production of petroleum: 1876 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
Total	283,751,317	1888	10,010,868
		1889	12,471,466
Previous to 1876	200,000	1890	16,124,656
1876	31,763	1891	17,740,301
1877	29,888	1892	16,362,921
1878	38,179	1893	16,249,769
1879	29,112	1894	16,792,154
1880	38,940	1895	19,545,233
1881	33,867	1896	23,941,169
1882	39,761	1897	21,560,515
1883	47,632	1898	18,738,708
1884	90,081	1899	21,142,108
1885	661,580	1900	22,362,730
1886	1,782,970	1901	21,648,083
1887	5,022,632	1902	21,014,231

Limestones and dolomites.—These stones are mentioned in the Second Annual Report of the Geological Survey of Ohio as having been used as early as 1838 for building, burning into lime, macadamizing roads, and even for ornamental purposes. They are almost uniformly of a dull color, and though in many cases durable and strong, are entirely unfit for any sort of fine building or ornamental work. They are, therefore, used chiefly for the rough work of foundations, street paving, and flagging, and to a very large extent for making quicklime.[1]

Ohio in 1902 ranked third in value of product in the list of limestone producing states, being exceeded by Pennsylvania and Illinois.

Natural gas.—There are three natural gas fields in Ohio. The first known field was along the eastern margin of the state, where occur the sands of the Lower Coal Measures, the Waverly Series, and the Ohio shales. The second field, the last to be developed, is in the central portion of the state and receives its natural gas from the Clinton limestone of the Upper Silurian series. The third field is found in the northwestern portion of the state and obtains its natural gas exclusively from the upper portion of the Trenton limestone of the Lower Silurian series. Natural gas was first used in Ohio in 1866 in the manufacture of lampblack at Gambier, Coshocton county; in 1874 it was used at East Liverpool, in the household, for heat and light. The great Trenton rock gas field was first opened at Findlay in November, 1884, and the Lancaster gas field was developed by a well drilled near that city in 1887.[2] The gas produced from the eastern portion of the state was not developed in sufficient quantities to warrant the piping of it to far distant localities, but it has been an important factor in supplying many nearby towns and industries.

[1] Stones for Building and Decoration, by George P. Merrill, page 319.

[2] United States Geological Survey, "Mineral Resources of the United States," 1902, page 645.

The value of the natural gas produced in Ohio in 1902 was $2,355,458, which is an increase of $208,243 over 1901. The greatest production was in 1889, after the great Findlay gas field had been first opened; the smallest production was in 1897, just before the Lancaster and Sugar Grove pools were developed. Of the 1,352 wells in operation during 1902, the 637 wells located in the counties of Fairfield, Franklin, Hancock, Licking, Knox, Belmont, Guernsey, Noble, and Mercer produced natural gas valued at $2,107,731. The remaining 715 wells were located in the following counties: Allen, Ashtabula, Auglaize, Columbiana, Cuyahoga, Darke, Hardin, Harrison, Holmes, Lake, Logan, Lorain, Lucas, Monroe, Morgan, Ottawa, Sandusky, Stark, Van Wert, Washington, and Wood.

Sandstones and quartzites.—Quarries of excellent sandstone abound in Ohio, of which the so-called Waverly group are the most important for building purposes.[3] The greatest sandstone deposits, known geologically as the Berea grit, are located in Cuyahoga and Lorain counties. The stone, of a very light buff, gray, or blue-gray color, is famous for its evenness of color and purity of texture, and for building purposes finds a ready market throughout the United States. The value of the sandstone quarried in these two counties in 1902 for building purposes amounted to $828,284.

The value of the sandstones and quartzites production of Ohio for 1902, $2,078,754, is exceeded only by that of Pennsylvania. These figures do not include the value of stone quarried for grindstones and pulpstones. The 115 quarries operated during 1902 were located in the following counties, arranged according to the value of the production: Cuyahoga, Lorain, Scioto, Fairfield, Summit, Erie, Richland, Morrow, Belmont, Carroll, Huron, Muskingum, Mahoning, Trumbull, Crawford, Holmes, Harrison, Jefferson, Stark, Morgan, Tuscarawas, Washington, Meigs, Pike, Columbiana, Ashtabula, Guernsey, Licking, Delaware, Miami, Pickaway, Highland, and Perry.

Cement.—Among the first cement plants to be established was a small one at Sandusky, about 1845. In 1846 a plant was established at Defiance, and in 1858 at Barnesville. The first Portland cement plant was established in 1889.[4] In 1902 Ohio ranked seventh among the states manufacturing this material. While the growth of this industry in Ohio has been steady, it has not been as marked as in some other states. In 1890 the production amounted to only 57,000 barrels while in 1902 it amounted to 563,113 barrels. But one company now produces natural rock cement.

Grindstones and pulpstones.—Four-fifths of all the grindstones produced in the United States are quarried in Ohio, the sandstone known as the Berea grit being the greatest source of supply. The 7 quarries operating

[3] Stones for Building and Decoration, page 154.

[4] United States Geological Survey, "Mineral Resources of the United States," 1902, page 803.

in 1902 were located in Cuyahoga, Stark, Jefferson, Athens, and Washington counties. The value of the total output in Ohio was $560,412, while that of the United States was $667,431.

The following table shows the value of the annual production of grindstones, 1899 to 1902, it being impossible to segregate the production from the total for the United States previous to 1899:

TABLE 6.—*Value of annual production of grindstones: 1899 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Value.	YEAR.	Value.
1899	$480,963	1901	$548,844
1900	542,721	1902	560,412

All other minerals.—The value of raw clay produced by the 31 operators in 1902 was $101,305.

The single gypsum plant in the state is near Gypsum, in Ottawa county. The product is converted principally into wall plaster.

The first blast furnace in Ohio was completed in 1804, in Mahoning county,[1] and it is probable that iron ore was first mined in this state about that time. The Hanging Rock district, in Lawrence county, along the Ohio river, was once quite a source of supply, but during late years the quantity of iron ore mined in Ohio has steadily decreased, owing probably to the inferiority of the ore. In 1889 the production of iron ore in Ohio amounted to 254,294 long tons, while in 1902 it was only 22,657 long tons.

The silica sand production for 1902 was valued at $152,274. A little less than a quarter of this crushed sandstone is used in the manufacture of glass.

At a number of the quarries in the Berea sandstone district a grade of stone is found suitable for making whetstones. The well-known Deerlick oilstone is made at Chagrin Falls, Cuyahoga county. The value of the production of whetstones and oilstones in Ohio can not be shown separately without disclosing the operations of an individual establishment.

The pyrite produced by three operators in Tuscarawas county is a by-product of coal. The phosphate rock produced is found in Mahoning county.

[1] Iron in All Ages, by James M. Swank, page 301.

OKLAHOMA.

Table 1 is a summary of the statistics for the productive quarries and wells in the territory of Oklahoma for 1902:

TABLE 1.—*Summary: 1902.*

	Total.	Limestones and dolomites.	All other minerals.[1]
Number of quarries and wells	21	12	9
Number of operators	17	12	5
Salaried officials, clerks, etc.:			
Number	18	4	14
Salaries	$12,223	$3,035	$9,188
Wage-earners:			
Average number	128	46	82
Wages	$64,545	$22,277	$42,268
Miscellaneous expenses	$15,830	$840	$14,990
Cost of supplies and materials	$31,934	$6,737	$25,197
Value of product	$186,706	$50,541	$136,165

[1] Includes operators as follows: Gypsum, 3 (5 quarries); petroleum, 1 (3 wells); sandstones and quartzites, 1.

From the above table it appears that mining in Oklahoma during 1902 was confined to the quarrying of limestone, gypsum, sandstone, and the operation of three petroleum wells. Gypsum is by far the most important product of mineral industry in the territory.

Many stories have been circulated from time to time regarding old Spanish mines existing in Oklahoma,[1] but they have little foundation. It is claimed, however, that dates cut in the rocks in the Wichita mountains[2] indicate the discovery of gold as early as 1832. These mountains are located in the forbidden ground of the Kiowa and Comanche reservation in the southwestern part of the territory, and prospectors or miners are not allowed to explore the locality.

There are indications in many parts of the territory of the occurrence of coal, asphalt, zinc, lead, copper, iron, cobalt, mica, clay, and cement,[3] but no production of these minerals was reported in 1902. Coal has been obtained in small quantities in Pawnee county and in the Osage reservation, and is also known to occur in Payne, Lincoln, Logan, and Pottawatomie counties and in the Kiowa and Comanche reservation.

Deposits of copper occur near Kenton in the extreme western end of Beaver county; zinc and lead are found in several places in eastern Oklahoma and in the Kiowa and Comanche reservation; and asphalt is known to occur in Comanche and Kiowa counties, in some places even oozing from the ground. Natural gas in small quantities is found in Kay and Greer counties, but no profitable flow has been obtained.[4]

An excellent quality of dolomitic limestone is found in Blaine county and deposits of granitic rocks occur in the Wichita mountains. Cement is found in a number of localities, and beds of clay suitable for the manufacture of building and paving brick occur in various parts of the territory. Cobalt and iron ore are among the minerals reported by Lewis and Clarke in their exploration into this territory in 1803 to 1807.

The value of the products of those manufacturing industries based primarily on the products of mines and quarries is shown in Table 2 in comparison with the total value of products of all manufactures.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$7,083,938
Based upon products of mines or quarries:		
Clay, glass, and stone products	$252,072	
Iron and steel and their products	59,250	
Metals and metal products, other than iron and steel	123,418	
Miscellaneous industries	188,881	
		623,621
All other		6,460,317

As shown in the above table the manufactures of Oklahoma, based on the products of mines and quarries, represent but 8.8 per cent of the total of all manufactures. The mineral industry is insignificant when compared with manufacturing in the territory; the value of the product of mines, quarries, and wells in 1902 being only 2.6 per cent of the total obtained by combining the total value of manufactured products in 1900 with the total value of the products of mines, quarries, and wells in 1902.

At the Twelfth Census manufactures were reported as giving employment to 2,054 wage-earners who were paid $807,826 in wages. Mines and quarries in 1902

[1] Report of the Governor of Oklahoma, 1899, page 79.
[2] Ibid., 1903, page 69.
[3] Ibid., 1899, pages 78 and 79.
[4] Report of the Governor of Oklahoma, 1901, page 102.

employed 128 wage-earners and paid $64,545 in wages. Manufactures therefore contributed 94.1 per cent of the wage-earners of the two industries and paid 92.6 per cent of the wages, while mines and mining gave employment to 5.9 per cent of the wage-earners and paid 7.4 per cent of the wages.

Limestones and dolomites.—Quarrying operations for limestones and dolomites are extensively carried on in Kay county, which locality reports the only commercial production in 1902. The value of the output from the 12 productive quarries was $50,541. The stone was used principally for building, flagging, and curbing.

During 1901 the product of the limestone quarries was chiefly crushed stone used for railroad ballast, building purposes, etc., and was valued at $32,497.[1]

All other minerals.—One of the most promising natural products of Oklahoma is gypsum, for which a considerable development is reported during the past few years, due principally to the extension of railroads through the territory.[2] In 1852, in his account of this locality, Marcy made the statement that the discovery of gold in the Wichita mountains would attract more attention, but that the gypsum beds would be worth more than the gold.

Extending across the territory are great ledges of gypsum. In some places along the rivers and creeks, this soluble rock has succumbed to the action of the water, and caves, tunnels, natural bridges, and fantastic figures have been produced. Only the most convenient and advantageous outcrops have thus far been quarried.[3]

The following table, compiled from reports of the United States Geological Survey, shows the annual production of gypsum from 1898 to 1902:

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 697.
[2] Ibid., page 906.
[3] Report of the Governor of Oklahoma, 1900, page 79.

TABLE 3.—*Annual production of gypsum: 1898 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Quantity (short tons).	Value.
1898	3,150	$12,000
1899	11,526	36,000
1900	18,437	60,380
1901	15,930	66,031
1902	34,156	111,215

In 1902 the territory's production of gypsum was quarried in the counties of Blaine, Caddo, Canadian, and Kay. The product is reported to be of the same character as that obtained in Kansas,[4] and it was all calcined as wall plaster or plaster of Paris. The first commercial production was reported in 1894, and amounted to 1,300 short tons valued at $7,500. No operations were reported during the next three years, but in 1898, 3,150 short tons were produced valued at $12,000, and since then there has been a steady increase.

Sandstone occurs as a surface rock in almost every county in Oklahoma, varying in texture from a coarse, rotten shale to a hard, fine grained stone.[5] The production in the territory for 1902 was all quarried in Logan county. It was used chiefly in the rough for foundations and similar building purposes, and also in small quantities as crushed stone for roadmaking.

There were three producing petroleum wells in the territory in 1902, all in Greer county. Two of them were drilled during the year. The petroleum is a heavy black lubricating oil, and it is found in hard, porous rock. Indications of large oil deposits occur in various parts of the territory,[6] notably in the Osage reservation and in Payne, Lincoln, Pottawatomie, Oklahoma, Comanche, and Kiowa counties.

[4] The Mineral Industry, 1897, Vol. VI, page 392.
[5] Report of the Governor of Oklahoma, 1901, page 102.

OREGON.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Oregon for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Gold and silver.	Coal, bituminous.	Siliceous crystalline rocks.	Limestones and dolomites.	All other minerals.[1]
Number of mines or quarries	294	262	9	10	7	6
Number of operators	293	262	9	10	6	6
Salaried officials, clerks, etc.:						
Number	153	110	32	3	1	7
Salaries	$180,103	$146,473	$27,660	$2,590	$1,200	$11,180
Wage-earners:						
Average number	1,166	855	211	35	19	46
Wages	$1,033,075	$816,711	$144,801	$25,454	$10,102	$36,007
Contract work	$19,522	$19,197				$325
Miscellaneous expenses	$143,748	$114,402	$25,737	$977	$120	$2,512
Cost of supplies and materials	$408,112	$299,705	$86,355	$1,496	$1,220	$16,336
Value of product	$2,087,389	$1,851,853	$160,075	$38,429	$20,133	$16,899

[1] Includes operators as follows: Borax, 1; copper, 2; gypsum, 1; nickel and cobalt, 1; sandstones and quartzites, 1.

In the Blue mountain region and the Rogue river section of the state are the principal gold producing localities. Although silver bearing ore is quite widely diffused, the production reported was principally obtained in the form of alloy with gold. The presence of more or less important coal deposits is indicated by outcroppings throughout the western and northwestern parts of the state and in Coos county. The deposits of stone promise unlimited supplies of building material.[1] Gypsum, used in making land plaster, occurs in Baker county; borax is found in Harney county; deposits of copper are known to exist in many portions of the state; and nickel ore occurs in Douglas county.

In addition to the production reported, valuable mineral deposits occur in many portions of the state. Some of these regions have been prospected or operated to a considerable extent, while others await only the advent of transportation facilities or the expenditure of sufficient capital in development to make them valuable workings. A synopsis of the principal of these known occurrences is herewith given, compiled chiefly from the facts given in the third revised edition of "The Resources of the State of Oregon," as collected and prepared by the state board of agriculture.

Antimony occurs in Jackson county, and asbestos of good fiber is found in the southern and eastern part of the state. Alkaline salts, potash, sodium, and niter, and also borax, for which a production is reported in 1902, are obtainable from lakes and springs in the arid region, east of the Cascades. Natural cement is reported in Douglas county and chrome iron ore or chromite in a condition of remarkable purity and in almost exhaustless quantity is being developed in the serpentine formations of Coos, Curry, Douglas, and Josephine counties. Clay is found in Clackamas, Clatsop, and Coos counties; glass sand exists in streams flowing from granite rocks; and graphite and infusorial earth are obtained in Jackson county.

Important deposits of iron ores exist, chiefly in basalt, in twelve counties, for the most part in the western half of the state, although occurrences are also noted in Umatilla and Grant counties in the Blue mountains. Lead is found in Clackamas, Grant, and Linn counties, principally as galena. Magnesite and other refractory minerals are obtainable, at least in small quantities, in the serpentine rocks of southern Oregon. Manganese ore occurs in Columbia county, in the northern part of the state; marble is found in Josephine and Wallowa counties, and platinum and iridium in lodes are believed to exist in the south, principally in Coos, Curry, and Douglas counties. Of the precious stones, jet has been found in Clatsop county, while opals, serpentine, and chrysoprase, generally useful for ornamental purposes and occasionally rising to the dignity of gems, have all been reported in the state. Quicksilver has been noted in Douglas and Jackson counties, and zinc is known to exist in the Cascade range in Lane and Linn counties, chiefly in the form of zinc blende.

Nonproductive development operations were carried on quite extensively in 1902, 192 operators reporting expenditures as follows: Salaries, $162,184; wages, $805,855; contract work, $75,594; cost of supplies and materials, $241,161; and miscellaneous expenses, $47,191. These operations are reported for gold and silver, quicksilver, and coal (bituminous), named in the order of the amount expended.

[1] The Resources of Oregon, pages 29 to 42.

The relative importance among manufactures of manufacturing industries closely allied to or based upon the mining industry, using as their raw material the product of mine or quarry, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$46,000,587
Based upon products of mines or quarries:		
Chemicals and allied products	$148,559	
Clay, glass, and stone products	524,097	
Iron and steel and their products	1,116,654	
Metals and metal products, other than iron and steel	893,657	
Miscellaneous industries	2,758,294	
		5,441,861
All other		40,558,726

As presented in the above table, the manufactures intimately related to mining and quarrying were valued at $5,441,861, which amount is about two and one-half times the total products of the mineral industry in the state and 11.8 per cent of the total of all manufactures. The product of mining and quarrying in 1902 was $2,087,389, or 4.3 per cent of the combined value of the product of manufactures in 1900 and of mines and quarries in 1902. Manufactures in 1900 gave employment to 17,236 wage-earners, who received $8,333,533 in wages. Mines and quarries in 1902 gave employment to 1,166 wage-earners and paid $1,033,075 in wages. Of the combined figures for the two industries—18,402 wage-earners and $9,366,608 paid in wages—manufactures gave employment to 93.7 per cent of the wage-earners and paid 89 per cent of the wages, while mines and quarries employed but 6.3 per cent of the wage-earners and paid 11 per cent of the wages.

The following table, compiled from the reports of the United States Geological Survey, shows the value of the annual production of the principal minerals reported for the state from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Gold.[1]	Coal, bituminous.	Silver.[1]	Siliceous crystalline rocks.	Limestones and dolomites.
1890	$1,100,000	$177,875	$96,969	$44,150	(2)
1891	1,640,000	155,478	297,374	3,000	(2)
1892	1,400,000	148,546	70,077	6,000	(2)
1893	1,645,800	164,500	15,257	11,255	$15,100
1894	2,118,356	183,914	10,351	4,993	(2)
1895	888,300	247,901	65,930	1,728	970
1896	1,251,000	294,564	78,998	2,449	1,600
1897	1,353,100	313,890	89,212	1,125	(2)
1898	1,177,600	212,184	168,081	(2)	7,480
1899	1,429,500	260,917	173,641	3,012	8,000
1900	1,694,700	220,001	[3]71,548	5,313	10,900
1901	1,818,100	178,646	[3]96,060	10,754	24,620
1902[4]	1,816,700	160,075	[3]49,449	38,429	20,133

[1] Estimates of the Director of the Mint, value of the refined product; silver at coining value. The values given in Table 1 are the values at the mine.
[2] Not reported separately.
[3] Commercial value.
[4] Census figures, except for gold and silver.

Table 3 shows that there was a slight decrease in mineral production during the past several years, siliceous crystalline rocks being the only industry reporting an increase over 1901. The gold production during 1902 was only slightly less than during the previous year and was considerably greater than that reported at the beginning of the decade.

Gold and silver.—Gold was discovered on the Coquille river in 1852 and along other streams in southern and eastern Oregon.[1] The Blue mountain region is the principal gold producing place, with the Rogue river section second in importance. Placer mining is more productive in the western, and quartz in the eastern part of the state. The first quartz mining was reported in 1860.

Silver bearing ore is quite widely diffused, but the percentage of the precious metal is often disappointing. The silver reported is principally obtained in the form of alloy with gold, but important discoveries in lodes have been prospected and promise well.

The annual production of gold and silver from 1891 to 1902 is given in the following table:

TABLE 4.—*Annual production of gold and silver: 1891 to 1902.*

[Reports of the Director of the Mint.]

YEAR.	Gold (fine ounces).[1]	Silver (fine ounces).[1]	YEAR.	Gold (fine ounces).[1]	Silver (fine ounces).[1]
1891	79,335	230,000	1897	65,456	69,000
1892	67,725	54,200	1898	56,966	130,000
1893	79,592	11,800	1899	69,152	134,300
1894	102,234	8,006	1900	81,980	115,100
1895	42,972	51,000	1901	87,950	160,100
1896	60,517	61,100	1902	87,881	93,300

[1] Estimates of the Director of the Mint are for the refined product.

Coal, bituminous.—The coal production is obtained principally from Coos county, where it has been mined since the early fifties.[1] Outcroppings indicate the existence of deposits throughout the western and northwestern parts of the state as well as in the Blue mountain region. The coal produced is mainly lignite, with an average of less than 50 per cent fixed carbon, a considerable proportion of water, and from 5 to 20 per cent of ash. Oregon coal is free burning and well adapted for steam and heating purposes, although it will not coke. The following table shows the annual production from 1885 to 1902:

TABLE 5.—*Annual production of coal, bituminous: 1885 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.	YEAR.	Short tons.
1885	50,000	1891	51,826	1897	107,289
1886	45,000	1892	34,661	1898	58,184
1887	37,696	1893	41,683	1899	86,888
1888	75,000	1894	47,521	1900	58,864
1889	64,859	1895	73,685	1901	69,011
1890	61,514	1896	101,721	1902	65,648

[1] The Resources of Oregon, pages 29 to 42.

The annual product has varied considerably, the year of least production being 1892. The greatest production was reported in 1897; since that time a decreased product has been shown. In 1902 development operations were reported which indicated an increasing interest.

Siliceous crystalline rocks.—Rocks of volcanic origin predominate in the state; among them are the andesites, the true basalts, the trachytes, and the tufas or fragmentary rocks. In 1902 the entire production was reported from Baker, Benton, Gilliam, Jackson, Marion, Multnomah, and Union counties. It was valued at $38,429.

The production during 1902 showed a decided increase as compared with the years following 1890. This increase in 1902 is chiefly attributed to the more extensive use of the stone as a paving material and in roadmaking.

Limestones and dolomites.—Limestone deposits at present commercially worked occur in Baker and Wallowa counties in the northeastern, and Jackson and Josephine counties in the southwestern part of the state. In Grant and Union counties there are valuable deposits,[1] the latter county being covered to a large extent with blue limestone. During 1902 the entire production, valued at $20,133, was used in lime burning; in 1901 a value of $12,420 was reported for lime burning; in 1900, $10,525; and in 1899, $8,000. There was thus a steady increase in the use of limestone for this purpose. The comparatively large product shown for 1901 included a value of $12,100 quarried for paving and roadmaking, while during 1902 siliceous crystalline rocks were more extensively used as a paving material and no limestone was reported except for lime burning.

All other minerals.—The entire production of borax in 1902 was reported by one company in Harney county, although borax and various other alkaline soluble salts are found also in Klamath and Lake counties. The arid plains of this region are of late volcanic origin and contain lakes with no outlets, carrying useful salts in heavy solution. All the production reported was subinitted to a process of crystallization before being marketed.

The copper produced is chiefly copper-glance and native copper, carrying gold, and it occurs chiefly in fissure veins. Deposits are known to exist in many parts of the state, notably the native ore and chalcopyrite of the Santiam region in Linn county, the sulphides of the eastern Oregon gold quartz mines, and the native copper of Union and Baker counties.[2] The 1902 production was reported by one company in Josephine county in southern Oregon, and was all reduced by smelting.

A considerable production of gypsum was reported in Baker county, none of which was sold in crude state, all being prepared as land plaster, wall or cement plaster, or plaster of Paris. As only one company was engaged in this production the statistics can not be given separately, because to do so would disclose the operations of an individual establishment.

Nickel ore occurs, in association with garnierite, chromite, magnetite, chrysoprase, chalcedonic quartz, and serpentine minerals, principally in Douglas county.[2] A small production was reported for 1902.

[1] The Resources of Oregon, pages 29 to 42.

[2] The Resources of Oregon, pages 24 to 42.

PENNSYLVANIA.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of Pennsylvania for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Coal, anthracite.	Petroleum.	Natural gas.	Cement.	Limestones and dolomites.	Slate.	Sandstones and quartzites.
Number of mines, quarries, and wells	48,672	1,023	334	40,444	5,408	17	907	91	283
Number of operators	12,266	514	119	9,808	363	14	896	84	258
Salaried officials, clerks, etc.:									
Number	9,368	3,830	3,014	550	718	207	287	259	252
Salaries	$9,592,910	$4,142,497	$2,907,293	$686,098	$769,042	$250,252	$228,826	$190,555	$177,786
Wage-earners:									
Average number	190,935	92,095	69,691	5,610	2,115	5,376	6,934	3,426	2,864
Wages	$114,122,437	$59,848,902	$38,716,113	$4,072,287	$1,308,205	$2,411,652	$2,881,295	$1,879,175	$1,779,993
Contract work	$5,598,074	$474,079	$406,421	$2,969,046	$1,745,500	.....	.....	.....	.....
Miscellaneous expenses	$23,218,856	$6,178,975	$9,307,239	$3,275,131	$2,899,633	$711,782	$260,428	$312,186	$108,608
Cost of supplies and materials	$33,111,903	$8,224,475	$12,740,780	$3,356,606	$2,687,228	$4,048,508	$972,605	$417,773	$208,883
Value of product	$236,871,417	$106,032,460	$76,173,586	$15,266,093	$14,352,183	$10,223,267	$5,458,433	$3,547,322	$2,800,108

	Iron ore.	Siliceous crystalline rocks.	Clay.	Mineral pigments, crude.	Silica sand.	Marble.	Feldspar.	Flint.	Buhrstones and millstones.	All other minerals.[1]
Number of mines, quarries, and wells	47	44	19	12	14	3	12	4	3	7
Number of operators	42	43	19	12	11	3	12	3	3	62
Salaried officials, clerks, etc.:										
Number	91	58	22	40	15	8	9	1	.....	7
Salaries	$74,788	$60,877	$28,473	$41,002	$11,800	$7,465	$8,712	$1,500	.....	$5,854
Wage-earners:										
Average number	1,140	703	312	148	141	109	125	27	1	58
Wages	$436,207	$341,720	$130,753	$67,906	$64,015	$95,623	$50,876	$11,713	$616	$26,286
Contract work	$1,228	.....	$300	.....	.....	.....	.....	.....	.....	$900
Miscellaneous expenses	$61,376	$41,056	$13,825	$21,259	$8,265	$4,274	$9,074	$3,137	$121	$2,497
Cost of supplies and materials	$166,422	$128,068	$42,349	$22,816	$16,572	$28,430	$32,423	$4,425	$65	$12,575
Value of product	$1,225,453	$661,062	$288,811	$246,346	$205,675	$160,423	$115,699	$42,721	$1,978	$69,797

[1] Includes operators as follows: Crystalline quartz, 1; garnet, 1; graphite, 2; phosphate rock, 1; precious stones, 55 (no mines); talc and soapstone, 2.

The vast and varied mineral resources of Pennsylvania give the state first rank in the mineral industry of the country. The value of the output of the productive mineral properties of the state in 1902 was $236,871,417, or 29.7 per cent of the total value for the United States.

The most important of the state's mineral resources, from a commercial standpoint at least, are its coals. In its vast stores of anthracite coal, which underlie some 484 square miles,[1] Pennsylvania has a notable advantage over other states. There are three groups of parallel valleys in which these coal measures appear, the Northern, or Wyoming and Lackawanna valley, the Middle, or Lehigh and Mahanoy, and the Southern, from which the Lykens valley coal comes.[2] The bituminous coal fields which run in six parallel valleys[3] from New York to Ohio and West Virginia, underlie some 15,800 square miles of the state, and belong to the great Appalachian field, which also includes the coal regions of Ohio, Maryland, Virginia, West Virginia, eastern Kentucky, Tennessee, Georgia, and Alabama.[4]

The petroleum and natural-gas fields cover many square miles of the state's area, and in the combined values of petroleum and natural-gas production Pennsylvania leads among the states.

The Cornwall hills, in Lebanon county, are composed of and underlaid with magnetic iron ore forming one of the most wonderful deposits of this variety of ore in the world. Since 1740 nearly 9,000,000 tons of ore have been quarried from these beds. Fine brown hematite is taken from great open quarry mines in the central valleys and transported by rail to the iron works in the bituminous coal region beyond the Alleghenies and along the Lehigh and Schuylkill valleys.[5]

At Friedensville, in Lehigh county, are located the zinc mines which were opened in 1853, and were strong producers up to 1876.[6] On the Juniata, beds of hard,

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 291.
[2] The Anthracite Coal Industry, by Peter Roberts, pages 5 and 6.
[3] King's Handbook of the United States, page 722.
[4] United States Geological Survey, Twenty-second Annual Report, 1900–1901, Part III, pages 125 and 233.
[5] King's Handbook of the United States, pages 721 and 722.
[6] Ore Deposits of the United States, by James F. Kemp, page 175.

white, siliceous sandstone occur, large quantities of which are yearly used in glassmaking. The quarries at Slatington, in Lehigh county, produce vast quantities of the finest blue-black slate for billiard tables and mantels, blackboards and slates, flooring and roofing.[1]

The Gap mine, in Lancaster county, once the most important nickel mine in the country, was opened in 1718 and worked for copper until 1852, when the presence of nickel was discovered.[2] The mine is now shut down.

Marble of many varieties, from black to white, is found in the Great Valley, in Chester county, and has been quarried in immense quantities in Montgomery county. Serpentine, or greenstone, largely used in fine buildings, is quarried at Birmingham, and elsewhere in Chester and Delaware counties.[3]

Among other minerals in deposits of which the state is rich may be mentioned the following: The mineral paint, of Parryville; steatite or talc, of Schuylkill; fire clay and flagstones in several localities; the bluestone, of Tunkhannock and Meshoppen; chrome ore and graphite, of Chester county; silver bearing lead, formerly mined in large quantities in Chester county; sandstones, of Swatara and Schuylkill counties; whetstones, of Darby creek; granites, of Delaware and Philadelphia counties; and the kaolin, of Pennsburg and New Garden, used for making porcelain and china.[3]

The minerals found in the state, but which were not produced in commercial quantities in 1902, are chromite, gypsum, ilmenite, lead ore, manganese ore, nickel, platinum, rutile, strontium ore, and zinc.

In addition to the productive mines, quarries, and wells referred to in Table 1, there were 13 operators in 1902 who reported development work, mostly in connection with bituminous coal, natural gas, and slate properties. These operators paid their salaried officials, clerks, etc., $3,590 during the year, gave employment to an average of 44 wage-earners, and paid $20,752 in wages. The work done by contract amounted to $36,332, the miscellaneous expenses were $4,677, and the cost of supplies and materials was $39,216.

[1] King's Handbook of the United States, pages 725 and 726.
[2] The Mineral Industry, 1892, Vol. I, page 345.
[3] King's Handbook of the United States, page 726.

The following table shows the value of the output of manufactures, based primarily upon the products of mines and quarries, and also the value of all manufactured products of the state, as reported at the census of 1900:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.
All manufactures	$1,834,[illegible]
Based upon products of mines or quarries:	
Chemicals and allied products	$60,794,380
Clay, glass, and stone products	57,386,453
Iron and steel and their products	632,501,781
Metals and metal products, other than iron and steel	35,504,249
Miscellaneous industries	86,408,772
	872,[illegible]
All other	962,[illegible]

As will be seen from the foregoing table, the value of the manufactures based primarily upon the products of mines and quarries was $872,595,635, or 47.6 per cent of that for all manufactured products of the state in 1900. The value of the output of the productive mines, quarries, and wells of the state for 1902 was $236,871,417, or 11.4 per cent of the combined value of manufactured products in 1900, and mine and quarry products in 1902.

The manufacturing industries of Pennsylvania, as reported at the Twelfth Census, employed 7[illegible] wage-earners during 1900 and paid $332,072,67[illegible] in wages. In 1902 the operators of the productive mining properties employed 190,935 wage-earners and paid $114,122,437 in wages. The two industries therefore employed a total of 924,769 wage-earners and paid $446,195,107 in wages. Manufactures employed 79.4 per cent of the wage-earners and paid 74.4 per cent of the wages, while mines and quarries employed 20.6 per cent of the wage-earners and paid 25.6 per cent of the wages.

The following table compiled from the reports of the United States Geological Survey, shows the value of the annual production of the principal minerals of Pennsylvania from 1890 to 1902:

TABLE 3.—VALUE OF ANNUAL PRODUCTION OF PRINCIPAL MINERALS: 1890 to 1902.

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Coal, anthracite.	Petroleum.	Natural gas.	Cement.	Limestones and dolomites.	Slate.	Sandstones and quartzites.	Iron ore.	Silicious crystalline rock.
1890	$35,376,916	$66,383,772	(1)	$9,551,025	$873,950	$2,655,477	$2,011,726	$1,609,159	(1)	$[illegible]
1891	37,271,058	73,944,736	$21,240,735	7,834,016	1,069,450	2,100,000	2,142,905	750,000	(1)	[illegible]
1892	39,017,104	82,442,000	15,302,968	7,876,281	1,099,611	1,900,000	2,333,000	650,000	$2,197,028	[illegible]
1893	35,260,674	85,687,078	12,563,893	6,488,000	928,347	1,552,336	1,472,275	622,552	1,374,313	[illegible]
1894	29,479,820	78,488,063	16,342,966	6,279,000	987,710	2,625,562	1,620,158	349,787	643,459	[illegible]
1895	35,980,357	82,019,272	24,900,630	5,852,000	1,056,861	3,055,913	1,647,751	500,000	997,719	[illegible]
1896	35,368,249	81,748,651	22,982,402	5,528,610	1,528,294	2,104,774	1,726,318	446,926	920,916	[illegible]
1897	37,636,347	79,301,954	14,295,825	6,242,543	2,757,086	2,327,870	2,365,299	380,813	851,079	[illegible]
1898	43,352,588	75,414,537	13,608,002	6,806,742	3,392,689	2,746,256	2,491,756	478,451	877,365	[illegible]
1899	56,247,791	88,142,130	17,053,410	8,337,210	4,546,322	3,088,583	2,537,022	717,053	1,991,772	[illegible]
1900	77,438,545	85,757,851	18,088,016	10,215,412	5,328,336	3,800,318	2,718,598	1,050,248	1,890,100	[illegible]
1901	87,397,586	112,504,020	15,430,609	12,688,161	6,759,304	5,081,387	2,984,264	2,068,082	1,561,620	[illegible]
1902[2]	106,032,460	76,173,586	15,266,093	14,352,183	10,228,267	5,458,433	3,547,322	2,800,108	1,225,453	[illegible]

[1] Value not reported.
[2] Census figures.

Coal, bituminous.—The bituminous coal fields underlying an area of 15,800 square miles,[1] lie chiefly in the western part of the state, and spread from Ohio, West Virginia, and Maryland northeast toward New York.[2]

The Upper Carboniferous in the bituminous coal fields of Pennsylvania has been divided into the following five subdivisions in descending order: Dunkard, Monongahela, Conemaugh, Allegheny, and Pottsville. The principal sources of coal are the Allegheny and Monongahela formations, over 95 per cent of the output having been derived therefrom. Shipping mines are also located in the Pottsville and Conemaugh formations, the mines of the former being situated on the very extensive outcrop near the margins of the coal fields, while those of the latter are almost entirely confined to the area of this formation near the southern boundary of the state.[3]

The earliest recorded instance of the mining of bituminous coal in Pennsylvania was in 1760, when a coal mine was opened in the deposit along the Monongahela river, at a point opposite the site of the present city of Pittsburg. With the advent of the first steam engine in Pittsburg in 1794 the demand for this fuel increased, and by 1800 a number of mines were being worked on both sides of the river, the coal being used quite extensively in salt works, glass factories, and for general purposes.[4]

Coal was first shipped from Pittsburg in 1803, and in 1846 the shipments from this point down the Ohio river amounted to 214,000 tons. About 1842 commercial shipments from the Blossburg basin began, and a little later the Barclay basin was developed. During the same decade the use of the Sharon block coal in the Mercer county furnaces is said to have begun. The rapid development of the Cambria county coals practically began with the construction of the State Portage and Pennsylvania railroads, and shortly after the completion of the Low Grade division of the Allegheny Valley Railway in 1872 the notable development of the Reynoldsville basin began.[4]

In 1902 there were 1,023 productive bituminous coal mines in Pennsylvania, and the total output was 98,574,367 short tons, or 37.9 per cent of the production of bituminous coal in the United States. The value of this bituminous coal product was $106,032,460, or 44.8 per cent of the total value of all mineral products of the state and 13.3 per cent of the total for the United States in 1902.

Twenty-four counties in the state contributed to the production of this mineral. Among these, Fayette and Westmoreland, which contain the Connellsville coking region and which have stood for a number of years at the head of the bituminous coal producing counties, retained their supremacy, the former having a production of 18,988,058 tons, and the latter 18,811,511 tons. Allegheny county is third in rank, with 11,919,569 tons, and Cambria county, with 10,561,835 tons, ranked fourth.[5]

The following table, compiled from reports of the United States Geological Survey, shows the annual production of bituminous coal in Pennsylvania from 1840 to 1902:

TABLE 4.—*Annual production of coal, bituminous: 1840 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
Total	1,250,945,473	1871	9,040,565
		1872	11,695,040
1840	464,826	1873	13,098,829
1841	475,000	1874	12,320,000
1842	500,000	1875	11,760,000
1843	650,000	1876	12,880,000
1844	675,000	1877	14,000,000
1845	700,000	1878	15,120,000
1846	760,000	1879	16,240,000
1847	399,840	1880	21,280,000
1848	500,000	1881	22,400,000
1849	750,000	1882	24,640,000
1850	1,000,000	1883	26,880,000
1851	1,200,000	1884	28,000,000
1852	1,400,000	1885	26,000,000
1853	1,500,000	1886	27,094,501
1854	1,650,000	1887	31,516,856
1855	1,780,000	1888	33,796,727
1856	1,850,000	1889	36,174,089
1857	2,000,000	1890	42,302,173
1858	2,200,000	1891	42,788,490
1859	2,400,000	1892	46,694,576
1860	2,679,773	1893	44,070,724
1861	3,200,000	1894	39,912,463
1862	4,000,000	1895	50,217,228
1863	5,000,000	1896	49,557,453
1864	5,839,000	1897	54,417,974
1865	6,350,000	1898	65,165,133
1866	6,800,000	1899	74,150,175
1867	7,300,000	1900	79,842,926
1868	7,500,000	1901	82,305,940
1869	6,750,000	1902	98,574,367
1870	8,736,399		

Coal, anthracite.—The anthracite coal region of Pennsylvania, situated in the eastern part of the state, embraces a territory of about 3,300 square miles, but only about 484 square miles is underlaid by workable coal measures. These measures are principally located in Lackawanna, Luzerne, Carbon, Schuylkill, and Northumberland counties, but are also found in Susquehanna, Sullivan, Columbia, Dauphin, Wayne, Wyoming, and Lebanon counties,[6] the last three mentioned, however, reporting no production in 1902.

The area is divided geographically into four divisions, known as the Northern, Eastern Middle, Western Middle, and Southern, and there is also a small basin in Sullivan county, known as the Western Northern or Loyalsock.[7] Of these fields, the Northern, also called the Wyoming, contains 200 square miles, or 34 per cent of all the workable coal area. This rich deposit, crescent in form, is 50 miles long and varies in width from

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 293.
[2] Ibid., Twenty-second Annual Report, 1900–1901, Part III, page 127.
[3] Ibid., pages 129 and 188.
[4] Ibid., page 188.
[5] United States Geological Survey, "Mineral Resources of the United States," 1902, page 423.
[6] Ibid., Twenty-second Annual Report, 1900–1901, Part III, page 61.
[7] Ibid., page 63.

5.5 miles to diminishing points where the coal seams end. The extreme northern point of the crescent is in Susquehanna county, near Forest City, and the remainder of the region is in Lackawanna and Luzerne counties.[1] Since 1866 this region has been the leading shipper of coal.[2]

The Middle fields contain 130 square miles and their total length is 40 miles. These deposits lie principally in Luzerne county, but some sections are in Northumberland, Carbon, Schuylkill, and Columbia counties.[3]

The Southern field extends over 140 square miles and lies in Carbon, Schuylkill, and Dauphin counties. The greatest width is about 4 miles, at Pottsville, and the length is 55 miles.[3]

The first authentic record connected with anthracite coal history in the state is that in 1762 coal was discovered by the early pioneers in the Wyoming district, near the site of the present city of Wilkesbarre, and in 1769 it was first used by Obadiah Gore, a blacksmith. The presence of coal in the Schuylkill region was known in 1770, but the beds were not developed until 1834. From 1775 throughout the Revolutionary War anthracite coal, from the mines near Wilkesbarre, was shipped to the arsenal at Carlisle for use in the manufacture of war materials.[4]

Anthracite coal was first discovered in the Lehigh region, near Mauch Chunk, in 1791 and in the following year the Lehigh Coal Mine Company was formed and secured control of a large tract of coal land. It was not until 1802, however, that this company succeeded in floating coal laden arks down the Susquehanna and through the Lehigh and Delaware rivers to Philadelphia. Owing to the belief that the coal would not burn, no progress was made in the development of the coal trade for some years.[4]

In 1805–6 two brothers, by the name of Smith, settled in Plymouth, Pa., bought coal lands, and at once commenced shipping coal to points along the Susquehanna river, and although reports of the anthracite coal trade usually commence with 1820, when 365 tons of coal were shipped to Philadelphia from the Lehigh region, the real credit should be given to the Smith brothers, who had been shipping coal successfully for thirteen years prior to the date usually accepted as that beginning the record.

The trade from the Lehigh region was firmly established between 1820 and 1823. About 1825 the Schuylkill region was opened and in 1829 coal was being shipped from Carbondale.[5] From this time on the trade has rapidly increased until it has reached its present enormous proportions.

[1] The Anthracite Coal Industry, page 5.
[2] United States Geological Survey, "Mineral Resources of the United States," 1902, page 418.
[3] The Anthracite Coal Industry, page 6.
[4] United States Geological Survey, Twenty-second Annual Report, 1900–1901, Part III, pages 74 to 76.
[5] Ibid., pages 75 and 76.

During the early days of anthracite coal mining a large percentage of the contents of the veins was not turned to commercial use. The methods of mining, transporting, and preparing were wasteful, and the operators were not economical in exploiting the veins, thinking them inexhaustible. In these early years of mining there was nothing to enforce economy in production, as the veins were rich, labor cheap, and prices comparatively high. These conditions existed until some years after the Civil War, when, owing to the diminution in profits, a more careful study was made of economical mining. Supplies were more carefully handled, the veins were operated more scientifically, and attention was given the great waste annually going on in the amount of coal sent to the dumps. Early in the fifties mining engineers in England had called attention to waste in mining, but it was not until many years later that mining engineers in this country turned their attention to the great waste in the anthracite coal fields. As a result of modern methods more coal is now being mined from the seams, better devices have been introduced in handling it, and better machinery put into the breaker.

A great economy in the use of coal was effected with a decrease in its size. Between 1870 and 1895 four or five sizes, theretofore unknown to the trade, were prepared for the market, and to-day they comprise 30 per cent of the coal shipped.

In 1890 attention was directed to the old culm heaps, so long such a disfiguring element in the coal regions. Previous to 1870 all sizes below chestnut were sent to the culm dump, and it has been estimated that in that year these dumps contained about 76,000,000 tons of marketable coal, and in the decade, 1870 to 1880, it has been estimated that about 19,500,000 more tons were thrown away. The matter of reclaiming the culm dumps was agitated. Despite opposition from many sources washeries were erected, and by the introduction of machinery, whereby still smaller sizes of coals could be prepared, a large percentage of the waste is now reclaimed and marketed.[6] The production of the 35 washeries reported at the census of 1902 amounted to 2,977,355 long tons.

In 1902 the 334 productive anthracite coal mines produced 36,940,710 long tons, the smallest annual production since 1886, while in 1901 the production was 60,242,560 tons. This decrease of 38.7 per cent was entirely caused by the strike in the anthracite regions, which lasted from May 12 to October 23, 1902.[7]

The following counties contributed to the state's output of anthracite coal for 1902: Carbon, Columbia, Dauphin, Lackawanna, Luzerne, Northumberland, Schuylkill, Sullivan, and Susquehanna. Among these Luzerne county ranked first in production, with

[6] The Anthracite Coal Industry, pages 213 to 227.
[7] Report on the Anthracite Coal Strike of 1902, page 37.

12,852,826 tons; Lackawanna second, with 10,779,268 tons; and Schuylkill third, with 7,704,202 tons.

The following table, compiled from reports of the United States Geological Survey, shows the annual production of anthracite coal from 1814 to 1902:

TABLE 5.—*Annual production of coal, anthracite: 1814 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.	YEAR.	Short tons.
Total.	1,554,322,592	1843	1,556,753	1874	24,818,790
		1844	2,009,207	1875	22,485,766
1814	22	1845	2,480,032	1876	22,793,245
1815	50	1846	2,887,815	1877	25,660,316
1816	75	1847	3,551,005	1878	21,689,682
1817	100	1848	3,805,942	1879	30,207,793
1818	200	1849	3,995,334	1880	28,649,811
1819	350	1850	4,138,164	1881	31,920,018
1820	450	1851	5,481,065	1882	35,121,256
1821	1,322	1852	6,151,957	1883	38,456,845
1822	4,583	1853	6,400,420	1884	37,156,847
1823	8,563	1854	7,394,875	1885	38,335,974
1824	13,685	1855	8,141,754	1886	39,035,446
1825	42,988	1856	8,534,779	1887	42,088,197
1826	59,194	1857	8,186,567	1888	46,619,564
1827	78,151	1858	8,426,102	1889	45,544,970
1828	95,500	1859	9,619,771	1890	46,468,641
1829	138,086	1860	10,488,168	1891	50,665,431
1830	215,272	1861	9,799,654	1892	52,472,504
1831	217,842	1862	9,695,110	1893	53,967,543
1832	447,550	1863	11,785,320	1894	51,921,121
1833	600,907	1864	12,588,649	1895	57,999,337
1834	464,015	1865	11,891,746	1896	54,346,081
1835	690,854	1866	15,651,183	1897	52,611,680
1836	842,832	1867	16,002,109	1898	53,382,644
1837	1,071,151	1868	17,003,405	1899	60,418,005
1838	910,075	1869	17,083,134	1900	57,367,915
1839	1,008,322	1870	18,315,540	1901	67,471,667
1840	1,064,914	1871	19,342,057	1902	41,373,595
1841	1,182,441	1872	24,233,166		
1842	1,365,563	1873	26,152,837		

In connection with the discussion of past production, a consideration of probable future production is of great importance, and as bearing on this subject the following extract from the Report of the Anthracite Coal Strike Commission has been inserted:

According to the estimates of the Pennsylvania geological survey, the amount of workable anthracite coal originally in the ground was 19,500,000,000 tons. The production to the close of 1901, as previously stated, amounted to 1,350,000,000 long tons, which would indicate that there remained still available a total of 18,150,000,000 tons. Unfortunately, however, for every ton of coal mined and marketed 1½ tons, approximately, are either wasted or left in the ground as pillars for the protection of the workings, so that the actual yield of the beds is only about 40 per cent of the contents. Upon this basis the exhaustion to date has amounted to 3,375,000,000 tons. Deducting this from the original deposits, the amount of anthracite remaining in the ground at the close of 1901 is found to be, approximately, 16,125,000,000 tons. Upon the basis of 40 per cent recovery this would yield 6,450,000,000 long tons. The total production in 1901 was 60,242,560 long tons. If this rate of production were to continue steadily the fields would become exhausted in just about one hundred years.

Mr. William Griffith, in a series of articles contributed to the Bond Record in 1896, considers that the estimates upon which the foregoing computations have been made were too liberal. His estimates of the amount of minable coal remaining at the close of 1895 was 5,073,786,750 tons.[1]

In the six years from 1896 to 1901, inclusive, the production has been, approximately, 308,570,000 tons, which would leave still available for mining 4,765,216,750 tons. This supply, at the rate of production in 1901, would last a little less than eighty years. But as indicating how susceptible to error are human predictions, it is well to state that in his carefully prepared statement, published in 1896, Mr. Griffith assumes the limit of annual production would be reached in 1906, and would amount in that year to 60,000,000 tons.

This amount of production was reached in 1901, in just half the time predicted by Mr. Griffith, and the production of January, 1903, as recently reported, shows that the anthracite mines are capable of producing at a rate of 72,000,000 tons annually in their present state of development. It is not to be supposed, however, that the annual rate of anthracite production will continue practically uniform until the mines are exhausted and then suddenly cease. Portions of the fields have already been worked out, others are rapidly approaching total exhaustion, while others at the present rate of production will, it is calculated, last from seven hundred to eight hundred years. If we can assume the annual production will have reached its maximum limit at between 60,000,000 and 75,000,000 tons, and that the production will then fall off gradually as it increased, we may expect anthracite mining to continue for a period of from two hundred to two hundred and fifty years.

This estimate is based upon the assumption that the available coal will remain at about 40 per cent of the reserves. How much this may be increased by better mining methods and the utilization of former waste material it is impossible to say. Already a large amount of fuel is being recovered from the old culm banks, and it seems safe to predict that the coal saved will, in the near future, equal 50 per cent of the contents of the fields worked. However we may make our estimates of future production, it is apparent that the maximum output has been almost if not quite reached. The production henceforth will be from lower levels and thinner seams than those previously worked. This will necessitate greater expense in mining and, consequently, higher prices for the fuel. With higher prices will necessarily follow more economy in consumption, greater restriction of the market, and the increased competition of other fuels. All conditions seem to combine for the conservation of the supply of anthracite coal.

Petroleum.—The Indians are known to have collected what was called "Seneca oil" from petroleum springs, and the indications are that at a much earlier period the Mound Builders not only gathered the oil flowing from springs, but even dug wells in Pennsylvania and dipped up the petroleum.[2]

The earliest mention of petroleum in the state appears to have been in 1721, and on a map published in 1755 the word "petroleum" appears near the mouth of what is at present known as Oil creek, on the Allegheny river. From this time mention of the Seneca oil, naphtha, or rock oil, as it was variously called, became more frequent.[3]

The real beginning of the petroleum industry dates from the discovery in 1858 of Drake's well, near Titusville, in Crawford county. The success of this well, which produced 25 barrels daily, at that time an enormous quantity, occasioned a period of great excitement, and during 1859 and the next few years western Pennsylvania was a scene of indescribable activity and spec-

[1] Mr. Griffith's estimate includes all workable coal in the Northern field having beds 4 feet thick and yielding 3 feet of clean coal. In the other fields it includes seams 3 feet in thickness, capable of yielding 2½ feet of clean coal. It excludes the culm piles, mine pillars, etc. The acreage of each bed is multiplied by the thickness of the seams in feet and thus reduced to foot-acres. Each foot-acre was estimated to produce 650 tons of coal, and on the 1st of January, 1896, the unworked areas were estimated to contain 7,805,826 foot-acres, or 5,073,786,750 tons.

[2] One Hundred Years of American Commerce, Vol. I, page 206.

[3] Transactions of the American Institute of Mining Engineers, Vol. VIII, pages 20 and 21.

ulation. Large numbers of wells were sunk along Oil creek, French creek, and the Allegheny river; adventurers flocked thither from all parts of the country, and what shortly became known as the "oil region" was transformed from an almost unbroken forest into camps and towns.

The first flowing well was struck early in 1861. Up to that time all of the oil was drawn from the wells by pumps. This well yielded 300 barrels per day and flowed for fifteen months. Soon after the largest flowing well ever operated in America, the Phillips, was struck, giving 3,000 barrels per day. The discovery of these "gushers" stimulated prospecting and enormously increased the production, with a corresponding decline in prices.

That the productive territory need not necessarily underlie the valleys and the river bottoms was demonstrated in 1862. In the succeeding years wells were struck on the high plateaus of Clarion, Butler, Armstrong, McKean, and Warren counties, the Clarion-Butler, or Southern, field being discovered in 1870.

In 1874 the great Bradford field was discovered. This field includes McKean county, Pa., and Allegany and Cattaraugus counties, N. Y., and has been one of the greatest oil producing fields in the history of the petroleum industry.

The other Pennsylvania oil fields are known as the Middle, including Warren and Forest counties; the Lower, or Southern, including Venango, Clarion, Butler, Beaver, and Lawrence counties; and the Washington, or Southwestern, including Allegheny, Washington, and Greene counties.[1]

For many years, in fact up to 1885, the Pennsylvania field, which includes New York, was looked upon as the undisputed source of supply of petroleum for the world,[2] and up to 1903 this field had produced 628,401,456 barrels, or 53.9 per cent of all the crude petroleum produced in the United States since 1859.

In 1891 the maximum annual output in the petroleum production of the state was reached. Since 1894 Ohio has surpassed Pennsylvania in the production of petroleum, and in 1902 the state ranked fifth, being outranked by Ohio, Texas, California, and West Virginia.[3]

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of petroleum from 1891 to 1902:

TABLE 6.—*Annual production of petroleum: 1891 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
1891	31,424,206	1897	17,982,911
1892	27,149,034	1898	14,743,214
1893	19,283,122	1899	13,053,608
1894	18,077,559	1900	13,268,202
1895	18,231,442	1901	12,625,378
1896	19,379,201	1902	12,063,880

Natural gas.—The largest area of natural gas in the country lies within the state of Pennsylvania. The pools are thickly scattered to the west of an imaginary line drawn from the southeast corner of Greene county to the northeast corner of Potter county, including an area of about one-third of the entire state. The counties cut by this imaginary line and all to the west of it produce more or less natural gas.[4]

The presence of natural gas in Pennsylvania was undoubtedly known early in the eighteenth century, but the first recorded use of it in this country was in 1824, when a supply from a well was used to illuminate the village inn at Fredonia, New York.[5]

Early in the history of oil well drilling, which began in 1859, the gas which always escaped from oil wells was used as a fuel for firing the boilers on the drilling engines; it was soon being piped to houses for use as light and fuel. In 1872 the first natural gas plant was built, and a 2-inch line run from the Newton well to furnish gas for domestic purposes in Titusville, Pa., about five and one-half miles distant. It was not, however, until 1874 that the great value of natural gas as a manufacturing fuel was demonstrated. After that date its use rapidly increased until by 1890 it was estimated that natural gas had annually displaced as a fuel 10,000,000 tons of coal.[5]

Before the value of natural gas as a fuel was fully appreciated the extensive fields about Pittsburg had been discovered. The first well in this field was opened November 4, 1878, but no attempt was made to use the product of this well for four years, and very little drilling was done in the field until 1884.

About 1890 the territory south of Pittsburg began to be developed, although gas had already been discovered and used to a considerable extent in the vicinity of Washington, Washington county.

In the early days of the production of natural gas the original "rock" pressure of the wells was so great and the productive area so extensive that the supply was believed to be practically inexhaustible, and as a result it was wasted in the most extravagant manner. However, between 1885 and 1890 the earlier fields began to show unmistakable evidences of depletion. As a result the gas became more valuable and meters and other saving appliances were introduced.[6]

In 1902 the value of the natural gas produced in Pennsylvania amounted to $14,352,183, or 46.5 per cent of the value of the entire production in the country for that year. The product came from 5,408 wells. The 1902 production is the greatest in the history of the state since 1885, with the exception of 1888, when it reached its highest point.

Cement.—A large mass of cement rock of excellent quality was exposed near Williamsport, in Lycoming county, in 1831, during the construction of a canal

[1] The Mineral Industry, 1893, Vol. II, pages 509 to 511.
[2] One Hundred Years of American Commerce, Vol. I, page 208.
[3] United States Geological Survey, "Mineral Resources of the United States," 1902, page 543 ff.
[4] Ibid., page 639.
[5] The Mineral Industry, 1901, Vol. X, pages 464 and 465.
[6] Ibid., pages 476 and 477.

between Lock Haven, Clinton county, and Muncy, Lycoming county. A plant was immediately erected for the manufacture of such cement as should be required in the construction of the locks and dams of the canal, and until the completion of the canal this plant flourished. After this, however, the industry continued only in a small way, as the local demand for cement was not great. In 1850, during the construction of the Lehigh canal, from Easton, Northampton county, to Mauch Chunk, Carbon county, the cement rock, of which such large quantities have been used in this valley, was discovered.

The manufacture of cement for the Lehigh canal was commenced at Siegfried, in Northampton county, and the product proved to be of excellent quality. In 1865 a large natural rock cement establishment was erected at Coplay, in Lehigh county. While the product of this plant was of good quality, competition led to experiments in the manufacture of an artificial or Portland cement, and in 1870 a small quantity of this important material was produced. This was the first plant to successfully make Portland cement in this country. In 1878 there were four plants manufacturing cement on the Lehigh river. Their success was followed by a steady growth of the industry, and this locality became the leading center of production of artificial cement. This position it still holds, contributing more than one-half the entire output of the United States.[1]

The development of this industry was, however, comparatively slow, caused undoubtedly by the increased imports of artificial cement, and in 1891 the output of Portland cement from the 6 plants in Lehigh county reached only 268,500 barrels.[2] From this time on the annual production of Portland cement in Pennsylvania has steadily increased, and in 1902 it reached the highest point in its history. The production of Portland cement for that year in the United States was 16,691,055 barrels, of which Pennsylvania contributed 8,563,926 barrels, or 51.3 per cent.

Of the 17 productive plants in the state in 1902, 7 were located in Northampton county, 8 in Lehigh, and 1 each in Berks and Lawrence. Portland cement alone was manufactured by 11 of these plants, while the remaining 6 made both artificial and natural-rock cement, the production of the latter kind of cement amounting to but 796,876 barrels. The value of the entire cement production of the state was $10,223,267.

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of both Portland and natural-rock cement, from 1890 to 1902:

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, pages 804 and 805.
[2] Ibid., pages 805 to 807.

TABLE 7.—*Annual production of cement: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

[Barrels.]

YEAR.	Portland.	Natural rock.	YEAR.	Portland.	Natural rock.
1890	221,000	555,000	1897	1,579,724	[1] 776,000
1891	268,500	695,000	1898	2,095,141	[1] 499,956
1892	300,840	664,594	1899	3,217,965	511,404
1893	285,317	567,110	1900	4,984,417	687,838
1894	437,106	605,812	1901	7,091,500	942,364
1895	504,276	600,895	1902	8,770,454	796,876
1896	825,054	608,000			

[1] Barrels of 300 pounds.

Limestones and dolomites.—Large quantities of gray or bluish gray stone, which because of its color and texture is unsuited to any form of ornamental work, are found in the Lower Silurian formations in Montgomery, Lancaster, and Chester counties. This stone has been extensively quarried for general building purposes and for foundations and bridge abutments. Limestone is also quarried for local use in Berks, Lebanon, Dauphin, Lancaster, York, and Cumberland counties, the Lancaster county stone being very durable. The stone quarried at York, in York county, is very fine grained, compact, and of a deep blue-black color, and if it were not uneven in texture might make a fine marble.[3]

In 1902 there were 907 limestone quarries in Pennsylvania, located in 43 different counties, among which Lawrence county was first in the value of its limestone production, Montgomery county was second, and Chester county third. The value of the limestone production in Pennsylvania in 1902 was $5,458,433, which gave the state first rank among the limestone producing states of the country. The value of the limestone quarried in the state for building purposes in this year amounted to $209,215, the balance of the production being used mainly for making lime, but also in road-making, railroad ballast, etc.

Slate.—Little is known of the beginning of American slate quarrying. Probably the first quarry opened was located in the Peach Bottom region in York county, Pa., about 1800. Another quarry was opened at Upper Mt. Bethel, Northampton county, in 1811, and the Franklin quarry located near Slatington, in Lehigh county, was being operated in 1846. On the southeastern side of the Blue or Kitatinny mountains, in Northampton county, is located the most important slate producing area of America.[4] This area forms a belt which extends throughout the entire northern part of Northampton and Lehigh counties and thence, in a gradually narrowing band, in a southwesterly direction through Berks, Lebanon, Dauphin, Cumberland, and Franklin counties.[5]

[3] Stones for Building and Decoration, by George P. Merrill, page 321.
[4] The Mineral Industry, 1897, Vol. VI, pages 593 to 595.
[5] Stones for Building and Decoration, pages 192 to 194.

This area has been divided into four regions—the Bangor, the Pen Argyl, the Lehigh, and the Hard Vein. Of these regions the Bangor is the most important, and the No. 1 Bangor slate is generally regarded as the standard in this country.[1] The slate of this region is soft and tough, and when free from ribbons is generally of high quality and noted for its durability. Aside from its use for roofing the material from the Bangor region is also used in making blackboards, school slates, and mantels. The slate of the Pen Argyl region closely resembles the Bangor slate. Almost the entire output is used for roofing purposes. In area the Lehigh region is the largest, and its output, besides being used for roofing purposes, also makes excellent blackboards. The slate from the Hard Vein region is harder than that from any of the other regions.[2]

In 1902 the 91 productive slate quarries of Pennsylvania were located in Northampton, Lehigh, and York counties. The total output of slate in the state for the year was valued at $3,547,322, of which $2,398,964, or 67.6 per cent, was contributed by Northampton county. Of the entire output the value of that used as roofing slate amounted to $3,001,545, the rest of the product being made into school slates, blackboards, mantels, tilings, etc.

In 1902 the output of slate in the United States amounted in value to $5,696,051, of which amount Pennsylvania contributed 62.3 per cent. In this branch of mineral industry Pennsylvania has long held first place.

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of roofing slate from 1884 to 1902:

TABLE 8.—*Annual production of roofing slate: 1884 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Squares.	YEAR.	Squares.
1884	339,004	1894	411,550
1885	345,660	1895	426,687
1886	360,805	1896	431,324
1887	390,439	1897	657,692
1888	435,000	1898	571,256
1889	476,038	1899	711,138
1890	(1)	1900	788,571
1891	507,824	1901	853,028
1892	550,000	1902	908,206
1893	364,051		

[1] Not reported.

Sandstones and quartzites.—The principal quarry in the state in the belt of Triassic sandstone is located in Dauphin county. The texture of the rock is of medium fineness and the color is a deep bluish brown. The stone compares very favorably with any other Triassic stones and is now in very general use in all principal eastern cities.

The Carboniferous sandstones of Pennsylvania, although occasionally of good quality, are little quarried except for local use. The stones of Subcarboniferous formation have been but little quarried for purposes of construction, although at Franklin, in Venango county, a fine grained, evenly bedded buff stone, resembling to some extent the buff variety of the Berea grit, is quarried for sidewalks and buildings in the vicinity.

Aside from the Triassic stones those quarried from the Devonian formations are the most important. The stone from this formation, known as the Wyoming Valley stone, agrees very closely in general appearance with much of the bluestone quarried in New York state.[3]

The value of the output of sandstones and quartzites, including bluestones, quarried in Pennsylvania in 1902 amounted to $2,800,108, which gives to the state first rank in the production of this class of minerals. The 1902 production exceeded that for 1901 by $737,026.

Iron ore.—The magnetite variety of iron ore, as well as the red and brown hematites and the carbonate, is found in various localities within the state in deposits of more or less richness. The brown hematites are apparently divided into two series, starting in the northern section of the state, and running southwest in nearly parallel lines. The magnetites occur between these two belts. The carbonate variety of iron ore is found in the western portion of the state, and between the carbonate and the brown hematite belts are found the red hematites.[4]

The celebrated Cornwall mines of magnetic ore, containing one of the largest and richest deposits of this variety of iron ore in the country, are located in Lebanon county, 5 miles south of Lebanon and about midway between Reading, on the Schuylkill river, and Harrisburg, on the Susquehanna.[5] The area of ore here exposed measures about 4,000 feet in a direction nearly east and west, with a breadth of from 400 to 800 feet, and includes three hills, separated by two valleys, running north and south. These mines have been among the most productive iron ore properties in the country, having produced up to 1889 over 10,000,000 tons.[6]

The limestones of the Cumberland valley are very rich in limonite, or brown hematite ores, which form a large part of the charges of the many blast furnaces situated on their outcrops. The mines from which these ores are obtained are really only pits or quarries, the ores being extracted by means of picks and shovels.[7]

While the presence of iron ore in Pennsylvania was undoubtedly known at an early date, it is not probable that any deposits were developed to any considerable extent until the latter part of the seventeenth or the early years of the eighteenth century.

[1] The Mineral Industry, 1897, Vol. VI, page 595.
[2] Stones for Building and Decoration, pages 192 to 194.
[3] Stones for Building and Decoration, pages 159 to 162.
[4] United States Geological Survey, "Mineral Resources of the United States," 1891, page 20.
[5] Transactions of the American Institute of Mining Engineers, Vol. XIV, page 873.
[6] A Treatise on Ore Deposits, by J. Arthur Phillips, F. R. S., pages 820 and 821.
[7] Transactions of the American Institute of Mining Engineers, Vol. III, page 410.

The first recorded instance of the manufacture of iron within the state was in 1692, and the first successful ironworks were established in 1716, on Manatawny creek, in Berks county.[1] In the same year the development of the iron ore mines of the Schuylkill valley began.[2] About 1720, a furnace, located in the heart of one of the richest deposits of magnetic iron ore in the country, was erected on Ironstone creek, Colebrookdale township, in Berks county.[3] The celebrated deposits of magnetic iron ore of Cornwall hills are said to have been worked about 1735,[3] and in 1742 the Cornwall furnace was built. The mine was described, a few years later, as being rich and abundant. During the War of the Revolution, Cornwall furnace cast cannon and shot and shell for the Continental Army, and it was still in operation as late as 1882.[4]

In 1902 there were 42 operators in Pennsylvania who reported 47 productive iron mines, having an output of 822,932 long tons, which gave to the state sixth rank in quantity of iron ore produced.

In the output of the different varieties of iron ores the state ranks first in magnetite, with a production of 616,645 tons; sixth in brown hematite, with 185,846 tons; and twelfth in red hematite, with 20,441 tons.[5]

In 1902 the following counties contributed to the state's output: Berks, Bucks, Center, Cumberland, Huntingdon, Lancaster, Lebanon, Lehigh, Northampton, Perry, Snyder, Union, and York. Among these Lebanon county ranks first, with 594,177 tons, or 72.2 per cent of the state's production, drawn entirely, in 1902, from the celebrated Cornwall mine. Center county ranks second with a production of 64,382 tons, and Lehigh county third with 58,508 tons.

Pennsylvania showed a decrease of 217,752 tons in the production of iron ore in 1902, as compared with 1901. The value of the state's production was $1,225,453, or an average value of $1.49 per ton.

The following table, compiled from reports of the United States Geological Survey, shows the annual production of iron ore from 1889 to 1902:

TABLE 9.—*Annual production of iron ore: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1889	1,560,234	1896	747,784
1890	1,361,622	1897	723,742
1891	1,272,928	1898	773,082
1892	1,084,047	1899	1,009,327
1893	697,985	1900	877,684
1894	532,087	1901	1,040,684
1895	900,340	1902	822,932

Siliceous crystalline rocks.—Although Pennsylvania leads among the stone producing states, it furnishes comparatively little in the way of granitic rock. Nearly all of the granite quarries in the state are in the district extending from the Delaware river, at Trenton, to the state line, near the Susquehanna, thus lying south of the limestone valley of Montgomery county. The largest of these quarries are in the vicinity of Philadelphia, and the product, which is for the most part a dark gray hornblende gneiss, is used particularly for the rough work of foundations.[6]

In 1902 siliceous crystalline rocks were quarried in Adams, Berks, Bucks, Chester, Delaware, Fayette, Lancaster, Lehigh, Montgomery, and Philadelphia counties, the total output amounting in value to $661,062. Among the counties referred to, Berks ranks first in the output of this rock, Delaware second, and Philadelphia third.

Clay.—The refractory clays and shales of the coal measures of Pennsylvania constitute one of its most important mineral resources, especially in the western part of the state. Among the more important of these are the Bolivar fire clay, under the upper Freeport Coal Measures, and a fire clay in Beaver county, underlying the Kittanning coal. Another important bed occurs in Indiana, Cambria, and Beaver counties.[7]

The deposits of kaolin near Brandywine Summit, in Delaware county, contain some of the oldest mines in the country. In southeastern Pennsylvania the decay of schistose or limestone rocks at the contact of the Cambrian and Silurian has yielded some white residual clays which, after washing, are suitable for white earthenware manufacture.[8]

In the manufacture of brick and tile Pennsylvania leads, but in the production of clay products as a whole the state ranks second. In 1902 clay was produced in the state by 18 counties, and was valued at $288,811.

The following table, compiled from reports of the United States Geological Survey, shows the annual production of clay from 1900 to 1902:

TABLE 10.—*Annual production of clay: 1900 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.
1900	140,734
1901	144,547
1902	161,546

Mineral pigments, crude.—The mineral substances included under this heading are the ores used in the manufacture of metallic paint, such as ocher, umber, sienna, venetian red, etc.

The "paint bed" at Lehighgap was discovered in 1856. This bed outcrops along the southern border of

[1] Iron in All Ages, by James M. Swank, page 164.
[2] United States Geological Survey, "Mineral Resources of the United States," 1883–84, page 263.
[3] Iron in All Ages, pages 167 and 168.
[4] Ibid., pages 182 and 183.
[5] United States Geological Survey, "Mineral Resources of the United States," 1902, page 43.
[6] Stones for Building and Decoration, page 81.
[7] The Mineral Industry, 1901, Vol. X, page 114.
[8] The Clays of the United States East of the Mississippi River, by Henrich Ries, page 49.

Carbon county, about 27 miles north of Bethlehem, in a well defined ridge of Oriskany sandstone, known as Stony Ridge. The bed, however, is not continuous throughout the extent of this ridge. The ore is bluish gray, resembling limestone, and is very hard and compact.[1]

In 1902 there were 12 mines in Pennsylvania which produced crude mineral pigments, located in the counties of Berks, Carbon, Lawrence, Lehigh, Lycoming, Luzerne, Montgomery, Northampton, and Wyoming. The output amounted to 20,807 short tons, valued at $246,346. Carbon county was the greatest contributor to this total, with Lehigh county next, and Northampton county third. The production for the United States amounted to 35,479 short tons, of which Pennsylvania contributed 58.6 per cent.

Silica sand.—The glass sand mined in Pennsylvania in 1902 came from the counties of Berks, Butler, Chester, Fayette, Lancaster, Lebanon, Mifflin, Somerset, and Westmoreland. It occurs both as a sandstone, which requires crushing and preparation before use, and as a sand, which quickly disintegrates when quarried and exposed to air and moisture.[2]

The output of silica sand in the state in 1902 was 268,262 short tons, of which Mifflin county contributed 76,000 tons, or 28.3 per cent, leading the remaining eight counties producing this mineral. The state's output was 60.2 per cent of that for the United States, which was 445,903 short tons.

Marble.—The only quarries of merchantable marble at present worked within Pennsylvania lie in the belt of Lower Silurian limestone, which extends from Sadsbury, in Lancaster county, in an easterly direction through Chester county, and through the western half of Montgomery county. The prevailing colors of the stone throughout the larger portion of this area are yellowish or bluish, and as a consequence are suitable only for making quicklime or for ordinary rough building purposes.[3]

Quarries were first opened in Montgomery county about the time of the Revolution, and up to 1840 this stone was almost the only material used in the better class of stone buildings in and about Philadelphia. Increased transportation facilities about this date brought the better varieties of eastern marbles into the Philadelphia market, and as a consequence the Montgomery county marble was not in as great demand.[3]

In 1902 there were only three productive quarries in the state, located one each in Chester, Dauphin, and Montgomery counties. The value of the output from these quarries was $160,423; of this amount $110,977 represented the value of that which was dressed for building purposes, and $24,000 that dressed for monumental purposes.

Feldspar.—Pennsylvania is one of the leading states in the production of feldspar, large deposits of this mineral occurring in the serpentines of Chester county and in the granitic rocks of Delaware county. Nearly all the feldspar quarries are worked as open pits, but in a few instances underground tunnels have been employed. The largest quarry is located near Elam, in Delaware county, and has been productive since 1883. This quarry has been worked to a depth of 100 feet, with some underground workings extending 300 feet or more along a vein which the open working shows to be 60 to 70 feet wide.[4]

In 1902 there were twelve productive feldspar quarries in the state, all of which were located in Chester and Delaware counties. The entire output amounted to 15,121 short tons, or 33.4 per cent of the production of the United States for 1902. The value of the state's output amounted to $115,699.

All other minerals.—The American millstone varies from a sandstone to a quartz conglomerate, and the rock from which it is made occurs along the eastern slopes of the Appalachian mountains from New York to North Carolina, and is known by various names.[5] In Pennsylvania it is called "Cocalico," and is found in Lancaster county. The three productive quarries in 1902 had an output valued at $1,978.

The crystalline quartz produced in Pennsylvania in 1902 came from Chester county and was largely used in the manufacture of sandpaper. No figures can be shown for the single operator without disclosing individual operations.

The mineral worked throughout the entire Appalachian region, either for pottery or under the name of "flint," and included in this report is quartz. It is used chiefly in the manufacture of pottery and porcelain, although some of it is used in soapmaking and wood fillers. The four productive quarries of the state in 1902 were located in Adams, Chester, and Lancaster counties, and had an output valued at $42,721, or 29.6 per cent of that for the United States.

The garnet found in Pennsylvania is of the ruby or rose colored variety, and is used by the manufacturers of shoes as an abrasive. The deposits are found in Delaware county and occur in a quartzose gneiss.[6] There was but one operator in the state in 1902.

Graphite is produced commercially only in Chester and Berks counties. In the mine near Chester Springs,

[1] Transactions of the American Institute of Mining Engineers, Vol. XIX, pages 322 to 325.
[2] United States Geological Survey, "Mineral Resources of the United States," 1902, page 1011.
[3] Stones for Building and Decoration, pages 222 and 223.
[4] The Mineral Industry, 1898, Vol. VII, pages 267 and 268.
[5] United States Geological Survey, "Mineral Resources of the United States," 1902, pages 878 and 879.
[6] The Mineral Industry, 1897, Vol. VI, page 21.

in Chester county, the mineral occurs in two layers of disintegrated mica schist, and the rock is so distinguished that most of the graphite material can be removed without blasting. In 1902 both the productive properties were located in Chester county.[1]

The output of the phosphate rock mines of Pennsylvania, located in Juniata county, was first reported in 1899 by the United States Geological Survey, and amounted to 2,000 tons, valued at $9,000. In 1902 there was but one operator.

The value of the output classed under "precious stones" was $5,000, and consisted of specimens of anthracite and iron ore suitable for making into ornaments.

The two soapstone quarries of the state productive in 1902 were located in Montgomery and Northampton counties; the output is put on the market as ground talc.

[1] The Mineral Industry, 1901, Vol. X, page 369.

RHODE ISLAND.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Rhode Island for 1902.

TABLE 1.—*Summary: 1902.*

	Total.	Siliceous crystalline rocks.	All other minerals.[1]
Number of mines or quarries	22	19	3
Number of operators	22	19	3
Salaried officials, clerks, etc.:			
Number	56	54	2
Salaries	$56,150	$55,310	$840
Wage-earners:			
Average number	667	638	29
Wages	$435,224	$421,608	$13,616
Miscellaneous expenses	$25,938	$22,898	$3,040
Cost of supplies and materials	$85,127	$71,908	$13,219
Value of product	$774,611	$734,623	$39,988

[1] Includes operators as follows: Graphite, 1; limestones and dolomites, 2.

Rhode Island has held for many years a very prominent position among granite producing states on account of the superiority of its granite for monumental purposes, particularly the stone that is quarried at Westerly and vicinity.[1]

In previous years some coal which was classed as anthracite was mined in the eastern part of the state. This product is not in reality an anthracite coal, but is graphitic, and, in the last few years, has been included with the graphite production.[2] It is of a structure between scaly and granular, and contains, in selected samples, as much as 52 per cent carbon.[3]

The following minerals also occur in the state, but were not mined in commercial quantities in 1902: Asbestos, galenite, garnet, iron ore, talc and soapstone, whetstones, copper pyrite, sandstone, manganese ore, agate, jasper, and molybdenum in Providence county, and serpentine in Providence and Newport counties.[4] Deposits of ilmenite, mica, monazite, and rutile also occur, but were not exploited in 1902.

The following table shows for 1900 the value of the products of manufactures closely allied to or based upon the products of mines and quarries, and also the total value of all manufactures for the year:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$184,074,378
Based upon products of mines or quarries:		
Chemicals and allied products	$871,485	
Clay, glass, and stone products	1,430,960	
Iron and steel and their products	18,107,330	
Metals and metal products, other than iron and steel	22,752,825	
Miscellaneous industries	8,021,006	
		51,183,606
All other		132,890,772

The value of the products of the manufacturing industries of the state for 1900, as shown in Table 2, was $184,074,378, to which amount those branches based primarily on the products of mines and quarries contributed $51,183,606, or 27.8 per cent. During the same year 98,813 wage-earners, receiving $41,114,084, were employed in all branches of manufacture. In 1902 the mines and quarries gave employment to 667 wage-earners, who were paid $435,224 in wages. The combined industries, therefore, gave employment to 99,480 wage-earners and paid $41,549,308 in wages. Manufactures contributed 99.3 per cent of the wage-earners and 99 per cent of the wages, while mines and quarries contributed seven-tenths of 1 per cent of the wage-earners and 1 per cent of the wages.

The following table shows the value of the state's annual production of siliceous crystalline rocks from 1890 to 1902:

TABLE 3.—*Value of annual production of siliceous crystalline rocks: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Value.	YEAR.	Value.
1890	$931,216	1897	$629,564
1891	750,000	1898	820,242
1892	600,000	1899	400,128
1893	509,799	1900	444,316
1894	1,211,439	1901	501,698
1895	968,473	1902	734,623
1896	746,277		

[1] United States Geological Survey, Twentieth Annual Report, Part VI, continued, page 279.
[2] Ibid., "Mineral Resources of the United States," 1902, page 292.
[3] Ibid., page 977.
[4] Ibid., 1887, page 785.

Siliceous crystalline rocks.—The mineral wealth of the state consists principally in its deposits of granite, which for the most part lie west of the bay in Providence, Kent, and Washington counties, although some stone is quarried in Newport county. Beginning in 1890 with an output valued at $931,216, the production decreased steadily until 1893; then increased in 1894 to $1,211,439, the maximum in the history of the state. The value of the output decreased again gradually until 1898, when the lowest value, $320,242, in the last thirteen years was reached. Since 1898 there has been again a gradual increase, the value in 1902 amounting to $734,623. This output was obtained from 19 quarries, 9 of which were located in Washington county, 6 in Providence, 3 in Newport, and 1 in Kent. The quarries in Washington county produced the greater part of the monumental stone of the state, 8 of the 9 quarries in this county showing this class of granite as their principal product. The output of the remaining quarries of the state was used chiefly for building stone, but some was also used as paving, curbing, and crushed stone for roadmaking and concrete, and some was sold as riprap and rubble stone.

The value of the stone used for monumental work in 1902 was $550,719, or 75 per cent of the total, and in 1901, $291,805, or 58.2 per cent of the total value for that year. For the years 1898, 1899, and 1900 no separation was made of rough stone, but the chief product was dressed stone for monumental work.

The importance of the state as a producer of monumental stone from 1898 to 1902 is shown in Table 4.

TABLE 4.—*Value of granite for monumental work for the United States and for Rhode Island, and per cent that Rhode Island forms of the United States: 1898 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	United States.	Rhode Island.	Per cent of total.
1898	$1,462,598	$204,739	14.0
1899	1,687,967	145,001	8.6
1900	1,598,812	232,144	14.5
1901	2,715,225	291,805	10.7
1902	3,998,911	550,719	13.8

The state, in 1898, was exceeded in value of its output of monumental stone only by Vermont and New Hampshire; its production was 14 per cent of the value for the United States. In 1899 the value of the production was 8.6 per cent of the total for all states, Rhode Island ranking fourth, being exceeded by Vermont, Massachusetts, and New Hampshire. In 1900, 1901, and 1902 the state ranked third, producing for the three years respectively 14.5, 10.7, and 13.8 per cent of the production of monumental stone in the United States. Vermont and New Hampshire led Rhode Island in 1900; Vermont and Massachusetts in 1901 and 1902.

All other minerals.—The only producer of graphite in the state is the Rhode Island Graphite Company, of Providence. The output has been combined with that of limestones and dolomites to avoid disclosing the operations of any single establishment.

Only two limestone quarries reported production in 1902, both located at Limerock, in Providence county. Almost the entire product was consumed in lime manufacture, though a small quantity was used for fluxing purposes.

SOUTH CAROLINA.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of South Carolina for 1902.

TABLE 1.—*Summary: 1902.*

	Total.	Phosphate rock.	Siliceous crystalline rocks.	Clay.	All other minerals.[1]
Number of mines or quarries	38	10	15	8	5
Number of operators	42	10	14	8	10
Salaried officials, clerks, etc.:					
Number	148	80	41	14	13
Salaries	$126,992	$65,401	$32,841	$11,300	$17,450
Wage-earners:					
Average number	2,694	1,498	815	198	183
Wages	$891,737	$435,553	$351,046	$45,448	$59,690
Miscellaneous expenses	$109,890	$65,157	$34,047	$3,185	$7,501
Cost of supplies and materials	$342,379	$162,836	$131,771	$11,612	$36,160
Value of products	$1,834,134	$950,208	$598,848	$107,325	$177,753

[1] Includes operators as follows: Gold and silver, 3; limestones and dolomites, 1; manganese ore, 1; precious stones, 5 (no mines).

The state ranked thirty-ninth in 1902 in the value of products of mines and quarries, with a total of $1,834,134. The range of mineral industry is confined in the main to three or four different products. Notable among these is phosphate rock, in the mining of which the state still takes high rank, though in former years it furnished nearly all of the production in the United States. Granite of high grade is found in abundance, and the kaolin beds of Aiken county are extensively worked. Gold ore, while not distributed over a wide area, is successfully mined.

Among the minerals of the state which were not mined commercially in 1902 are the following: Asbestos occurs near Glenn Springs and Cedar Springs in Spartanburg county, and in Pickens county. Fuller's earth is found in white, gray, yellow, pink, and black. The deposits extend in a broken, sinuous band across almost the entire state, and in some localities they approximate 40 feet in thickness.[1] Graphite has been found in the northeast corner of Spartanburg county and at Paris mountain in Greenville county. Iron ores occur in many sections of the northern and northwestern part of the state, many of the banks having been worked. The counties in which the principal deposits are located are York, Union, Spartanburg, Greenville, Abbeville, Lexington, Pickens, and Chesterfield. Iron pyrites are abundant in Spartanburg and York counties, and occur also in Chesterfield and Lancaster. Monazite has been found and mined in the extreme northern part of the state, especially in Spartanburg county. Talc is found in Abbeville, Lexington, Chester (where it has been worked), Anderson, Spartanburg, Union, and Pickens counties. Other minerals occurring in the state in varying quantities are: Bismuth, ocher, copper, pyrites, galena, brown coal, malachite, phosphate of lead, and barytes.[2]

The relative importance of manufacturing industries closely allied to or based on mining industry using as raw material the products of the mine or quarry is shown in the following table:

TABLE 2.—*Manufactures based primarily upon products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$58,748,731
Based upon the products of mines or quarries:		
Chemicals and allied products	$4,882,506	
Clay, glass, and stone products	888,935	
Iron and steel and their products	412,493	
Metals and metal products, other than iron and steel	291,845	
Miscellaneous industries	596,535	
		7,072,314
All other		51,676,417

The total value of the products of the manufacturing industries based primarily upon mining and quarrying was, as shown by Table 2, $7,072,314, or 12 per cent of the total value of the product of all manufacturing industries in the state in 1900. The value of the output of the mines and quarries of the state in 1902 was $1,834,134, or 3.1 per cent of the combined value of the product of manufacturing and mining. In 1900 there were employed in all branches of manufactures 48,135 wage-earners, who were paid $9,455,900 in wages. In 1902 there were employed in the mines and quarries 2,694 wage-earners, who received $891,737 in wages. By

[1] Clays of South Carolina, by Earle Sloan, page 60.

[2] United States Geological Survey, "Mineral Resources of the United States," 1887, page 786 ff.

combining the figures of these two branches of industry and comparing, it is disclosed that 94.7 per cent of the wage-earners, receiving 91.4 per cent of the wages, were employed in manufacturing, while 5.3 per cent of the wage-earners, receiving 8.6 per cent of the wages, were employed in mining.

The following table shows the value of the annual production of the principal minerals of the state from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Phosphate rock.	Siliceous crystalline rocks.	Clay.
1890	$2,875,605	$47,614	(1)
1891	2,948,138	50,000	(1)
1892	1,877,709	60,000	(1)
1893	2,157,014	95,443	(1)
1894	1,745,576	45,899	(1)
1895	1,411,032	22,083	(1)
1896	1,181,649	55,320	(1)
1897	986,572	37,820	$83,200
1898	1,107,272	169,518	123,250
1899	1,078,099	361,034	94,899
1900	1,041,970	500,802	79,900
1901	961,840	996,084	143,700
1902[2]	950,208	598,848	107,325

[1] Not reported separately. [2] Census figures.

Phosphate rock.—The phosphate rock belt of the state is 70 miles long and 30 miles wide, extending from the mouth of the Broad river, near Port Royal, in the southeast, to the headwaters of the Wando river in the northeast. Its major axis is parallel with the coast, and its greatest width is in the neighborhood of Charleston.[1] The principal deposits are located in Berkeley, Dorchester, Charleston, Colleton, and Beaufort counties.[2] So far as occurrence in commercial quantities is concerned, their distribution is confined within narrow limits. They are found at the bottom of rivers, 20 to 30 feet in depth, and on land they occur at an elevation but slightly above mean tide. The rock of commerce occurs always above the marl and is known as land or water rock, according to its location. The water rock is darker in color and harder than the land rock, and is frequently found in a layer or sheet of cemented or tightly compacted nodules overlying the marls at the bottom of rivers and creeks, where it either forms the bottom itself or is overlaid by a deposit of mud of greater or less depth. The land rock is found generally at a depth of from 2 to 10 feet below the surface of the soil. It occurs in masses or nodules varying in size from that of a potato to several feet in diameter. These nodules are rounded, rough, indented, and frequently perforated with irregular cavities, and in color they vary from olive or bluish black to a yellowish or grayish white. By analysis they are found to contain 55 to 61 per cent of phosphate of lime, 5 to 10 per cent of carbonate of lime, 2 to 10 per cent of organic matter and water, with small quantities of fluorine, iron, magnesia, alumina, sulphuric acid, and sand. This land rock is found in a loose layer varying from a few inches to 30 feet in depth, and averaging about 8 inches. It occurs in sand, mud, clay, or peat, and is often intermingled with numerous remains of land and marine animals. Among the former are the bones of the mastodon, elephant, tapir, deer, and the domestic animals, the horse, cow, and the hog.[3]

The great bed, or series of beds, of phosphate rock which was later destined to supply the civilized world with the chief part of all the phosphate of lime used in the manufacture of commercial fertilizers was discovered, or rather its value was first definitely established, in 1867.[4] To Dr. St. Julian Ravenel, of Charleston, this honor has been accredited. However, forty years before, Robert Mills forecasted this discovery, saying, that "besides gypsum, we may also expect to find in that part of the state (the Atlantic seaboard), the same kind of marl which has so greatly contributed to enhance the value of the poor lands of New Jersey, by the fertility which it imparts to the soil."[5]

At the close of the Civil War Dr. N. A. Pratt, of Georgia, formerly connected with the Niter Bureau of the Confederacy, visited Charleston with the object of starting sulphuric acid chambers. His attention was directed by Doctor Ravenel, who had already noted the presence of phosphate of lime in considerable quantity in the marl stones, or nodules, near Charleston, to samples of the rock taken from the Ashley river region. Doctor Pratt analyzed the specimens and found that the rocks contained a sufficiently high percentage of phosphate of lime to render them of merchantable value.[6] As soon as the commercial importance of the deposits became generally known other available beds were located, and considerable capital was employed in developing the industry by mining the crude rock, and exporting the product or manufacturing it into superphosphates. Later the beds of many navigable streams were found to be largely paved with the valuable substance. In 1870 the mining for this river rock began, and was developed through the introduction of dredging and grappling apparatus into an industry of equal importance with the mining of the rock on land.[7]

[1] Phosphates of America, by Francis Wyatt, Ph. D., page 49.
[2] South Carolina, by Harry Hammond, page 47, and map.
[3] South Carolina, page 48.
[4] United States Geological Survey, "Mineral Resources of the United States," 1882, page 511.
[5] Statistics of South Carolina, by Robert Mills, page 27.
[6] United States Geological Survey, "Mineral Resources of the United States," 1882, page 511 ff.
[7] Ibid., Eighteenth Annual Report, Part V, continued, page 1236.

Table 4 shows the annual production of phosphate rock from 1867 to 1902.

TABLE 4.—*Annual production of phosphate rock: 1867 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
Total	10,632,492	Ending December 31—	
		1885[1]	277,789
Ending May 31—		1886	430,549
1867	6	1887	480,558
1868	12,202	1888	448,567
1869	31,958	1889	541,645
1870	65,241	1890	463,998
1871	74,188	1891	475,506
1872	58,760	1892	394,228
1873	79,203	1893	502,564
1874	109,340	1894	450,108
1875	122,790	1895	431,975
1876	132,478	1896	402,423
1877	163,000	1897	358,280
1878	210,322	1898	399,884
1879	199,365	1899	356,650
1880	190,768	1900	329,173
1881	266,734	1901	321,181
1882	332,077	1902	313,365
1883	378,380		
1884	431,779		
1885	395,403		

[1] Seven months.

From the first the industry yielded large profits, and for a period of two and a half decades was prosecuted with great energy. Beginning with a production of 6 long tons in 1867, it had increased in 1877 to 163,000 tons, and ten years later to 480,558 tons, reaching the maximum in 1889, with 541,645 tons. In 1890 the output from the Florida mines had so increased that the condition of the industry in South Carolina became serious, and by 1892 what was once at a premium became a drug. The Florida developments had not only caused an overproduction of high-grade rock, but had forced upon the market immense quantities of lower grades, which could be used without any enriching material. The reason why 75 per cent and 80 per cent rock should retain an exceptional value no longer existed, and so it sank to a common level with the poorer products.[1] The adoption by the phosphate miners of the state of desperate measures to stem the tide and shut off competition by cutting the prices, only resulted in further embarrassment, until the market price dropped below the cost of production, and it became possible for them to remain in the market only by selling at a very tangible loss.[2]

The industry received further setbacks through a royalty dispute between the state and river miners and through a cyclone, August 27, 1893, which severely injured the mining plants, especially those of the river miners at Beaufort.[3] Barring a temporary setback in 1900 to the industry in the state, due mainly to scarcity of transportation facilities and high ocean freights, a gradual recovery has continued up to the present year.[4]

Siliceous crystalline rocks.—The granites and gneisses are widely distributed and extensively quarried above the fall line. The term granite is generally applied to all these rocks by the miners of the state. The granites proper are found in abundance and their outcrops lie along three nearly parallel lines. On the most southern of these lines they show themselves among the sand hills at Graniteville on Horse creek, Aiken county, and thence at various points, in a northeasterly direction, to Columbia. Many years ago notable quarries for building materials began to be worked on this line at Graniteville and at points in Richland county.[5]

The second line of outcrop extends from the neighborhood of Harris creek, Edgefield county, across Newberry, Fairfield, and Kershaw counties to the northwestern corner of Chesterfield. Here, also, quarries of excellent granite, fine grained and easy splitting, have been found, especially in Newberry and Fairfield counties, where there are inexhaustible quantities of the best building granite. A flesh colored porphyritic granite is found in Kershaw. In Edgefield and Lancaster counties it becomes coarser and syenitic in character. The third line of outcrop stretches through Laurens, Union, and York counties. In the vicinity of Union the granite is of exceedingly fine grain and well adapted for architectural purposes, but most of it on this line is characterized by a coarse porphyried structure.[6] Granite quarrying is an important industry in the state, being exceeded in value of product only by the mining of phosphate rock.

Clay.—Clays of many varieties are found widely distributed and constitute perhaps its greatest actual and prospective resource, being susceptible of greater extension and development than any other mineral.[6] The clays were among the first in the United States to attract attention, and early in the nineteenth century, prior to 1826, a Doctor Garden carried a small shipment of South Carolina kaolin to England and manufactured it into china ware.[7] While common, or brick, clay of excellent quality is found in almost every neighborhood, the state's principal wealth in clays lies in the extensive deposits of kaolin remarkable for purity. The sedimentary kaolins are widely distributed in the Savannah river area, the Santee area, and the Edisto area, in the counties of Aiken, Lexington, Richland, and Kershaw. In this region there are extensive beds of pure white kaolin exceeding 18 feet in thickness, and affording 98 per cent of clay substance, which requires no other preparation than drying.[8]

The Savannah river area affords perhaps the most remarkable exposures of sedimentary kaolin in the United States. In some places they are practically continuous for miles. From Hamburg to Aiken extends a zone 14 miles long by 5 miles wide.[9] The beds vary from 5 to 25 feet in thickness with an overburden of

[1] The Mineral Industry, 1892, Vol. I, page 368.
[2] Ibid., page 371.
[3] United States Geological Survey, "Mineral Resources of the United States," 1893, pages 704 and 705.
[4] Ibid., 1901, page 811.
[5] South Carolina, page 131.
[6] South Carolina Geological Survey, Series IV, Bulletin No. 1, Clays of South Carolina, by Earle Sloan, page 9.
[7] Statistics of South Carolina, page 28.
[8] Clays of South Carolina, pages 49 and 50.
[9] Ibid., pages 49, 50, and 81.

cross-bedded sands, thin layers of clay, and occasional Lafayette loams and cobbles, ranging in thickness from almost nothing to more than 100 feet. The thickness of the kaolin determines the amount of overburden that can be economically removed. This overburden is degraded by laborers with pick, shovel, and cart, or with scrapes or steam shovels until a sufficient terrace of clay is bared for extraction. The kaolin is moved in lump form to the dry sheds, where, after exposure to air and light for a few weeks, it is packed in casks of 1 ton capacity and shipped to the consumer. These deposits probably represent the largest body of clay closely approximating kaolinite to be found in the United States.[1]

In the Savannah river area of the coastal plain outside of the distinctive clay zone pertaining to the Cretaceous and Eocene formations, there are beds of clay of economic importance. At North Augusta and Hamburg a large deposit of alluvial clays occurs, which is excellently adapted to the manufacture of brick and the coarser stonewares.[2] A zone of older clays occurs approximately parallel with and about 30 miles distant from the coast. These clays are often fine grained and vary in color from pale yellow to a mottled blue; they are associated in many instances with coarse sands. Their average elevation above the sea level is 60 feet. These beds are developed near Garnett, and are adapted to the manufacture of tiling, face brick, and common brick.[3]

All other minerals.—The gold belt extends from the North Carolina border, southwest across the counties of York, Lancaster, Chesterfield, Kershaw, Fairfield, Chester, Spartanburg, Greenville, Pickens, and Abbeville. Auriferous gravels are found in many localities, but chiefly in York, Union, and Spartanburg counties.[3] The first consignment of gold from the sands of this state reached the United States Mint in the latter part of 1829.[4] The first recorded discovery of gold in the state, however, antedates this by three years, and was made in the Abbeville and Spartanburg districts.[5] In 1830 and 1831 numerous workings were under way in the state, especially in Lancaster and Chesterfield counties, where, in the latter, at the Brewer mine, even at this early date, from 100 to 200 men were employed.[6]

In 1859, 20 gold mines had been opened in the talc slates of Chesterfield and Lancaster counties, and 10 in the same slates in Abbeville and Edgefield, among the latter the celebrated Dorn mine from which more than a million dollars in gold has been taken. In Spartanburg, Union, and York counties there were 19 and in Pickens and Greenville 8 others.[5]

Gold mining, except in a few localities, remains practically as it stood in 1861. One notable exception, however, is found in the Haile gold mine, located in Lancaster county, which for many years has been perhaps the most consistent producer east of the Rocky mountains. The small silver production in 1902 was also from this mine.

Limestone occurs and to some extent has been quarried in York, Spartanburg, Laurens, and Pickens counties.[7] It is used for bridge work and in crushed form for road building.[8] However, owing to the abundance of granite for these purposes, it is used chiefly for burning into lime.

A few tons of manganese ore were mined near Greenwood in 1902, the mineral in great purity and abundance having been found at the old Dorn gold mine in Edgefield county and also in Abbeville, York, Laurens, and Anderson counties.[7]

Precious stones have been found at a number of places in the state. The first garnet found in the United States was picked up in Abbeville county, about 1825.[9] It was of a greenish yellow color. Garnets have also been found in Spartanburg county; rubies in Pickens; tourmaline in York, Edgefield, Laurens, Anderson, and Oconee; beryl in Edgefield and Laurens, and zircons in Abbeville and Anderson.

[1] Clays of South Carolina, pages 49, 50, and 81.
[2] Ibid., page 81.
[3] United States Geological Survey, "Mineral Resources of the United States," 1882, page 728.
[4] Ibid., Twentieth Annual Report, Part VI, page 111 ff.
[5] South Carolina, page 134.
[6] United States Geological Survey, Sixteenth Annual Report, Part III, page 257.
[7] South Carolina, page 137.
[8] United States Geological Survey, "Mineral Resources of the United States," 1889, page 428.
[9] Statistics of South Carolina, page 27.

SOUTH DAKOTA.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of South Dakota for 1902.

TABLE 1.—*Summary: 1902.*

	Total.	Gold and silver.	Sandstones and quartzites.	Limestones and dolomites.	All other minerals.[1]
Number of mines, quarries, and wells	77	40	12	10	15
Number of operators	77	40	12	10	15
Salaried officials, clerks, etc.:					
Number	167	148	4	1	14
Salaries	$242,461	$222,590	$2,833	$1,278	$15,760
Wage-earners:					
Average number	3,131	2,914	94	55	68
Wages	$3,374,776	$3,217,456	$69,509	$43,714	$44,097
Contract work	$8,349				$8,349
Miscellaneous expenses	$261,452	$240,112	$1,669	$366	$19,305
Cost of supplies and materials	$1,992,575	$1,936,617	$9,703	$10,455	$35,800
Value of product	$6,769,104	$6,464,258	$110,789	$86,605	$107,452

[1] Includes operators as follows: Cement, 1; graphite, 2; gypsum, 2; lithium ore, 1; mica, 3; natural gas, 3 (6 wells); precious stones, 3 (no mines).

Within the Black Hills region, which covers about 3,500 square miles, and is embraced within Custer, Lawrence, Meade, Pennington, and Fall River counties, a great diversity of minerals is found. The gold and silver mines located here have since their discovery yielded many million dollars' worth of the two metals. This region also contains vast gypsum beds, used for plaster of Paris; mica, of which large sheets are exported; petroleum and natural gas; white, red, and variegated sandstones; white and purple limestones; granite; and marble.[1]

Both lode tin and stream tin are found in the Black Hills, the ore deposits covering an area of 500 square miles, and extending in a great semicircle of 40 miles, around and northwest of Harneys peak. The production of tin in this region, however, has not yet amounted to much, though great hopes are entertained of future development. Copper, iron, manganese, lead, tungsten, graphite, and spodumene are also found in greater or less quantities in the Hills.[2]

Near Sioux Falls, in Minnehaha county, are found inexhaustible deposits of the so-called jasper, in red, pink, cherry, purple, peachblow, and gray tints. This stone has been extensively used in building and for monuments.[2]

[1] King's Handbook of the United States, page 791.

The minerals of known occurrence in the state, but which were not produced in commercial quantities in 1902, are antimony, copper, fuller's earth, granite, iron, lead, marble, nickel, pumice, tin, tungsten, and uranium.[2]

In addition to the productive mines, quarries, and wells for which statistics are shown in Table 1, 114 operators reported gold and silver mines the work in connection with which was exclusively devoted to their care and development. During the year 1902 these operators employed 522 wage-earners and paid $581,163 in wages. The 99 salaried officers, clerks, etc., received $114,956. Miscellaneous expenses amounted to $45,210, and the cost of supplies and materials to $166,585.

Table 2 shows the value of the products of the manufacturing industries of South Dakota, based primarily on minerals mined and quarried, and also the value of all products manufactured in the state as reported to the census of 1900.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$12,231,259
Based upon products of mines or quarries:		
Clay, glass, and stone products	$293,568	
Iron and steel and their products	54,265	
Metals and metal products, other than iron and steel	2,351,342	
Miscellaneous industries	583,644	
		3,282,819
All other		8,948,426

The value of the manufactured products of the state, based primarily on minerals mined and quarried, was $3,282,819, or 26.8 per cent of the value of all the manufactured products. The total value of the product of the mines, quarries, and wells of South Dakota in 1902, plus the total value of all manufactured products in 1900, was $19,000,343, of which amount the product of mines, quarries, and wells for 1902 formed 35.6 per cent and that of manufactures for 1900, 64.4 per cent.

At the census of 1900 the manufacturing industries of South Dakota were reported as giving employment during the census year to an average number of 3,121 wage-earners and paying $1,544,409 in wages. The

[2] Ibid., pages 792 and 793.

operators of the mines, quarries, and wells of the state reported that they employed an average of 3,131 wage-earners during 1902, and paid $3,374,776 in wages. The combined industries, therefore, employed 6,252 wage-earners and paid $4,919,185 in wages. Mining gave employment to 50.1 per cent of the wage-earners, but paid 68.6 per cent of the wages, while manufactures gave employment to 49.9 per cent of the wage-earners and paid only 31.4 per cent of the wages.

Table 3, compiled from reports of the United States Geological Survey, shows the value of the annual production of the principal minerals of the state from 1890 to 1902.

TABLE 3.—*Value of annual production of the principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Gold.[1]	Silver.[1]	Sandstones and quartzites.	Limestones and dolomites.
1890	[2]$3,200,000	[2]$129,292	$93,570	([3])
1891	3,550,000	129,293	25,000	([3])
1892	3,700,000	77,576	20,000	([3])
1893	4,006,400	181,527	36,165	$100
1894	3,290,100	76,248	9,000	3,663
1895	3,809,500	205,960	26,100	4,000
1896	4,969,800	296,727	37,077	3,126
1897	5,694,900	199,836	([3])	3,895
1898	5,699,700	196,913	9,000	26,868
1899	6,469,500	188,251	18,326	45,808
1900	6,177,600	[4]332,444	12,675	47,762
1901	6,479,500	[4]46,800	17,647	53,780
1902[5]	6,965,400	[4]180,306	110,789	86,605

[1] Estimates of the Director of the Mint; value of refined product; silver at coining value. The values given in Table 1 are the values at the mine.
[2] Includes production from North Dakota.
[3] Not reported separately.
[4] Commercial value.
[5] Census figures, except for gold and silver.

Gold.—The earliest authentic date of the finding of gold in the Black Hills is July 27, 1874, when small quantities of the precious metal were found in the bed of French creek, in Custer county, by miners accompanying the expedition of Gen. George A. Custer. From certain stories, still current, it would seem that some of the Sioux Indians and a few white men knew of the presence of gold in this region before 1874, but nothing definite is known concerning the actual facts.

A few weeks after the Custer expedition, other deposits of the precious metal were found, on December 23, 1874, about 3 miles below the present site of Custer, by a party entering the Black Hills region for settlement. Much prospecting was done in this vicinity during the winter, though little gold was found, and in the spring of 1875 the party was forced by the military to leave. The Black Hills country, then included within the Sioux reservation, was not open to settlement, and the Government made every effort to prevent prospectors from entering. This policy only intensified the desire to explore the region, and as a result of the widespread interest the Government, early in 1875, organized a special survey for the purpose of learning whether the mineral and other natural resources of the region warranted its purchase from the Indians.

The first authentic published statement of the finding of gold in the Black Hills was in a letter dated June 17, 1875, from the geologist in charge of the survey to the Commissioner of Indian Affairs at Washington, D. C., and which was first published in the Mining and Engineering Journal. The gold referred to in this letter was found June 12, 1875, in terraces or bars of quartz gravel, on the north bend of Castle creek. About a month later important discoveries in the placer deposits of Spring and Rapid creeks, northeast of Harneys peak, caused a rush in that direction, which was the first real stampede in connection with the gold excitement in the Black Hills. By this time several hundred prospectors had succeeded in gaining access to the region, and of this number more than a hundred staked out claims on Spring creek and commenced panning for gold.

The results of the survey having established the fact that the Black Hills region was of much greater value for mining purposes than it ever could be to the Indians, the Government finally purchased it from the Sioux for $4,500,000, and opened it for legal settlement February 28, 1877.

The discovery in the fall of 1875 of the rich placers of the Deadwood region, in Lawrence county, and, a few weeks later, of the rich conglomerate ores and of the great impregnated zone known as the Homestake Belt, indicated the permanent wealth of that part of the Hills and the tide of settlement turned accordingly northward from Custer. Since 1875 Lawrence county alone has far surpassed the balance of the region in the production of gold.

For ten years after gold was discovered the Black Hills had no railway facilities of any kind, but at the present time the northern part has excellent railway facilities, which fact has occasioned the opening up of many important mines. The central and southern hills are not so favored.

The gold bearing quartz veins are found chiefly in Pennington and Custer counties, in the central and southern part. Lawrence county, to the north, also has some valuable quartz veins. The ores of the impregnated zones are of great importance, one of them, the Homestake Belt, having furnished approximately three-fourths of the total output of gold in the Black Hills. The Homestake ore bearing area is an irregular belt 1½ miles long and one-half mile wide, near Lead city, forming perhaps the largest and most easily worked mass of low-grade gold ore in the world. In Lawrence county only have the ores of the impregnated zones been worked continuously for any length of time, though many claims, in Custer and Pennington counties, are said to carry as high values as the Homestake ore.

The cement ores within the Hills west and southwest of Deadwood were discovered in the early part of 1876, and in the same year the first quartz mill brought into the Hills reached Deadwood. The siliceous ores are

found only in the northern part, the producing ores lying in Lawrence county.

Placer gold is found in the gravel bars of all the streams and in the various terraces lining their valleys. The richest deposits, however, are either exhausted or can no longer be worked extensively with profit because of the lack of water supply. Associated with the gold in the placers are garnets, hematite and limonite pebbles, columbite, tantalite, cassiterite, and other less noticeable minerals.[1]

The following table, compiled from reports of the Director of the Mint, shows the annual production of gold in South Dakota from 1887 to 1902:

TABLE 4.—*Annual production of gold: 1887 to 1902.*

[Reports of the Director of the Mint.]

YEAR.	Fine ounces.[1]	YEAR.	Fine ounces.[1]
1887[2]	116,110	1895	187,187
1888[2]	125,775	1896	240,414
1889[2]	140,287	1897	275,491
1890[2]	154,800	1898	276,723
1891	171,731	1899	312,962
1892	178,987	1900	298,842
1893	193,809	1901	313,446
1894	159,594	1902	336,952

[1] Estimates of the Director of the Mint for refined product. The values given in Table 1 are the values at the mine.
[2] Includes production from North Dakota.

Silver.—Excepting the small but fairly regular amount of silver obtained from gold bullion, silver in the Black Hills is closely associated with lead.[2] Argentiferous galena ores are found in the Galena district southeast of Deadwood, in the Carbonate district northwest of Deadwood, and at Spokane. It is occasionally found elsewhere, but apparently little or no contribution to the output of the galena ores has been made from other than the three localities mentioned. The earliest developments worthy of note were made in 1881 at Galena.[3]

Silver-lead ores were found near Carbonate in 1886. Considerable lead and silver was produced by the Spokane mine during the years 1898–1900, but the mine is now idle. The character of the ore bodies in the various localities differs widely. They occur in the Algonkian in veins, in the Cambrian as shoots, and in the Carboniferous as contact deposits, the latter two graduating more or less into each other.[3]

Table 5, compiled from reports of the Director of the Mint, shows the annual production of silver from 1887 to 1902.

[1] Mineral Wealth of the Black Hills, by Cleophus O. O'Harra, page 6 ff.
[2] Ibid., page 60.
[3] Ibid., pages 60 and 61.

TABLE 5.—*Annual production of silver: 1887 to 1902.*

[Reports of the Director of the Mint.]

YEAR.	Fine ounces.[1]	YEAR.	Fine ounces.[1]
1887[2]	417,690	1895	1[illegible]
1888[2]	77,344	1896	[illegible]
1889[2]	50,000	1897	1[illegible]
1890[2]	100,000	1898	1[illegible]
1891	100,000	1899	1[illegible]
1892	60,000	1900	[illegible]
1893	140,400	1901	[illegible]
1894	58,973	1902	[illegible]

[1] Estimates of the Director of the Mint for refined product.
[2] Includes production from North Dakota.

Sandstones and quartzites.—One of the most promising stones of the West is the pink and red quartzite quarried near Sioux Falls, in Minnehaha county. The stone is so strong as to endure a pressure of 25,000 pounds to the square inch, is grained so closely as to be almost impervious to moisture, and will take a polish almost like glass, with which it favorably compares in durability. In color the stone varies from light pink to jasper red, and is one of the few stones now quarried in the United States which are adapted equally to rough building and both interior and exterior ornamental work.[4]

Eight of the 12 quarries in the state productive in 1902 were located in Minnehaha county, while Butte, Fall River, Hanson, and Lawrence counties had only 1 each. The entire output of these quarries in 1902 was valued at $110,789, an increase over 1901 of $93,142. The value of the sandstone produced for building purposes amounted to $42,162.

Limestones and dolomites.—The 10 quarries productive in 1902 were located in Custer, Lawrence, and Meade counties, and the output was valued at $86,[illegible], of which $54,750 was for flux for blast furnaces.

All other minerals.—The single cement plant in South Dakota was built at Yankton, Yankton county, in 1889, and produced its first Portland cement in the following year, since which time it has been in successful operation. Chalkstone of the Colorado Cretaceous and the dark, fat overlying clay are the materials used.[5]

In many parts of the Hills graphitic slates abound, and in many places the percentage of graphite is sufficiently high to arouse some interest in the economic possibilities of the deposits. Considerable prospecting has been done in the central hills, particularly near Custer, Custer county, and Rochford, Pennington county.[6]

[4] Stones for Building and Decoration, by George P. Merrill, page 162.
[5] United States Geological Survey, "Mineral Resources of the United States," 1902, page 802.
[6] Mineral Wealth of the Black Hills, page 72.

The deposits of gypsum of the Black Hills are utilized for the manufacture of wall plaster at Spearfish, Lawrence county, and Hot Springs, Fall River county.[1]

Spodumene, a source of lithium salts, has recently acquired commercial importance in the Black Hills, and considerable local activity has been shown in the development of the industry. The deposits are all found in Custer and Pennington counties. This mineral first attracted attention during the tin mining activity in 1884, at which time its occurrence was noted in several localities.[2] The most noted of these is the Etta mine, which is the only locality in which this mineral was produced in 1902.[3]

The earliest explorations for mica in the Black Hills were made in 1879, the first property upon which much work was done being the McMacken mine, near Custer. Several other mines were opened somewhat later, but most of them practically ceased operating after 1884, the work during subsequent years until 1899 being merely sufficient development work to hold claims. The mineral is found in pegmatite dikes, which occur in great abundance in the granite region of Pennington and Custer counties.[4] Many of the dikes do not contain large mica books in sufficient quantity to make them profitable producers, but all have the mica present to a greater or less extent. In 1899 the output of mica was 20,299 pounds, valued at $18,000; in 1900 the sheet mica output reached the unprecedented amount of 65,000 pounds, valued at $45,000, while the production of scrap mica was 222 tons, worth $1,554.[5] In 1902 the production of rough mica amounted to 205 tons, valued at $17,250, and 6,000 pounds of sheet mica, worth $1,200.

The natural gas found in South Dakota is associated with flows of water at various localities in Hughes and Sully counties.[6] The first well in the state was drilled at Pierre, Hughes county, in 1892, and there is no apparent diminution of gas.[7] In 1902 the 6 productive wells had an output valued at $10,280.

The rose quartz reported under the head of precious stones was mined in Custer county, where there are immense quantities of the mineral in sight.[8]

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 906.
[2] Mineral Wealth of the Black Hills, page 75.
[3] United States Geological Survey, "Mineral Resources of the United States," 1902, page 260.
[4] Mineral Wealth of the Black Hills, pages 72 and 73.
[5] Ibid., pages 73 and 74.
[6] United States Geological Survey, "Mineral Resources of the United States," 1902, page 653.
[7] Ibid., Twenty-first Annual Report, 1899-1900, Part VI, page 316.
[8] Ibid., "Mineral Resources of the United States," 1901, page 750.

TENNESSEE.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of Tennessee for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Phosphate rock.	Iron ore.	Marble.	Limestones and dolomites.	All other minerals.[1]
Number of mines, quarries, and wells	241	84	40	22	11	51	33
Number of operators	203	73	37	13	10	44	26
Salaried officials, clerks, etc.:							
Number	773	418	115	106	38	37	59
Salaries	$664,379	$381,939	$82,125	$71,535	$37,430	$27,826	$63,524
Wage-earners:							
Average number	10,890	6,220	1,597	1,209	607	698	569
Wages	$4,864,241	$3,218,532	$493,809	$512,702	$218,764	$222,475	$202,959
Contract work	$174,496	$14,094	$157,402				$3,000
Miscellaneous expenses	$720,483	$432,029	$81,882	$111,851	$11,268	$11,462	$71,988
Cost of supplies and materials	$850,485	$390,561	$93,715	$144,540	$18,725	$101,195	$101,749
Value of products	$9,533,782	$5,399,721	$1,308,872	$1,123,527	$518,256	$482,033	$701,373

[1] Includes operators as follows: Barytes, 6; clay, 9; copper ore, 2; fluorspar, 1; gold and silver, 2; mineral pigments, crude, 1; natural gas, 1; petroleum, 1; and sandstones and quartzites, 3.

Tennessee has long been conspicuous as a mining state; for more than one hundred years its great wealth of iron ore deposits has engaged the attention of miners. The coal fields, comprising almost one-eighth of the total area of the state, are practically inexhaustible and have been worked extensively. Since the discovery of phosphate rock early in the present decade its mining has grown until the state's output of this mineral has become second only to its production of coal. The marble deposits of the state have long been famous. Their early development brought the state into prominence, and with the increasing demand for "Tennessee" marble the industry of its quarrying has grown steadily. Another important branch of mining industry is that which has developed around the valuable and extensive deposits of copper ore in the Ducktown district.

Manganese is of frequent occurrence in various parts of the state, chiefly in the eastern section in association with the iron ores. The first manganese ore mined in the United States was produced near Whitfield, Hickman county. The mine was first worked in 1837, and the output was used for coloring earthenware. The two sections from which manganese ores have been taken in commercial quantities are the vicinity of Sweetwater, Monroe county and in Unicoi county.[1]

Lead and zinc ores occur at numerous points in the eastern and middle parts of Tennessee, and a half century or more ago in the Valley range west of the line of Red Knobs lead mining gained considerable headway. The industry has not been revived, although deposits of galena occur that seemingly would warrant commercial exploitation. Interesting features of this locality are the old and quite extensive "diggins," about which the oldest inhabitants and the Indians before them knew nothing.[2] It has been surmised that these excavations were made in a search for galena. Whether the object was to secure galena or other minerals, these workings point unerringly to an era of mining activity which antedates both history and tradition, and most probably was cotemporaneous with the still more extensive and systematic operations in the mountains of North Carolina, and with prehistoric copper mining in the Lake Superior region. The deposits of zinc ore, especially those in the vicinity of Knoxville, have been worked in a desultory way for many years, and considerable quantities of ore have been calcined and shipped to eastern smelters.[3]

Millstones of excellent quality have been made from some of the rock formations. Those made from chert were in great demand at one time and were regarded as being equal to the French buhrstone.[4]

Cement has been manufactured at numerous points from the outcroppings of the limestone, and asphaltum, granite, gypsum, and roofing slate are known to occur in greater or less quantities.

[1] United States Geological Survey, Sixteenth Annual Report, 1894–95, Part III, pages 423 and 424.

[2] Geology of Tennessee, by James M. Safford, A. M., Ph. D., pages 484 and 485.

[3] United States Geological Survey, "Mineral Resources of the United States," 1882, page 367 ff.

[4] Geology of Tennessee, page 511.

The following minerals are known to occur in the state, but were not produced in commercial quantities in 1902: Asphaltum, cement, granite, gypsum, lead ore, manganese ore, millstones, slate, and zinc ore.

A total of $22,940 was expended in the state in development work during 1902, but no product was realized. The minerals receiving attention in this way were natural gas, petroleum, and copper ore.

Table 2 shows the relative importance of the manufacturing industries closely allied to or based upon the mining industry, using as their raw material the products of mines and quarries.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$108,144,565
Based upon products of mines or quarries:		
Chemicals and allied products	$1,649,078	
Clay, glass, and stone products	2,056,386	
Iron and steel and their products	9,848,440	
Metals and metal products, other than iron and steel	1,308,700	
Miscellaneous industries	3,703,078	
		18,565,682
All other		89,578,883

The total value of the products of the manufacturing industries based on mining was $18,565,682 or 17.2 per cent of the total value of the product of all manufacturing industries in 1900. During the same year there were employed in all branches of manufactures 50,504 wage-earners, who were paid $16,647,638 in wages. In 1902 the mines and quarries gave employment to 10,890 wage-earners, who received $4,864,241 in wages. By combining the figures of these two branches of industry it is disclosed that 82.3 per cent of the wage-earners receiving 77.4 per cent of the wages were employed in manufacturing, while 17.7 per cent of the wage-earners receiving 22.6 per cent of the wages were employed in mining.

The following table shows the value of the annual production of the principal minerals of the state from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Phosphate rock.	Iron ore.	Marble.	Limestones and dolomites.
1890	$2,395,746	(1)	(2)	$419,467	$73,028
1891	2,668,138	(1)	(2)	400,000	70,000
1892	2,355,441	(1)	$505,359	350,000	20,000
1893	2,048,449	(1)	392,771	150,000	126,089
1894	2,119,481	$67,158	288,005	231,796	188,664
1895	2,349,032	82,160	447,852	362,277	156,898
1896	2,281,295	57,370	432,932	381,373	157,176
1897	2,329 534	193,115	479,485	441,954	118,774
1898	2,337,512	498,392	481,192	316,814	182,402
1899	2,940,644	1,192,916	694,372	[3] 384,705	208,097
1900	4,003,082	1,328,707	669,087	424,054	238,505
1901	4,067,389	1,192,090	912,849	494,637	330,927
1902[4]	5,399,721	1,308,872	1,123,527	518,256	432,033

[1] No production.
[2] Value not reported.
[3] Includes production from North Carolina.
[4] Census figures.

Coal, bituminous.—The most valuable contribution to the mineral wealth of the state are the coal fields, comprising more than 5,000 square miles and traversing the state in a northeast and southwest direction.[1] The belt in which these coal measures occur is coextensive with the Cumberland table-land and varies in width from 71 miles at the northern boundary to 50 miles at the Georgia and Alabama state line.[2] In this belt the industry of coal mining has been developing since long before the Civil War, during which its growth was temporarily interrupted.[1] Practically all the mining of these earlier years was on a petty scale, and outside of Nashville and Memphis very little coal was used, except for blacksmithing purposes.[3] The industry did not reach a scale of any considerable importance until some fifteen years after the war,[3] but it has developed steadily since. In 1892 its progress was seriously interfered with by strikes. Since 1893 production has increased rapidly, the output for 1902 being 50 per cent greater than that for 1897, and more than double the production at the beginning of the decade.[4] Nineteen counties of the state are embraced wholly or in part within the coal belt, and the range of the industry has expanded until coal is produced in practically all of these counties. In Campbell county is a part of the famous Jellico steam-coal field. The Sewanee vein, one of the most important, is extensively worked in Grundy county. Much high-grade coke is made from this product.

Other counties in which extensive coking establishments are under way are Claiborne, Hamilton, Marion, Rhea, and Roane.[5] Eighty-eight per cent of the yield in 1902 was from the following counties: Anderson, Campbell, Claiborne, Cumberland, Grundy, Marion, Morgan, Rhea, and Scott. The annual production of the Tennessee mines from 1870 to 1902 is shown in Table 4.

TABLE 4.—*Annual production of coal, bituminous: 1870 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1870	149,428	1887	1,900,000
1871	180,000	1888	1,907,297
1872	224,000	1889	1,925,689
1873	350,000	1890	2,169,585
1874	350,000	1891	2,413,678
1875	360,000	1892	2,092,064
1876	550,000	1893	1,902,258
1877	450,000	1894	2,180,879
1878	375,000	1895	2,535,644
1879	450,000	1896	2,663,106
1880	641,042	1897	2,888,849
1881	750,000	1898	3,022,896
1882	850,000	1899	3,330,659
1883	1,000,000	1900	3,509,562
1884	1,200,000	1901	3,633,290
1885	1,440,957	1902	4,382,968
1886	1,714,290		

[1] Geology of Tennessee, page 366.
[2] United States Geological Survey, Sixteenth Annual Report, Part IV, page 188.
[3] Ibid., "Mineral Resources of the United States," 1885, page 64.
[4] The Production of Coal in 1902, by Edward W. Parker, page 183.
[5] United States Geological Survey, Sixteenth Annual Report, page 188.

Phosphate rock.—The phosphate rock mined in this state has been classified into three groups or varieties, according to color. These are blue rock, which occurs mainly in Hickman county; white rock, as typified by the deposits occurring in Perry county; and brown rock, deposits of which are confined principally to Maury county.[1] Rocks containing varying percentages of phosphate occur in several other counties in the phosphate rock region, which extends from the vicinity of Nashville, south to the Tennessee river.

The discovery and exploitation of the deposits of this valuable mineral in the state constitutes, in the main, a repetition of the events attending the discovery of phosphatic rock in both South Carolina and Florida. In all these cases the valuable phosphatic contents of the rock became known by accident. The existence of the rocks was a matter of common knowledge, and their peculiarities, at least in the case of South Carolina and Tennessee, had been the subject of extended study and investigation by geologists. A remarkably accurate description of the physical characteristics of the phosphate deposits of Tennessee was given by Doctor Safford, in 1869, in his Geology of Tennessee. Their chemical nature and great commercial value, however, remained a secret for a quarter of a century longer.

Certain kinds of phosphate rock in Tennessee have been used for many years in building operations requiring stone. An object of interest to visitors to the fields at present is a stone house made almost entirely of phosphate rock many years ago by a religious recluse.[2]

The discovery of the deposits, the development of which marked the beginning of phosphate mining in the state, occurred in October, 1893. During that year Messrs. L. Bates and R. Childs had been prospecting for coal in this section and a Mr. Harder, while fishing in Swan creek in Lewis county, found some peculiar looking rocks, which he sent to these coal prospectors for examination. Thinking the rocks indicated coal these prospectors shipped them to Prof. J. C. Wharton, an analytical chemist of Nashville. Upon examining them the chemist found one of the specimens to be a high grade of phosphate rock.[3] When the discovery became known the scenes enacted in South Carolina and Florida were repeated. Prospectors and speculators were early on the ground, and other discoveries quickly followed in all directions. By July, 1894,[3] several companies had been organized, extensive tracts of land had been purchased or leased, and the industry of phosphate mining was well under way. In the latter part of this year the phosphate rock of Tennessee first became a distinct factor in the market. About 45,000 tons were mined and shipped between July, 1894, and July, 1895. For two years after the beginning of the industry all the phosphate rock that left the state was mined in Hickman county.[4] In December, 1895, the Hon. S. Q. Weatherby, while passing along a road near Mt. Pleasant, in Maury county, observed in the deep cuts a thinly laminated rock that to him suggested zinc ore. Actuated mainly by curiosity, and with no thought of making any valuable discovery, he broke a piece to study its structure, and found that instead of confirming his impression as to zinc ore it presented a granulated appearance characteristic of the phosphate rock of Lewis and Hickman counties. Samples were secured and sent to Mr. Lucius P. Brown, an analytical chemist of Nashville, for examination, and they were found to contain phosphate of lime ranging in percentages from 75.2 to 78.1. For some months this new discovery was not allowed to become known beyond a chosen few, and in the meantime options were taken on much of the land containing the phosphates. Mining operations were begun within the town limits of Mt. Pleasant in July, 1896, and the first shipment was made on the 20th of that month. On this public disclosure there was excitement in all the surrounding neighborhood, pervading all classes.[5] The industry was prosecuted on a commercial scale from the start, and grew rapidly. Table 5 shows the monthly shipments of rock from Mt. Pleasant during the first thirteen months.

TABLE 5.—*Monthly shipments of phosphate rock from Mt. Pleasant district: 1896 and 1897.*

[United States Geological Survey, "Mineral Resources of the United States."]

DATE.	Pounds.	DATE.	Pounds.
1896.		1897.	
July (11 days)	784,797	January	16,518,412
August	5,788,943	February	15,244,650
September	5,746,782	March	15,061,300
October	5,016,589	April	18,514,460
November	10,772,986	May	22,323,520
December	15,302,292	June	12,369,000
		July	20,142,900

By the latter part of 1896 the center of activity had moved from Hickman to Maury county, and it has remained there since. In 1898 Tennessee contributed 22 per cent of the total production of phosphate in the United States, and 12.4 per cent of the aggregate output of the world.[6] In 1899 the state exceeded South Carolina in production, and has been second to Florida since.

The outlook for the industry in the state is promising. Conditions are favorable for the economical operation of fertilizer factories. The shales with which the deposits of phosphate are interstratified are rich in sulphur, from which can be manufactured the sulphuric acid necessary in the treatment of phosphate rock. Thus the two essential raw materials in the manu-

[1] United States Geological Survey, Twentieth Annual Report, Part VI, continued, page 633.
[2] Bureau of Labor Statistics and Mines, of Tennessee, Fifth Annual Report, page 269.
[3] Ibid., page 270.
[4] Bureau of Labor Statistics and Mines, of Tennessee, Eighth Annual Report, page 195.
[5] Ibid., pages 203 and 204.
[6] Ibid., Ninth Annual Report, page 101.

facture of fertilizers are delivered, as it were, at the very doors of the factories free of freight charges.[1]

Table 6 shows the annual production of phosphate rock from 1894 to 1902.

TABLE 6.—*Annual production of phosphate rock: 1894 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1894	19,188	1899	430,192
1895	38,515	1900	454,491
1896	26,157	1901	409,953
1897	128,723	1902	390,799
1898	308,107		

Iron ore.—The iron ore deposits of Tennessee are comprised within four clearly defined belts extending across the state. The central, or Cumberland, belt embraces an area of about 5,000 square miles,[2] and is coextensive with the coal fields. The ore found in this belt is red hematite. In a relative sense this belt is of minor importance.[3] The other three belts are producers, and the bulk of the state's great wealth in iron ores lies within their limits. The eastern belt extends along the Smoky mountains. Limonite, hematite, and magnetic ores are found in this region. They do not occur in regularly stratified beds nor in true veins, but in masses of varying sizes, ranging from small lumps to blocks of 10 and 15 feet in diameter. Ore recently discovered in this district is highly impregnated with magnetic properties, and exerts a marked influence over the needle of a compass 10 feet away. There are indications that this ore exists in large quantities.[4] The Dyestone belt is parallel with the base of the Cumberland table-land.[5] The chief ore of this belt is a stratified red iron rock of highly fossiliferous character. The belt is remarkable for the extent and richness of its ore deposits, from which has been taken the bulk of the state's production. The ore averages 60 per cent metallic iron.[4] The western belt traverses the state from north to south along the dividing line between middle and west Tennessee. It is 50 miles in width, and embraces an area of more than 5,000 square miles. The ore throughout this belt averages about one-third metallic iron.[5]

The iron ores of Tennessee have long been celebrated. The first settlers in the state began the manufacture of iron soon after the close of the War of the Revolution.[6] Three-quarters of a century ago iron in the form of blooms was manufactured and shipped to Pittsburg.[7] In 1850 Tennessee stood fourth among the states in the production of iron ore,[8] and except during the Civil War the industry has grown steadily since that time. In the manufacture of car wheels and the best grades of bar iron no ore is superior to the ore of Tennessee.[9] In Table 7 is shown the annual production of iron ore in the state from 1890 to 1902.

TABLE 7.—*Annual production of iron ore: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1890	465,695	1897	604,497
1891	543,923	1898	593,227
1892	406,578	1899	632,046
1893	372,996	1900	594,171
1894	292,831	1901	789,494
1895	519,796	1902	874,542
1896	535,484		

Marble.—The marbles of Tennessee, forming one of the state's principal mineral resources, are widely distributed. They have been quarried in the eastern, middle, and western sections of the state.[10] The chief deposits, however, are comprised within an almost unbroken zone or belt 20 miles in width and more than 100 miles in length, situated in eastern Tennessee, with Knox county as its center.[11] Within this range the supply of marble is practically inexhaustible. There are many kinds suitable for the various uses to which marble has been put. In color almost every tint and shade between white and black is found in a great variety of combination. There is no record of the earliest marble working in the state except that chiseled into the first products of the industry. These old tombstones, still sharp and clear in outline, scattered through the churchyards of the region, and especially those around the First Presbyterian church in Knoxville, serve the double purpose of carrying the date of their manufacture back into the morning of the nineteenth century and of affording the most convincing proof of the enduring qualities of the marble from which they were cut. Marble quarrying along systematic lines dates from April, 1838, the first quarry being opened at Rogersville, the seat of Hawkins county.[12] Orville Rice, a Yankee clock peddler,[13] was elected president, and the company was organized for the purpose of sawing marble and establishing a marble factory in the vicinity of Rogersville.[14] This quarry was located on the line of the stage road, and

[1] Bureau of Labor Statistics and Mines, of Tennessee, Fourth Annual Report, page 119.
[2] Ibid., Second Annual Report, page 308.
[3] The Universal Cyclopedia, Vol. II, page 350.
[4] Bureau of Labor Statistics and Mines, of Tennessee, Second Annual Report, page 309.
[5] The Universal Cyclopedia, Vol. II, page 350, and Bureau of Labor Statistics and Mines, of Tennessee, Second Annual Report, page 308.
[6] Iron in All Ages, by James M. Swank, page 288.
[7] The United States Geological Survey, "Mineral Resources of the United States," 1883–84, page 277.
[8] Bureau of Labor Statistics and Mines, of Tennessee, Seventh Annual Report, page 51.
[9] United States Geological Survey, "Mineral Resources of the United States," 1883–84, page 279.
[10] Geology of Tennessee, page 506 ff.
[11] Bureau of Labor Statistics and Mines, of Tennessee, Fifth Annual Report, page 248.
[12] Ibid., page 244.
[13] Ibid., page 245.
[14] Geology of Tennessee, page 508.

soon after the quarrying operations were started Mr. Rice began the erection of a large brick tavern, the interior of which he richly and profusely ornamented with marble mantels, shelves, steps, and wainscoting. The house was known as "Marble Hall," and is still standing, being used at present as a residence.[1] A block of the light mottled strawberry variety was sent to the builders of the Washington Monument; it was inscribed "Hawkins County Block." Another block, sent by authority of the legislature, was called the "Tennessee State Block."[1] These attracted the attention of the building committee of the Capitol at Washington, D. C., and although they had specimens from all the then known marble deposits of the country, they decided in favor of the East Tennessee marble.[2]

Following this decision an extensive quarry was opened by the Government at a point near Rogersville where the Holston river intersects the marble range, and from here many thousand cubic feet were taken. It was used in constructing the balustrades and columns of the stairs leading up to the House and Senate galleries, the walls of the marble room, and other parts of the building. About one-half of the ornamental material in the Capitol is of Tennessee marble.[3] This unequaled means of advertising at once brought the state into national prominence as a marble producer. In 1902 Tennessee ranked second in the production of marble for interior decoration and fourth in the total value of marble products.

Limestones and dolomites.—Most of the product of the limestone and dolomite quarries is burned into lime or is used as flux in iron furnaces. The building limestones of the state have only a local reputation, are generally not of high grade, and are quarried to only a limited extent. Almost one-half of the output of building stone of this character during 1902 was from Davidson county. A compact, finely fossiliferous, light pink spotted limestone occurs near Nashville. Near Chattanooga a magnesian limestone of bluish black color is quarried for local use. This stone is said to be durable. Other localities where limestones occur and have been quarried to some extent for building purposes are near Columbia, and at Carters Creek, in Maury county, and at Morristown and Springfield. A fine grained, compact, and light colored oolitic stone, which cuts to a sharp, smooth edge and seems to be a most excellent stone, occurs near Sherwood station.[4]

All other minerals.—Barytes occurs in numerous places in the state. Since it is frequently the matrix of lead ore, its occurrence is notable in the lead regions. There are important deposits in Greene county and at Haysboro, in the vicinity of Nashville.[5]

Except in the use of common clay for brick, very little mining of this mineral is carried on. A large bed of what is claimed to be kaolin or porcelain clay occurs in the state,[6] but there was no production from it in 1902. The production of clay in 1902 consisted of pipe, ball, fire, and stoneware clay, and was mined to some extent in Carroll and Hardeman counties, but chiefly in Henry county.

While deposits of copper ore occur at numerous places in the mountain region, the great deposits are in the Ducktown district of Polk county, in the extreme southeastern portion of the state. These ore deposits are not true fissure veins; they are great lenticular masses of ore and gangue material lying conformably between strata of country rock. These masses or veins occur generally in long ranges or belts, one succeeding another longitudinally in approximately the same line, and their feather edges not infrequently overlap though thrown apart by intervening rock.[7] The discovery of copper in Polk county followed the discovery of gold made some years previously on Coqua creek. It was in the search for the latter metal that one of the gold hunters, Mr. Semmons, in 1843, found crystals of red copper ore while panning the gravels for gold in a branch at a point where the Hiwassee copper mine was later opened. Further investigation was carried on by a Mr. Grout and several rich specimens of native copper were found. In 1847 a German miner named Weber secured possession of the property and made the first shipment of copper ore from the district. This consisted of 90 casks and was sent to the Revere Smelting Works, near Boston. Before he had learned the real value of his shipment the miner left and operations ceased. In 1849 Mr. John Caldwell reached the district in a search for copper ore, and to him, perhaps, more than to any other is due the credit for the development and exploitation of these valuable and extensive deposits. The first mine opened in the district was the Hiwassee in August, 1850. Next came the Cocheco in October of the same year, and one year later the Tennessee. In 1852 two other mines were opened. In 1853 this number was increased by 6 others with 3 more in 1854. When the almost insuperable obstacles in the way of the transportation of machinery through the wild mountainous country to the district and the hauling of the product from it are considered, this rapid development is all the more remarkable and indicates plainly the richness and extent of the deposits. By the end of September of the following year, 1855, 14,291 tons of ore, worth more than a million dollars, had been shipped from the district. The Ducktown district continued to develop; to the industry of mining was added that of smelting, and later rolling mills were constructed. Mining operations were interrupted during the greater part of

[1] Bureau of Labor Statistics and Mines, of Tennessee, Fifth Annual Report, page 245.
[2] Geology of Tennessee, page 508.
[3] Ibid., page 509.
[4] Stones for Building and Decoration, by George P. Merrill, page 322.
[5] Geology of Tennessee, pages 224, 283, and 503.
[6] United States Geological Survey, "Mineral Resources of the United States," 1893, page 609.
[7] Geology of Tennessee, page 477.

the Civil War period. As a result of this prolonged suspension the mining properties suffered greatly, skilled laborers were dispersed, and, on the whole, conditions in 1865 were altogether unfavorable for a resumption of activity. However, the excellent quality of the Ducktown copper, and the demand for it, furnished a very potent stimulus, and soon operations were under way on an even wider scale than before. The copper industry was one of the first to recover from the effects of this period of great industrial depression, and has continued to be an important factor in the state's mineral development since.[1]

Fluorspar occurs in numerous places in the state and especially in Smith, Trousdale, and Wilson counties. Some of the deposits are of commercial importance. Fluorspar mining is new in the state, being a development of the last one or two years.[2]

The only section of the state in which gold has been found in any important quantity is the southeastern part between the French Broad river and the Georgia line. Most of the mining operations have been confined to Coqua creek and vicinity, a strip of country about 10 miles long by 2 or 3 miles wide. The first discovery of gold in the state occurred in this region in 1831. Considerable placer mining was done at this time and some gold has been mined each year since, but the industry is of minor importance.[3]

The only production of crude mineral pigments reported for 1902 was a small quantity from James county.

The beginning of the production of natural gas in the state is of quite recent date, and the only report in 1902 was of a small amount in Franklin county.

The first successful borings for petroleum in the state were probably those in the southern part of Overton county in 1866.[4] The industry at present is of minor importance, the total production reported in 1902 being a small quantity from Fentress county.

The workable sandstones of the state are not widely distributed. A fine grained light pink and coarse buff variety occurs at Sewanee and a coarse gray variety at Parksville.[5]

[1] Geology of Tennessee, page 469 ff.
[2] United States Geological Survey, "Mineral Resources of the United States," 1902, page 899.
[3] Geology of Tennessee, page 489 ff.
[4] Ibid., pages 350 and 499.
[5] Stones for Building and Decoration, page 163.

TEXAS.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of Texas for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Petroleum.	Coal, bituminous.	Quicksilver.	Limestones and dolomites.	Sandstones and quartzites.	Siliceous crystalline rocks.	Natural gas.	All other minerals.[1]
Number of mines, quarries, and wells	1,067	955	26	5	35	13	8	14	11
Number of operators	308	211	24	3	34	13	8	5	10
Salaried officials, clerks, etc.:									
Number	1,210	999	91	19	30	11	8	1	51
Salaries	$664,802	$444,129	$90,086	$19,876	$21,393	$8,689	$8,400	$2,000	$70,229
Wage-earners:									
Average number	3,853	723	1,979	233	275	191	56	.....	396
Wages	$2,261,639	$699,209	$991,391	$87,414	$124,272	$100,399	$41,184	.....	$217,770
Contract work	$1,387,796	$1,363,463	$38	$235	.....	.....	.....	$18,812	$5,248
Miscellaneous expenses	$923,769	$713,176	$102,237	$6,305	$8,458	$7,644	$2,301	$2,612	$81,033
Cost of supplies and materials	$1,051,457	$975,937	$99,127	$73,373	$34,222	$21,261	$6,095	$125	$142,317
Value of product	$6,981,532	$4,174,731	$1,477,245	$254,350	$228,662	$165,565	$60,003	$14,953	$606,023

[1] Includes operators as follows: Asphaltum and bituminous rock, 1; cement, 2; clay, 3; gold and silver, 1; gypsum, 2; iron ore, 1 (2 mines).

As shown in the above table, the total output of the mineral industry in Texas during 1902 was valued at $6,981,532; of this amount the product of petroleum wells, valued at $4,174,731, formed 59.8 per cent, and that of coal mining, with a valuation of $1,477,245, constituted 21.2 per cent. Petroleum and bituminous coal together represented more than four-fifths of the total value of the mineral production in the state.

The gypsum reported in Texas was about one-tenth that of the entire United States production and ranked third in importance among the minerals of the state. There were but two establishments reporting, and therefore the separate statistics for this industry are not published.

Quicksilver ranked fourth in value among the minerals of the state, the value of the production amounting to 16.4 per cent of the total for the United States. Following in the order of their importance may be mentioned the production of cement, limestones and dolomites, sandstones and quartzites, gold and silver, siliceous crystalline rocks, natural gas, iron ore, clay, and asphaltum and bituminous rocks.

A large number of minerals, for which no commercial production was reported during 1900, are known to occur in Texas. Among these may be mentioned the following: Antimony, asbestos, bismuth, copper, feldspar, garnet, manganese, marble, molybdenum, slate, and talc. Agate, amethyst, opal, and tourmaline have also been found in the state.

Development work was carried on during the year at 71 mines, quarries, and wells by 51 operators, their attention being almost entirely directed to petroleum and gas wells, coal mines, and sulphur and pyrite mines. These operators paid $37,209 to their 36 salaried officials, clerks, etc. They also gave employment to 48 wage-earners and paid $46,766 in wages. The amount expended for contract work was $245,542; the miscellaneous expenses were $29,912; and the cost of supplies and materials was $51,679.

The relative importance of manufacturing industries closely allied to or based upon the mineral industry, and using as their raw material the products of the mines and quarries, is shown in Table 2 by value of products.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures	.....	$119,414,982
Based upon products of mines or quarries:		
Chemicals and allied products	$637,827	
Clay, glass, and stone products	2,490,360	
Iron and steel and their products	2,949,000	
Metals and metal products, other than iron and steel	8,346,672	
Miscellaneous industries	5,199,974	
		19,623,833
All other	.....	99,791,149

Table 2 shows that the value of the manufactured products bearing intimate relation to the mining industry amounted to $19,623,833, or 16.4 per cent of the

total manufactured product of the state in the year 1900. During this year there were employed in the manufacturing industries in Texas 48,153 wage-earners, who received $20,552,355 in wages. In 1902 the operators of the productive mines, quarries, and wells of the state reported the employment of 3,853 wage-earners, to whom was paid the sum of $2,261,639. Of the combined figures it is shown that 92.6 per cent of the total wage-earners were employed by manufacturing establishments in 1900 and that they received 90.1 per cent of the wages, while but 7.4 per cent of the entire number of wage-earners were, in 1902, engaged in the mineral industry, and were paid 9.9 per cent of the total wages.

The following table compiled from the reports of the United States Geological Survey, shows the value of the principal minerals produced in Texas from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Petroleum.	Coal, bituminous.	Limestones and dolomites.	Sandstones and quartzites.	Siliceous crystalline rocks.
1890	$227	$465,900	$217,835	$14,651	$22,550
1891	227	412,300	175,000	6,000	75,000
1892	225	569,333	180,000	48,000	50,000
1893	210	688,407	28,100	77,675	38,991
1894	300	976,458	41,526	62,350	(1)
1895	250	913,138	62,626	97,336	(1)
1896	1,050	896,251	77,252	36,000	(1)
1897	37,662	972,323	57,258	30,030	3,500
1898	277,135	1,139,763	70,321	77,190	4,685
1899	473,443	1,331,895	100,025	35,738	84,945
1900	871,996	1,581,914	124,728	37,038	76,009
1901	1,247,351	1,907,024	209,658	111,568	27,005
1902[2]	4,174,731	1,477,245	228,662	165,565	60,003

[1] Not reported separately.
[2] Census figures.

Petroleum.—The presence of oil in tar springs, oil seeps, etc., in Texas had been known for many years, but the first record of the discovery of petroleum in quantities sufficient for use seems to have been about 1867, when it was found at a point 15 miles southeast of Nacogdoches.[1] But little attention was paid to these petroleum deposits until 1883. During the period from 1887 to 1890, 90 wells were drilled in the vicinity of Nacogdoches. Statistics of production first appeared in 1889, when 48 barrels were reported, with a valuation of $340.

About 1894 oil was accidentally found at Corsicana, during the sinking of an artesian well.[2] A company was formed and other wells were sunk, oil being discovered in 1898 at a depth of 1,040 feet. The drilling in this locality is entirely through a hard clay, and the oil obtained, resembling the Kansas product, is better than the Ohio oil, but not as good as the Pennsylvania. The Corsicana product has been used exclusively for fuel and in the manufacture of illuminating gas in Dallas, Houston, and Austin.[3]

[1] Bulletin of the University of Texas, No. 5, July, 1901, pages 1 and 2.
[2] United States Geological Survey, Nineteenth Annual Report, 1897, Part VI, page 104.
[3] The Mineral Industry, 1897, Vol. VI, page 515.

The unexpected outburst of a 6-inch gusher in 1901 near Beaumont, in Jefferson county, was the sensation of the petroleum industry in the United States. Beginning on January 10, in nine days a stream 160 feet in height emptied out an estimated quantity of 500,000 barrels of oil before being capped. As a result of this wonderful find many companies were formed, drilling commenced without delay, and in less than six months there were 211 operators in that county. The elevation known as Spindle Top embraces about 125 acres, and is in its highest part 40 feet above sea level; the surrounding plain slopes southward 18 miles to the Gulf of Mexico. This was the scene of most active operations, and land was divided into small lots selling for fabulous prices.[4]

At Sour Lake, in Hardin county, a slight development was reported in 1893, but it was not until 1901 that any considerable results were obtained. A gushing well, flowing an 8-inch stream, was drilled early in 1902, and during the year a number of wells have been completed and the value of the field has been fully established.

At the Saratoga well, 12 miles northwest of Sour Lake, successful development work in 1902 was reported. In Bexar county a small quantity of heavy oil was produced and supplied a local demand. Work in the Nacogdoches district, in which there were the first indications of petroleum in the state, has been practically abandoned, and no production was reported for 1902.[5]

Table 4, compiled from the reports of the United States Geological Survey, presents the annual production of petroleum in the state of Texas from the beginning of the industry to the present time.

TABLE 4.—*Annual production of petroleum: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
1889	48	1896	1,450
1890	54	1897	66,975
1891	54	1898	546,070
1892	45	1899	669,013
1893	50	1900	836,039
1894	60	1901	4,393,658
1895	50	1902	18,083,658

This table indicates the wonderful development of the Texas petroleum fields since 1900. During 1902 the volume of production was second only to that of Ohio. In a number of counties, not actual producers, petroleum has been located in greater or less quantity. Development work has been carried on to a very great extent, over $400,000 having been expended during 1902 in nonproductive operations in connection with the petroleum industry.

Coal, bituminous.—Coal was known to exist in Texas as early as 1836, and in 1840 a company was incorporated

[4] United States Geological Survey, "Mineral Resources of the United States," 1901, pages 565 to 567.
[5] Ibid., 1902, pages 571 and 572.

to mine this fuel. A further investigation in 1846 of the Trinity river district, 200 miles above Galveston, resulted in the finding of coal in more extensive measures than was anticipated, both anthracite and a semibituminous coal resembling cannel coal, being discovered.[1] In 1859 the first geological report of Texas contained an estimate as to the area of the coal fields in the state, and in 1866 the coal seams at Belknap were mentioned as well as a bed of coal about 6 miles north of that place.[2]

Coal production in Texas during 1902 may be said to have centered in Erath county, where the amount reported exceeded that of all the other counties in the state. Webb county, in the southern part of the state, was second in importance, and Wise county in the northern part of the state, ranked third. Maverick county, on the Rio Grande river, and adjoining Webb county, was fourth, and Parker county, between Erath and Wise counties, ranked fifth, and a small production was also reported in Eastland county. These were all bituminous localities, and their total production was valued at over $1,300,000 during 1902.

The secondary coal fields of Texas, for which production of lignite was reported during 1902, were found principally in the following counties, ranking in the order named: Milam, Bastrop, Medina, Robertson, and Wood. Several other minor productive localities were reported.

Coal measures are found in Texas in three districts. The northern or bituminous field is the southern extremity of the Western coal basin of the United States; the semibituminous seam along the Rio Grande is second in importance; and larger than either in extent and thickness, but least in value of production, is the lignite field, lying in the central part of the state, and including over fifty counties in whole or in part.[3]

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of coal in Texas from 1883 to 1902:

TABLE 5.—*Annual production of coal, bituminous: 1883 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.	YEAR.	Short tons.
1883	100,000	1890	184,440	1897	639,341
1884	100,000	1891	172,100	1898	686,734
1885	133,928	1892	245,690	1899	883,832
1886	100,000	1893	302,206	1900	968,373
1887	75,000	1894	420,848	1901	1,107,953
1888	90,000	1895	484,959	1902	901,912
1889	128,216	1896	544,015		

As shown in the above table there was a uniformly increasing production of coal in Texas from 1891, until within the last year, when the vast exploitation of petroleum wells exerted a depressing effect on the industry. The reports for 1902 showed a decrease in production of 206,041 short tons, with a valuation of $429,779 less than that reported for the previous year.

Quicksilver.—The existence of cinnabar, in the neighborhood of California Hill, was known to the Comanche Indians, as evidenced by the use in rude paintings and hieroglyphics found on the limestone bluffs in this locality of a vermilion pigment prepared from this ore. With this exception no knowledge of these cinnabar deposits reached civilization until about 1887, when rumors of their existence were reported, but it was not until 1894 that their location was actually discovered. During 1896 and 1897 considerable prospecting was done, and in 1900 the first furnace was erected and ore treatment was begun.[4]

The cinnabar deposits occur in massive limestone, in siliceous shales, and in a white, earthy, clay-like rock; the ore is generally soft and friable, differing in this respect from the cinnabar of the New Almaden mine in California, which is found in hard masses or in veinlets.[5] The mercury occurs, not only as cinnabar and as yellow sulphide, but it also is present in the native state in several localities. Cinnabar, however, is the principal mineral.

The mining operations have been most crude in method; often the material mined has been carried to the surface on the backs of the Mexican miners. A scarcity of water and fuel has delayed the complete development of these quicksilver deposits, but the recent discovery of asphaltum and coal and the possible occurrence of petroleum may increase the general interest in this locality.

During 1900 the first production of quicksilver in Texas was reported, amounting to 750 flasks; in 1901 this amount was increased to 2,932 flasks, valued at $132,438, while in 1902 there were reported 5,319 flasks of quicksilver and 1,300 short tons of unrefined cinnabar, with a total valuation of $254,350. This production is entirely in Brewster county in the vicinity of Terlingua.

Limestones and dolomites.—Valuable limestone deposits are scattered throughout a large portion of the state; a production was reported in 25 counties during 1902. The principal productive locality is in the vicinity of Austin, Travis county, where a light colored, fine grained limestone is quarried. El Paso county is second in value of product and Williamson county, adjoining Travis on the north, is third. Much of the production is a compact, fine grained cretaceous stone of excellent quality, a part of which is crystalline, and when highly polished is suitable for interior decorative work. A dark mottled variety of stone also occurs in some parts of the state.[6]

[1] Statistics of Coal, by Richard C. Taylor, pages 223 and 224.
[2] The Coal Regions of America, by James Macfarland, Ph. D., pages 501 and 502.
[3] United States Geological Survey, "Mineral Resources of the United States," 1888, pages 368 and 369.
[4] Bulletin of the University of Texas, No. 15, 1902, pages 11 and 12.
[5] Transactions of the American Institute of Mining Engineers, Vol. XXV, pages 72 and 73.
[6] Stones for Building and Decoration, by George P. Merrill, page 322.

There was quarried in Texas during 1902 limestone and dolomites to the value of $228,662.

Sandstones and quartzites.—The principal sandstone quarrying operations in Texas during 1902 were in Brazos county, where a carboniferous stone of a gray color is obtained.[1] Ward county, in the extreme western part of the state, was the second locality in importance, with Burnet and Fayette counties, respectively, third and fourth in rank.

Before 1901 the sandstone quarrying in Texas was of but little consequence, but during that year and 1902 the industry grew until it has taken an important place among the minerals of the state. The production of 1902 was valued at $165,565.

Siliceous crystalline rocks.—The siliceous crystalline rocks quarried in the state during 1902 were obtained in Llano and Burnet counties, in the central part of the state, near the towns of Llano, Kingsland, and Burnet. Both fine and coarse red granite were quarried, the latter corresponding closely to that obtained from Platte canyon, Colorado. Red and gray granites occur in Gillespie county, although no production was reported from that locality during the year.[2]

The value of siliceous crystalline rocks quarried in Texas in 1902 was reported as $60,003, and about three-fourths of this stone was used for monumental purposes. The remainder, amounting in value to $13,784, was used in building operations.

Natural gas.—While prospecting for oil and gas in the southwestern part of Washington county during 1879 a well was drilled which gave a strong flow of natural gas at a depth of about 160 feet. No practical use was made of this gas, and the first commercially successful well in this locality was not drilled until 1888.[3]

The production during 1902 was all obtained in Jefferson and Navarro counties, in the Beaumont and Corsicana oil districts. The value of the output reported by the 14 wells in operation during this year was $14,953, indicating a decrease in comparison with 1900 and 1901.

In some instances the gas obtained was used to force the flow of oil wells. It spread over the surface of the petroleum in the porous limestone, and thereby started the wells into operation.

All other minerals.—The principal mineral in Texas for which statistics may not be separately reported is gypsum, and its production ranks next to that of bituminous coal. Hardeman county was the only locality where gypsum or gypsite was quarried, and the product was sold chiefly as cement or wall plaster, although a small amount was reported as consumed in making plaster of Paris.

Cement also is quarried to a considerable extent in Dallas and Bexar counties, and in value of production ranks among the important mineral products of the state.

Silver bearing quartz is mined quite extensively in Presidio county, in the locality of the Rio Grande. Blanket deposits in limestone are found in pockets and in some places in the strata. The ore is transported in wagons to the town of Shafter, where it is reduced to the metallic state by amalgamation.

Small quantities of stoneware and fire clay were mined by individuals near Elmendorf, in Bexar county. The stoneware clay was not prepared at the mines, but was sold in the raw state to a pottery establishment.

Deposits of asphaltum and asphaltic rock exist in Texas, but the only production during 1902 was a small amount of liquid asphaltum obtained from test holes sunk by an oil and development company in Travis county.

Iron ores are found in a number of counties in Texas, and some of the product is of Bessemer quality. In character, the deposits are a brown hematite or bog ore, and the occurrences are found in a continuous and persistent ledge covering the mountains of the eastern part of the state.[4] According to the first record the iron industry in Texas was started in Cass county, where a blast furnace was in operation for some years prior to 1859. A number of other furnaces and bloomeries were also reported about this time, those in Cherokee county, near Rusk, having been established during the Civil War.[5]

[1] Stones for Building and Decoration, page 164.
[2] Ibid., page 83.
[3] Bulletin of the University of Texas, No. 5, July, 1901, page 4.
[4] Annual Report of the Dallas Commercial Club, 1899, page 37.
[5] Iron in All Ages, by James M. Swank, page 338 ff.

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UTAH.

Table 1 is a summary of the statistics of the productive mines and quarries in the state of Utah for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Gold and silver.	Coal, bituminous.	Copper ore.	Limestones and dolomites.	Sandstones and quartzites.	Siliceous crystalline rocks.	All other minerals
Number of mines or quarries	178	83	30	13	16	10	5	[illegible]
Number of operators	170	83	36	13	15	6	5	[illegible]
Salaried officials, clerks, etc.:								
Number	413	261	67	51	7	6	.....	[illegible]
Salaries	$587,005	$391,317	$80,065	$71,155	$2,295	$6,720	.....	$35,453
Wage-earners:								
Average number	5,712	3,349	1,576	487	103	65	1	[illegible]
Wages	$5,089,122	$3,176,599	$1,254,090	$439,612	$77,296	$50,225	$330	$90,970
Contract work	$37,054	$28,493	$340	.....	$250	$500	.....	$7,473
Miscellaneous expenses	$761,557	$570,250	$94,123	$71,448	$4,457	$4,460	$63	$16,756
Cost of supplies and materials	$1,835,658	$1,312,176	$196,114	$166,226	$75,046	$5,070	$130	$80,896
Value of product	$12,378,350	$8,500,904	$1,797,454	$1,459,192	$186,663	$105,011	$1,479	$327,647

[1] Includes operators as follows: Asphaltum and bituminous rock, 2; cement, 1; clay, 1; gypsum, 1; iron ore, 4; marble, 2; and sulphur and pyrite, 1.

The mineral resources of Utah constitute one of its principal sources of wealth. The state ranked third in 1902 among the states and territories in the value of gold and silver production and fourteenth in the value of all minerals.

The development of the mineral resources of the state has been slow, principally because of the lack of transportation facilities and to the fact that some of the greatest ore bodies are in almost inaccessible regions. However, the activity in developing properties within the past few years has begun to attract capital, and when the immense bodies of coal, iron, copper, and other ores that the state is known to contain are properly worked, Utah will rank among the foremost mineral producing states of the Union.

Gold and silver mining has been developed to a greater extent than any other branch of the mining industry, and the product of this class of mines in 1902 amounted to $8,500,904, or 68.7 per cent of the entire production from the mines and quarries of the state. The other minerals in the order of their importance are: Coal, bituminous; copper ore; limestones and dolomites; sandstones and quartzites; cement, asphaltum, and bituminous rock; sulphur and pyrite; gypsum; iron ore; marble; siliceous crystalline rocks; and clay.

Natural gas has been produced in Utah, but the wells which were located near Salt Lake City became choked by the decomposition of the slate forming their walls, and the industry in the state has practically been abandoned.[1]

The list of minerals found in Utah but not worked commercially is a long one, including slate, antimony, cinnabar, mineral wax, alabaster, alum, natural gas, precious stones, tripoli and pumice, saltpeter, borax, and many others. In Millard county is found the only known deposit of lump pumice stone in the United States.[2]

Among the gems to be found are some of the most beautiful and brilliant crystals of the North American topaz. These are found in considerable quantities on Thomas mountain, Deseret, an isolated and arid elevation about 6 miles long in Millard county. These crystals are larger than those from California; are always white, and evidently have been decolorized by heat or exposure to sunlight. They are equally as brilliant as those from San Luis Potosi, Mexico, which they closely resemble.[3]

Besides the work done at the productive mines and quarries in 1902, development work was done on 273 mining properties, 266 of which were gold and silver, the others being distributed among the industries of iron and manganese ores, marble, and petroleum. The operators of these properties employed 214 salaried officials, clerks, etc., to whom they paid $162,744 in salaries. They also gave employment to 966 wage-earners, and paid them $920,624 in wages. The work done by contract cost $162,745; the miscellaneous expenses amounted to $133,551, and the cost of supplies and materials was $468,505.

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 653.

[2] United States Geological Survey, "Mineral Resources of the United States," 1900, page 196.

[3] Ibid., 1892, page 764.

The relative importance of manufacturing industries closely allied to or based on the mining industry, using as their raw material the product of the mines and quarries, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$21,156,183
Based upon products of mines or quarries:		
Clay, glass, and stone products	$499,372	
Iron and steel and their products	244,542	
Metals and metal products, other than iron and steel	7,595,594	
Miscellaneous industries	783,720	
		9,123,228
All other		12,032,955

As may be seen from the foregoing table, the value of the products of the manufacturing industries of the state based primarily upon minerals mined and quarried was $9,123,228, or 43.1 per cent of all the manufactures in the state. The value of the output of the productive mines and quarries of the state in 1902 was $12,378,350, or 36.9 per cent of the combined value of product of manufactures in 1900 and mines and quarries in 1902.

In 1902 the operators of the productive mines and quarries of Utah gave employment to 5,712 wage-earners and paid $5,089,122 in wages, and in 1900 the manufactures of the state gave employment to 6,615 wage-earners and paid $3,388,370 in wages. The total average number of wage-earners employed in mining and manufactures was 12,327, and $8,477,492 was paid in wages. Mining, therefore, employed 46.3 per cent of the wage-earners and paid 60 per cent of the wages, while manufactures contributed 53.7 per cent of the wage-earners and paid 40 per cent of the wages.

Table 3, compiled from the reports of the United States Geological Survey, shows the value of the annual production of the principal minerals of the state, with the exception of copper ore, values for which can not be obtained, from 1890 to 1902.

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Gold and silver.[1]	Coal, bituminous.	Limestones and dolomites.	Sandstones and quartzites.
1890	$11,023,434	$552,390	$27,568	$48,306
1891	11,963,131	666,045	(2)	36,000
1892	11,638,179	562,625	8,000	40,000
1893	10,157,907	611,092	17,446	136,402
1894	9,576,297	603,479	28,696	15,428
1895	11,028,720	617,349	22,503	5,000
1896	13,313,363	500,547	9,358	7,860
1897	9,827,078	618,230	9,250	7,907
1898	10,671,210	752,252	11,721	15,752
1899	12,621,935	997,271	6,381	29,091
1900	[3]9,718,112	1,447,750	12,749	66,733
1901	[3]10,146,680	1,666,082	78,900	38,919
1902[4]	[3]9,335,301	1,797,454	186,663	105,011

[1] Estimates by the Director of the Mint; value of the refined product; silver at coining value. The values in Table 1 are values at the mine.
[2] Not reported separately.
[3] Silver at commercial value.
[4] Census figures, except for gold and silver.

Gold and silver.—Ores of the precious metals were known to exist in Utah in the early days, but mining of most descriptions, and especially of gold and silver, was not encouraged, and it was not until 1862 that any systematic prospecting was done.[1] In that year General Connor, with the Third California Infantry, arrived and established Fort Douglas, near Salt Lake City. Many of the members of his command, who were old California prospectors, were sent out to prospect the territory, and they located mines at Stockton, Bingham Canyon, in Little Cottonwood canyon, and many other localities. Capital was obtained and attempts were made to smelt the lead-silver ore near Stockton about 1866–67, but the conditions were unfavorable, and the net result was a failure at that time. No further general activity in mining the precious metals was reported until about 1870.[2]

Ores of good quality have been found in almost every part of the state, even in the isolated mountains rising out of the desert in western Utah; but any considerable development of mining in that region must await additional facilities, especially those of transportation. From 1870 until 1886 the state's production of these metals was 135,135 fine ounces of gold and 59,065,016 fine ounces of silver.[3]

The following table, compiled from the reports of the Director of the Mint, shows separate values for the annual production of gold and silver from 1890 to 1902:

TABLE 4.—*Value of annual production of gold and silver: 1890 to 1902.*

[Reports of the Director of the Mint.]

YEAR.	Gold.	Silver.[1]	YEAR.	Gold.	Silver.[1]
1890	$680,000	$10,343,434	1897	$1,726,100	$8,100,978
1891	650,000	11,313,131	1898	2,285,400	8,385,810
1892	660,175	10,978,004	1899	3,450,800	9,171,135
1893	858,600	9,304,307	1900	3,972,200	[2]5,745,912
1894	1,128,062	8,448,235	1901	3,690,200	[2]5,455,480
1895	1,373,000	9,655,720	1902	3,594,600	[2]5,740,801
1896	1,899,900	11,413,463			

[1] Coining value. [2] Commercial value.

The production of gold and silver in 1902, while a decrease of $811,379 from that of 1901, was 7.8 per cent of $109,415,000, estimated by the Director of the Mint as the value of the output for the United States in 1902, including silver at its commercial value.

Coal.—The first discovery of coal in Utah was made in 1851 at Coal creek, near Cedar city.[4] Mining was carried on at Wales, Sanpete county, as early as 1855, but only to a limited extent, and no general mining of coal was done until about 1876. There was but a limited development of the industry until 1888 and 1889.

[1] Bancroft's History of Utah, page 740.
[2] Transactions of the American Institute of Mining Engineers, Vol. XVI, page 3.
[3] A Treatise on Ore Deposits, by J. A. Phillips and Henry Louis, page 760.
[4] Harper's Encyclopedia of United States History, Vol. 9, page 535.

It is estimated that over 2,000 square miles of the state's area are underlaid by workable coal, and the outcroppings for hundreds of miles in the central and southern parts are evidences of the great bodies of fuel under the surface, which, with future development, may make Utah one of the greatest coal producing states in the Rocky mountain field.[1]

The industry has made its greatest development within the past five years, the product for 1902 amounting to more than three times the product for 1897. The yearly production since 1889 has shown a steady increase, excepting in 1892 and 1896. Despite the prevailing tendency toward higher prices throughout the coal producing states in 1902, the average price per ton in Utah was only $1.14, as compared with $1.26 in 1901.[2]

The production for 1902 exceeded that of 1901 by 251,907 tons, or 19 per cent, and shows an increase in value of $131,372, or 7.8 per cent. The 39 coal mines reporting in 1902 had a combined output of 1,574,521 short tons, valued at $1,797,454, which places Utah nineteenth and twentieth, respectively, for quantity and value, in the rank of coal producing states. As in 1901, the greater part of the state's production, amounting to over 95 per cent, came from Carbon county.

Table 5, compiled from the reports of the United States Geological Survey, shows the annual production of coal in Utah, from 1876 to 1902.

TABLE 5.—*Annual production of coal, bituminous: 1876 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.
1876	50,400	1890	318,159
1877	50,400	1891	371,045
1878	67,200	1892	361,013
1879	225,000	1893	413,205
1880	225,000	1894	431,550
1881	225,000	1895	471,856
1882	250,000	1896	418,627
1883	250,000	1897	521,560
1884	250,000	1898	593,709
1885	213,120	1899	786,049
1886	200,000	1900	1,147,027
1887	180,021	1901	1,322,614
1888	258,961	1902	1,574,521
1889	236,651		

Copper ore.—Copper has long been produced from the Utah mines, but until quite recently the metal has been obtained only as a by-product from the smelting of gold and silver ores. Since the development of the mines of the West mountain district, Salt Lake county, the copper output has increased rapidly. The principal producers are in Salt Lake, Beaver, Tooele, Juab, Summit, and Piute counties. Some of the mines in Beaver county are among the most promising to be found anywhere at a similar stage of development.[3]

Utah is fast coming to the front as one of the important copper producing states, and the fact that the output of 23,939,901 pounds of copper, valued at $1,459,192, produced in 1902, is more than six times the production of 1898, shows what extensive development this industry is receiving.

The following table, compiled from reports of the United States Geological Survey, shows the annual production of smelted copper in Utah, from 1883 to 1902:

TABLE 6.—*Annual production of smelted copper: 1883 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Pounds.	YEAR.	Pounds.
1883	341,885	1893	1,135,330
1884	265,526	1894	1,147,570
1885	126,199	1895	2,184,708
1886	500,000	1896	3,502,012
1887	2,500,000	1897	3,919,010
1888	2,131,047	1898	3,760,000
1889	65,467	1899	9,684,746
1890	1,006,686	1900	18,354,726
1891	1,562,098	1901	20,116,978
1892	2,209,428	1902	23,939,901

Limestones and dolomites.—The value of the limestone production of the state for 1902 was $186,663, or more than double that of 1901, and over twenty times that of 1897. The limestone was used principally for burning into lime and as a fluxing material. The following counties, arranged according to the value of their production, contributed to the state's output: Salt Lake, Utah, Weber, Sanpete, Tooele, Summit, and San Juan.

Sandstones and quartzites.—Apparently inexhaustible supplies of Triassic sandstone of various shades of red and pink occur at Red Butte near Salt Lake City, and stones from this formation have been used to some extent in Salt Lake City.[4]

The value of the sandstone quarried in the state in 1902 was $105,011, or nearly three times that for 1901 and over thirteen times that for 1897. In 1902 the following counties contributed to the state's output of sandstone: Summit, Utah, Salt Lake, and Iron.

Siliceous crystalline rocks.—In Little Cottonwood canyon, not far from Salt Lake City, occurs a coarse, light gray granite in seemingly inexhaustible quantities. The stone is apparently of excellent quality and was used in the construction of the Mormon temple.[5] The value of the output of the 5 quarries productive in 1902 was $1,479, a decrease of 73.5 per cent from that for 1901. The value of the granite quarried for monumental work was $984. Beaver, Salt Lake, Utah, and Weber counties contributed to the state's output.

All other minerals.—Utah is exceptionally rich in asphaltum deposits. Bituminous limestone occurs in large quantities, but the excessive cost of transportation may prevent it becoming the source of a profitable industry for some time to come. The streets of Salt Lake City, Ogden, and other cities in the state, are paved with asphaltum produced near by, and the demand

[1] United States Geological Survey, "Mineral Resources of the United States," 1888, page 374.
[2] Ibid., 1902, page 431.
[3] The Copper Handbook, by Horace J. Stevens, Vol. III, page 117.
[4] Stones for Building and Decoration, by George P. Merrill, page 164.
[5] Ibid., page 83.

at present is confined almost wholly to the local trade. Hard varieties of asphaltum such as gilsonite and elaterite occur in several widely separated localities, frequently being associated with ozocerite. The principal localities are at Fort Duchesne in the Uinta reservation and at a place east of this reservation.[1] The gilsonite from the Uinta reservation is an exceptionally pure form of asphaltum. In spite of the fact that it has to be hauled from 70 to 100 miles to the nearest railroad point, its remarkable purity makes it possible to stand the heavy cost of transportation, and a ready market is found for the supply. Most of the output is used in making varnish, but it is also used for various other purposes.[2] No statistics can be shown without disclosing individual operations.

Cement rock of good quality was discovered in 1888 between Ogden and Provo City, and in 1891 the first production of Portland cement from Utah was reported. The plant in operation in 1902 was at Salt Lake City and the stone used came from Parleys canyon, about 10 miles east of the city. The plant had a capacity of 600 barrels per day.[3]

The production of clay in Utah in 1902 was confined to one establishment. The clay mined was used principally for making bricks and tile.

The gypsum deposits of Utah are extensive. The demand in 1902 was for local consumption and only one plant located at Nephi was reported as active.

On the divide between the heads of Big Cottonwood and Snake creeks is a large deposit of marble, which covers many acres and is said to be many hundred feet in thickness. This marble is white in color, and is free from cracks or stains; it can be taken out in blocks as large as it would be possible for the largest machinery to handle.[4] In 1902 but two quarries in the state reported production.

Apparently inexhaustible supplies of iron ore exist in southern Utah, especially in Iron county. Beds of magnetite and hematite that bear evidence of being metamorphosed limonite, occur in limestone of uncertain Silurian age, and associated with eruptive masses, the ore forming great projecting ridges and prominent outcrops, locally called "blow-outs." These deposits occur over an area 15 by 5 miles and are in the southern end of the Wasatch mountains. The samples show rich ores, which at times exceed the Bessemer limit of phosphorus. The importance of these deposits lies in the future. They are the largest in the West, and are interesting in their bearing on the general origin of magnetite.[5] The 4 productive mines produced 16,240 tons of ore in 1902, valued at $27,417. The counties contributing to the output were Millard, Juab, and Utah.

The sulphur beds of Utah extend over a large area and in places are of remarkable purity, but the excessive cost of transportation and the development of the sulphur beds of Louisiana and other points more accessible to the market have, however, tended to curtail the production in Utah. The principal source of the production is Beaver county.

[1] United States Geological Survey, "Mineral Resources of the United States," 1888, page 513.
[2] Ibid., 1892, page 702.
[3] Ibid., 1902, pages 807 and 808.
[4] United States Geological Survey, "Mineral Resources of the United States," 1889–90, page 432.
[5] Ore Deposits of the United States, by James F. Kemp, page 128.

VERMONT.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Vermont for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Marble.	Siliceous crystalline rocks.	Slate.	Limestones and dolomites.	All other minerals.[1]
Number of mines or quarries	192	22	74	76	14	6
Number of operators	160	16	68	68	13	5
Salaried officials, clerks, etc.:						
Number	433	195	128	97	12	1
Salaries	$376,077	$184,877	$104,655	$78,442	$7,953	$150
Wage-earners:						
Average number	5,398	2,074	1,505	1,689	156	24
Wages	$3,114,399	$1,206,208	$958,950	$874,263	$65,083	$9,895
Miscellaneous expenses	$382,734	$226,103	$70,653	$79,700	$5,810	$468
Cost of supplies and materials	$1,076,143	$523,075	$272,888	$162,410	$116,301	$1,469
Value of product	$5,904,705	$2,628,164	$1,570,423	$1,464,918	$225,703	$15,497

[1] Includes operators as follows: Buhrstones and millstones, 1; clay, 2; iron ore, 1; mineral pigments, crude, 1; oilstones, whetstones, and scythestones (1 quarry—operator reported in Arkansas).

The great bulk of the mineral wealth of Vermont lies in its vast rock deposits, comprising marble, granite, limestone, slate, etc. The quarrying of these rocks began more than a hundred years ago, and at an early date some of them, notably marble, granite, and slate, brought the state into national prominence; later, through superiority of quality and especial fitness for certain uses, these products were shipped beyond the limits of the United States and found a market in practically every civilized country of the world.[1]

The range of metalliferous ores in the state is quite limited, and these, excepting copper, have not been found in such quantities as to warrant extensive exploitation.

There are several minerals occurring in the state for which no production in commercial quantities was reported in 1902. Among them is asbestos, which was discovered at numerous places in the state many years ago. It has been during the last few years only, however, that any systematic development of the deposits has been attempted.[2] In 1902 these operations were carried on in the north central part of the state, in the towns of Eden, Lamoille county, and Lowell, Orleans county.[3] The Vermont asbestos is of good quality and exists in great abundance.

Copper ores occur extensively in eastern Vermont, particularly in Orange county, and considerable quantities have been extracted in the past. In this region there were four mines, one of which was worked long before the development of the Lake Superior mines, and reached a depth of over 1,500 feet.[4] The present owners have expended large sums in installing new and modern machinery and methods, and have given evidence of an intention to develop the property on a large scale.[5]

Ilmenite, the most abundant of all the titanium minerals, occurs to some extent in combination with varying quantities of ferric oxide. Rutile, one of the allied minerals, also occurs in the state.[6]

Mica, while of quite general occurrence throughout the state in the form of small flakes, has been found in deposits of commercial importance in only one locality. This bed is at Sherburne.

Talc and soapstone have been found and mined in Vermont, although there was no production reported for 1902. The known deposits occur in many localities in the state, notably in Grafton,[7] and operations are being resumed at Rochester, Windsor county, on a property which was worked rather extensively during 1865 and 1866.[8]

Gold has been found in small quantities at some places in the state, but its mining has not proved profitable.

[1] Report of the Vermont State Geologist, 1901–2, page 40.
[2] United States Geological Survey, "Mineral Resources of the United States," 1900, pages 862 and 863.
[3] Report of the Vermont State Geologist, 1901–2, pages 34 and 35.
[4] Report of the Vermont State Geologist, 1901–2, page 84.
[5] Report of the State Geologist on the Mineral Resources of Vermont, 1899–1900, page 8.
[6] United States Geological Survey, "Mineral Resources of the United States," 1901, page 272.
[7] Report of the State Geologist on the Mineral Resources of Vermont, 1899–1900, page 77.
[8] United States Geological Survey, "Mineral Resources of the United States," 1902, page 867.

The relative importance of manufacturing industries closely allied to or based upon the mining industry, using as their raw material the products of mines and quarries, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$57,623,815
Based upon products of mines or quarries:		
Chemicals and allied products	$407,337	
Clay, glass, and stone products	6,936,749	
Iron and steel and their products	4,939,690	
Metals and metal products, other than iron and steel	410,643	
Miscellaneous industries	1,319,382	
		14,013,801
All other		43,610,014

Table 2 shows that the total value of the state's manufactures in 1900 amounted to $57,623,815, and that of this sum $14,013,801, or 24.3 per cent, was the value of the product of manufacturing establishments using as their raw material the products of mines and quarries. For 1902 the reported value of the output of the mines and quarries of the state was $5,904,705, or 9.3 per cent of the combined value of the state's manufactures in 1900 and mining and quarrying in 1902.

As reported at the census of 1900, the manufactures of the state employed on an average 29,455 wage-earners during the year and paid $12,237,684 in wages. The corresponding figures for mines and quarries in 1902 were 5,398 wage-earners and $3,114,399 paid in wages. Comparing the figures for manufactures and mines and mining, it is seen that manufactures employed 84.5 per cent of the wage-earners and paid 79.7 per cent of the wages, while mines and quarries gave employment to 15.5 per cent of the wage-earners and paid 20.3 per cent of the wages.

The following table, compiled from the reports of the United States Geological Survey, shows the value of the annual production of the principal minerals of the state from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Marble.	Siliceous crystalline rocks.	Slate.	Limestones and dolomites.
1890	$2,169,560	$581,870	$842,013	$195,066
1891	2,200,000	700,000	955,617	175,000
1892	2,275,000	675,000	1,014,000	200,000
1893	1,621,000	778,459	535,732	151,067
1894	1,500,399	893,956	658,167	408,810
1895	1,321,598	1,007,718	625,831	300,000
1896	1,101,557	895,516	600,596	147,128
1897	2,050,229	1,074,300	695,815	165,657
1898	2,067,038	1,084,218	732,684	174,150
1899	2,241,806	1,212,967	872,673	282,178
1900	2,484,852	1,113,788	917,462	188,100
1901	2,753,583	1,245,828	1,162,191	205,138
1902	2,628,164	1,570,423	1,464,918	225,703

Marble.—Vermont leads all other states in the production of marble. The total value of the output of this stone in the United States in 1902 was $5,044,182, and of this amount Vermont contributed $2,628,164, or 52.1 per cent.

Marble has been quarried in Vermont for more than a century, the earliest authentic record of such work having been made in 1785.[1] In 1902 the state's output of marble came from the quarries in Rutland, Bennington, Franklin, Chittenden, and Grand Isle counties, though the stone is of known occurrence at many other localities in the state.[2] The most famous of Vermont marble beds are those of West Rutland, and the name "Rutland marble" is used to designate either that from these quarries or from Proctor.[3] Important quarries are also located at Dorset and East Dorset, in Bennington county. Much of this stone is of the finest quality and is used for monuments, decorative work, and for statues, as well as for general building purposes.[4]

The color effects of Vermont marble are many and beautiful, ranging from pure white through all shades of blue, and sometimes green, to deep blue-black, often being beautifully mottled and veined. The dark varieties, as a rule, are the most durable and valuable, although the white is in the greatest demand for monumental and statuary work. This stone differs from the marble of Italy in being of a dead white color and lacking the luster so characteristic of the Italian product. Marbles of different shades of gray, with sinuous veins, as well as some of red, pink, and chocolate colors, plain and mottled, are also found.[5] Black marble is found at Isle La Motte, in Grand Isle county.

Since the deposits in Vermont are of great thickness, the quarries occasionally reach a considerable depth, or in following the vein the opening is pushed far under a hill and forms a cavern, the walls and roof of which are supported at intervals by enormous piers left for that purpose.

The value of the marble, both rough and dressed, that was used for monumental purposes, amounted to $758,390, or 28.8 per cent of the total, while the value used for building purposes amounted to $433,265, or 16.5 per cent of the total.

Siliceous crystalline rocks.—The occurrence of extensive granite deposits in Vermont has been known since the state was first settled.[6] Notwithstanding this knowledge, the quarrying of granite as an industry of importance has had its growth almost entirely since 1880, although small quantities of the stone were taken out much earlier.[7] Granite has been uncovered in appar-

[1] One Hundred Years of American Commerce, Vol. I, page 189.
[2] United States Geological Survey, Sixteenth Annual Report, 1894–95, Part IV, page 469.
[3] Report on the Marble, Slate, and Granite Industries of Vermont, by George N. Perkins, page 16.
[4] Stones for Building and Decoration, by George P. Merrill, page 235.
[5] Ibid., pages 233 to 237.
[6] Report on the Marble, Slate, and Granite Industry of Vermont, page 51.
[7] Report of the State Geologist on the Mineral Resources of Vermont, 1899–1900, page 57.

ently inexhaustible quantities in all parts of the state, though the center of the granite quarrying industry is at Barre and Woodbury, in Washington county. In fact, the former place, now a thriving city, owes practically its whole importance to the quarrying of this stone.[1]

Vermont granites vary in color, from light to dark gray and range in texture from coarse to very fine.[2] The granite of Barre, is of the best quality known, and is used to a very large extent for monuments and fine decorative work, because it takes a fine polish, and stands exposure to weather without apparent injury.[3] The stone occurs in thick strata, and can be taken out in immense blocks which adds greatly to its value as a structural material.[4]

In 1902 Vermont ranked third among the granite producing states with a product valued at $1,570,423, or 26.6 per cent of mineral output of the state, and 8.6 per cent of total value of product of the industry in this country.

The value of the granite, both rough and dressed, that was used for monumental purposes, amounted to $1,209,194, or 77 per cent of the state's production, while the value of that used for all other purposes amounted to $361,229, or 23 per cent.

Slate.—Although slate is found in a majority of the counties of the state, there are three distinct belts traversing the eastern, middle, and western parts of the state. Of these, the western belt, especially that section lying in Rutland county, is by far the most important, and it is here that the well-known quarries at Castleton, Fair Haven, Poultney, Wells, and Pawlet are located.[5]

The first slate quarry in Vermont is said to have been opened in 1805,[6] although the year 1839 is usually considered to be the date of the beginning of the industry in the state. It was, however, not until 1845 that the quarrying of this stone began to assume the proportions of an important branch of the mineral industry of the state.[7]

In Vermont slate is found in many colors, the most common of which are green, purple, black, red, and chocolate, with the variegated or mottled varieties,[7] a single quarry not infrequently producing several different colors of stone. Of the green shades, there are two classes known as "sea green" and "unfading green," both being used extensively for roofing purposes, the unfading green retaining its color permanently, while the sea green, upon exposure to weather, turns to a yellowish brown. The quality of the two is about the same, and where fine artistic effect is not sought the sea-green variety is equally satisfactory.[8]

The quarries are all open pits, ranging in depth to as much as 300 feet. The quarrying of slate is attended by an enormous waste of material, not more than one-sixth of the total quantity of rock removed being available for use, and the dump piles grow with such rapidity and to such size as to become a serious hindrance to the progress of the work.[9]

The state's product of slate in 1902 amounted in value to $1,464,918, or 24.8 per cent of the total value of its output of all minerals. Of this amount, 91.4 per cent was used for roofing purposes. Vermont ranked second among the states in 1902 in the production of slate, and the output was valued at 25.7 per cent of the total yield of the country. It was put to the usual uses, including roofing, school slates, beds for billiard tables, etc. Large quantities of domestic slate are exported and the demand increases steadily.[10]

Limestones and dolomites.—The most important deposits of limestone are found in Washington and Orange counties.[11] The stone has been quarried on the southern end of Isle La Motte for over a century, the quarry being nowhere much below the level of the lake.[12] The stone is thickly bedded, thus permitting the removal of blocks 15 or 16 feet in thickness, and ranges in color from white to dark gray or black. The value of the stone burned for lime formed 97.2 per cent of the total product.

All other minerals.—The only quarry credited to Vermont as having produced buhrstones and millstones in 1902 is in Rutland county.

Clay has been found in Grand Isle county, some of the deposits being 25 feet thick, and in small quantities in various other parts of the state.[13] In 1902 a production was reported by two establishments located in Bennington county.

An iron ore mine located near Brandon, Rutland county, reported a small production for 1902. The ore has also been found at Monkton, Bennington, and other localities, mostly in the southern part of the state.[14] It usually occurs in the form of bog ore and limonite, and was first discovered at Brandon in 1810, soon after which a forge and furnace were erected there. In the same vicinity ocher has been discovered.[15]

In 1902 small amounts of ocher, iron, and metallic substances were extracted in Rutland county and, being ground for paints, were classified as crude mineral pigments. Aside from the small value they added to the total mineral output of Vermont, these serve chiefly to show the diversity of Rutland county's mineral wealth.

There was one quarry in Orleans county from which a production of oilstones, whetstones, and scythestones was reported in 1902.

[1] Report on the Marble, Slate, and Granite Industry of Vermont, page 55.
[2] Report of the State Geologist on the Mineral Resources of Vermont, 1899–1900, page 57.
[3] Ibid., pages 57 and 58, and 61 to 66.
[4] Report on the Marble, Slate, and Granite Industries of Vermont, pages 58 to 67.
[5] Stones for Building and Decoration, pages 195 and 196.
[6] Report on the Marble, Slate, and Granite Industries of Vermont, page 43.
[7] Report of the State Geologist on the Mineral Resources of Vermont, 1899–1900, page 17 ff.
[8] The Mineral Industry, 1897, Vol. VI, page 599.
[9] The Mineral Industry, 1897, Vol. VI, pages 600 and 607.
[10] Ibid., page 609.
[11] Report of the Vermont State Geologist, 1899–1900, page 30 ff.
[12] Report of the State Geologist on the Mineral Resources of Vermont, 1899–1900, page 31.
[13] Report of the Vermont State Geologist, 1901–2, page 111.
[14] Report of the State Geologist on the Mineral Resources of Vermont, 1899–1900, page 15.
[15] Report of the Vermont State Geologist, 1901–2, pages 14 and 15.

VIRGINIA.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Virginia for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Iron ore.	Limestones and dolomites.	Sulphur and pyrite.	Cement.	Siliceous crystalline rocks.	Slate.	Manganese ore.	All other minerals.[1]
Number of mines or quarries	192	26	62	37	6	3	17	4	6	31
Number of operators	140	22	25	28	4	3	17	4	6	31
Salaried officials, clerks, etc.:										
Number	700	179	257	63	32	43	21	15	10	80
Salaries	$546,204	$155,930	$174,034	$35,459	$20,970	$44,675	$12,904	$11,490	$4,241	$77,501
Wage-earners:										
Average number	8,993	3,004	2,686	890	655	178	469	247	113	751
Wages	$3,468,450	$1,407,867	$888,958	$290,979	$222,986	$83,423	$190,322	$97,645	$33,903	$242,367
Contract work	$35,964	$27,600	$6,730		$1,134					$500
Miscellaneous expenses	$603,290	$315,384	$120,563	$24,898	$23,285	$31,487	$12,466	$24,366	$600	$50,241
Cost of supplies and materials	$928,387	$215,458	$201,426	$126,956	$137,491	$91,100	$22,290	$20,964	$8,691	$104,011
Value of product	$6,607,807	$2,543,595	$1,652,799	$535,113	$501,642	$327,659	$282,046	$160,951	$29,444	$574,558

[1] Includes operators as follows: Asbestos, 1; barytes, 3 (4 mines); buhrstones and millstones, 3; copper ore, 1; flint, 1; gold and silver, 5; gypsum, 2; infusorial earth, tripoli, and pumice, 2; lead and zinc ore (2 mines—operator reported under iron ore); marl, 1; mica, 2; mineral pigments, crude, 2; precious stones, 3 (no mines); rutile, 1; sandstones and quartzites, 2; talc and soapstone, 2.

The range of mineral industry in Virginia in 1902 was wide and varied, comprising within its scope the production on a commercial scale of twenty-four different minerals. First among these in point of value was the production of bituminous coal, obtained in the main from the vast deposits of high-grade steam and coking coal in the southwestern part of the state. It is this region that furnishes the celebrated Pocahontas coal. Iron ore, which was extensively produced in 1902, occurs among the mountains in deposits of remarkable richness, the beds of ore being from 20 to 100 feet in thickness and many miles long. For 300 miles the western foothills of the Blue Ridge are lined with brown hematite ore and solid masses of it appear along the Alleghenies.[1] The yield of brown hematite from this region comprises an important percentage of the total output of this variety in the country, and also constitutes the bulk of iron ore production in the state.

The industry of manganese ore mining had its beginning in Virginia, and more than one-half of the total output of this mineral in the United States has been contributed by the mines of this state, during the third of a century of manganese ore exploitation in the country.

The lead and zinc deposits of Wythe county have been worked for more than a hundred and twenty-five years, and furnished lead to both the Continental and Confederate Armies.[2]

The great gold belt, 200 miles in length, which stretches from the Potomac to the Dan, has furnished more than $2,000,000 worth of gold to the Mint.[3]

The copper deposits of the state are extensive, especially in southwestern Virginia,[3] and the noted deposits of Louisa county have long been the seat of an important industry.[4]

The sandstones of the Blue Ridge, the limestones and slates of the valleys, and the granites which are widely distributed afford an abundant supply of building materials, and their exploitation constitutes an important industry in the state.[4]

From the fertilizing marls and greensands of Tidewater westward to the vast coal and metalliferous deposits near the Kentucky and West Virginia lines is spread a great variety of mineral wealth, which affords such basis as to make the mining industry an important factor in the industrial activity of the state.

The following is a list of minerals of known occurrence in Virginia which were not produced commercially in 1902: Allanite, alum, arsenic, bismuth, carbonite, feldspar, fire clay, kaolin, marble, plumbago, quartz, serpentine, and tin.

Work of a developing character, where no production was realized from the mining properties, was reported by 5 operators, and was confined during 1902 to gold and silver and manganese ore. These operators

[1] King's Handbook of the United States, page 858.
[2] Transactions of the American Institute of Mining Engineers, Vol. V, page 85.
[3] Transactions of the American Institute of Mining Engineers, Vol. V, page 81 ff.
[4] The New International Encyclopedia, Vol. XVII, page 374.

paid $4,535 to 8 salaried officials, clerks, etc., during 1902, and gave employment to an average number of 51 wage-earners who received $17,964 in wages. Contract work amounted to $158, miscellaneous expenses to $9,752, and the cost of supplies and materials to $26,305.

The relative importance of manufacturing industries closely allied to or based upon the mining industry, using as their raw material the products of mines and quarries, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$132,172,910
Based upon products of mines or quarries:		
Chemicals and allied products	$4,483,348	
Clay, glass, and stone products	2,121,495	
Iron and steel and their products	13,549,769	
Metals and metal products, other than iron and steel	1,698,151	
Miscellaneous industries	5,419,838	
		27,272,601
All other		104,900,309

The total value of the products of the manufacturing industries based upon mining was $27,272,601, or 20.6 per cent of the total value of the product of all manufacturing industries in the state in 1900. During the same year there were employed in all branches of manufacture in the state 72,702 wage-earners, who were paid $22,445,720 in wages. In 1902 there were employed in the mines and quarries of the state 8,993 wage-earners, who received $3,458,450 in wages. Comparing the figures for these two branches of industry, it will be seen that 89 per cent of the wage-earners, receiving 86.6 per cent of the wages, were employed in manufacturing, while 11 per cent of the wage-earners, receiving 13.4 per cent of the wages, were employed in mining.

The following table, compiled from the reports of the United States Geological Survey, shows the value of the annual production of the principal minerals of the state from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Iron ore.	Limestones and dolomites.	Cement.	Siliceous crystalline rocks.	Slate.	Manganese ore.
1890	$589,925	(1)	$159,023	[2]$45,000	$332,548	$113,079	$125,121
1891	611,654	(1)	170,000	18,000	300,000	127,819	180,533
1892	578,429	[2]$1,428,801	185,000	10,000	300,000	150,000	58,966
1893	692,748	[2]1,050,977	82,685	15,084	103,703	117,347	30,802
1894	933,576	[2]873,805	284,547	8,700	123,861	138,151	16,658
1895	869,873	987,077	268,892	7,830	70,426	111,357	15,656
1896	848,851	1,220,619	182,640	10,566	95,040	107,863	21,485
1897	1,021,918	974,031	192,972	9,139	88,096	145,370	38,630
1898	1,070,417	1,226,290	182,852	5,301	136,180	150,946	55,938
1899	1,304,241	[2]1,766,410	255,640	38,100	223,380	183,110	53,069
1900	2,123,222	[2]1,489,318	403,318	88,286	211,080	190,211	69,924
1901	2,353,989	[2]1,466,423	539,128	(3)	275,701	178,979	52,853
1902[4]	2,543,595	1,652,799	535,113	827,659	282,046	160,951	29,444

[1] Not reported separately.
[2] Includes production from West Virginia.
[3] Reported with the production for Ohio.
[4] Census figures.

Coal.—The mining of coal in Virginia, and in the United States, began in 1775, near Richmond; its occurrence in this locality, however, had been noted some five years earlier.[1] From the beginning of the industry of coal mining until 1789 the entire output went to supply the local demand. During 1789 the product of the mines began to find a wider market in the northern cities, and for many years the bituminous coal deposits of the Richmond basin were the only source from which this mineral could be procured and shipped coastwise.[2] The product sent out in this way to other cities had grown in 1822 to 48,000 tons and in 1833 to 143,000 tons.[2] About this time the discovery and development of other coal areas carrying deposits of superior quality and more economical of exploitation caused a rapid decline in the output of this region. By the middle of the century the production of coal in this field had practically ceased. For more than a quarter of a century the output of coal in the state was insignificant, but the building of the Norfolk and Western Railway, in 1883, was followed by the development of the great coal deposits of southwestern Virginia, notably the Pocahontas region, and the state soon came again into prominence as a coal producer. In 1880 the total coal production of the state was only 112,000 short tons, but in 1889, or seven years after operations in the new fields were under way, the output had increased to 865,786 short tons, and in 1902 had reached a total of 3,182,993 short tons.

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of coal in the state from 1822 to 1902:

TABLE 4.—*Annual production of coal, bituminous: 1822 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.	YEAR.	Short tons.
1822	54,000	1849	15,000	1876	85,000
1823	60,000	1850	10,000	1877	90,000
1824	67,040	1851	10,000	1878	96,000
1825	75,000	1852	25,000	1879	105,000
1826	88,720	1853	50,000	1880	112,000
1827	94,000	1854	70,000	1881	112,000
1828	100,080	1855	80,782	1882	112,000
1829	100,000	1856	52,087	1883	252,000
1830	102,800	1857	63,605	1884	336,000
1831	118,000	1858	77,090	1885	567,000
1832	132,000	1859	59,055	1886	684,951
1833	125,000	1860	64,759	1887	825,263
1834	124,000	1861	45,165	1888	1,073,000
1835	120,000	1862	45,124	1889	865,786
1836	124,000	1863	40,000	1890	784,011
1837	110,000	1864	40,000	1891	736,399
1838	107,999	1865	40,000	1892	675,205
1839	96,000	1866	40,000	1893	820,339
1840	88,000	1867	50,000	1894	1,229,083
1841	79,600	1868	59,051	1895	1,368,824
1842	73,640	1869	65,000	1896	1,251,723
1843	70,000	1870	69,219	1897	1,528,302
1844	65,000	1871	70,000	1898	1,815,274
1845	50,000	1872	69,440	1899	2,105,791
1846	40,000	1873	67,200	1900	2,393,754
1847	25,000	1874	70,000	1901	2,725,873
1848	18,000	1875	80,000	1902	3,182,993

The coal deposits of the state occur in two distinct areas. The first of these, that in which the industry

[1] United States Geological Survey, Twenty-second Annual Report, Part III, page 38.
[2] Statistics of Coal, by R. C. Taylor, page 21.

of coal mining in the country had its inception, comprises the counties of Henrico, Chesterfield, and Goochland, and parts of Powhatan and Amelia; the second, and by far the more important field of the state, is a part of the great Appalachian region and lies in the southwestern part of the state.[1] Perhaps the most remarkable and valuable occurrence of bituminous coal to be found in the United States in association with vast deposits of metalliferous ores is that forming the southeastern portion of the Kanawha basin and comprising Tazewell, Russell, Scott, Buchanan, Wise, and Lee counties.[2]

Iron ore.—Probably the first iron ore mining in the New World occurred in Virginia, for on April 10, 1608, a ship belonging to the Virginia Company of London sailed from Jamestown loaded with iron ore and other commodities, reaching England on May 20. The record of this first exploitation of American ore by Europeans states that this ore was smelted and 17 tons of metal were sold at £4 per ton.[3]

For several years following numerous attempts were made by the Virginia Company to establish the industry of iron manufacture in the vicinity of Falling creek. Under the direction of John Berkley, who was sent out by the company in 1621, the construction of several plants for the reduction of the ore was begun. However, just when these works were nearing completion and the prospects for a rapid development of the industry were bright, the colony was massacred by the Indians, on March 22, 1622. There is no record of further efforts to manufacture iron in the colony for many years. In 1687 and again in 1696 Col. William Byrd set on foot a plan to rebuild these works, but the project never materialized.[4]

In the eighteenth century, however, the colony became very prominent in the manufacture of iron and fulfilled in an eminent degree, though at a much later day, the expectations which had been entertained of its iron producing capabilities by the enterprising but unfortunate Virginia Company of London.[4]

To Col. Alexander Spotswood, who was governor of the colony from 1710 to 1723, has been accredited the honor of establishing the iron industry of the state on a firm and permanent basis. During this period a colony of German Protestants settled at the head of the Rappahannock river, with the hope of locating mines. It is probable that the first furnace in the state was owned by Governor Spotswood and was built and operated in 1715 or 1716 by these German miners, who were in his employ.[5]

The industry of iron making, the growth of which was stimulated by encouragement from the colonial government, spread rapidly into other localities and at the beginning of the Revolution was an important factor in the industrial development of the colony.[6]

In common with other industries, iron making took a fresh start subsequent to the War of the Revolution and for many years no state in the Union gave closer attention to domestic manufactures than Virginia. As the result of various causes, however, the iron industry in Virginia declined rapidly toward the middle of the nineteenth century and by 1856 many of the furnaces and forges had been abandoned.[6]

A new era of activity in iron working in Virginia opened, however, with the discovery of vast deposits of high-grade ore in the southwestern part of the state. This was followed by extension of railroads into the region and the exploitation of the celebrated coal deposits of the Pocahontas Flat Top district, and has resulted in a reawakening in the industry that has again brought the state into prominence as an iron producer.[7]

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of iron ore in the state from 1890 to 1902:

TABLE 5.—*Annual production of iron ore: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1890	543,583	1897	711,128
1891	658,916	1898	557,713
1892	741,027	1899	[1] 986,476
1893	[1] 616,965	1900	[1] 921,821
1894	[1] 600,562	1901	[1] 926,394
1895	712,241	1902	[1] 987,958
1896	859,466		

[1] Includes production from West Virginia.

Limestones and dolomites.—The predominating rocks of the region west of the Blue Ridge are the limestones. This region has long been famous for the occurrence of natural curiosities in the limestone formations, such as Weyers cave, in Augusta county, the caves of Luray, in Page county, and the Natural Bridge, the arched remnant of a cave, in Rockbridge county.[8]

The limestones have been quarried extensively at numerous places, but have been used to only a very limited extent for building purposes, the bulk of the output being utilized for making lime and as a flux in the reduction of ores.

Sulphur and pyrite.—The extensive pyrite deposits of the state, and especially those of Louisa county, where practically inexhaustible quantities occur, have long been exploited. The bulk of the product of these mines has gone into the manufacture of sulphuric acid, the demand for which commodity has increased materially during the last decade, as a result of its extended use in the manufacture of paper from wood pulp and in the manu-

[1] Coal Statistics, published by Alder & Ruley, 1902, page 164.
[2] Transactions of the American Institute of Mining Engineers, Vol. VIII, page 343.
[3] Iron in All Ages, by James M. Swank, page 103.
[4] Ibid., pages 103 to 107.
[5] Ibid., pages 258 and 259.
[6] Iron in All Ages, pages 261 to 269.
[7] Ibid., pages 269 to 271.
[8] The New International Encyclopedia, Vol. XVII, page 374.

facture of superphosphates from phosphate rock, in which latter process a chemically pure sulphuric acid is not essential and that made from pyrite serves the purpose equally as well as that made from sulphur.[1]

In the production of pyrite, the importance of which is rapidly increasing, Virginia took first rank in 1902, with an output valued at $501,642, or 64.7 per cent of the total yield of this mineral in the United States.

Cement.—The industry of the manufacture of cement from natural rock in Virginia dates from 1835 and had its beginning in Rockbridge county. The quality of this first product was excellent. Works were established at Balcony Falls in 1848; subsequently this plant was destroyed by flood and later was rebuilt on a more extended scale at Locker, a short distance away, where it is at present in operation and enjoys the distinction of being the oldest active cement plant in the state. Another large and important cement plant is located near Staunton, at Craigsville. It was built in 1900, and in 1902 contributed an important percentage of high-grade cement to the total output of this mineral in the state.[2]

Table 6, compiled from the reports of the United States Geological Survey, shows the annual production of cement from 1890 to 1902.

TABLE 6.—*Annual production of cement: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
1890	[1] 50,000	1897	15,232
1891	20,000	1898	8,835
1892	10,000	1899	68,500
1893	17,509	1900	83,792
1894	14,500	1901	[2]
1895	13,050	1902	368,869
1896	16,776		

[1] Includes production from West Virginia.
[2] Included in the production of Ohio.

Siliceous crystalline rocks.—The production of building stone has long been an important industry in the state, and the output of the Virginia granite quarries has been used in many notable structures. Among these is the State, War, and Navy Department building at Washington.[3]

The siliceous crystalline rocks of the state are confined in the main to a belt or zone running from Alexandria county through Fairfax, Fauquier, Spottsylvania, Henrico, Goochland, Chesterfield, Dinwiddie, and Greenesville counties, into North Carolina. While a wide area of occurrence is comprised within this belt, the outcrops of quarriable granite are confined to a very limited part of this region, the principal points being in Chesterfield and Dinwiddie counties, on the James river, and in the immediate vicinity of Richmond.

The product of the quarries in the vicinity of Richmond and of those in Chesterfield county is a massive gray granite, well adapted for general building purposes, paving stone, and monumental work. This granite has found a market in practically all the states and cities south of New England and as far west as Nebraska.[3]

Slate.—The occurrences of slate in deposits of commercial importance are distributed over a considerable area in Virginia and have been exploited in numerous places. The principal producing district in 1902, and that within which the industry of slate quarrying in the state most probably had its origin, was in Buckingham county.[4] Smaller products were also reported from Amherst and Albemarle counties. Abundant deposits of this mineral have been found and developed to a limited extent in the Great Valley and Appalachian districts.[5]

Manganese ore.—The beginning of manganese ore mining in Virginia, and perhaps in the United States, occurred in 1857 in the Shenandoah valley, about 100 tons being taken out during that year. In 1868 and 1869 about 5,000 tons of manganese ore were taken out near Warminster, and this marks the beginning of systematic manganese ore mining in the state.[6]

For many years the states of Virginia and Georgia have contributed the bulk of the output of this valuable mineral in the United States, nearly all the yield being exported to England. The period of greatest activity in manganese mining in the state was that beginning in 1885 and closing with 1891, during which years the average annual production was about 15,000 tons, the maximum output occurring in 1886, when the total was 20,567 long tons. There has been a marked decline in the state's production in recent years.

Table 7, compiled from reports of the United States Geological Survey, shows the annual production of manganese ore in the state from 1880 to 1902, inclusive, during which period the state contributed more than 55 per cent of the total output of this mineral in the country.

TABLE 7.—*Annual production of manganese ore: 1880 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
Total	191,067	1891	16,248
		1892	6,079
1880	3,661	1893	4,092
1881	3,295	1894	1,797
1882	2,982	1895	1,715
1883	5,355	1896	2,018
1884	8,980	1897	3,650
1885	18,745	1898	5,662
1886	20,567	1899	6,228
1887	19,835	1900	7,881
1888	17,646	1901	4,275
1889	14,616	1902	3,041
1890	12,699		

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 941.
[2] Ibid., page 808.
[3] Stones for Building and Decoration, by George P. Merrill, pages 85 and 86.
[4] United States Geological Survey, "Mineral Resources of the United States," 1882, page 742.
[5] The Universal Cyclopedia, Vol. 12, page 211.
[6] United States Geological Survey, "Mineral Resources of the United States," 1892, page 202 ff.

The known occurrences of manganese ore in the state are widely distributed, being practically coextensive with its area. Beginning with the pocket occurrences in the eastern part or Tidewater district, manganese ore has been found and mined in the Midland, Piedmont, Blue Ridge, Valley, Appalachia, and trans-Appalachia divisions westward to the West Virginia line. The great bulk of the state's output, however, has come from the Valley region.[1]

All other minerals.—Asbestos, which occurs in numerous places in western and southwestern Virginia,[2] was mined to a limited extent during the year. Barytes of good quality and in large quantities occurs at many points in the southern and southwestern parts of the state, notably in Campbell county in the vicinity of Lynchburg,[3] and its mining has for many years been of relative importance. The output of this mineral in Virginia in 1902 comprised more than one-fifth of the total production in the country.

Buhrstones and millstones were obtained from granitic rocks at several places in the state, the production for 1902 constituting nearly 20 per cent of the total value of production of the United States.

Copper ores occur extensively in southwestern Virginia and in some other sections of the state, especially in Louisa county near Talersville.[4] Copper was produced on a commercial scale in 1902 at only one mine.

Virginia became a producer of flint in 1902, though the output was small and was confined to one mine.

Gold and silver in a limited way has been a mineral product of the state for more than a century and a quarter. The first recorded discovery of gold in the state was that noted in the papers of Thomas Jefferson. About 4 miles below the falls on the Rappahannock river there was found a lump of ore weighing 4 pounds; this yielded, when treated, 17 pennyweights of gold.[5] Gold is of wide occurrence in the state, and extensive mining operations have been prosecuted at different times over a wide area. The principal deposits occur within the Virginia gold belt, which extends from the Potomac river to Halifax county, a distance of about 200 miles, with a width varying from 15 to 25 miles.[6]

Gypsum, the producing localities of which are the Holston river fields around Saltville, was mined in 1902 to a limited extent at two points, though in former years large quantities of this mineral were taken out.[7]

An extensive bed of infusorial earth is traceable from the Patuxent river in Maryland to the Meherrin in Virginia. Exposed patches occur at Richmond and other points.[8] The output in 1902 was limited to the production of two concerns.

A small quantity of lead ore was produced in 1902 at two mines, the work being carried on in connection with the mining of iron ore. Extensive deposits of lead ore occur in southwestern Virginia, and lead mining was begun in this region more than a century ago.[9]

The marls which occur in the eastern part of the state were mined to a limited extent during the year, one establishment reporting production. Virginia and New Jersey mined the entire production of marl in the United States in 1902.

Mica occurs in numerous places, notably in Hanover, Goochland, Bedford, Henry, and Amelia counties.[9] The production in 1902 was from two mines.

Mineral paints were produced to a limited extent during the year in Bedford and Page counties.

While no mining operations were prosecuted for precious stones, specimens of value were picked up in a number of places.

Deposits of rutile occur on both sides of the Tye river near Roseland post office, in Nelson county, and the production of this mineral during the year was confined to the output of one company operating in this vicinity.

Sandstones and quartzites were quarried during the year on a commercial scale at two points. The occurrence of these rocks in the state is extensive.[9]

Numerous occurrences of soapstone have been noted in the state, notably in the southern and southwestern parts. In Campbell county there is a continuous belt traceable for miles.[10] The product of the state in 1902 was reported from two mines.

[1] United States Geological Survey, "Mineral Resources of the United States," 1892, page 202 ff.
[2] Ibid., 1882, page 738.
[3] Ibid., page 741.
[4] Ibid., 1887, page 799.
[5] Ibid., Sixteenth Annual Report, 1894–95, Part III, page 256.
[6] United States Geological Survey, "Mineral Resources of the United States," 1887, page 800.
[7] King's Handbook of the United States, page 858.
[8] United States Geological Survey, "Mineral Resources of the United States," 1887, page 803.
[9] The New International Encyclopedia, Vol. XVII, page 374.
[10] United States Geological Survey, "Mineral Resources of the United States," 1887, page 802.

WASHINGTON.

Table 1 is a summary of the statistics for the productive mines and quarries of the state of Washington for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Gold and silver.	Limestones and dolomites.	Siliceous crystalline rocks.	Marble.	Sandstones and quartzites.	All other minerals.[1]
Number of mines or quarries	90	27	31	12	9	5	3	3
Number of operators	84	22	31	12	8	5	3	3
Salaried officials, clerks, etc.:								
Number	258	160	34	22	20	12	4	6
Salaries	$328,280	$221,915	$36,065	$35,701	$11,948	$10,400	$4,100	$8,160
Wage-earners:								
Average number	4,567	3,931	229	147	137	63	32	28
Wages	$3,735,484	$3,220,263	$232,058	$87,850	$95,949	$46,099	$23,237	$30,028
Contract work	$29,600	$200	$29,400					
Miscellaneous expenses	$225,161	$180,213	$23,651	$8,498	$2,644	$9,350	$350	$456
Cost of supplies and materials	$615,807	$473,254	$55,668	$28,425	$21,264	$22,349	$4,315	$10,532
Value of product	$5,393,659	$4,572,295	$338,351	$218,814	$147,273	$61,176	$30,725	$30,025

[1] Includes operators as follows: Clay, 1; copper ore, 1; molybdenum, 1.

The large, mountainous area abounds in rich deposits of useful and precious minerals awaiting only the further progress of development operations and improved transportation facilities to become valuable workings. The coal fields have thus far received the greatest attention, the product of coal mines in 1902 amounting to 84.7 per cent of the total mineral production in the state.

There was no production, on a commercial scale, of iron ores in 1902, although deposits of considerable extent are known to occur in the state. The iron ores found in Washington are magnetites, hematites, limonites, and mixtures of hematite and magnetite, and the localities of principal occurrence are in Skagit, King, Kittitas, Stevens, and Mason counties, while bog ore is found in Whatcom, Clallam, Spokane, Whitman, Thurston, and Jefferson counties.[1] Galena is about the only lead ore found in the state and it occurs chiefly in association with other sulphides, as does also zinc, which is found in small quantities in the form of sphalerite or zinc-blende.[2]

The occurrence of platinum has been reported, but the deposits have not been sufficiently rich to place the extraction of this metal on a paying basis. Nickel ore is said to exist in Ferry county, and deposits of tungsten are found in some parts of the state, but no mines have been developed. Petroleum is obtainable in many of the coal regions, but has not been produced in commercial quantities.

[1] Washington Geological Survey, Vol. I, pages 224 to 227.
[2] Ibid., pages 40 and 41.

One hundred and fifty-one operators in the state of Washington reported a total expenditure of $1,022,397 for development without production during 1902. This amount includes salaries and wages, miscellaneous expenses, cost of supplies and materials, and contract work, and represents an outlay greater than one-fifth of the total expenditures reported by the 90 producing mines and quarries in the state. Of the 151 mines reporting development work, 143 were gold and silver mines with expenses amounting to $989,812, or 96.8 per cent of the total disbursements for this purpose.

Mineral products form a basis for manufacturing industries to a large extent, being used as raw or partially manufactured material. The following table shows the extent to which the manufacture or remanufacture of mine and quarry products into manufactured products prevails in the state of Washington:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$86,795,051
Based upon products of mines or quarries:		
Chemicals and allied products	$69,500	
Clay, glass, and stone products	1,056,545	
Iron and steel and their products	2,592,946	
Metals and metal products, other than iron and steel	4,867,672	
Miscellaneous industries	5,562,302	
		14,148,965
All other		72,646,086

As shown by the above table the products of those manufactures bearing intimate relation to mining or quarrying represent 16.3 per cent, or almost one-sixth of the total value of the products of all manufacturing industries in the state.

The total mine and quarry production during 1902 was valued at $5,393,659, or 5.8 per cent of the combined products of manufactures in 1900 and mines and quarries in 1902.

During 1900 there were employed in all branches of manufactures in the state 33,806 wage-earners who were paid $19,106,873 in wages. In 1902 there were employed in the mines and quarries of the state 4,567 wage-earners who received $3,735,484 in wages. Comparing the figures for these two branches of industry, it is seen that 88.1 per cent of the wage-earners, receiving 83.6 per cent of the wages, were employed in manufacturing establishments, while 11.9 per cent of the wage-earners, receiving 16.4 per cent of the wages, were employed in the mines and quarries of the state.

The following table, compiled from reports of the United States Geological Survey, shows the value of the annual production of the principal minerals from 1890 to 1902:

TABLE 3.—VALUE OF ANNUAL PRODUCTION OF PRINCIPAL MINERALS: 1890 TO 1902.

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Silver.[1]	Gold.[1]	Limestones and dolomites.	Siliceous crystalline rocks.	Marble.	Sandstones and quartzites.
1890	$3,426,590	$90,505	$204,000	$231,287	(2)	(3)	$75,936
1891	2,437,270	213,334	335,000	25,000	(2)	(3)	75,000
1892	2,763,547	214,238	373,561	100,000	(2)	(3)	75,000
1893	2,920,876	197,430	222,100	139,862	(2)	(3)	15,000
1894	2,578,441	12,520	232,761	59,148	(2)	(3)	6,611
1895	2,577,958	168,640	351,000	75,910	(2)	(3)	14,777
1896	2,396,078	355,426	405,700	83,742	(2)	(3)	11,090
1897	2,777,687	138,214	419,900	126,877	$5,800	(3)	16,187
1898	3,352,798	328,921	766,200	140,239	9,700	$3,600	15,575
1899	3,603,989	330,990	685,400	139,339	42,766	4,837	58,395
1900	4,700,068	[4]139,190	718,200	249,163	48,900	11,836	68,133
1901	4,271,076	[4]206,640	580,500	234,587	43,808	22,816	89,174
1902	4,572,295	[4]328,070	272,200	213,814	147,273	61,176	30,725

[1] Estimates of the Director of the Mint, the values being for the refined product; silver at coining value. The values in Table 1 are the values at the mine.
[2] Not reported separately.
[3] Not reported.
[4] Commercial value.

There has been a noticeable growth in the mining industry during the last decade. With the construction of railways into mining and quarrying districts, more extensive development of the mineral resources of the state should speedily follow. Metalliferous deposits occur in many parts of the state,[1] the sulphide ores appearing in greatest abundance. Arsenides and antimonites are also found, but oxides and carbonates are somewhat less plentiful. The value of the nonmetallic mineral product during 1902 greatly exceeded that of the metallic, because of the extensive operations in coal mining and stone quarrying.

Coal, bituminous.—The first discovery of coal[2] was in the Cowlitz valley during 1848, but the quality was inferior. The occurrence of coal on the Stilaguamish river[3] was known as early as 1851, and deposits near Bellingham bay were discovered in 1852. In the following year the Sehome coal deposit, and that on the Black river not far from Seattle, were opened. In 1863 coal was discovered at Gilman and also near Lake Washington, and at a later date the Green river and other coal fields were found.

The character of the coal produced is chiefly lignite, although it often ranges to a bituminous or a semibituminous variety. Washington is the only one of the Pacific states in which coal of a coking quality has been mined, all the coal produced thus far in California and Oregon having been lignite.

The principal coal fields of the state are located in Kittitas, King, Pierce, Skagit, Whatcom, and Lewis counties in the order named, and important outcroppings have been noted in Lincoln, Spokane, Thurston, and other counties. The production increased phenomenally from 145,015 short tons, valued at $389,046, in 1880, to 1,263,689 short tons, with a value of $3,426,590, in 1890, an increase of 771.4 per cent in the quantity and 780.8 per cent in value. During the period of twelve years from 1890 to 1902 the increase in quantity was 112.2 per cent, and in value 33.4 per cent.

In 1902 the state ranked fifteenth in the United States in coal production, the total value of the product reported in that year being over $4,500,000. Table 4, compiled from reports of the United States Geological Survey, shows the annual production of coal from 1870 to 1902.

TABLE 4.—*Annual production of coal, bituminous: 1870 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.	YEAR.	Short tons.
1870	17,844	1881	167,554	1892	1,213,427
1871	20,000	1882	177,340	1893	1,264,877
1872	23,000	1883	244,990	1894	1,106,470
1873	26,000	1884	166,936	1895	1,191,410
1874	80,352	1885	380,250	1896	1,195,504
1875	99,568	1886	423,525	1897	1,434,112
1876	110,342	1887	772,601	1898	1,884,571
1877	120,896	1888	1,215,760	1899	2,029,881
1878	131,660	1889	1,030,578	1900	2,474,098
1879	142,666	1890	1,263,689	1901	2,578,217
1880	144,315	1891	1,056,249	1902	2,681,214

[1] Washington Geological Survey, page 39.
[2] History of the Pacific States, by Hubert H. Bancroft, Vol. XXVI, page 340.
[3] Washington Geological Survey, page 257 ff.

The economic importance of coal mining to the state is illustrated by the fact that in 1902 the 3,931 wage-earners employed received $3,220,263 in wages, a sum equal to 16.9 per cent of the wages paid to all the wage-earners in the manufacturing industries in the state in 1900. Of all the industries reported in the census of manufactures in 1900, only the lumber and timber industry paid a larger sum to wage-earners than the amount reported by coal mining in 1902.

Gold and silver.—The discovery of gold[1] in 1848 did much to attract settlers to Washington. Gold is commonly found in the state associated with iron pyrite, arsenopyrite, chalcopyrite, sphalerite, and galena,[2] the localities of occurrence being chiefly in Chelan, Ferry, Kittitas, Okanogan, Snohomish, Spokane, Stevens, Wallawalla, and Whitman counties.

Silver ores, principally galena,[3] pyrite, and ruby silver in slate, are widespread in their occurrence, being often found in the same veins with gold and copper. In Cedar canyon[2] and some other districts, native silver is also found.

The following table, compiled from reports of the Director of the Mint, shows the annual production of gold and silver from 1891 to 1902:

TABLE 5.—*Annual production of gold and silver: 1891 to 1902.*

[Reports of the Director of the Mint.]

YEAR.	Gold (fine ounces).	Silver (fine ounces).	YEAR.	Gold (fine ounces).	Silver (fine ounces).
1891.....	16,206	165,000	1897.....	20,312	106,900
1892.....	18,071	165,700	1898.....	37,065	254,400
1893.....	10,744	152,700	1899.....	33,156	256,000
1894.....	11,260	9,683	1900.....	34,743	224,500
1895.....	16,980	122,700	1901.....	28,082	344,400
1896.....	19,626	274,900	1902.....	13,166	619,000

As shown by Table 5, the production of precious metals in Washington has fluctuated considerably during the last decade. Extensive development operations during 1902 indicate an unusual interest in the many gold and silver deposits of the state.

Limestones and dolomites.—Extensive deposits of limestone are found in many parts of the state, but thus far only those in the vicinity of large towns or along railroads or boat lines have been developed. Limestone production is third among the important mineral industries of Washington, and the principal quarrying localities are in the northern and northwestern parts of the state.

The limestone quarried in the state has been utilized chiefly in lime burning, and has never been used to any considerable extent as a building material. The production has decreased during the last three years.

Siliceous crystalline rocks.—The siliceous crystalline rocks were second to limestone among the quarry products of the state in 1902, with a product valued at $147,273, or 32.5 per cent of the entire stone production of the state. The principal quarrying localities of this class of rocks are in the region adjacent to Puget sound, although considerable activity was reported in the extreme eastern portion of the state.

A large increase in production is shown for 1902, the value being more than that for the four previous years combined. This increase was principally in riprap and rubble, although the reports showed a gain in the use of siliceous crystalline rocks for all purposes.

Marble.—The marble quarried in Washington is of a serpentinous character, and is found principally in the eastern part of the state in Adams and Stevens counties. It is necessarily extracted in small blocks on account of its seamed markings. The production in 1902 was largely utilized for building purposes and interior decorations.

There was a large increase in the production of 1902 over former years, especially in the output of rough and building marble.

Sandstones and quartzites.—The principal occurrences of sandstones in Washington are found in the extreme northwestern part of the state in San Juan and Whatcom counties, and the production has decreased materially as compared with previous years.

All other minerals.—Clay deposits occurring chiefly as glacial clays, residual clays, and clay shales are found, and a small production was reported from the northeastern part of the state, but no extensive mining of these was done during the year.

The prevailing mineralogical character of the copper ore mined in this state is copper glance passing into chalcopyrite, and it is found in fissure veins with granite. The state's production in 1902 was confined to the output of one establishment.

The utilization of molybdenum in the preparation of steel has caused an increased demand for this mineral. It is also used in the manufacture of chemical reagents, principally ammonium molybdate, and in the preparation of "blue carmine" for porcelain coloring.[4] The molybdenite in this state occurs in association with gold, silver, and copper ore, and all the production was reported by one company.

[1] History of the Pacific States, Vol. XXVI, pages 230 and 343.
[2] Washington Geological Survey, Vol. I, pages 39 and 40.
[3] The Mineral Industry, 1901, Vol. X, page 302.
[4] United States Geological Survey, "Mineral Resources of the United States," 1901, pages 266 and 267.

WEST VIRGINIA.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells in the state of West Virginia for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Petroleum.	Natural gas.	Limestones and dolomites.	Sandstones and quartzites.	All other minerals.[1]
Number of mines, quarries, and wells	14,874	522	13,109	949	174	110	10
Number of operators	5,192	406	4,446	63	167	100	10
Salaried officials, clerks, etc.:							
Number	2,614	1,987	328	221	31	38	9
Salaries	$2,443,150	$1,766,448	$399,207	$225,501	$27,259	$18,965	$5,770
Wage-earners:							
Average number	30,002	23,914	3,800	634	1,068	453	133
Wages	$17,469,826	$13,524,429	$2,773,312	$410,845	$426,401	$272,123	$62,716
Contract work	$5,194,279	$23,092	$4,176,647	$994,540			
Miscellaneous expenses	$7,468,346	$2,087,528	$4,523,499	$822,639	$8,144	$17,533	$9,003
Cost of supplies and materials	$8,519,767	$2,327,377	$4,564,908	$1,495,069	$78,146	$28,500	$25,767
Value of product	$18,378,414	$24,748,658	$17,040,317	$5,390,181	$616,366	$423,532	$159,360

[1] Includes operators as follows: Cement, 1; clay, 4; grindstones and pulpstones, 2; iron ore, 1; silica sand, 2.

The extensive coal deposits in the state are almost inexhaustible, coal being found in all but three counties, and the annual production has steadily increased until in 1902 West Virginia ranked fourth among the coal producing states. The oil production is large and the state has within its borders the largest single producing oil field in the world. Natural gas wells are numerous and productive. Most excellent building stones abound throughout the state, and the white sand near Berkeley Springs, in Morgan county, is of exceptional purity. In several places in the state good grits are found for making grindstones. One of the most widespread of all the natural resources of the state is its clay. Iron ore is known to abound in many counties.[1] The manufacture of natural rock cement has been going on for many years.[2]

The following minerals found in the state were not mined or quarried in commercial quantities in 1902: Grahamite, manganese ore, and strontium ore. The celebrated grahamite deposits of Ritchie county, although once mined extensively, have been abandoned for over twenty-five years.[3]

In addition to the active mines, quarries, and wells shown in the foregoing table, development work, confined to bituminous coal, natural gas, and silica sand was reported by 13 operators in 23 mines, quarries, and wells; these gave employment during 1902 to 51 wage-earners, and paid $26,645 in wages. The 14 salaried officials, clerks, etc., received $7,731. The cost of work done by contract was $45,315; the miscellaneous expenses were $6,303, and the cost of supplies and materials amounted to $73,437.

Table 2 shows the value of the products of manufactures, based primarily upon minerals mined and quarried, and also the value of all products manufactured in the state as reported at the census of 1900.

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$74,838,330
Based upon products of mines or quarries:		
Chemicals and allied products	$827,560	
Clay, glass, and stone products	3,934,849	
Iron and steel and their products	20,407,336	
Metals and metal products, other than iron and steel	760,433	
Miscellaneous industries	5,015,645	
		30,945,823
All other		43,892,507

The value of the manufactured products, based primarily upon minerals mined and quarried, was $30,945,823, or 41.4 per cent of the total for all manufactures, as shown in the foregoing table. The total value of products of mines, quarries, and wells of West Virginia in 1902 and manufactures in 1900 amounted to

[1] The Mountain State, by George W. Summers, page 41.
[2] United States Geological Survey, "Mineral Resources of the United States," 1902, page 809.
[3] Ibid., Twenty-second Annual Report, 1900-1901, Part I, page 233.

$123,216,744. Of this amount, manufactures contributed 60.7 per cent, and mines and quarries 39.3 per cent.

In 1900, according to the Twelfth Census reports, 33,272 wage-earners were employed in manufacturing, and the wages paid them during the same year amounted to $12,969,237. The operators of the 14,874 productive mines, quarries, and wells in 1902 employed 30,002 wage-earners, and paid them $17,469,826 in wages. Manufactures and mining together gave employment during the year to 63,274 wage-earners, and paid $30,439,063 in wages. Manufactures, therefore, gave employment to 52.6 per cent of the wage-earners, and paid 42.6 per cent of the wages, while mines, quarries, and wells furnished employment to 47.4 per cent of the wage-earners, and paid 57.4 per cent of the wages.

The following table shows the value of the annual production of the leading minerals of the state from 1890 to 1902:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Petroleum.	Natural gas.	Limestones and dolomites.	Sandstones and quartzites.
1890	$6,208,128	$501,198	$5,400	$93,856	$140,687
1891	7,359,816	1,612,826	35,000	85,000	90,000
1892	7,852,114	2,119,901	500	85,000	85,000
1893	8,251,170	5,425,522	123,000	19,184	46,135
1894	8,706,808	7,221,717	895,000	43,778	63,865
1895	7,710,575	11,038,770	100,000	42,892	40,000
1896	8,336,685	11,829,618	640,000	59,113	24,693
1897	8,987,393	10,310,178	912,528	61,546	47,288
1898	10,131,264	12,426,359	1,334,023	56,167	14,381
1899	12,053,268	18,014,766	2,335,864	58,802	33,860
1900	18,416,871	21,922,702	2,959,032	53,701	72,488
1901	20,848,184	17,172,724	3,954,472	447,049	103,010
1902	24,748,658	17,040,317	5,390,181	616,366	423,532

Coal.—The coal deposits of West Virginia, underlying some 17,280 square miles of the state's area,[1] belong to the great Appalachian coal field, and have almost the largest expanse of continuous coal measures in the world.[2] In all but 4 of the 55 counties of the state bituminous coal has been found.[3]

The advantages of the state in coal production lie in the facts that a great number of the seams found are accessible above water level, and that the coals are of various compositions adapted to the requirements of trade. The fat coking, gassy bituminous, the hard and valuable splint, and the rich and oily cannel coal are found in great purity and made easily accessible through the agency of running water, which has exposed the seams in thousands of places. This fact, added to their size, permits, as a general rule, the mining of coal in West Virginia to be carried on at less cost, and with more economy, under corresponding labor rates, than is possible in any other part of the Allegheny coal fields.[4]

[1] United States Geological Survey, "Mineral Resources of the United States," 1902, page 293.
[2] Resources of West Virginia, by Maury and Fontaine, page 162.
[3] The Mountain State, page 11.
[4] Resources of West Virginia, page 215.

The presence of coal in West Virginia was known to the earliest settlers, and shipments were made from the Cumberland-Piedmont district of Maryland and West Virginia as early as 1842, but until 1855 all the shipments were from Maryland.[5] In 1863 a few small coal mines produced some coal for domestic consumption,[6] and in 1864 the first splint coal was mined at Coalburg, in Kanawha county.[7] During the past twenty-three years the increase in the coal production of West Virginia has averaged 1,000,000 tons a year.

The principal coal producing regions of the state may be divided into four districts, which include the more important coal producing counties. These during 1902 produced nearly 90 per cent of the output of the state. The two northern districts are known as the Fairmont, or Upper Monongahela district, and the Elk Garden, or Upper Potomac district. The two southern districts are the Pocahontas, or Flat Top district, and the New and Kanawha river district. The most important district from the productive point of view is the New and Kanawha river district, which includes the counties of Fayette, Kanawha, Raleigh, and Putnam.[8]

In 1902 coal was mined in 29 counties, among which McDowell ranked first with a production of 5,459,655 tons, Fayette second with 4,775,112 tons, and Marion third with 3,397,194 tons. The total production in 1902 was 24,570,826 tons, an increase of 502,424 tons over 1901. The greatest increase was shown in McDowell county. Fayette county showed a decrease of 1,277,277 tons, due to the strikes in 1902.

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of coal in West Virginia from 1863 to 1902:

TABLE 4.—*Annual production of coal, bituminous: 1863 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.	YEAR.	Short tons.
1863	44,648	1877	1,120,000	1890	7,894,654
1864	54,888	1878	1,120,000	1891	9,220,665
1865	87,897	1879	1,400,000	1892	9,738,755
1866	112,068	1880	1,568,000	1893	10,708,578
1867	89,360	1881	1,680,000	1894	11,027,757
1868	109,227	1882	2,240,000	1895	11,387,961
1869	103,148	1883	2,335,833	1896	12,876,296
1870	75,138	1884	3,360,000	1897	14,248,159
1871	118,830	1885	3,369,062	1898	16,700,999
1872	149,521	1886	4,005,796	1899	19,252,995
1873	672,000	1887	4,881,620	1900	22,647,207
1874	1,120,000	1888	5,498,800	1901	24,068,402
1875	1,120,000	1889	6,231,880	1902	24,570,826
1876	896,000				

Petroleum.—At an early date petroleum in small quantities was found in West Virginia, and as far back as 1771 Thomas Jefferson described a burning

[5] United States Geological Survey, "Mineral Resources of the United States," 1902, page 305.
[6] Report of the Commissioner of Labor of West Virginia, 1897–98, page 116.
[7] Transactions of the American Institute of Mining Engineers, Vol. X, page 82.
[8] United States Geological Survey, "Mineral Resources of the United States," 1902, page 442.

spring, and the oil connected therewith, located in the Kanawha valley.[1] Prior to the Civil War the discovery of oil in shallow wells near Parkersburg, in the Burning Springs region in the Little Kanawha valley, caused the most intense excitement, scarcely equaled by that in California over the discovery of gold. Towns sprang into existence, derricks were erected, and oil wells were bored, but the war broke up the oil excitement, the derricks and machinery were destroyed, and for a time, the business was at a standstill.[2] After the close of the Civil War, in 1865, interest in the petroleum in the state was revived and the industry instead of being entirely speculative was put on a legitimate business basis. As a consequence oil development became more scientific and operations were commenced almost simultaneously at Burning Springs, Oil Rock, California House, Volcano, Sandhill, and Horseneck. It is estimated that before 1876 not less than 3,000,000 barrels, valued at $20,000,000, had been produced in these districts.[3]

The following table, compiled from the reports of the United States Geological Survey, shows the annual production of petroleum in West Virginia from 1876 to 1902:

TABLE 5.—*Annual production of petroleum: 1876 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Barrels.	YEAR.	Barrels.
Total	131,701,296	1888	119,448
		1889	544,113
Previous to 1876	3,000,000	1890	492,578
1876	120,000	1891	2,406,218
1877	172,000	1892	3,810,086
1878	180,000	1893	8,445,412
1879	180,000	1894	8,577,624
1880	179,000	1895	8,120,125
1881	151,000	1896	10,019,770
1882	128,000	1897	13,090,045
1883	126,000	1898	13,615,101
1884	90,000	1899	13,910,630
1885	91,000	1900	16,195,675
1886	102,000	1901	14,177,126
1887	145,000	1902	13,513,345

The modern development of the oil interests of the state dates from 1889. That year marked the opening of the Dolls Run, Eureka, and Mannington oil pools,[4] and from that time until 1900 there was an almost steady increase in the production. In 1900 the output of the oil wells of the state was 16,195,675 barrels.

Although oil had been developed in Pennsylvania long before 1865, it was in West Virginia that the means of transporting it to market in the manner now recognized to be cheap, safe, and expeditious, were first furnished.[5]

In 1902 the production of petroleum in West Virginia amounted to 13,513,345 barrels, a decrease of 663,781 barrels from the product of the preceding year. The 1902 output was valued at $17,040,317. The state ranked second among the oil producing states and territories in 1902, producing 15.1 per cent of the entire output of the United States.

[1] Resources of West Virginia, page 305.
[2] The Mountain State, page 77.
[3] Resources of West Virginia, pages 306 and 307.
[4] West Virginia Geological Survey, 1899, Vol. I, pages 148 to 150.
[5] Resources of West Virginia, page 308.

Natural gas.—It is quite probable that the burning springs of West Virginia had attracted the attention of the Indians long before the advent of the white man in this region. One of the earliest records of these natural gas vents was made by George Washington in 1775, when he described a "burning spring" on the Kanawha river, 9 miles above Charleston. This was preempted along with other lands and given to him for military services by the state of Virginia, and he deeded it, together with a square acre of ground, to the public.[6]

The first natural gas field to be developed and put into practical use was that near Wellsburg, Brooke county. Natural gas was first used for manufacturing purposes in West Virginia in the Kanawha valley thirty years before it was used for that purpose in Pennsylvania.[7]

In 1902 West Virginia ranked third among the states in the production of natural gas. Large areas in Lewis, Harrison, Marion, Monongalia, and Wetzel counties were discovered and developed between 1900 and 1902. More or less natural gas has been developed in Tyler, Ritchie, Doddridge, Marshall, Wood, Wirt, Roane, Calhoun, Boone, Mingo, Kanawha, Logan, and Gilmer counties.[8]

Since 1895 there has been a notable yearly increase in production of natural gas. In 1902 the value of the production was $5,390,181, an increase of $1,435,709, or 36.3 per cent as compared with 1901.

Limestones and dolomites.—The value of the output of the 174 quarries productive in 1902 amounted to $616,366, an increase of $169,317 over the product of 1901. Jefferson county ranked first among the 11 counties in value of product, but Preston county ranked first in number of quarries. The value of the blast furnace flux produced in the state in 1902 was $268,059, or 43.5 per cent of the value of all limestone.

Sandstones and quartzites.—Among the beds of the conglomerate coal measures, sandstones of almost any size and texture can be quarried. In Monongalia county a beautiful sandstone, of a light buff and dove color, is found which can be dressed readily, and is most suitable for building purposes. In Taylor county occurs the so-called Grafton sandstone of close texture, sharp and clean grit, and gray color. The gray sandstone of Lewis county has few, if any, superiors in the United States in architectural beauty. The sandstones of the Lower Coal Measures on the upper portion of the Kanawha river have furnished materials for locks and dams built by the Government.[9]

Only 10 of the 110 quarries productive in 1902 had an output valued at more than $10,000. The value of the sandstones quarried in the state in 1902 was $423,532, an increase of $320,522 over the value for 1901. Mercer

[6] West Virginia Geological Survey, 1899, Vol. I, page 124.
[7] The Mountain State, pages 77 and 78.
[8] United States Geological Survey, "Mineral Resources of the United States," 1902, page 643.
[9] Resources of West Virginia, pages 315 and 316.

ranked first among the counties in the state in the value of its sandstones quarried in 1902.

All other minerals.—Natural rock cement was made near Shepherdstown, Jefferson county, as early as 1825.[1] The industry was not followed continuously in this locality, but about 1870 a new plant was erected, and for more than thirty years a superior brand of natural rock cement was produced.[2] A single plant reported production during 1902.

Quantities of good potter's and fire clay are found in the state, and in 1902 West Virginia ranked fourth among the states in the value of its pottery products, which amounted to $1,166,464, and ninth in the value of all its products of clay, which reached $2,518,544. The value of the clay production of the state was $43,266.

Good grits for grindstones are found in many counties in the state, and a part of the well-known ledge of stone appearing in Ohio across the river from Parkersburg is found in Wood county.[3] In 1902 Jackson and Wood were the only counties from which grindstones were reported; the value was $22,347.

Iron ore is found in the coal hills, the best being around Laurel hills and at Beaver Lick mountain; but the enormous beds of ore in the state have been as yet only slightly developed.[4] At various times, before and since the organization of the state, iron has been made from West Virginia ores, which, in every instance, produced iron of an excellent quality.[5] Only one iron mine was operated in the state in 1902.

Near Berkeley Springs, in Morgan county, is a ridge of sandstone, which, when crushed, yields a beautiful white sand of exceptional purity. It is about the best sand found in the United States, and large quantities of it have been shipped for glassmaking.[6] Sand for other uses is obtained in Marion, Hampshire, Randolph, and Monongalia counties.[6] The output of sand in the state for 1902 was 107,520 short tons, of which 74,720 tons were glass sand. The value of all sand was $121,540, while that of the glass sand was $99,340.

[1] Resources of West Virginia, page 313.
[2] United States Geological Survey, "Mineral Resources of the United States," 1902, page 809.
[3] The Mountain State, page 91.
[4] King's Handbook of the United States, page 883.
[5] The Mountain State, page 41.
[6] United States Geological Survey, "Mineral Resources of the United States," 1902, page 1011.

WISCONSIN.

Table 1 is a summary of the statistics for the productive mines and quarries in the state of Wisconsin for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Iron ore.	Limestones and dolomites.	Lead and zinc ore.	Siliceous crystalline rocks.	Sandstones and quartzites.	All other minerals.[1]
Number of mines or quarries	411	16	216	90	18	62	9
Number of operators	392	10	207	90	15	62	8
Salaried officials, clerks, etc.:							
Number	275	83	82	50	30	13	17
Salaries	$232,758	$85,262	$58,353	$26,202	$31,284	$9,129	$22,528
Wage-earners:							
Average number	3,583	1,361	1,062	417	391	199	153
Wages	$1,987,565	$837,661	$539,169	$192,209	$236,495	$109,066	$72,965
Contract work	$3,758	$2,750	.....	$1,008	.....	.....	.....
Miscellaneous expenses	$427,847	$247,149	$47,052	$54,594	$26,211	$3,632	$49,269
Cost of supplies and materials	$804,142	$375,959	$290,150	$56,774	$35,409	$17,169	$28,681
Value of product	$4,427,813	$1,800,864	$1,351,058	$473,652	$369,137	$207,086	$226,016

[1] Includes operators as follows: Cement, 2; clay, 3; copper ore, 1; graphite, 1 (2 mines); mineral pigments, crude, 1.

Wisconsin has valuable iron ore deposits along the borders of Lake Superior in the north, the output of which is yearly increasing, as well as extensive lead and zinc ore mines which have been operated for many years in the Galena-Dubuque region in the southwestern part of the state. Large and valuable areas of building stones are found in many parts of the state, and along the shore of Lake Michigan there are large beds of clay. Flint also is found, but was not mined in commercial quantities in 1902.

The relative importance of manufacturing industries closely allied to or based upon the mining industry, using as their raw material the product of the mine or quarry, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures		$360,818,942
Based upon products of mines or quarries:		
Chemicals and allied products	$1,135,963	
Clay, glass, and stone products	5,159,062	
Iron and steel and their products	36,300,640	
Metals and metal products, other than iron and steel	6,066,962	
Miscellaneous industries	11,808,224	
		60,470,851
All other		300,348,091

The total value of the products of manufactures, based primarily upon minerals mined or quarried, was $60,470,851, or 16.8 per cent of the value of all manufactured products. The value of the output of the mines and quarries in Wisconsin in 1902 was $4,427,813, or 1.2 per cent of the total value of the product of manufacturing and mining industries of the state.

The average number of wage-earners employed in manufacturing establishments in 1900 was 142,076, and the total wages paid amounted to $58,407,597. The corresponding figures for the mines and quarries of Wisconsin in 1902 were 3,583 wage-earners and $1,987,565 paid in wages. It appears that of the number of wage-earners engaged in the two industries during the year, 98 per cent were employed in manufacturing establishments and received 97 per cent of the wages, while 2 per cent of the wage-earners were engaged in mining and were paid 3 per cent of the wages.

The following table shows, for the years from 1890 to 1902, the value of the annual production of the principal minerals, with the exception of lead and zinc for which values can not be obtained:

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Iron ore.	Limestones and dolomites.	Siliceous crystalline rocks.	Sandstones and quartzites.
1890	(1)	$813,963	$266,095	$183,958
1891	(1)	675,000	406,000	417,000
1892	$1,428,921	675,000	400,000	400,000
1893	584,094	543,283	133,220	92,193
1894	320,518	798,406	166,098	94,888
1895	633,165	750,000	80,761	78,000
1896	1,071,511	552,921	126,689	65,017
1897	703,770	641,232	126,134	33,620
1898	687,913	698,464	175,867	80,341
1899	837,766	826,486	270,538	132,901
1900	2,081,272	989,685	407,711	81,571
1901	1,564,173	1,225,448	389,953	90,425
1902	1,800,864	1,351,058	369,137	207,086

[1] Value not reported.

Iron ore.—Although the existence of iron ore, similar to the Michigan ore, occurring in Wisconsin along Lake Superior, was known early in the last century, nothing of any consequence was done toward developing the deposits until about 1877, when work was begun in Florence county, and in 1882, 276,017 tons were shipped from that county. The greatest development of the iron ore resources of the state has occurred since 1884 in the Gogebic district in Ashland and Iron counties.[1] Iron ore of the red hematite variety from the Iron Ridge, in Dodge county, was probably mined to some extent as early as 1854, reference being made in that year to its quality and abundance.[2] In 1902 the state produced 783,996 long tons. The greatest amount was mined in Iron county, which produced about 79 per cent of the total. The production in the state from 1889 to 1902 is shown in the following table:

TABLE 4.—*Annual production of iron ore: 1889 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Long tons.	YEAR.	Long tons.
1889	837,399	1896	607,405
1890	948,965	1897	554,155
1891	589,481	1898	509,645
1892	790,179	1899	579,798
1893	439,429	1900	746,105
1894	847,601	1901	738,868
1895	649,351	1902	783,996

Limestones and dolomites.—Limestone underlies a large part of Wisconsin, the beds extending in a broad belt through the eastern, southern, and western portions of the state. The suitability of the stone for building purposes varies greatly, not only in the different formations, but also in the different beds of the same formation, and the color of the stone ranges from buff, or straw-yellow, to dark bluish gray.[3]

The earliest recorded quarry in the state was opened at Genesee, Waukesha county, in 1848, and this quarry was operated continuously until 1872, since which time it has been worked only at intervals. The Wauwatosa quarries, near Milwaukee, were opened in 1855, and one year later the quarry near Bridgeport was opened.[4] Previous to 1880, however, with a single exception, no product of the quarries had been exported from the state.[5]

Wisconsin ranked seventh in 1902 among the limestone producing states. The value of its production was $1,351,058, of which $296,998 was the value of the building stone, which comes principally from the quarries in Brown, Door, Milwaukee, Rock, and Waukesha counties. The largest quarries were in Calumet, Door, Fond du Lac, Manitowoc, Racine, and Waukesha counties.

Lead and zinc ore.—The lead mines of the upper Mississippi valley district, comprising Grant, Lafayette, and Iowa counties in Wisconsin; Jo Daviess county in Illinois; and Dubuque county in Iowa, seem to have been discovered by Nicholas Perrott about 1692. This metal was also noticed by Le Sueur in 1700, and by John Carver in 1766. The first mining in this district was done by Julien Dubuque in 1788 on the site of the present city of Dubuque, Iowa, but it was not until about 1830 that lead mining became general in southwestern Wisconsin. From that time until today mining has been continuous in the state.[6] About 1860 zinc ore was first mined, the earlier work having been entirely devoted to lead mining; now, however, this district has become more important as a source of supply of zinc than of lead ore. The ores mined are galena, smithsonite, and sphalerite, the latter being the most important.[6]

In 1902 the total production of lead and zinc ore in Wisconsin amounted to 21,999 short tons, having a value of $473,652. Of this production only 2,623 tons were lead ores. Lafayette county had a production of 9,156 short tons, the greater part of which was sphalerite. Of the 90 mines operated in 1902, 27 mined lead ore only, 23 mined zinc ore only, and 40 mined both lead and zinc ore.

Siliceous crystalline rocks.—Although about one-third of the entire area of Wisconsin is underlaid by the older siliceous crystalline rocks, it has been within the last twenty-five years only that the quarrying of granite has assumed any considerable importance, and even now the annual output is insignificant when compared with that of many other states.[7] For monumental purposes the Wisconsin granites have been selected in preference to granites from other parts of the country, and for structural purposes the quarries can furnish either gray or red granite of any required dimension. For road construction probably no state in the Union is better provided with material. The granites vary in texture from exceedingly fine grained to the coarse grained porphyritic variety, and in color from a brilliant red to a dark gray. The first granite quarry was opened at Granite Heights in Marathon county in 1880.[8] Near Utley, in Green Lake county, there occurs a beautiful stone, almost black in color, with white porphyritic feldspar, which has been quarried to some extent; and near Berlin, in the same county, occur two mounds of compact, dense grayish black to pinkish quartz porphyry or rhyolite, which takes a high polish and seems to be eminently adapted for monumental work.[9]

[1] Iron in All Ages, by James M. Swank, pages 329 and 330.
[2] Metallic Wealth of the United States, by J. D. Whitney, page 482.
[3] Wisconsin Geological and Natural History Survey, Bulletin No. IV, pages 255 and 256.
[4] Ibid., pages 300 and 313.
[5] Stones for Building and Decoration, by George P. Merrill, page 323.
[6] Wisconsin Geological and Natural History Survey, Bulletin No. IX, pages 1 and 2.
[7] Stones for Building and Decoration, pages 87 and 98.
[8] Wisconsin Geological and Natural History Survey, Bulletin No. IV, pages 89, 90, and 132.
[9] Stones for Building and Decoration, pages 167 and 168.

The 18 quarries operating in 1902 were located in Dodge, Green Lake, Marathon, Marinette, Marquette, Sauk, Waupaca, and Waushara counties, and their output was valued at $369,137.

Sandstones and quartzites.—One of the most widely distributed building stones, and one which furnishes perhaps the greatest variety in color and texture among the sedimentary rocks, is the sandstone of the Potsdam and St. Peter's formation. The Potsdam appears first in the northeast corner of the state and swings in a broad belt around to the southwest and then again northwest. A second smaller belt skirts the south shore of Lake Superior entirely across the state in an east and west direction. The stone from this belt, on account of its color, is commonly known as the Lake Superior brownstone, and was first quarried in 1868 on Bass Island. This stone was quarried in the counties of Ashland, Bayfield, and Douglas, and has been used for structural purposes in many states.[1] The stone quarried from the southern Potsdam area is mostly used locally, the color, texture, durability, and composition of the stone varying greatly in the different beds. The so-called St. Peter's sandstone is found in a comparatively narrow strip extending from the Menominee river, in the northeastern part of the state, south as far as the state line, thence west to the Mississippi river. The stone is brown, red, yellow, or nearly white in color, and as a rule is coarse and rather friable.[1]

Based on the value of product, Sauk ranked first among the sandstone producing counties of Wisconsin, Dunn county second, and Bayfield third. Only 6 of the 23 counties in which sandstone is quarried had a value of output in excess of $10,000. The value of the sandstone quarried in the state in 1902 was $207,086.

All other minerals.—In 1875, at Whitefish Bay, Milwaukee county, the first cement mill in the state was erected, and with scarcely any interruption this plant has been a steady producer of an excellent quality of natural rock cement. A second plant was erected near the first in 1890. Based on the value of the production, Wisconsin ranked fourth among states producing natural rock cement.

Stratified beds of clay, from which over 50,000,000 brick are made annually, are found along the shore of Lake Michigan. Although the clay usually is red the bricks are cream colored, and Milwaukee derives its name of "The Cream City" from the fact that this brick has been used so extensively in its buildings.[2] The value of the clay produced in Wisconsin in 1902 was $23,178, and the value of the brick and tile made from it was $1,014,373.[3]

There are copper ores in the zinc and lead district of southwestern Wisconsin, and some crude attempts at copper mining have been made. By far the most important recent development, however, has been in Douglas county, in the northern part of the state.[4]

Some graphite was produced in Portage county in 1902, and some metallic paints were made from a certain hematite iron ore found in Dodge county, but no figures can be shown for either of these minerals without disclosing individual operations.

[1] Stones for Building and Decoration, pages 167 and 168.

[2] King's Handbook of the United States, page 894.

[3] United States Geological Survey, "Mineral Resources of the United States," 1902, page 726.

[4] The Copper Handbook, by Horace J. Stevens, Vol. III, page 118.

WYOMING.

Table 1 is a summary of the statistics for the productive mines, quarries, and wells of the state of Wyoming for 1902.

TABLE 1.—SUMMARY: 1902.

	Total.	Coal, bituminous.	Sandstones and quartzites.	Limestones and dolomites.	Gold and silver.	All other minerals.[1]
Number of mines, quarries, and wells	74	36	12	3	4	19
Number of operators	50	22	12	3	4	9
Salaried officials, clerks, etc.:						
Number	153	125	3	.....	4	21
Salaries	$188,616	$159,153	$2,038	.....	$3,245	$24,180
Wage-earners:						
Average number	4,486	4,197	74	7	25	183
Wages	$3,492,059	$3,207,645	$58,897	$5,640	$24,570	$195,407
Contract work	$15,547	$12,747	.....	.....	$300	$2,500
Miscellaneous expenses	$280,602	$224,947	$2,291	$2	$160	$53,202
Cost of supplies and materials	$818,496	$669,328	$4,337	$225	$11,139	$133,467
Value of product	$5,684,286	$5,236,339	$90,691	$6,340	$4,923	$346,993

[1] Includes operators as follows: Copper ore, 1; graphite (1 mine, operator reported in South Dakota); grindstones and pulpstones (operator reported under sandstones and quartzites); gypsum, 2 (3 quarries); iron ore, 1; petroleum, 2 (13 wells); precious stones, 3 (no mines).

Wyoming is excelled by few states in the variety and amount of its mineral resources.[1] Although greatly hindered in the development of its mines and quarries because of the lack of capital and means of transportation, its product in 1902 was valued at $5,684,286. In the value of its mineral products the state was twenty-seventh in rank; almost the entire mineral production was from its mines of coal, in the output of which mineral the state ranked fourteenth.

The rocks included in the group "sandstones and quartzites," occur in almost inexhaustible beds, and are equal to those of any other state in point of beauty and durability.[2]

Limestones and dolomites are of wide occurrence and were quarried to a limited extent in 1902.

Gold and silver mining, which was an important factor in the early development of the state, has decreased in importance, until in 1902 the product amounted to only $4,923.

Other minerals produced commercially in 1902 were copper ore, graphite, grindstones and pulpstones, gypsum, iron ore, petroleum, and precious stones.

Arsenic, asbestos, glass sand, granite, kaolin, and fire clay, magnesium, marble, mica, platinum, vein and stream tin, and volcanic ash are of known occurrence in the state, but were not mined on a commercial scale in 1902.[3]

[1] The State of Wyoming, by Fenimore Chatterton, pages 9 and 13.
[2] Ibid., page 17.
[3] Ibid., page 13 ff.

Development work confined to gold and silver and petroleum was reported by 87 operators in 1902. They paid out $405,285 for salaries and wages, $86,204 for contract work, $35,120 for expenses of a miscellaneous character, and $140,754 for supplies and materials.

Certain manufacturing industries are closely allied to or based upon the mining industry, using as raw material the products of mines and quarries. The relative importance of these branches of manufacture, as indicated by the value of their products, is shown in the following table:

TABLE 2.—*Manufactures based primarily upon the products of mines and quarries: 1900.*

INDUSTRY.	Value of product.	
All manufactures	.....	$4,301,240
Based upon products of mines or quarries:		
Clay, glass, and stone products	$43,675	
Iron and steel and their products	332,175	
Metals and metal products, other than iron and steel	43,102	
Miscellaneous industries	225,662	
		644,614
All other	.....	3,656,626

The total value of product of these manufacturing industries based on mining was, as shown by Table 2, $644,614, or 15 per cent of the product of all manufactures in the state in 1900.

The number of wage-earners employed in manufactures in 1900 was 2,241, and they received $1,386,140 in wages. In 1902, 4,486 wage-earners were employed

in mines and quarries, and they were paid $3,432,059 in wages. By combining the figures for these two branches of industry it is shown that mines and quarries furnished employment to 66.7 per cent of the wage-earners, and paid 71.2 per cent of the wages, while there were employed in manufactures 33.3 per cent of the wage-earners, who were paid 28.8 per cent of the wages.

Table 3, compiled from the reports of the United States Geological Survey, shows the value of the annual production of the principal minerals from 1890 to 1902.

TABLE 3.—*Value of annual production of principal minerals: 1890 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Coal, bituminous.	Sandstones and quartzites.	Gold and silver.[1]
1890	$3,183,669	$16,760	(2)
1891	3,555,275	25,000	(2)
1892	3,168,776	15,000	(2)
1893	3,290,904	100	(2)
1894	3,170,392	4,000	(2)
1895	2,977,901	10,000	(2)
1896	2,904,185	16,465	$14,429
1897	3,136,694	11,275	11,329
1898	3,664,190	6,382	5,429
1899	4,742,525	32,588	20,717
1900	5,457,953	27,671	[3] 34,324
1901	6,060,462	54,145	[3] 25,540
1902[4]	5,236,339	90,691	[3] 41,460

[1] Estimates of the Director of the Mint; values of the refined product; silver at coining value.
[2] Not reported separately.
[3] Silver at commercial value.
[4] Census figures, except for gold and silver.

Coal, bituminous.—The production of coal on a commercial scale in Wyoming began in 1869.[1] The first mine was opened at a point about 3 miles from Evanston, in Uinta county, soon after the construction of the transcontinental railway.

The coal fields of Wyoming cover an area of more than 20,000 square miles; they have been known since 1850, but remained undeveloped until 1868 because of the lack of transportation facilities and market.[2] Since that time coal mining has developed into the leading branch of mineral industry in the state, and the known area of coal deposits has been extended through successive discoveries until it includes every county in the state; some of the veins vary in thickness up to 75 feet. The most common variety is a pure lignite, though in certain localities a good coking coal is mined. In 1887 a semianthracite coal was discovered in Johnson county.[3]

The best grades are low in ash and sulphur, and are excellent for steam making, domestic purposes, and the manufacture of gas. During the early development of the industry, almost the entire product was sold to the railway companies,[4] but in later years their consumption has amounted approximately to one-third of the production.[5]

[1] Harper's Encyclopedia, Vol. 9, page 564.
[2] United States Geological Survey, "Mineral Resources of the United States," 1883, page 100.
[3] The State of Wyoming, page 14.
[4] King's Handbook of the United States, pages 906 and 907.
[5] Proceedings of the Wyoming Industrial Convention, 1901, page 86.

Table 4, compiled from reports of the United States Geological Survey, shows the annual production of coal, bituminous, from 1865 to 1902.

TABLE 4.—*Annual production of coal, bituminous: 1865 to 1902.*

[United States Geological Survey, "Mineral Resources of the United States."]

YEAR.	Short tons.	YEAR.	Short tons.	YEAR.	Short tons.
1865	800	1878	333,200	1891	2,327,841
1866	2,500	1879	400,991	1892	2,503,839
1867	5,000	1880	527,811	1893	2,439,311
1868	6,925	1881	628,181	1894	2,417,463
1869	49,382	1882	707,764	1895	2,246,911
1870	105,295	1883	779,689	1896	2,229,624
1871	147,328	1884	902,620	1897	2,527,886
1872	221,745	1885	807,328	1898	2,863,812
1873	259,700	1886	829,355	1899	3,837,392
1874	219,061	1887	1,170,318	1900	4,014,602
1875	300,808	1888	1,481,540	1901	4,485,374
1876	334,550	1889	1,388,947	1902	4,429,491
1877	342,863	1890	1,870,366		

In 1902 the reports from 11 of the 13 counties showed the mining of coal. Sweetwater county ranked first, with a product of 1,595,340 tons, followed by Uinta, with 1,595,333; Carbon, with 382,207; and Converse, with 72,329 tons. The state's production in 1902 shows a decrease from that of 1901 of 55,883 tons, Carbon and Sweetwater counties showing the greatest loss. The statistics for Uinta county show an increase of 156,186 tons for the year.

Sandstones and quartzites.—A large amount of the product of the sandstone quarries in Carbon county is shipped to Colorado, Nebraska, and Utah. The capitol at Cheyenne and the state penitentiary were built of this stone. The Iron mountain quarries in Laramie county produce a white stone that is much used for building purposes. The Carnegie Library and Federal building at Cheyenne were constructed from this material.[6]

In 1902 sandstones and quartzites were quarried in Albany, Carbon, Crook, Laramie, and Uinta counties. Of the total production, $90,691, that sold for building purposes amounted to $40,451, and that for rubble to $10,096.

Limestones and dolomites.—There are several exposures of a thick limestone formation near Lava creek and in the valley of the East Fork of the Yellowstone river. Compact crystalline limestone also occurs near the summit of the Owl creek range of mountains, and in the Wind river range there are numerous strata resembling the Quebec and Niagara limestones.[7]

The only quarries reported in 1902 were in Albany county, and their product amounted to $6,340. Of this amount, $2,250 was the value of stone used for lime making and $4,000 the value used for blast furnace flux.

Gold and silver.—Though the Laramie trail, one of the principal highways to the Pacific coast, was traversed by many caravans of Mormons on their way to Deseret, Utah, and by thousands of prospectors going

[6] The State of Wyoming, page 17.
[7] Reconnaissance of Wyoming, by William A. Jones, pages 111 and 112.

to the gold fields of California, the occurrence of gold in Wyoming was not discovered until 1867. In that year the placer mines on the Sweetwater river were found, and for several years produced rich results. Placer and quartz mines have been discovered in almost every county in the state.[1] The annual production of gold and silver in the state since 1867 has ranged in value from $25,000 to $125,000.[2]

All other minerals.—Copper, in the form of glance, pyrites, silicate, green carbonate, and red oxide, occurs in Laramie, Carbon, Albany, and Crook counties.[3]

Veins of graphite occur at French creek, Plumbago canyon, and Halleck canyon in Albany county, and in the Indian Grove mountains in Carbon county. The veins are large and easily accessible and contain from 40 to 60 per cent of carbon.[4]

The Triassic formation exposed along the eastern side of the Laramie plains contains a large percentage of gypsum, one stratum near the bottom of the formation being of considerable thickness. The Laramie bed, known locally as a deposit of gypsite, has an average depth of 9 feet, and the mineral needs only to be calcined to prepare it for the market. The manufacture of plaster of Paris and stucco has been carried on at Red Buttes since 1889.[5]

The occurrence of iron ore has been known for some time at a point 2½ miles north of Rawlins station. Two mines were opened here in 1871 and worked until 1877. Since that time only a few tons have been mined in this region and these have been used for the manufacture of mineral paints.[6] Hematite ore has been discovered since in Crook, Uinta, Johnson, Fremont, Bighorn, Albany, and Sheridan counties. Besides these hematites, beds of clay ironstone have been found in the Cretaceous rocks and magnetites in the Laramie mountains.[7] Iron mountain, in Laramie county, 52 miles north of Cheyenne, is a mass of red hematite 7 miles long,[1] and Bradleys peak in Carbon county has been called a mountain of iron since it contains not less than 1,500,000,000 tons of iron ore.[7]

About a quarter of a century prior to the great oil excitement in Pennsylvania, Bonneville announced the discovery of oil in Wyoming. Little attention seems to have been paid to his announcement because the territorial geologist, as late as 1890, stated that the first discovery had been made only twenty-five years before. Certainly from 1869 to 1880, little or no attention was paid to oil in the state. In Crook county a company collected oil from the springs and sold it to miners until the advent of the railway, which could bring eastern lubricating oil cheaper than it could be brought in by team from points in Wyoming.

The oil industry of the state was placed on a profitable basis in 1894, when a company at Casper completed its wells in the Salt Creek basin. Because of the necessary haul by wagon and the high freight rates, progress in the development of this industry has been necessarily slow. There are now 19 known fields located in Bighorn, Converse, Crook, Fremont, Natrona, Uinta, and Weston counties.[8] The oil is stored in sandstone, magnesium, limestone, and conglomerate. It occurs in all possible grades, containing in some cases as high as 40 per cent of illuminating oil, and ranges in color from honey-yellow to jet-black.[9]

The semiprecious stones are found in abundance, quartz crystals, agates, jaspers, moss agates, garnets, and beryls being the most important ones. The moss agates found here are the best in the world.[10] No mines were in operation in 1902, though three operators reported the finding of precious stones in surface workings.

[1] King's Handbook of the United States, pages 906 and 907.
[2] The State of Wyoming, page 13.
[3] United States Geological Survey, "Mineral Resources of the United States," 1887, page 808.
[4] The State of Wyoming, page 16.
[5] The Laramie Cement Plaster, by E. E. Slosson and R. B. Moody, page 3 ff.
[6] Tenth Census of the United States, Vol. XV, page 485.
[7] The State of Wyoming, page 27 ff.
[8] Proceedings of the Wyoming Industrial Convention, 1901, page 39 ff.
[9] The Mineral Industry, 1896, Vol. V, pages 442 to 444.
[10] The State of Wyoming, page 19.