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DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

J. W. POWELL, DIRECTOR

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR 1885

DIVISION OF MINING STATISTICS AND TECHNOLOGY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1886

ADVERTISEMENT.

[Mineral Resources of the United States, 1885.]

The publications of the United States Geological Survey are issued in accordance with the statute approved March 3, 1879, which declares that—

"The publications of the Geological Survey shall consist of the annual report of operations, geological and economic maps illustrating the resources and classification of the lands, and reports upon general and economic geology and paleontology. The annual report of operations of the Geological Survey shall accompany the annual report of the Secretary of the Interior. All special memoirs and reports of said Survey shall be issued in uniform quarto series if deemed necessary by the Director, but otherwise in ordinary octavos. Three thousand copies of each shall be published for scientific exchanges and for sale at the price of publication; and all literary and cartographic materials received in exchange shall be the property of the United States and form a part of the library of the organization: And the money resulting from the sale of such publications shall be covered into the Treasury of the United States."

On July 7, 1882, the following joint resolution, referring to all Government publications, was passed by Congress:

"That whenever any document or report shall be ordered printed by Congress, there shall be printed, in addition to the number in each case stated, the 'usual number' (1 900) of copies for binding and distribution among those entitled to receive them."

Except in those cases in which an extra number of any publication has been supplied to the Survey by special resolution of Congress or has been ordered by the Secretary of the Interior, this Office has no copies for gratuitous distribution.

ANNUAL REPORTS.

Of the Annual Reports there have been already published:

I. First Annual Report to the Hon. Carl Schurz, by Clarence King. 1880. 8°. 79 pp. 1 map.—A preliminary report describing plan of organization and publications.

II. Report of the Director of the United States Geological Survey for 1880–'81, by J. W. Powell. 1882. 8°. lv, 588 pp. 61 pl. 1 map.

III. Third Annual Report of the United States Geological Survey, 1881–'82. by J. W. Powell. 1883. 8°. xviii, 564 pp. 67 pl. and maps.

IV. Fourth Annual Report of the United States Geological Survey, 1882–'83, by J. W. Powell. 1884. 8°. xxxii, 473 pp. 85 pl. and maps.

V. Fifth Annual Report of the United States Geological Survey, 1883–'84, by J. W. Powell. 1885. 8°. xxxvi, 469 pp. 58 pl. and maps.

The Sixth and Seventh Annual Reports are in press.

MONOGRAPHS.

Of the Monographs, Nos. II, III, IV, V, VI, VII, VIII, IX, X, and XI are now published, viz:

II. Tertiary History of the Grand Cañon District, with atlas, by Clarence E. Dutton, Capt. U. S. A. 1882. 4°. xiv, 264 pp. 42 pl. and atlas of 24 sheets folio. Price $10.12.

III. Geology of the Comstock Lode and the Washoe District, with atlas by George F. Becker. 1882. 4°. xv, 422 pp. 7 pl. and atlas of 21 sheets folio. Price $11.

IV. Comstock Mining and Miners, by Eliot Lord. 1883. 4°. xiv, 451 pp. 3 pl. Price $1.50.

V. Copper-bearing Rocks of Lake Superior, by Roland D. Irving. 1883. 4°. xvi, 464 pp. 15 l. 29 pl. Price $1.85.

VI. Contributions to the Knowledge of the Older Mesozoic Flora of Virginia, by Wm. M. Fontaine. 1883. 4°. xi, 144 pp. 54 l. 54 pl. Price $1.05.

VII. Silver-Lead Deposits of Eureka, Nevada, by Joseph S. Curtis. 1884. 4°. xiii, 200 pp. 16 pl. Price $1.20.

VIII. Paleontology of the Eureka District, by Charles D. Walcott. 1884. 4°. xiii, 298 pp. 24 l. 24 pl. Price $1.10.

IX. Brachiopoda and Lamellibranchiata of the Raritan Clays and Greensand Marls of New Jersey, by Robert P. Whitfield. 1885. 4°. xx, 338 pp. 35 pl. Price $1.15.

X. Dinocerata. A Monograph of an Extinct Order of Gigantic Mammals, by Othniel Charles Marsh. 1885. 4°. xviii, 243 pp. 56 l. 56 pl. Price $4.75.

XI. Geological History of Lake Lahontan, a Quaternary Lake of Northwestern Nevada, by Israel Cook Russell. 1885. 4°. xiv, 288 pp. 46 pl. Price $1.75.

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The following is in press, viz:

XII. Geology and Mining Industry of Leadville, with atlas, by S. F. Emmons. 1886. 4°. xxix, 770 pp. 45 pl. and atlas of 35 sheets folio.

The following are in preparation, viz:

I. The Precious Metals, by Clarence King.

— Gasteropoda of the New Jersey Cretaceous and Eocene Marls, by R. P. Whitfield.

— Geology of the Eureka Mining District, Nevada, with atlas, by Arnold Hague.

— Lake Bonneville, by G. K. Gilbert.

— Sauropoda, by Prof. O. C. Marsh.

— Stegosauria, by Prof. O. C. Marsh.

— Brontotheridæ, by Prof. O. C. Marsh.

— Geology of the Quicksilver Deposits of the Pacific Slope, with atlas, by George F. Becker.

— The Penokee-Gogebic Iron-Bearing Series of North Wisconsin and Michigan, by Roland D. Irving.

— Younger Mesozoic Flora of Virginia, by William M. Fontaine.

— Description of New Fossil Plants from the Dakota Group, by Leo Lesquereux.

— Report on the Denver Coal Basin, by S. F. Emmons.

— Report on Ten-Mile Mining District, Colorado, by S. F. Emmons.

— Report on Silver Cliff Mining District, by S. F. Emmons.

— Flora of the Dakota Group, by J. S. Newberry.

BULLETINS.

The Bulletins of the Survey will contain such papers relating to the general purpose of its work as do not properly come under the heads of Annual Reports or Monographs.

Each of these Bulletins contains but one paper and is complete in itself. They are, however, numbered in a continuous series, and may be united into volumes of convenient size. To facilitate this, each Bulletin has two paginations, one proper to itself and another which belongs to it as part of the volume.

Of this series of Bulletins Nos. 1 to 35 are already published, viz:

1. On Hypersthene-Andesite and on Triclinic Pyroxene in Augitic Rocks, by Whitman Cross, with a Geological Sketch of Buffalo Peaks, Colorado, by S. F. Emmons. 1883. 8°. 42 pp. 2 pl. Price 10 cents.

2. Gold and Silver Conversion Tables, giving the coining values of troy ounces of fine metal, etc., by Albert Williams, jr. 1883. 8°. 8 pp. Price 5 cents.

3. On the Fossil Faunas of the Upper Devonian, along the meridian of 76° 30′, from Tompkins County, New York, to Bradford County, Pennsylvania, by Henry S. Williams. 1884. 8°. 36 pp. Price 5 cents.

4. On Mesozoic Fossils, by Charles A. White. 1884. 8°. 36 pp. 9 pl. Price 5 cents.

5. A Dictionary of Altitudes in the United States, compiled by Henry Gannett. 1884. 8°. 325 pp. Price 20 cents.

6. Elevations in the Dominion of Canada, by J. W. Spencer. 1884. 8°. 43 pp. Price 5 cents.

7. Mapoteca Geologica Americana. A catalogue of geological maps of America (North and South), 1752–1881, by Jules Marcou and John Belknap Marcou. 1884. 8°. 184 pp. Price 10 cents.

8. On Secondary Enlargements of Mineral Fragments in Certain Rocks, by R. D. Irving and C. R. Van Hise. 1884. 8°. 56 pp. 6 pl. Price 10 cents.

9. Report of work done in the Washington Laboratory during the fiscal year 1883–'84. F. W. Clarke, chief chemist; T. M. Chatard, assistant. 1884. 8°. 40 pp. Price 5 cents.

10. On the Cambrian Faunas of North America. Preliminary studies, by Charles D. Walcott. 1884. 8°. 74 pp. 10 pl. Price 5 cents.

11. On the Quaternary and Recent Mollusca of the Great Basin; with Descriptions of New Forms, by R. Ellsworth Call; introduced by a sketch of the Quaternary Lakes of the Great Basin, by G. K. Gilbert. 1884. 8°. 66 pp. 6 pl. Price 5 cents.

12. A Crystallographic Study of the Thinolite of Lake Lahontan, by Edward S. Dana. 1884. 8°. 34 pp. 3 pl. Price 5 cents.

13. Boundaries of the United States and of the several States and Territories, by Henry Gannett, 1885. 8°. 135 pp. Price 10 cents.

14. The Electrical and Magnetic Properties of the Iron-Carburets, by Carl Barus and Vincent Strouhal. 1885. 8°. 238 pp. Price 15 cents.

15. On the Mesozoic and Cenozoic Paleontology of California, by Charles A. White. 1885. 8°. 33 pp. Price 5 cents.

16. On the higher Devonian Faunas of Ontario County, New York, by John M. Clarke. 1885. 8°. 86 pp. 3 pl. Price 5 cents.

17. On the Development of Crystallization in the Igneous Rocks of Washoe, Nevada, by Arnold Hague and Joseph P. Iddings. 1885. 8°. 44 pp. Price 5 cents.

18. On Marine Eocene, Fresh-water Miocene, and other Fossil Mollusca of Western North America, by Charles A. White. 1885. 8°. 26 pp. 3 pl. Price 5 cents.

19. Notes on the Stratigraphy of California, by George F. Becker. 1885. 8°. 28 pp. Price 5 cents.

20. Contributions to the Mineralogy of the Rocky Mountains, by Whitman Cross and W. F. Hillebrand. 1885. 8°. 114 pp. 1 pl. Price 10 cents.

NOTICE.

This volume, "Mineral Resources of the United States, 1885," is the third of a series which began in 1882. It can be obtained for 40 cents. The first volume is entitled "Mineral Resources of the United States, 1882." It is sold for 50 cents. The second volume is called "Mineral Resources of the United States, 1883 and 1884," and is sold for 60 cents. Remittances should be made by postal note (not stamps), and should be addressed to the Director United States Geological Survey, Washington, D. C. In ordering the different volumes of this series care should be taken to designate the first as "Mineral Resources, 1882," the second as "Mineral Resources, 1883 and 1884," and this volume as "Mineral Resources, 1885."

Corrections, additions, or notice of important omissions, reports and maps of mines and mining districts, pamphlets on metallurgical processes, brief notes on new mineral localities, etc., will be highly appreciated, and should be addressed to David T. Day, U. S. Geological Survey, Washington, D. C. Duplicate copies of such reports, etc., are especially desired for extending the fine set of mining pamphlets in the library of the Survey, and will be thankfully acknowledged if sent to the

DIRECTOR OF THE
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C.

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CONTENTS.

LETTER OF TRANSMITTAL.

UNITED STATES GEOLOGICAL SURVEY,
DIVISION OF MINING STATISTICS AND TECHNOLOGY,
Washington, D. C., September 15, 1886.

SIR: I have the honor to transmit herewith a statistical report upon the present condition of the mining industries of the United States. The statistical canvass for the report was arranged and conducted by Mr. Albert Williams, jr., who remained in charge of this division until the material was nearly ready for printing. Mr. Williams has also given valuable aid in the final revision. This report is the third of the series entitled "Mineral Resources of the United States." The first volume contained the statistics for 1882 and the first six months of 1883; in the second, the statistics were carried to December 31, 1884; and the present volume deals with the changes in the mineral industries during the calendar year 1885. In accordance with your instructions it is proposed to issue a fourth report, for the calendar year 1886, early in 1887.

Very respectfully, your obedient servant,

DAVID T. DAY,
Geologist in Charge.

Hon. J. W. POWELL,
Director United States Geological Survey.

INTRODUCTORY.

Object of the report.—The present volume is the third of a series designed to present the principal statistics concerning the mineral products of the United States, together with such descriptive matter as will throw light upon the condition of the industries which these products materially affect, or will aid in utilizing material which has no value at present. In the first volume the state of the mineral industries was presented as it appeared in 1882, and the statistics were extended through the first six months of the calendar year 1883. The second volume carried the statistics to December 31, 1884, and gave the changes during the calendar years 1883 and 1884, together with information supplementary to the first volume. The present report deals with the changes in 1885, and carries the statistics to December 31 of that year. The repetition of all matter except statistical tables is avoided wherever possible, hence the three reports should be consulted together. The omission from the present report of certain subjects which have been treated in the former volumes may be taken as indicating that the changes are slight in so far as information has been obtainable by this office.

Acknowledgments.—It is impossible to mention even the names of all the persons who have freely given valuable assistance, often at a great sacrifice of time and labor, in the compilation of a report embracing statistics from so large a territory. In any importmant chapters of the book the contributions have been obtained from experts whose entire attention has been given for years to the study of the subjects under which their names appear; and hence these articles contain more valuable and extended information than could otherwise have been secured. It is gratifying to testify to the general courtesy and hearty co-operation of the manufacturers and dealers in responding to the numerous requests for information.

Delay in publication.—It is recognized that the value of statistical information depends largely upon promptness in publication. This has, however, been partly sacrificed in order to make use of every available aid towards accuracy, particularly with subjects like coal, where the information must be sought from very many sources. Delay in a single subject thus extends to the whole report. Advance sheets of the important subjects have been published, however, as soon as the information was complete. All the matter in the book, moreover, has been subjected to revision much later than the end of the period treated. The delay in printing and binding has been much less than could reasonably have been expected in a season of great pressure at the Government Printing Office.

The period included in the report is the calendar year 1885. The tables of production are made to conform to this period except where information is only obtainable for other divisions of time, as in the reports of imports and exports furnished for fiscal years by the Bureau of Statistics, and in a few industries where the seasons of production or manufacture make more actual divisions. Thus the manufacture of artificial fertilizers has been given from May 1 to April 30, because the most active season would be divided at December 31.

The methods of statistical inquiry.—A canvass of the United States for precise returns has been made concerning some of the industries; with others this is impossible within a period consistent with valuable statistics, unless made at a disproportionate expenditure of money. The composition of aggregates by such a system is also open to serious danger when the returns are withheld from a single point of production. The estimates of authorities are therefore of more practical value where the detailed canvass would be too complicated, provided these estimates are checked by actual returns from all available sources. Both of these systems are used in this report with results which are by no means uniform in their accuracy. They simply represent the best figures attainable. Fortunately the greater the industrial importance of a mineral the greater are usually the facilities for determining its output. With some substances, such as copper and pig iron, the production can be given to within a small fraction of a per cent. In other cases the widely scattered points of production make this impossible, and the statement of an exact figure of production would then imply a co-operation among the producers which frequently does not yet exist. As a matter of fact, a large proportion of the results are direct returns.

MINERAL RESOURCES OF THE UNITED STATES.

CALENDAR YEAR 1885.

Division of Mining Statistics and Technology.

SUMMARY—1885.

Coal.—The total commercial product of coal of all kinds in 1885, exclusive of that consumed at the mines, known as colliery consumption, was 95,834,705 long tons, valued at $152,915,108. Of this 32,265,421 long tons were Pennsylvania anthracite, valued at $72,274,544; while of other coals, including bituminous, brown coal, lignite, and small lots of anthracite produced outside of Pennsylvania, the production was 63,569,284 long tons, valued at $80,640,564 at the points of production. The total production including colliery consumption was: Pennsylvania anthracite 34,228,548 long tons, all other coals 64,840,668 long tons, making the total absolute production of the coal mines of the United States 99,069,216 long tons, valued as follows: Anthracite, $76,671,948; bituminous, $82,347,648; total, $159,019,596. The total production (including local consumption) of anthracite was 1,052,792 tons in excess of that of 1884, and its value was $10,320,436 greater. The total production of bituminous coal was 8,889,871 tons less than in 1884, but its value was $4,930,582 greater. The total production of coal of all kinds shows a net loss in tonnage of 7,837,079 long tons compared with that of 1884, but a gain in value of $15,251,018, the increase in value being due to an average increase of 25 cents per long ton. The total value is about the same as that of 1883.

Coke.—The total production of coke in 1885 was 5,106,696 short tons, valued at the ovens at $7,629,118. Of this Pennsylvania produced 78 per cent., or 3,991,805 tons, valued at $4,981,656. The remainder was produced by fourteen States and Territories. The maximum production of coke in the United States was reached in 1883, when 5,464,721 tons were made. This declined in 1884 to 4,873,805 tons. The production of 1885 shows a gain upon that of 1884, being within 360,000 tons of the make in 1883.

Petroleum.—The total production was 21,842,041 barrels of 42 gallons, of which the Pennsylvania and New York fields produced 20,776,041 barrels. The total value, at an average price of 87⅞ cents per barrel, was $19,193,694. The production showed a decrease of 2,247,717 barrels and $1,282,600 in value from 1884.

Natural gas.—No record is kept of the yield in cubic feet. The amount of coal displaced by gas in 1885, was 3,161,600 tons, valued at $4,854,200. In 1884 the coal displaced was valued at $1,460,000. The yield has increased tenfold since 1883.

Iron.—The principal statistics for 1885 were: Domestic iron ore consumed, 7,600,000 long tons; value at mine $19,000,000. Imported iron ore consumed, 390,786 long tons; total iron ore consumed, 7,990,786 long tons; pig iron made, 4,044,525 long tons, a decrease of 53,343 tons as compared with 1884; value at furnace $64,712,400, or $9,049,224 less than in 1884. Total spot value of all iron and steel in the first stage of of manufacture, excluding all duplications, $93,000,000 a decline of $14,000,000 from 1884.

Gold and silver.—The mint authorities estimate the value of the gold produced in 1885 at $31,801,000, an increase of $1,001,000 over 1884. The production of silver is similarly estimated at $51,600,000, an increase of $2,800,000 over 1884.

Copper.—The production in 1885, including 5,086,841 pounds made from imported pyrites, was 170,962,607 pounds, valued in New York at $18,292,999 at the average price of 10.7 cents per pound. The increase in pounds over 1884 was 23,157,200; in value $186,337.

Lead.—Production, 129,412 short tons. Total value, at an average price of $81 per short ton at the Atlantic coast, $10,469,431, a decline of 10,485 tons and $67,611 in value from the product of 1884. The production of white lead is estimated at 60,000 short tons, worth at 5¼ cents per pound, $6,300,000.

Zinc.—The production of metallic zinc in 1885 was 40,688 short tons, valued at $3,539,856 at an average value of 4.35 cents per pound, an increase of 2,144 tons and $117,149 in value over 1884. Zinc was also made from the ore directly into zinc white (zinc oxide) to the extent of 15,000 short tons, valued at $1,050,000.

Quicksilver.—Production, 32,073 flasks (of 76½ pounds net), or 160 flasks more than in 1884. Total value, at an average price of $30.53 per flask at San Francisco, $979,189, an increase of $42,862 over 1884. The production of quicksilver vermilion was about 600,000 pounds, the same as in 1884, but the price advanced to 52 cents per pound, making the total value $312,000.

Nickel.—The production of metallic or "grain" nickel was 245,504 pounds, valued at $169,397. In addition, matte and ore containing 32,400 pounds of nickel were exported. Total value of all nickel, $191,753.

Cobalt.—The amount of cobalt oxide was 8,423 pounds, valued at $19,373. The total value of cobalt in ore, matte, and the above oxide was $65,373.

Manganese.—The production of manganese ores was 23,258 long tons, valued at $190,281. Manganiferous iron ore, 3,237 long tons, valued at $17,318. Total value, $207,599.

Chromium.—The production of chrome iron ore was 2,700 long tons, valued at $40,000. The consumption for making potassium and sodium bichromates increased markedly, due to imports of chrome iron ore from Asia Minor.

Tin.—Probably 200 tons of "black tin" ore were made at the concentrating works at the Etta mine in Dakota. No smelting works have yet been erected.

Platinum.—The amount of crude platinum mined in 1885 was about 250 troy ounces, valued at $187. This is exclusive of about 300 ounces of iridosmine, for pointing pens.

Aluminum.—The production of metallic aluminum increased from 1,800 troy ounces in 1884 to 3,400 ounces in 1885, valued at $2,550. Aluminum bronze, containing 10 per cent. aluminum, was made to the amount of about 4,500 pounds, valued at $1,800.

Building stone.—Value, $19,000,000; about the same as in 1884.

Brick and tile.—The demand and consequent production increased to an estimated value of $35,000,000 in 1885.

Lime.—With the price constant at 50 cents per barrel at the kilns, the production increased from 37,000,000 barrels in 1884 to 40,000,000 in 1885.

Cement.—The production of cement from natural rock increased to 4,000,000 barrels of 300 pounds each, but was valued at only $3,200,000. Artificial Portland cement amounted to 150,000 barrels of 400 pounds each, with a total value of $292,500. The total production of cement of all kinds was 4,150,000 barrels, valued at $3,492,500, against $3,720,000 in 1884.

Precious stones.—The value of American precious stones produced in 1885 was $69,900. This includes $42,800 for stones sold as specimens and souvenirs and $27,100 for stones to be cut into gems. Besides this, gold quartz, with an estimated value of $140,000 was sold for specimens and for ornaments and jewelry.

Millstones.—The trade in millstones of all kinds has decreased markedly from the introduction of roller mills. The total value of the Esopus millstones in New York and Cocalico stone in Pennsylvania did not exceed $100,000 in 1885.

Grindstones.—Estimated value of product for 1885, $500,000.

Phosphates.—With the exception of a local consumption of about 1,000 tons in North Carolina, thetotal production of phosphate rock came from South Carolina, and amounted to 437,856 long tons of washed rock for the calendar year 1885, valued at $2,846,064, at an average value of $6.50 per ton.

Gypsum.—The estimated production of land plaster in 1885 was 100,600 short tons; of calcined plaster 72,200 tons; total 172,800 tons, valued at $959,600. The above includes 75,100 tons from native stone, the remainder being imported from Nova Scotia.

Salt.—The total production in barrels of 280 pounds was 7,038,653, exceeding the yield of 1884 by 523,716 barrels. The total value of all salt produced was $4,825,345, an increase of $732,887, which was due partly to the increased value of the Michigan product, and partly to the large increase in the production of western New York.

Bromine.—The production increased slightly, being about 310,000 pounds against 281,100 in 1884. The total value, at an average of 29 cents per pound, was $89,900, an increase of $22,436 above the previous year.

Borax.—Production, limited to California and Nevada, 8,000,000 pounds; value, at 6 cents per pound for concentrated, $480,000. While the product increased by 1,000,000, the fall in price lowered the total value by $10,000.

Sulphur.—The production was only about 700 tons, worth about $18,000.

Pyrites.—About 49,000 long tons were mined, valued at $220,500. In addition 47,500 tons were imported.

Barytes.—The production was about 15,000 tons, valued at $75,000, in the unground condition, as taken from the mines.

Mica.—The production decreased in the West, owing to the inferior value of the sheets obtained. The whole product, excluding waste, was 92,000 pounds, valued at $161,000.

Feldspar.—Production, 13,600 long tons, valued, before grinding, at $68,000.

Asbestus.—The amount mined was about 300 short tons, valued at $9,000.

Asphaltum.—The production remained constant at about 3,000 tons, with a spot value of $10,500.

Mineral waters.—The sales amounted to $1,312,845, from 9,148,401 gallons; the value is slightly less than in 1884. The great change in the number of gallons stated in the last report is due to the exclusion of the water from artesian wells in Madison, Wisconsin, which is used as the regular city supply. A large local consumption is also excluded.

Totals.—The statements made in the last report in regard to the total mineral product require little change for the year 1885. The statistics have been compiled with a view to giving information on those points which are of most interest and utility, and are presented in the form usual in the several branches of trade statistics. Comparing the totals given since 1882, a continuous decrease in value is noted in 1883 and

1884, being marked in the latter year. The year 1885 shows, on the other hand, an increase, due, no doubt, in part to more complete returns and closer estimates, but indicating, nevertheless, a more profitable business year, which would be still more apparent if the last half were compared with the corresponding period in 1884, since, in many important branches of trade, prices increased towards the end of the year.

Metallic products of the United States in 1885.

	Quantity.	Value.
Pig-iron, spot value .... long tons..	4,044,525	$64,712,400
Silver, coining value .... troy ounces..	39,910,279	51,600,000
Gold, coining value .... do....	1,538,376	31,801,000
Copper, value at New York City (*a*) .... pounds..	170,962,607	18,292,999
Lead, value at New York City .... short tons..	129,412	10,469,431
Zinc, value at New York City .... do....	40,688	3,539,856
Quicksilver, value at San Francisco .... flasks..	32,073	979,189
Nickel, value at Philadelphia .... pounds..	277,904	191,753
Aluminum, value at Philadelphia .... troy ounces..	3,400	2,550
Platinum, value, crude, at New York City .... do....	250	187
Total	....	$181,589,365

a Including copper from imported pyrites.

Non-metallic mineral products of the United States in 1885 (*spot values*).

	Quantity.	Value.
Bituminous coal, brown coal, lignite, and anthracite, mined elsewhere than in Pennsylvania .... long tons (*a*).	64,840,668	$82,347,648
Pennsylvania anthracite .... do (*b*).	34,228,548	76,671,948
Petroleum .... barrels..	21,842,041	19,193,694
Building stone	....	19,000,000
Lime .... barrels..	40,000,000	20,000,000
Salt .... do....	7,038,653	4,825,345
Cement .... do....	4,150,000	3,492,500
South Carolina phosphate rock .... long tons..	437,856	2,846,064
Limestone for iron flux	....	1,694,656
Mineral waters .... gallons sold..	9,148,401	1,312,845
Natural gas	....	4,854,200
Zinc, white .... short tons..	15,000	1,050,000
Concentrated borax .... pounds..	8,000,000	480,000
New Jersey marls .... short tons..	875,000	437,500
Mica .... pounds..	92,000	161,000
Pyrites .... long tons..	49,000	220,500
Gold quartz souvenirs, jewelry, &c	....	140,000
Manganese ore .... long tons..	23,258	190,281

a The commercial product, that is, the amount marketed, was only 63,569,284 tons, valued at $80,640,564.

b The commercial product, that is, the amount marketed, was only 32,265,421 tons, valued at $72,274,544.

Non-metallic mineral products of the United States in 1885 *(spot value), &c.*—Continued.

	Quantity.	Value.
Crude barytes .... long tons..	15, 000	75, 000
Ocher .... do....	3, 950	43, 575
Precious stones	....	69, 000
Bromine .... pounds..	310, 000	89, 900
Feldspar .... long tons..	13, 600	68, 000
Chrome iron ore .... do....	2, 700	40, 000
Asbestus .... short tons..	300	9, 000
Slate ground as a pigment .... long tons..	1, 975	24, 687
Sulphur .... short tons..	715	17, 875
Asphaltum .... do....	3, 000	10, 500
Cobalt oxide .... pounds..	68, 723	65, 373
Total	....	$239, 431, 991

Résumé of the values of the metallic and non-metallic mineral substances produced in the United States in 1885.

Metals	$181, 589, 365
Mineral substances named in the foregoing table	239, 431, 991
	$421, 021, 356
Estimated value of mineral products unspecified	7, 500, 000
Grand total	$428, 521, 356

Summary of the mineral products of the United States, calendar years 1882, 1883, 1884, *and* 1885.

Products.	1882.		1883.		1884.		1885.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
METALLIC.								
Pig-iron, spot value ....long tons..	4, 623, 323	$106, 336, 429	4, 595, 510	$91, 910, 200	4, 097, 868	$73, 761, 624	4, 044, 525	$64, 712, 400
Silver, coining value..........................troy ounces..	36, 197, 695	46, 800, 000	35, 733, 622	46, 200, 000	37, 744, 605	48, 800, 000	39, 910, 279	51, 600, 000
Gold, coining value..................................do.....	1, 572, 186	32, 500, 000	1, 451, 249	30, 000, 000	1, 489, 949	30, 800, 000	1, 538, 376	31, 801, 000
Copper, value at New York City....................pounds..	91, 646, 232	16, 038, 091	117, 151, 795	18, 064, 807	147, 805, 407	18, 106, 162	170, 962, 607	18, 292, 999
Lead, value at New York City..................short tons..	132, 890	12, 624, 550	143, 957	12, 322, 719	139, 897	10, 537, 042	129, 412	10, 469, 431
Zinc, value at New York City..........................do....	33, 765	3, 646, 620	36, 872	3, 311, 106	38, 544	3, 422, 707	40, 688	3, 539, 856
Quicksilver, value at San Francisco.................flasks..	52, 732	1, 487, 042	46, 725	1, 253, 632	31, 913	936, 327	32, 073	979, 189
Nickel, value at Philadelphia......................pounds..	281, 616	309, 777	58, 800	52, 920	64, 550	48, 412	277, 904	191, 753
Antimony, value at San Francisco..............short tons..	60	12, 000	....	....	....	....	....	....
Platinum, value (crude) at New York City ...troy ounces..	200	600	200	600	150	450	250	187
Aluminum, value at Philadelphia ....troy ounces..	....	....	1, 000	875	1, 800	1, 350	3, 400	2, 550
Total value metallic products..............................	....	219, 755, 109	....	203, 116, 859	....	186, 414, 074	....	181, 589, 865

Summary of the mineral products of the United States, &c.—Continued.

Products.	1882.		1883.		1884.		1885.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
NON-METALLIC (SPOT VALUES).								
Bituminous coal .... long tons..	60, 861, 190	$76, 076, 487	68, 531, 500	$82, 237, 800	73, 730, 539	$77, 417, 066	64, 840, 668	$82, 347, 648
Pennsylvania anthracite .... do....	31, 358, 264	70, 556, 094	34, 336, 469	77, 257, 055	33, 175, 756	66, 351, 512	34, 228, 548	76, 671, 948
Petroleum .... barrels..	30, 053, 500	23, 704, 698	23, 400, 229	25, 740, 252	24, 089, 758	20, 476, 294	21, 842, 041	19, 193, 694
Lime .... do....	31, 000, 000	21, 700, 000	32, 000, 000	19, 200, 000	37, 000, 000	18, 500, 000	40, 000, 000	20, 000, 000
Building stone	....	21, 000, 000	....	20, 000, 000	....	19, 000, 000	....	19, 000, 000
Salt .... barrels..	6, 412, 373	4, 340, 140	6, 192, 231	4, 211, 042	6, 514, 937	4, 197, 734	7, 038, 653	4, 825, 345
Cement .... do....	3, 250, 000	3, 672, 750	4, 190, 000	4, 293, 500	4, 000, 000	3, 720, 000	4, 150, 000	3, 492, 500
Limestone for iron flux .... long tons..	3, 850, 000	2, 310, 000	3, 814, 273	1, 907, 136	3, 401, 930	1, 700, 965	....	1, 694, 656
South Carolina phosphate rock .... do....	332, 077	1, 992, 462	378, 380	2, 270, 280	431, 779	2, 374, 784	437, 856	2, 846, 064
New Jersey marls .... short tons..	1, 080, 000	540, 000	972, 000	486, 000	875, 000	437, 500	875, 000	437, 500
Borax .... pounds..	4, 236, 291	338, 903	6, 500, 000	585, 000	7, 000, 000	490, 000	8, 000, 000	480, 000
Mica .... do....	100, 000	250, 000	114, 000	285, 000	147, 410	368, 525	92, 000	161, 000
Ocher .... long tons..	7, 000	105, 000	7, 000	84, 000	7, 000	84, 000	3, 950	43, 575
Soapstone .... short tons..	6, 000	90, 000	....	....	....	....	....	....
Crude barytes .... long tons..	20, 000	80, 000	27, 000	108, 000	25, 000	100, 000	15, 000	75, 000
Precious stones	....	75, 000	....	74, 050	....	82, 975	....	69, 900
Gold-quartz souvenirs, jewelry, etc	....	75, 000	....	115, 000	....	140, 000	....	140, 000
Pyrites .... long tons..	12, 000	72, 000	25, 000	137, 500	35, 000	175, 000	49, 000	220, 500
Manganese ore .... do....	3, 500	52, 500	8, 000	120, 000	10, 000	120, 000	23, 258	190, 281
Chrome iron ore .... do....	2, 500	50, 000	3, 000	60, 000	2, 000	35, 000	2, 700	40, 000
Asbestus .... short tons..	1, 200	36, 000	1, 000	30, 000	1, 000	30, 000	300	9, 000
Graphite .... pounds..	425, 000	34, 000	575, 000	46, 000	....	....	....	....
Cobalt oxide .... do....	11, 653	32, 046	1, 096	2, 795	2, 000	5, 100	68, 723	65, 373
Slate ground as a pigment .... long tons..	2, 000	24, 000	2, 000	24, 000	2, 000	20, 000	1, 975	24, 687
Sulphur .... short tons..	600	21, 000	1, 000	27, 000	500	12, 000	715	17, 875
Asphaltum .... do....	3, 000	10, 500	3, 000	10, 500	3, 000	10, 500	3, 000	10, 500
Corundum .... do....	500	6, 250	....	....	....	....	....	....

Pumice-stone ....do....	70	1,750						
Feldspar........long tons..			14,100	71,112	10,900	55,112	13,600	68,000
Zinc-white........short tons..					13,000	910,000	15,000	1,050,000
Bromine........pounds..			301,100	72,264	281,100	67,464	310,000	89,900
Mineral waters ....gallons sold..			7,529,423	1,119,603	10,215,328	1,459,143	9,148,401	1,312,845
Natural gas........		215,000		475,000		1,460,000		4,854,200
Total value non-metallic mineral products		$227,461,580		$241,049,889		$219,800,674		$239,431,991
Total value metallic products........		219,755,109		203,116,859		186,414,074		181,589,365
Estimated value of mineral products unspecified		8,000,000		8,000,000		7,000,000		7,500,000
Grand total		$455,216,689		$452,166,748		$413,214,748		$428,521,356

COAL.

BY CHARLES A. ASHBURNER.

The coal statistics for 1885 have been compiled from various sources. The report on the anthracite region of Pennsylvania has been furnished by the geologist in charge of the State survey; those from Colorado, Dakota, Montana, New Mexico and Wyoming, by Mr. F. F. Chisolm, and those for the Pacific coast States, by Mr. C. G. Yale. In most other cases the reports have been compiled from data furnished by the different State mine inspectors, or by the State authorities, credit being given in each case.

PRODUCTION.

The statistics of the following regions are reported in long tons ot 2,240 pounds: Pennsylvania anthracite region, Virginia, West Virginia, Maryland, Iowa, Kentucky, Alabama, Michigan, and Missouri. In all other regions the statistics are reported in short tons of 2,000 pounds. The former tonnage unit is the one most generally used, and the total production of each State where it is given in short tons, in the special report, has been reduced to long tons for the table showing the summary for the United States. The commercial product, exclusive of that which is consumed at the mines, known as colliery consumption, during 1885 was: Pennsylvania anthracite, 36,137,272, short, or 32,265,421 long tons, the market value of which has been estimated to have been $72,274,544; bituminous, brown coal, lignite, and small lots of anthracite, mined in Colorado and Arkansas, 71,195,358 short, or 63,567,284 long tons, the market value of which has been estimated to have been $80,640,724, making a total production of 107,332,629 short, or 95,832,705 long tons, valued at $152,915,268. The total production, including colliery consumption, was Pennsylvania anthracite 38,335,973 short, or 34,228,548 long tons, all other coals 72,621,549 short, or 64,840,668 long tons, making the total absolute production of the coal mines of the United States for the year 110,957,522 short, or 99,069,216 long tons.

The following table shows the commercial output in long tons of the States and Territories, from 1881 to 1885 inclusive. In the case of a few of the small items, originally estimated in short tons, it has not been thought advisable to convert the figures into long tons, the difference being less than the probable error, and the round numbers being considered preferable. In addition the table shows the estimated value at the mines of the commercial coal produced in each State or Territory, in 1885.

Coal produced in the several States and Territories, not including the local and colliery consumption, and the value of the mines in 1885.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	Value of coal at mines, 1885.
Pennsylvania:	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	
Anthracite	23, 437, 242	28, 500, 016	29, 120, 096	31, 793, 027	30, 718, 293	32, 265, 421	$72, 274, 544
Bituminous	19, 000, 000	20, 000, 000	22, 000, 000	24, 000, 000	25, 000, 000	23, 214, 285	24, 700, 000
Illinois	4, 000, 000	6, 000, 000	9, 000, 000	10, 350, 000	10, 000, 000	8, 742, 745	11, 456, 493
Ohio	7, 000, 000	8, 250, 000	9, 450, 000	8, 229, 429	7, 650, 062	6, 978, 732	8, 206, 988
Maryland	2, 136, 160	2, 261, 918	1, 540, 466	2, 206, 172	2, 469, 051	2, 865, 974	3, 209, 891
Missouri	1, 500, 000	1, 750, 000	2, 000, 000	2, 250, 000	2, 500, 000	2, 750, 000	3, 850, 000
West Virginia	1, 400, 000	1, 500, 000	2, 000, 000	2, 805, 565	3, 000, 000	3, 008, 091	3, 369, 062
Indiana	1, 500, 000	1, 771, 536	1, 976, 470	2, 560, 000	2, 260, 000	2, 120, 535	2, 731, 250
Iowa	1, 600, 000	3, 500, 000	3, 127, 700	3, 881, 300	3, 903, 458	3, 583, 737	4, 819, 230
Kentucky	1, 000, 000	1, 100, 000	1, 300, 000	1, 650, 000	1, 550, 000	1, 700, 000	2, 094, 400
Tennessee	600, 000	750, 000	850, 000	1, 000, 000	1, 200, 000	892, 857	1, 100, 000
Virginia	100, 000	100, 000	100, 000	225, 000	300, 000	567, 000	666, 792
Kansas	550, 000	750, 000	750, 000	900, 000	1, 100, 000	1, 082, 230	1, 410, 438
Michigan	75, 000	100, 000	130, 000	135, 000	135, 000	45, 178	75, 000
Rhode Island	10, 000	10, 000	10, 000	10, 000	10, 000	....	....
Alabama	340, 000	375, 000	800, 000	1, 400, 000	2, 000, 000	2, 225, 000	2, 990, 000
Georgia	100, 000	150, 000	175, 000	200, 000	200, 000	133, 929	180, 000
Colorado	390, 183	631, 021	947, 749	1, 097, 851	1, 008, 950	1, 210, 769	3, 051, 590
Wyoming	471, 259	560, 876	631, 932	696, 151	805, 911	720, 828	2, 421, 984
New Mexico	(?)	(?)	146, 421	188, 703	196, 924	271, 442	918, 606
Utah	225, 000	225, 000	250, 000	250, 000	250, 000	190, 286	426, 000
California	175, 000	125, 000	150, 000	175, 000	150, 000	63, 942	214, 845
Oregon	30, 000	30, 000	30, 000	50, 000	50, 000	44, 643	125, 000
Washington	175, 000	175, 000	225, 000	300, 000	300, 000	339, 510	950, 615
Texas	....	....	....	100, 000	100, 000	133, 928	300, 000
Arkansas	....	....	....	75, 000	150, 000	133, 928	225, 000
Montana	....	....	....	60, 000	60, 000	77, 179	302, 540
Dakota	....	....	....	50, 000	31, 250	23, 214	91, 000
Idaho	....	....	....	10, 000	20, 000	893	4, 000
Indian Territory	....	....	....	175, 000	400, 000	446, 429	750, 000
Totals	65, 414, 844	76, 865, 357	86, 710, 834	96, 823, 198	97, 518, 899	95, 832, 705	152, 915, 268

THE WORLD'S COAL PRODUCTION.

The following table shows the commercial coal produced by the principal governments of the world, compiled by Mr. Ashburner. Long tons of 2,240 pounds are used in giving the statistics of the United States, Great Britain, Australia, India, Nova Scotia, New Zealand, British Columbia, Russia, and "other countries," and metric tons of 2,204 pounds for all continental countries of Europe, except Russia.

The world's production of coal.

Country.	Tons.	Country.	Tons.
Great Britain (1885)	159, 351, 361	New Zealand (1885)	480, 831
United States (1885)	95, 832, 705	India, Bengal (1884)	1, 200, 957
Germany and Luxemburg (1884)	72, 113, 820	Borneo (1884)	5, 866
France (1885)	19, 534, 341	Nova Scotia (1885)	1, 352, 205
Belgium (1885)	17, 346, 771	British Columbia (1885)	400, 000
Austria and Hungary (1884)	18, 000, 000	Japan (1884)	900, 000
Russia (1884)	3, 950, 000	Australia (1884)	2, 749, 109
Sweden (1884)	250, 000	Other countries (1884)	10, 000, 000
Spain (1884)	952, 950		
Italy (1884)	220, 000	Total	404, 640, 916

From this table it is seen that next to Great Britain the United States is the largest coal-producing country in the world; during 1885 its production was nearly one-fourth of the total reported above.

IMPORTS AND EXPORTS.

The following tables show the movement of coal during recent years, as reported by the custom houses. The values are those declared, and are of course much higher than the "spot" rates which have been used in computing the total annual value of the domestic production.

The tariff from 1824 to 1843 was 6 cents per bushel, or $1.68 per long ton; from 1843 to 1846, $1.75 per ton; 1846, 30 per cent. ad valorem; 1847 to 1861, 24 per cent. ad valorem; 1862 to 1864, $1 per ton; 1865, $1.10; 1866 to 1872, $1.25 per ton; since August, 1872, 75 cents per ton. During the period from June, 1854, to March, 1866, the reciprocity treaty was in force, and coal from the British possessions in North America was admitted into the United States duty free.

The imports are from Australia and British Columbia to San Francisco; from Great Britain to the Atlantic and Pacific coasts, and from Nova Scotia to Atlantic coast ports. The exports are mainly from the lake and Atlantic shipping ports to the Canadian provinces and to the West Indies.

Coal imported and entered for consumption in the United States, 1867 to 1885, inclusive.

Fiscal years ending June 30—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1867			509,802	$1,412,597
1868			394,021	1,250,513
1869			437,228	1,222,119
1870			415,729	1,103,965
1871	973	$4,177	430,508	1,121,914
1872	390	1,322	485,063	1,279,686
1873	2,221	10,764	460,028	1,548,208
1874	471	3,224	492,063	1,937,274
1875	138	963	436,714	1,791,601
1876	1,428	8,560	400,632	1,592,846
1877	630	2,220	495,816	1,782,941
1878	158	518	572,846	1,929,660
1879	488	721	486,501	1,716,209
1880	8	40	471,818	1,588,812
1881	1,207	2,628	652,963	1,988,199
1882	36	148	795,722	2,141,373
1883	507	1,172	645,924	2,013,555
1884	1,448	4,404	748,995	2,494,228
1885	4,976	15,848	768,477	2,548,432

Coal of domestic production exported from the United States, 1867 to 1885, inclusive.

Fiscal years ending June 30—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1867	192, 912	$1, 333, 457	92, 189	$512, 742
1868	192, 291	1, 082, 745	86, 367	433, 475
1869	283, 782	1, 553, 115	....	....
1870	121, 098	803, 135	106, 820	503, 223
1871	134, 571	805, 169	133, 380	564, 067
1872	259, 567	1, 375, 342	141, 311	586, 264
1873	342, 180	1, 827, 822	242, 453	1, 086, 253
1874	401, 912	2, 236, 084	361, 490	1, 587, 666
1875	316, 157	1, 791, 626	203, 189	828, 943
1876	337, 934	1, 869, 434	230, 144	850, 711
1877	418, 791	1, 891, 351	321, 665	1, 024, 711
1878	319, 477	1, 006, 843	340, 661	1, 352, 624
1879	386, 916	1, 427, 886	276, 000	891, 512
1880	392, 626	1, 362, 901	222, 634	695, 179
1881	462, 208	2, 091, 928	191, 038	739, 532
1882	553, 742	2, 589, 887	314, 320	1, 102, 898
1883	557, 813	2, 648, 033	463, 051	1, 593, 214
1884	649, 040	3, 053, 550	646, 265	1, 977, 959
1885	588, 461	2, 586, 421	683, 481	1, 989, 541

THE COAL FIELDS OF THE UNITED STATES.

ALABAMA.

Alabama during 1885 produced 2,225,000 tons of coal, an increase during the year of 225,000 tons, or a little over 11 per cent., while the increase during 1884 was over 40 per cent. This, however, is not to be taken as detrimental to the coal development, since the production of the Alabama fields is approaching more nearly every year to the demand of the market which will take the coal.

The development of the coal fields of this State has been phenomenal. In 1872 only 10,000 tons of coal were mined. The opening up of the Pratt seam in 1879, by the Pratt Coal and Coke Company, for steam, coke, and gas purposes, and the mining of the Helena seam for grate and domestic purposes, gave the trade a great impetus.

The Pratt mines alone are reported now to have an average daily output of 2,000 tons, which was the entire coal tonnage of the Louisville and Nashville railroad six years ago. It is thought by many that the opening up of the Warrior river and the deepening of Mobile harbor will lead to the further development of the Alabama coal trade.

The appended analyses will serve to show the character of some of the more important coal mines:

Analyses of Alabama coal.

	Pratt.	Williams.	Jaggers.	Lost Creek.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Volatile matter	31. 48	26. 18	29. 00	33. 79
Fixed carbon	61. 60	66. 02	56. 53	57. 00
Water	1. 50	1. 52	3. 09	2. 26
Ash	5. 42	6. 28	11. 38	6. 95
Totals	100. 00	100. 00	100. 00	100. 00
Sulphur	. 92	. 60	. 57	. 73

Production of coal in Alabama since 1873.

Years.	Long tons.	Years.	Long tons.
1873	40,000	1881	375,000
1874	45,000	1882	800,000
1875	60,000	1883	1,400,000
1876	100,000	1884	2,000,000
1877	175,000	1885	2,225,000
1878	200,000		
1879	200,000	Total for 13 years	7,960,000
1880	340,000		

ALASKA.

Coal has been found at several places in Alaska, but most of it is unfit for use for steam coal. At Kellesnoo, Admiralty island, there is a seam of coal which is thus described by the *Alaskan:* "The seam runs at an angle of about 45 degrees, and where the work was suspended in the tunnel there was in all, between the walls, five feet apart, about two feet of coal; the balance of the bed consists of bituminous shale, which will burn to a certain extent." The following analysis of the coal was made by Prof. C. F. Chandler:

Analysis of coal from Alaska.

	Per cent.
Water, at 100° C	3.74
Volatile combustible matter	37.02
Fixed carbon	45.15
Ash	14.09
Total	100.00
Coke	59.24

There was 0.72 per cent. of sulphur distributed between the last three constituents. The coke is powdery and not coherent. The ash is brown and white. Specific gravity of the coal, 1.45.

The surface croppings of seams, from an inch to a foot wide, are visible almost everywhere in the vicinity of the tunnel. From some horizontal seams several tons of good coal were taken. In one place, after going through the upper seam of coal a foot thick, and then through a few inches of sandstone, another seam of clear coal, a foot in thickness, was cut through and another layer of stone encountered which could not be penetrated owing to the inadequacy of the tools at hand. Another seam, some distance from the tunnel, showed ten inches in thickness on the face, which, at the depth of six feet, had increased to two feet in width.

ARIZONA.

The extensive coal beds on the San Carlos Indian reservation cannot be utilized under present circumstances, though the settlers are anxious to open and develop them. Coal is known to exist in many places in the Territory, but thus far no effort at systematic development has been made.

ARKANSAS.

No detailed facts have been obtained as to the amount of coal produced in Arkansas during 1885. The total production is variously estimated at from 150,000 to 175,000 tons. It is believed that the lower estimate is more nearly correct. The output of Sebastian county alone was estimated at 50,000 tons during 1885. The Little Rock and Fort Smith railroad company carried 45,583 tons.

The following are analyses of two prominent coals, the Ouita (No. 1) and Spadra (No. 2) respectively:

Analyses of coal from Arkansas.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Water	1.77	3.80
Volatile combustible matter	12.66	1.076
Fixed carbon	80.46	84.10
Ash	5.11	1.40
Sulphur	0.78	(*a*)

a Not determined.

These two coals, under the trade classification of the Pennsylvania anthracites, would be called anthracite coals.

CALIFORNIA.

There are quite a number of places in California where coal has been found in small quantities, and generally of an inferior character, but it is only at the Mount Diablo mines that any extended developments have been carried on. Moreover, the extensive mines of Oregon, Washington, and British Columbia can supply the market with a cheaper and better quality of coal, so that even the Mount Diablo mines are not worked to the same extent as formerly. Australian, English, and Scotch coals are brought in great quantities to San Francisco, by vessels seeking cargoes of wheat at that port, at a price of freight which admits of the coal being sold at a low price.

San Francisco received 899,301 tons of coal in 1883, of which the Mount Diablo mines produced 76,162 tons. Of the total, the Pacific coast produced 392,244 tons. Some of the coast collieries have increased their product materially, and the following statistics show the receipts of coal at San Francisco for the past three years:

Receipts of Pacific coast coal at San Francisco.

Mines.	Location.	1883.	1884.	1885.
		Short tons.	*Short tons.*	*Short tons.*
Mount Diablo	Mount Diablo, California	76,162	77,485	8,020
Seattle	Newcastle, Washington	139,600	125,000	75,112
Renton	do	20,476	32,412	21,206
Newport	Coos bay, Oregon	....	5,000	18,161
South Prairie	Tacoma, Washington	15,871	32,910	28,237
Carbon Hill	Carbon Hill, Washington	140,135	122,060	157,241
Green River	Washington	....	....	43,149
Cedar River	do	....	....	20,446

More or less of this coal goes direct by sea to Wilmington, the port of Los Angeles, Los Angeles county, California, and the arrivals at that port are included in the above figures.

The various sources from which California derived her coal supplies during the past three years are as follows:

Sources of California coal supply.

	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*
British Columbia (Wellington and Nanaimo)	128,503	291,546	224,298
Australia	174,143	190,497	206,751
English and Welsh	131,355	108,808	170,656
Scotch	21,942	21,143	20,228
Eastern States (Cumberland and anthracite)	43,861	38,124	29,834
Seattle	139,600	125,000	75,112
Carbon Hill	140,135	122,060	157,241
Green River, Cedar River, Mount Diablo	76,162	77,485	71,615
Renton, Newport, South Prairie	43,600	60,413	67,604
Total	899,301	1,035,076	1,023,339

The arrivals at Wilmington are included in the above figures.

The following table of prices from J. W. Harrison's circular will show the monthly fluctuations of foreign coals for "spot" cargoes at San Francisco. The average price is given for each month.

Average prices of coal in San Francisco in 1885.

	Australian.	English steam.	Scotch splint.	West Hartley.
January	$6.87½	$6.87½	$7.00	$8.00
February	6.75	6.00	6.50	7.50
March	6.50	6.00	6.50	7.50
April	6.62	6.00	6.50	7.50
May	6.75	6.50	6.75	8.00
June	6.62	6.50	6.75	7.75
July	6.50	6.37½	6.75	7.50
August	6.25	6.00	6.50	7.50
September	6.00	5.75	6.50	7.50
October	5.75	5.75	6.50	7.50
November	5.75	5.62	6.62½	7.50
December	5.87½	5.50	6.62½	7.50

The San Francisco *Journal of Commerce* gives the following table, showing the imports of foreign coal at San Francisco for twenty-one years:

Imports of foreign coal into San Francisco for twenty-one years.

Years.	British Columbia.		Great Britain.		Australia.		Chili.		Other countries.		Total.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1865	21, 937	$112, 962	10, 849	$45, 142	27, 682	$78, 499	647	$1, 300	1, 897	$10, 422	63, 012	$248, 325
1866	9, 066	46, 887	8, 220	34, 091	51, 551	144, 659	2, 200	9, 312	1, 048	5, 222	72, 085	240, 171
1867	14, 653	166, 793	4, 564	22, 391	25, 165	81, 773	11, 136	44, 440	5, 591	24, 197	61, 109	239, 594
1868	22, 790	123, 214	28, 859	94, 260	31, 701	89, 056	8, 213	34, 473	742	3, 348	92, 305	344, 351
1869	16, 779	97, 784	13, 446	38, 983	70, 319	159, 796			433	1, 607	100, 977	298, 170
1870	13, 979	84, 457	28, 673	79, 142	84, 251	182, 753	7, 350	34, 244	2, 612	21, 155	136, 865	401, 751
1871	16, 004	92, 093	55, 478	152, 013	38, 751	84, 125	4, 179	21, 972	345	998	114, 757	351, 201
1872	23, 574	133, 772	28, 059	131, 234	110, 111	255, 465	2, 644	10, 823	1, 826	12, 234	166, 214	543, 528
1873	32, 327	178, 504	57, 156	281, 715	91, 100	310, 401	400	2, 255	1, 519	10, 429	182, 502	783, 304
1874	62, 672	324, 362	46, 932	199, 447	107, 010	403, 860			1, 252	7, 950	217, 866	935, 619
1875	62, 110	326, 588	65, 932	228, 188	139, 164	522, 792			183	1, 138	267, 389	1, 078, 706
1876	101, 572	522, 555	116, 836	317, 927	129, 097	502, 102	3, 203	9, 799	696	3, 840	351, 404	1, 356, 223
1877	98, 842	456, 004	(a)76, 750	193, 214	92, 768	345, 943	7, 259	(b) 26, 731			(c)275, 619	1, 021, 892
1878	143, 241	607, 427	46, 722	120, 935	137, 684	517, 186			9	31	327, 656	1, 245, 579
1879	165, 102	643, 380	31, 911	74, 899	77, 522	318, 613					274, 535	1, 036, 892
1880	178, 334	638, 990	61, 779	103, 019	51, 137	195, 620					291, 250	937, 629
1881	153, 541	488, 641	267, 940	593, 298	125, 780	351, 373					547, 261	1, 433, 312
1882	144, 816	496, 692	163, 643	403, 881	165, 353	487, 905					473, 812	1, 388, 478
1883	117, 822	423, 831	155, 102	363, 676	150, 318	447, 407			6, 895	8, 655	430, 137	1, 243, 569
1884	254, 202	1, 039, 997	138, 295	322, 238	153, 192	457, 967			790	2, 611	546, 479	1, 822, 813
1885	217, 848	854, 799	182 998	476, 058	167, 567	413, 164					568, 413	1, 744, 021

a Exclusive of some cargoes arriving and not clearing, and some not entered. *b* Exclusive of some not entered. *c* Exclusive of several cargoes not entered.

2 M R

The prices of coal at San Francisco have been low during the past year. Several new collieries came into the field, but still foreign competition continued, and was greater than during the previous year.

The coal mines at Pinacate, San Diego county, are reported as having been lately sold to parties who are to open them. A 7-foot bed has been discovered, but little has been done.

Coal has also been found lately in the Santa Ana cañon. It is described as a 4-foot vein, and is on government land. It is said to have been known 20 years ago, and worked by Mexicans at that time, but afterwards abandoned. At this writing no developments have been made sufficient to determine the value of the bed.

There is a small production of the Amador and Placer county lignites, which is locally consumed, the average product being about the same as in 1884.

A coal seam, 4 miles from Elsinore, in San Diego county, has a tunnel 125 feet long, in the face of which is a bed from 4 to 7 feet thick. The quality of the coal is not good.

At Livermore, in Alameda county, a 4-foot vein of coal has been found, and is utilized to some extent locally, for domestic purposes.

A coal bed 18 miles west of Huron, Fresno county, is 4½ to 5 feet thick, and its product has been found good for domestic use. The coal has been mined and used locally for a long time.

COLORADO.

During 1885 only one new coal field was opened in Colorado, the Cimarron or Cutler; steps have been taken, however, to open the coking coals on Rock creek in Gunnison county. As a general rule the mining of coal in the State has been profitable, little loss having occurred from strikes, except at the Union Pacific mines in the northern part of the State. This loss has, however, been more than compensated for by the increased production of the Colorado Coal and Iron company. The strikes grew out of those at the Wyoming coal mines in September, and existed only at the Northup, Boulder Valley, and Welch mines. As a result of this strike the Union Coal company, which operated these mines, has now ceased mining coal in Boulder and Weld counties. The increased production of the Marshall mine more than that of any other mine was largely due to this strike, the output in November alone probably exceeding the total output in 1884.

No new mines were opened. The demand for coal did not increase beyond the assured capacity of the mines already in operation. Nothing of general interest here has occurred in the coal-mining districts, except the introduction of coal-cutting machines into the Marshall mines, which will have direct communication with Denver by the Denver, Marshall, and Boulder railway, now nearly completed.

A very thorough and complete study of western Colorado coals is being made by Mr. R. C. Hills, of Denver, and through his kindness some valuable notes and analyses of coals from northwestern Colorado have been obtained. The work on which Mr. Hills is engaged is not yet fully completed, and the next volume of the "Mineral Resources" will contain fuller notes on the subject. All the analyses of coal have been made from samples taken personally by Mr. Hills.

Analysis of anthracite coal from Union Pacific land west of Irwin, Colorado.

	Per cent.
Water	3.8
Volatile matter	3.9
Fixed carbon	87.7
Ash	4.6
Total	100.0

Bed 3 feet thick, dipping north 15° west. Specific gravity at 16° C., 1.526.

Analyses of anthracite coal from Thompson's bank, Colorado.

	East tunnel.	West tunnel.
	Per cent.	*Per cent.*
Water	1.3	1.8
Volatile matter	3.9	3.9
Fixed carbon	90.3	87.8
Ash	4.5	6.5
Totals	100.0	100.0
Specific gravity at 16° C	1.492	1.558

Analyses of anthracite coal from Thatcher's mine, Colorado.

	East tunnel.	West tunnel.
	Per cent.	*Per cent.*
Water	1.6	2.3
Volatile matter	3.3	3.5
Fixed carbon	90.6	87.7
Ash	4.5	6.5
Totals	100.0	100.0
Specific gravity at 16° C	1.468	1.587

The samples were taken from Thatcher's openings, about 1 mile east of Thompson's bank; bed in east tunnel 3 feet thick, dipping north 20° west. In the west tunnel the bed is 3½ feet thick, dipping north 15° west.]

From 15 to 20 miles north-northwest of this anthracite field occurs the Ragged Mountain anthracite district. Here openings have been made in two mines, the Black Diamond and Tuscarora.

In the Black Diamond, the bed is 5 feet thick, the coal benches being separated by from 1½ to 2 feet of shale, included in the bed.

Analyses of anthracite from the Ragged Mountain district, Colorado.

	Upper bench.	Lower bench.
	Per cent.	*Per cent.*
Water	1.9	2.1
Volatile matter	5.1	6.4
Fixed carbon	89.6	88.0
Ash	3.4	3.5
Total	100.0	100.0
Specific gravity at 16° C	1.379	1.389

In Tuscarora the bed of anthracite is about 6 feet thick, with 4 inches of shale in the center, and dips north fifty-four degrees west.

Analysis of anthracite from Tuscarora, Colorado.

	Per cent.
Water	2.0
Volatile matter	6.5
Fixed carbon	86.3
Ash	5.2
Total	100.0
Specific gravity at 16° C	1.362

No development has been made of the Ragged Mountain anthracite bed.

The coal fields on the Grand river produce a coking coal. The mine known as Wheeler's Old Bank is on the north fork of Thompson creek, and about 40 miles from Aspen. The bed is from 12 to 14 feet thick. The coal cokes well, but is too high in ash to be valuable. The mine has been abandoned.

Wheeler's New Bank is on Edgerton creek, about 4 miles distant from the old mine, and a little nearer Aspen. The bed is 5½ feet thick, and dips south forty degrees west. Analyses show:

Analyses of coal from Wheeler's banks, Colorado.

	New Bank.	Old Bank.
	Per cent.	*Per cent.*
Water	2.5	2.0
Volatile matter	37.9	29.4
Fixed carbon	57.0	48.2
Ash	2.6	20.4
Total	100.0	100.0

The coal cokes well, and five ovens are now in operation making coke for the smelter at Aspen. To the north of these fields coal beds are opened at numerous points. The following brief description of these beds, yet undeveloped, will suffice to show the character of the coal which they contain:

Analyses of coal from Four-Mile creek mine, near Glenwood springs.

	5-foot bed.	15-foot bed.
	Per cent.	*Per cent.*
Water	11.7	11.1
Volatile matter	31.4	33.5
Fixed carbon	53.5	51.2
Ash	3.4	4.2
Totals	100.0	100.0

South Cañon creek, near Glenwood springs, semi-coking coal, 12 *feet thick.*

	Top bench.	Middle bench.	Bottom bench.
	Per cent.	*Per cent.*	*Per cent.*
Water	5.4	5.1	4.7
Volatile matter	38.2	37.9	35.9
Fixed carbon	53.3	52.5	52.1
Ash	3.1	4.5	7.3
Totals	100.0	100.0	100.0

Grand river, at the north of Elk creek, 14-*foot seam, semi-coking coal.*

	No. 1.	No. 2.	No. 3.
	Per cent.	*Per cent.*	*Per cent.*
Water	10.1	2.4	2.4
Volatile matter	31.1	32.7	37.1
Fixed carbon	51.2	48.8	58.3
Ash	7.6	16.1	2.2
Totals	100.0	100.0	100.0

The first analysis does not fairly represent the coal, which had been ignited on the outcrop and was still burning partially in the end of the short tunnel from which the sample was taken. The second analysis below the above seam is from a bed which is 5½ feet thick. The coal is bright, lustrous, quite brittle, and semi-coking.

Lower still there is a 5-foot seam of dirty coal. Below this occurs a 4-foot bed of semi-coking coal, the composition of which is shown in the third analysis.

On Highland pass, between Elk and Rifle creeks, there is a 12-foot seam of semi-coking coal. Its composition is—

	Per cent.
Water	4.7
Volatile matter	36.8
Fixed carbon	54.4
Ash	4.1
Total	100.0

There are four workable coal beds outcropping at Highland pass. The dip of the bed is 50° west. On White river, near Meeker, there are several seams of good coal.

The following are typical analyses:

	12-foot seam.		6-foot seam.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Water	7.3	7.0	7.0	6.8
Volatile matter	38.8	36.0	39.0	38.7
Fixed carbon	50.2	50.0	48.0	48.5
Ash	3.7	7.0	6.0	6.0
Total	100.0	100.0	100.0	100.0

The 12-foot seam was formerly worked for the use of the White river Indian agency at Meeker.

Near Bear river, on Sage creek, there is an outcrop of a 10-foot seam, showing a lustrous and brittle coal, dipping 40° west and containing—

	Per cent.
Water	6.5
Volatile matter	39.5
Fixed carbon	50.5
Ash	3.5
Total	100.0

In the Little Book cliffs, north of Grand Junction, two seams of coal occur, the upper of which is 10 feet thick and the lower 7 feet. They have been opened only to a small extent, and produce a semi-coking coal, analyses of which show—

	Upper seam.	Lower seam.
	Per cent.	*Per cent.*
Water	8.2	5.7
Volatile matter	34.3	36.3
Fixed carbon	53.5	46.5
Ash	4.0	11.5
Total	100.0	100.0

The sulphur in none of these coals has yet been tested.

The principal coal mines of Colorado are owned or controlled by the railway companies in the State. The companies operating on the largest scale, and the corporate names under which they transact their mining operations, are the following: Denver and Rio Grande Railway, Colorado Coal and Iron Company; Union Pacific Railway, Union Coal Company; Burlington and Missouri River Railroad, Colorado Fuel Company; Atchison, Topeka and Santa Fé Railroad, Cañon City and Trinidad Coal and Coking Companies; Denver and New Orleans Railroad, New Orleans Coal Mining Company; Denver, Utah and Pacific Railroad, Mitchell

Coal Mining Company. Of these the largest is the Colorado Coal and Iron Company, which has its headquarters at South Pueblo, and controls mines in Fremont, Las Animas, Huerfano, and Gunnison counties. It owns all the important coking-coal beds as far as opened in the State, except that of the Trinidad Coal and Coking Company, and those in Garfield county, now operated on a limited scale.

The production of coal by this company is shown by the following table:

Production of coal by the Colorado Coal and Iron Company.

Years.	Short tons.	Years.	Short tons.
1873	12,187	1880	221,378
1874	18,092	1881	350,944
1875	15,278	1882	511,239
1876	20,816	1883	602,396
1877	44,410	1884	450,808
1878	82,140	1885	562,660
1879	120,102		

The greater portion of this coal is consumed by the Rio Grande railway; the rest is used by the company's steel works for making coke, or is sold.

Statement showing the production of the company's mines in 1885.

Name and location.	Short tons.
Coal Creek Mine, Fremont county	104,033
Oak Creek, Fremont county	25,066
El Moro, Las Animas county	264,206
Walsen Mine, Huerfano county	89,441
Crested Butte Mine, Gunnison county	79,914
Total	562,660

The Union Coal company embraces the mines owned by the Union Pacific Railway company. This company owns mines mainly in northern Colorado, and the greater part of its production is consumed by the railway for fuel. The principal mines and their production in 1885 were as follows:

Production of the Union Coal Company's mines in 1885.

Name and location of mine.	Short tons.
Boulder Valley, Weld county	732
Welch, Boulder county	33,646
Como, Park county	43,752
Baldwin, Gunnison county	14,175
Total	92,305

Product of other mines owned by railways in Colorado in 1885:

	Short tons.
Burlington and Missouri railroad (Anthracite Mesa coal), Gunnison county	26,020
Atchison, Topeka and Santa Fé railway:	
Cañon City Coal and Coke company, Fremont county	169,023
Trinidad Coal and Coke company, Las Animas county	189,525
Denver, Texas and Gulf railroad, Franceville mine, El Paso county	39,038
Denver, Utah and Pacific railroad, Mitchell mine, Weld county	28,413
The total product of mines operated for the benefit of railways in Colorado in 1885 was	1,106,984

In the Central division, all the mines show a decrease of production in 1885, except those near Cañon City, where the output was twice as great as in 1884.

The mines of Fremont county have been worked to a larger extent than heretofore, and show an increased production; the output in 1885 having been more than twice as great as in 1884. The coal is a favorite for domestic use throughout the State. The new mines here, the Thornton and Caldwell, are assuming importance as producers.

In the Southern field there has been considerable increase at El Moro, Starkville, and Walsenburg.

In the northwestern section there has also been a fair increase, the product of the Colorado Coal and Iron Company's mine being enlarged to meet the growing demand from Utah and Nevada smelters for the coke made from this coal.

The Jerome Park mine, in Pitkin county, appears as a producer of importance; 4,500 tons of coking coal having been mined here, all of which was made into coke for the use of the Aspen Smelting company at Aspen.

Coal production of Colorado from 1864 *to* 1885.

Years.	Localities.	Short tons.	
1864	Jefferson and Boulder counties		500
1865	do		1,200
1866	do		6,400
1867	do		17,000
1868	do		10,500
1869	do		8,000
1870	do		13,500
1871	do		15,860
1872	do	14,200	
	Weld county	54,340	
			68,540
1873	Jefferson and Boulder counties	14,000	
	Weld county	43,790	
	Las Animas and Fremont counties	12,187	
			69,977
1874	Jefferson and Boulder counties	15,000	
	Weld county	44,280	
	Las Animas and Fremont counties	18,092	
			77,372
1875	Jefferson and Boulder counties	23,700	
	Weld county	59,860	
	Las Animas and Fremont counties	15,278	
			98,838
1876	Jefferson and Boulder counties	28,750	
	Weld county	68,600	
	Las Animas and Fremont counties	20,316	
			117,666
1877			160,000
1878	Northern division	87,825	
	Central division	73,137	
	Southern division	39,668	
			200,630
1879	Northern division	182,630	
	Central division	70,647	
	Southern division	69,455	
			322,732
1880	Northern division	123,518	
	Central division	136,020	
	Southern division	126,403	
	Northwestern division	1,064	
	Unreported mines	50,000	
			437,005
1881	Northern division	156,126	
	Central division	174,882	

Coal production of Colorado from 1864 *to* 1885—Continued.

Years.	Localities.	Short tons.	
1881	Southern division	269,045	
	Northwestern division	6,691	
	Unreported mines	100,000	
			706,744
1882	Northern division	300,000	
	Central division	243,694	
	Southern division	474,285	
	Northwestern division	43,500	
			1,061,479
1883	Northern division:		
	Mines near Erie and Canfield	80,165	
	Louisville	97,138	
	Langford	45,500	
	Golden	21,100	
			243,903
	Central division:		
	Mines near Sedalia	1,500	
	Franceville	54,416	
	Como	60,140	
	Cañon City	280,345	
			396,401
	Southern division:		
	Mines near Trinidad and El Moro	400,929	
	Walsenburg	87,689	
	Durango and Rico	12,689	
			501,307
	Northwestern division:		
	Mines near Crested Butte		87,982
	Total, 1883		1,229,593
1884	Northern division	253,282	
	Central division	296,188	
	Southern division	483,865	
	Northwestern division	96,689	
			1,130,024
1885	Northern division:		
	Mines near Erie and Canfield	111,089	
	Louisville	33,646	
	Langford	75,392	
	Golden	22,719	
			242,846
	Central division:		
	Mines near Sedalia	1,500	
	Franceville	44,083	
	Como	43,752	
	Cañon City	327,038	
			416,373
	Southern division:		
	Mines near Trinidad and El Moro	463,731	
	Walsenburg	89,441	
	Durango	15,147	
	La Veta	125	
	Rico	3,240	
			571,684
	Northwestern division:		
	Mines near Crested Butte	79,914	
	Baldwin	14,175	
	Keubler	250	
	Wheeler's	4,500	
	Four Mile	300	
	Anthracite coal	26,020	
			125,159
	Total 1885		1,356,062

The statement shows a very gratifying increase of 226,238 tons over the product in 1884, or about 16 per cent. The increasing railway and manufacturing developments of the State will call yet more heavily upon the coal mines in future, and it seems not improbable that the now unavailable deposits in northwestern Colorado, particularly in Garfield county, will show a large product within a year.

The number of miners employed in coal mines was about 2,200. Prices paid for coal mining vary from 60 cents to $1.25 per ton. The value of the coal product in 1885 may be averaged at about $2.25 per ton at the mines, a total of $3,051,589 for 1885. There are about fifty producing coal mines now in operation in Colorado.

DAKOTA.

Western Dakota shows the rocks of the Laramie formation over a vast extent of country, and a large portion of this Territory is probably underlaid by seams of coal of varying thickness and quality, but similar to those of the eastern coal field of Montana. As in all the northwestern Territories, lack of surveys render all estimates of the area underlaid by coal worthless. In 1874 the government land office estimated the coal area at 100,000 square miles, but investigations have shown that this estimate is much too great, and the probability is that only a comparatively small area is underlaid by coal beds. Although some coal deposits are known to occur north of the Black Hills and elsewhere, the development of coal beds has been confined thus far to two localities, Sims and Little Missouri, where the Northern Pacific Coal company has opened mines. The Little Missouri mine is near the western boundary of the Territory, on the line of the Northern Pacific railroad. The coal produced here is a poor lignite. The coal has been superseded entirely for use on locomotives by the greatly superior coals found elsewhere on the Northern Pacific, notably at Bozeman, Montana. Reports of coal discoveries in this Territory continue to be made, and it is reported that there is coal in 4-foot seams, equal to Illinois soft coal, in the country around the headwaters of the Morean river, and between the Morean and Grand rivers. No practical business has been carried on to any extent. A total of 26,000 tons is credited for the year 1885 against about 35,000 tons for the preceding year; the decrease being accounted for by the fact that better coal can be had in Montana, while the supply from Duluth of first-class coal at low prices is considerable.

GEORGIA.

No reliable statistics have been gathered of the amount of coal mined in the northwestern part of the State. It is currently reported that the annual production for both 1884 and 1885 was 200,000 tons. It is believed that upon a conservative estimate the coal production during 1885 did not exceed 150,000 short tons.

IDAHO.

There is some coal on Thompson Fork, in eastern Idaho, and at Cokeville, near the Wyoming line. The coal output of the Territory in 1885 did not exceed 1,000 short tons.

ILLINOIS.

The statistics of coal in Illinois for 1885 have been fully reported by Mr. John S. Lord, secretary of the State Bureau of Labor Statistics, as follows:

Coal statistics of Illinois.

Number of counties producing coal	49
Number of mines and openings of all kinds	786
Number of employés of all kinds	25,446
Number of short tons of coal mined	9,791,874
Aggregate value of the same at the mines	$11,456,493
Average value per ton at the mines	$1.17
Average number of days of active operations	225
Average price per ton paid for mining	$0.725
Number of kegs of powder used	140,382
Number of men killed	39
Number of men injured so as to lose time	176
Number of tons mined for each life lost	251,073
Number of employés for each life lost	652

These summaries present some noteworthy differences and contrasts with the results obtained in former years. The number of mines and openings of all kinds reported this year is considerably larger than before, which is due in part to the opening of new coal, but probably more to the fact that the territory in the several districts is receiving more careful scrutiny each year, and certain small mines in remote regions are thus being brought to light. There are forty-six more openings reported this year than last, though during the year nine mines have for various reasons been closed and abandoned. This makes the total number of active openings seven hundred and seventy-eight, or an increase of thirty-seven over the aggregate of last year. Of this total of so-called mines, nineteen are "strippings," or places where the coal lies so near the surface that the soil can be profitably removed, uncovering the seam, so that it can be quarried like stone.

An analysis of the mines of this State, based upon the relative amount of their output, shows in general not only the proportion of small to large mines, but also the classes which have increased in numbers. The following tabulation presents a grouping of the mines for the last three years:

Years.	Mines producing less than 1,000 tons.	Mines producing from 1,000 to 10,000 tons.	Mines producing from 10,000 to 50,000 tons.	Mines producing over 50,000 tons.	Total.
	Number.	*Number.*	*Number.*	*Number.*	*Number.*
1883	209	233	135	62	639
1884	262	273	146	60	741
1885	286	290	139	63	778

From this it is seen, that the increase in numbers is wholly among the smaller mines, or at least among the mines which have produced during the past year less than 10,000 tons.

Production and prices in Illinois.—Notwithstanding the increase in the number of mines given, the total output of the State has been somewhat less than in either of the two years immediately preceding. The total tonnage of 1884 was 10,101,005; in 1885 it was 9,791,874, a difference of 309,131 tons. This falling off in product is traceable to the third and fourth districts, the output of the other districts being substantially the same as last year. In these two districts occurred the longest strike of the greatest number of men reported for the year. The Ellsworth Coal company has twelve collieries, six in Macoupin county, and two recently acquired in Madison county, in the fourth district, and four in the vicinity of Danville, in the third district. In the first group there was a suspension of over three months, and in the last of four months. In Macoupin county the strike extended to some neighboring mines also, and the number of men involved was about 1,375, which, added to 325 in the Danville district, makes a total of 1,700 men who were idle for over three months. We find the total shrinkage of product in the field covered by this strike, as shown by the reports of the two years, to be 317,458 tons. But prior to this strike the amount of coal mined had been greater than in former years, owing to an enlargement of the capacity of some of the lately acquired property of the Ellsworth company, so that the real disparity is not so great as would otherwise have appeared.

The subjoined table shows the record of the State as a producer of coal for the last five years in comparison with the output of 1870 as shown by the United States Census Report of that year:

Year.	First district.	Second district.	Third district.	Fourth district.	Fifth district.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1870						2,624,163
1880	1,631,440	696,046	1,185,189	1,022,718	1,579,984	6,115,377
1882	2,540,532	710,526	1,350,020	2,075,244	2,412,321	9,088,643
1883	2,495,072	831,522	1,585,108	3,128,368	1,990,921	10,030,991
1884	2,507,370	728,341	1,932,881	2,804,183	2,128,230	10,101,005
1885	2,519,397	723,077	1,811,405	2,615,992	2,122,003	9,791,874

Average value of coal per short ton at the mines in Illinois.

Districts.	1882.	1883.	1884.	1885.	Percentage decline.
First	$1 75	$1 59	$1 49	$1 41	19
Second	1 87	1 97	1 79	1 71	9
Third	1 43	1 45	1 31	1 25	12
Fourth	1 33	1 32	1 09	98.5	26
Fifth	1 31	1 26	96.1	89.4	32
The State	1 51	1 48	1 26	1 17	22

This shows a decline since 1882 in the average market value of coal in Illinois from $1.51 to $1.17 per ton, or about 22 per cent.

INDIANA.

The following is compiled principally from data collected by Mr. Thomas McQuade, mine inspector. There are 96 mines in the State that employ 10 men or more, the total number of all coal mines being estimated as 215.

The 96 mines are distributed in the counties of the State as follows: Clay, 27; Davies, 10; Dubois, 2; Fountain, 7; Greene, 2; Knox, 2; Pike, 4; Sullivan, 7; Vigo, 8; Vermillion, 3; Vanderburgh, 5; and Warrick, 7.

Of these, 58 mines produce bituminous coal, 26 block, 10 semi-block, and 2 bituminous and cannel combined. Out of the 27 mines in Clay county, 23 produce block coal.

Annual production of coal in Indiana for 13 years.

Years.	Short tons.	Years.	Short tons.
1873	1,000,000	1880	1,500,000
1874	812,000	1881	1,771,536
1875	800,000	1882	1,976,470
1876	950,000	1883	2,560,000
1877	1,000,000	1884	2,260,000
1878	1,000,000	1885	2,375,000
1879	1,196,490		

During 1885 there were less strikes among the miners than during 1884, so that the production for 1885 was 115,000 greater than for 1884, although 185,000 tons less than for 1883.

The amount of capital employed is estimated at $1,850,000. This is $100,000 more than for any former year. This can be accounted for by the number of improvements and new coal openings made during 1885. Of 32 accidents during the year, 7 were fatal. Of all, two-thirds resulted from roof falls.

INDIAN TERRITORY.

The total production of coal in the Territory for 1885 was about 500,000 tons, which would cover the coal shipped and that sold locally.

The Osage Coal Mining company mined and shipped from McAlister 199,882 tons, and the Atoka company mined and shipped from Savannah and Lehigh 250,000 tons.

IOWA.

The following table, compiled by Mr. Park C. Wilson, State mine inspector, contains the number of tons produced in each county for 5 years. In several instances the mines have not reported their total output:

Name of county.	1881.	1882.	1883.	1884.	1885.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Mahaska	917, 495	701, 397	927, 387	932, 714	762, 785
Keokuk	463, 010	511, 849	500, 040	430, 940	372, 816
Lucas	458, 274	413, 217	487, 821	410, 729	439, 956
Polk	473, 893	327, 819	558, 821	619, 921	462, 895
Boone	337, 724	286, 891	466, 981	473, 073	458, 191
Webster	184, 300	218, 478	248, 560	214, 014	145, 296
Wapello	131, 815	207, 721	237, 821	240, 720	187, 911
Appanoose	107, 348	97, 976	128, 896	158, 986	245, 896
Monroe	98, 143	90, 325	93, 435	98, 427	101, 517
Marion	93, 997	90, 927	90, 985	97, 085	100, 011
Greene	81, 530	62, 531	88, 851	96, 327	89, 587
Jasper	42, 435	40, 189	45, 883	46, 321	90, 425
Dallas	47, 884	36, 201	38, 008	37, 185	32, 986
Jefferson	39, 124	22, 121	38, 887	8, 172	1, 116
Warren	12, 987	11, 081	12, 828	13, 727	12, 825
Scott	3, 804	3, 711	3, 714	3, 821	5, 937
Hardin	1, 317	1, 125	1, 203	1, 075	885
Adams	3, 708	1, 691	3, 891	3, 981	3, 896
Hamilton	1, 787	871	1, 998	1, 878	918
Wayne	77	51	1, 892	4, 947	25, 812
Van Buren	98	216	1, 678	1, 778	1, 193
Davis	489	301	527	1, 207	33, 655
Page	685	118	748	1, 009	1, 819
Taylor	78	84	94	127	617
Henry	67	65	65	87	196
Cass	36	41	43	....	....
Guthrie	....	....	....	5, 187	4, 596
Total	3, 500, 765	3, 126, 997	3, 981, 057	3, 903, 438	3, 579, 737

For the year 1885 returns were made from 417 mines, leaving 72 mines not reported.

It will be noticed that the output for 1885 is 317,701 tons less than for 1884. This deficiency is attributed to several causes, one of which was the protracted strike at What Cheer, in Keokuk county, and at Angus, in Boone county; another cause is the increasing competition of the Illinois coal. The operators in the latter State have reduced the cost of mining to 40 cents per ton as against 75 cents to $1 per ton in Iowa.

KANSAS.

The State mine inspector, Mr. John R. Braidwood, has reported full statistics of coal mining in Kansas for 1885. The coal mines produced 25,931,851 bushels (1,037,274 short tons), and the stripped banks 4,370,576 bushels (174,823 short tons), an aggregate of 30,302,427 bushels (1,212,097 short tons), or 2,802,427 bushels (112,097 short tons) more than were produced in 1884.

The following table exhibits the production of the coal mines in each county of the State, together with the value of the coal at the mines, and the amount of capital invested:

Coal production of Kansas.

Name of county.	Number of bushels mined.	Value of product.	Capital invested.
Crawford	3,832,717	$145,873.21	$332,100
Cherokee	9,260,681	344,116.61	481,300
Osage	8,460,711	490,171.22	183,000
Shawnee	95,600	9,082.00	4,200
Coffey	11,582	1,042.38	1,800
Franklin	344,952	23,165.48	17,700
Douglas	20,000	1,700.00	1,500
Cloud	102,948	7,721.10	2,650
Republic	60,785	4,558.88	3,650
Ellsworth	82,708	7,089.47	3,500
Lincoln	69,365	6,687.17	4,100
Russell	3,500	310.00	700
Neosho	191,500	14,362.50	1,600
Linn	113,911	6,030.55	10,000
Leavenworth	3,014,024	120,560.96	375,000
Bourbon	66,867	4,179.19	8,150
Labette	200,000	14,000.00	....
Total	25,931,851	1,200,650.72	1,430,950

This production would represent about 1,037,314 short tons.

The amount of stripped coal produced in the different counties is shown in the following table:

Counties.	Total number of bushels of coal mined in each county.	Cost price per bushel for putting coal on board cars.	Total value of the product at the cost price, ready for shipment.
	Bushels.	*Cents per bushel.*	*Value.*
Labette	200,000	7	$14,000.00
Crawford	1,760,816	5½	96,844.88
Cherokee	37,574	6	2,254.44
Linn	25,000	6½	1,625.00
Bourbon	311,000	7	21,770.00
Coffey	215,100	8½	18,283.00
Osage	803,086	7¼	58,223.73
Franklin	18,000	7½	1,350.00
All other coal mined in the State, in 1885, estimated	1,000,000	7	70,000.00
Total	4,370,576	....	284,351.05

To strip and get out ready for market the above amount of coal, will give employment to 856 head of horses, at 50 cents per head per day, and 856 men, at $1.50 per day each, for 166 days out of the year. The largest amount of stripped coal mined in the year is in the winter season—in the months of October, November, December, January, February, and March. This work is done largely by the surrounding farmers of the neighborhood where the coal is mined. It is a valuable help, and almost a clear gain to them, as they and their horses would evidently be idle pretty much all this time of the year if they did not get this work to do. There are some men who follow stripping as a trade.

For each of the twelve months of 1885 there were 3,597 miners and 578 laborers employed about the mines, an increase over 1884 of 951 miners and 290 laborers.

Since January, 1884, a great many small mines have been abandoned, which makes the number much less to-day than it was then. In the beginning of 1884 there were 273 mines in the State; in January, 1886, there were a little less than 200. Although the number has fallen off the quality and production have increased. The business is becoming more concentrated, and the mines are worked in a more systematic way. They are handled by more capital. Their capacity is being increased, so that about 200 mines to-day can produce more and better coal than 273 could two years ago.

KENTUCKY.

The output of the Kentucky mines for 1885 is estimated at 1,700,000 long tons. This includes all coal shipped to outside markets, and that consumed locally in the vicinity of the mines.

For 1884 Mr. C. J. Norwood reported the output from the three distinct fields, as follows:

	Long tons.
Western coal field	875, 593
Southeastern coal field	384, 031
Northeastern coal field	278, 630
Total	1, 538, 254

The estimate published in the "Mineral Resources" for 1884 gave the total production as 1,550,000 tons. This would cover the tonnage reported by Mr. Norwood and additional local sales. The following table is a detailed report for the last four years, of the production of the mines along the principal transportation routes in the western coal field:

	1882.	1883.	1884.	1885.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Henderson division of Louisville and Nashville railroad	269, 600	364, 360	340, 887	357, 745
Chesapeake and Ohio and Southwestern railroads	274, 700	324, 552	292, 071	282, 660
Green river	96, 000	108, 000	118, 000	78, 000
Ohio river below Green river	60, 000	72, 500	62, 000	75, 000
Ohio river above Green river	60, 000	76, 000	66, 000	....
Total	760, 300	945, 412	878, 958	793, 405

The decrease in the output on the Ohio and Green rivers has been accounted for by the consumption of Pittsburgh nut and slack coal. These two coals have been thrown on the market by the use of natural gas in the vicinity of that city. Slack coal carried 42 miles sold at 60 cents per ton, and nut coal carried 70 miles, loaded on barges alongside of steamboats, sold at $1.43 per ton.

The yearly production for the past thirteen years has been as follows:

Production of coal in Kentucky.

Years.	Long tons.	Years.	Long tons.
1873	300, 000	1880	1, 000, 000
1874	360, 000	1881	1, 100, 000
1875	500, 000	1882	1, 300, 000
1876	650, 000	1883	1, 650, 000
1877	850, 000	1884	1, 550, 000
1878	900, 000	1885	1, 700, 000
1879	1, 000, 000		
		Total since 1872	12, 860, 000

MARYLAND.

The Cumberland (George's Creek) region constitutes the producing coal field of the State. During 1885 it produced 2,865,974 long tons. The production since 1873, as represented by the shipments over the Baltimore and Ohio, the Chesapeake and Ohio, and the Pennsylvania State Line branch is shown in the following table:

Coal shipments from Maryland.

Years.	Baltimore and Ohio.	Chesapeake and Ohio.	Pennsylvania State Line.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
1873	1,780,710	778,802	114,589	2,674,101
1874	1,576,160	767,064	67,671	2,410,895
1875	1,302,237	879,838	160,698	2,342,773
1876	1,070,775	632,440	131,866	1,835,081
1877	818,450	584,996	170,884	1,574,330
1878	924,254	609,204	145,864	1,679,322
1879	1,075,198	501,247	154,264	1,730,709
1880	1,319,589	603,125	213,446	2,136,160
1881	1,478,502	504,818	278,598	2,261,918
1882	1,085,249	269,782	185,435	1,540,466
1883	1,434,766	680,119	419,288	2,544,173
1884	2,233,928	344,954	356,097	2,934,979
1885	2,076,485	368,744	420,745	2,865,974

The production by the different companies in the region for the last three years has been as follows:

Coal production in Maryland.

Companies.	1883.	1884.	1885.
	Long tons.	*Long tons.*	*Long tons.*
Consolidation Coal company	456,238	689,212	710,064
New Central Coal company	210,850	210,140	203,814
George's Creek Coal and Iron company	257,490	266,042	257,343
Maryland Union Coal company	137,105	117,180	98,095
Borden Mining company	151,665	162,057	179,537
Maryland Coal company	235,854	295,736	365,319
American Coal company	190,055	194,330	220,339
Potomac Coal company	139,723	169,463	196,280
Hampshire and Baltimore Coal company	194,534	36,416	....
Atlantic and George's Creek Coal company	69,000	75,467	64,938
Swanton Mining company	34,905	28,620	52,862
Blæn Avon Coal company	84,721	100,961	69,192
West Virginia Central and Pittsburgh Railroad company	262,874	382,508	269,883
Piedmont Coal and Iron company	4,619	1,250	32
Union Mining company	5,024	5,310	5,641
Big Vein Coal company	70,430	83,170	66,326
National Coal	38,998	42,680	48,307
Davis mines	....	74,437	58,002
Totals	2,544,085	2,934,979	2,865,974

The following are the average prices for Cumberland coal at Baltimore for the past fourteen years:

Prices of Cumberland coal.

Years.	Prices.	Years.	Prices.
1872	$4.52	1879	$2.75
1873	4.83	1880	3.75
1874	4.70	1881	3.75
1875	4.35	1882	3.50
1876	3.87	1883	2.90
1877	3.15	1884	2.40
1878	2.86	1885	2.25

The low price for 1885 resulted from competition with the Clearfield, Beech Creek (Pennsylvania) coals, and the New River and Pocahontas (Virginia and West Virginia) coals.

The prevailing miners' wages in the Cumberland region since 1856 have been as follows:

Wages of Cumberland coal miners, per ton.

1856—January to May, 1862, 30 cents.

1862—In June advanced to 40 cents, and in September to 45 cents.

1863—January to March, 1864, 50 cents.

1864—In April advanced to 60 cents, and in June to 75 cents.

1864—September to May, 1865, $1.

1865—In June reduced to 75 cents, at which it continued to May, 1866.

1866—May, reduced to 65 cents.

1877—In January reduced to 50 cents; advanced in August to 55 cents.

1878—March, 40 cents, at which it continued until October 15, 1879.

1879—October, 50 cents, at which rate it continued till February, 1880.

1880—February, advanced to 65 cents, at which rate it continued till March 15, 1882. Then strike until August 24.

1882—August 24, 50 cents, until November 15, 1884.

1884—November 15, 40 cents, at which it continues.

The following analyses will show the general character of the coal from this region:

	George's Creek, analyzed by Prof. A. S. McCreath.		Hampshire Consolidation.	
Water	1.23	1.11	....	1.01
Volatile matter	15.47	15.30	12.30	13.92
Fixed carbon	73.51	73.28	79.50	81.96
Sulphur	.70	1.23	.80	....
Ash	9.09	9.08	7.40	3.11
	100.00	100.00	100.00	100.00

MICHIGAN.

Mr. Charles D. Lawton, commissioner of mineral statistics for the State, reports that the coal-mining business in Michigan does not make much of a showing. Some of the larger producing mines at Jackson have been worked out and abandoned within the last two years, and there has been but little inducement to push the matter of opening new mines. The price of coal has been too low of late.

It is impossible for the Michigan coal mines, working a thin seam of coal, 2 feet to 3½ feet thick, and contending against a great influx of water, to compete with the Ohio coal mines, which are comparatively dry, and which are worked in beds that are 6 to 8 feet thick.

The Ohio coal is sold in Detroit at $1.80 per ton, a price which it is difficult for a Michigan mine to compete with successfully.

The Michigan coal deposits seem to lie in shallow basins, sometimes so near the surface as to be directly beneath the drift, and thus to be so situated as to preclude the possibility of working, from the fact that there is no roof (overlying rock) sufficient to support the soil, etc., above. Beds of coal situated in this manner have been opened in several places and have been abandoned for this reason.

The most important of the coal mines at Jackson—the Slope mine, Eureka mine, and the Michigan mine—have been wholly idle during the past two years. It is supposed that the coal has all been taken out; this is especially the case of the Slope.

The following table, showing the product of the Michigan coal mines for the years indicated, is taken from Mr. Charles D. Lawton's report:

Production of coal in Michigan.

	Years previous to 1877.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Williamston mine	......	......	......	......	......	......	10, 454	884	......	......
Jackson mine	......	67, 697	61, 785	65, 000	......	......	......	......	......	......
Corunna Coal company	......	......	22, 537	16, 215	12, 252	7, 000	8, 624	9, 000	8, 000	10, 000
Other mines	......	1, 500	1, 000	800	......	......	......	......	......	......
Jackson Coal company	......	......	......	......	66, 780	61, 666	60, 103	40, 412	13, 712	15, 553
Eureka Coal company	......	......	......	......	30, 000	37, 477	25, 000	......	......	......
Michigan Coal company	......	......	......	......	20, 021	23, 987	25, 000	......	..	..
Porter Coal company	......	......	......	......	......	......	6, 158	21, 000	15, 000	13, 000
Star Coal company	......	......	......	......	......	......	......	......	......	5, 125
Standard Coal company	......	......	......	......	......	......	......	......	......	1, 500
Total	350, 000	69, 197	85, 322	82, 015	129, 053	130, 130	135, 339	71, 296	36, 712	45, 178

MISSOURI.

The lower coal measures in Missouri, according to Prof. G. C. Brodhead, are about 300 feet thick and are composed chiefly of sandstones and shales with a few limestone beds, and include eight or nine beds of coal, of which five are workable, with an aggregate of at least thirteen and a half feet of coal. The middle and lower coal measures are exposed over an area of about 15,000 square miles, the lower measure coming to the surface on the greater part of this area. We know that under 8,000 square miles coal may be practically considered near the surface, and under that area most of the best coals may be reached at a depth less than 200 feet, and therefore the cost of obtaining such coals is trifling, for coals at a depth of 200 feet can be worked almost as cheaply as those nearer the surface. Good coal of workable thickness has been and is mined in the counties of Barton, Vernon, Cedar, Saint Clair, Bates, Henry, Johnson, Pettis, Saline, Cooper, La Fayette, Ray, Carroll, Chariton, Howard, Boone, Callaway, Monroe, Randolph, Macon, Adair, Putnam, Schuyler, and Sullivan. In other counties adjoining these there are coal beds worked with some profit, but they are not so thick, and cannot be mined so economically.

During 1885 there were 2,750,000 long tons of coal mined in this State, of which the Keith and Perry Coal company, of Rich Hill, shipped 172,601 tons and the mines at Carbon Centre produced 198,000 tons. The following table shows the production of the mines of the State since 1873:

Coal production of Missouri.

Years.	Long tons.	Years.	Long tons.
1873	700,000	1881	1,750,000
1874	714,000	1882	2,000,000
1875	750,000	1883	2,250,000
1876	900,000	1884	2,500,000
1877	900,000	1885	2,750,000
1878	900,000		
1879	900,000	Total	18,514,000
1880	1,500,000		

MONTANA.

No new coal field was opened in Montana during 1885. The mines at Lignite, on the Yellowstone, worked in former years, have been permanently closed, the quality of the coal being too inferior for use on the locomotives of the Northern Pacific railway.

The loss in the production of the Lignite mines has been compensated for by an increased production at the Timberline mines, between Bozeman and Livingstone.

As stated on page 52 of the "Mineral Resources" for 1883 and 1884, much of the Territory is underlaid by a very inferior lignite or brown coal, containing an excessive proportion of water and ash, but a small proportion of which is of full value.

To the explored fields named in previous reports, there must now be added the Medicine Lodge field, covering about six square miles. The only coal mining district which has as yet obtained any importance as a producer is the Bozeman, six to eight miles east of the town of Bozeman. The principal mines here are the Timberline, owned by the Northern Pacific Coal company; the Bozeman and Maxey, owned by the Union Pacific, and the Trail Creek, owned by private parties. The Timberline mine has been partially described. Here eight coal seams have been explored which vary in thickness and are badly faulted. The dip ranges from 30° to 60°. The Bonanza seam is alone considered workable. It is a clean, hard bed four feet thick. A recent analysis made by the Northern Pacific Coal company shows:

Analysis of coal from the Bonanza seam.

	Per cent.
Water	2.19
Volatile matter	21.51
Fixed carbon	69.67
Ash	6.63
Total	100.00

This coal makes a good coke, but must be washed before coking, since the raw coal produces a coke containing 20 per cent. of ash. When the coal is washed the coke contains about 12 per cent. of ash.

The Timberline mine was opened in January, 1883. The production has been as follows:

Production of coal in the Timberline mine.

Years.	Short tons.
1883	10,489
1884	55,664
1885	83,156
Total	149,309

It is estimated that the Timberline mine will produce 1,000 tons a day as soon as the shaft opening and the 300 and 600 foot levels are completed.

Coal from this mine is used almost exclusively by the Northern Pacific railroad in Montana. General Manager T. F. Oakes speaks of the mine as furnishimg a serviceable coal for locomotives.

The Maxey and Bozeman mines are in the same field as the Timberline and from 3 to 5 miles distant. As at the Timberline mine, the coal is much faulted. In the Maxey mine the dip is nearly 70° and the bed varies in thickness; at one point it is 30 feet. The average thickness of the coal is 7 feet. Analyses of two specimens, taken 30 feet apart, one from hard solid coal and one from a seam of broken coal, showed respectively:

Analysis.

	Hard coal.	Broken coal.
	Per cent.	*Per cent.*
Water	2.95	2.80
Volatile matter	36.65	36.85
Fixed carbon	46.50	46.35
Ash	13.90	14.00
Total	100.00	100.00

This mine produced 236 tons in 1883 and 394 tons in 1884; it was closed in 1885.

The Bozeman mine is on the same bed as the Maxey, and is distant about one mile. It is similar in many respects to the Maxey mine, but the dip is greater (85°), and the bed thinner, only six feet of clean coal being available.

Analysis of a sample taken in July, 1885.

	Per cent.
Water	2.75
Volatile matter	33.05
Fixed carbon	51.32
Ash	12.88
Total	100.00

The coking quality of this coal is questioned. The mine was formerly worked under a contract with the Northern Pacific railroad.

Production for three years.

Years.	Short tons.
1883	8,970
1884	7,612
1885	100
Total	16,682

The Trail Creek mine can only be reached by wagon. The product in 1885 was 609 tons. The beds are said to be large and the coal of good quality.

The Gardiner field is not of great value. Its extent is small, and the coal bed is so much broken that it is improbable that there will ever be any great amount of coal produced. The quality of the coal has already been described. It produced in 1884, 485 tons, and in 1885, 500 tons.

The Rock Creek coal field, on the Crow Indian reservation, was described on page 54 of the "Mineral Resources" for 1883 and 1884. It still remains untouched.

The Sand Coulée coal field occurs in the neighborhood of the Great Falls of the Missouri. The area of the explored field is about 50 square miles. The coal occurs in the strata of the Dakota group. The worked bed varies in thickness from 9 to 18 feet. This coal is favorably situated for working, and can easily be delivered at the town of Great Falls, which is not more than eight miles distant.

Analyses of the coal.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Water	5.54	6.50
Volatile matter	18.48	28.36
Fixed carbon	64.57	59.35
Ash	11.41	5.79
Total	100.00	100.00
Sulphur	.44	1.20

The coal is only mined to supply a small local demand at Great Falls, Fort Benton, and small consumers in the neighborhood. The production in 1885 was 700 tons.

The Belt Creek coal mines are in the Sand Coulée field, and are similar in almost every respect to those on the Sand Coulée Coal company's property, already described. The production here in 1885 was 1,200 tons.

Near Anaconda occurs a thin seam of coal which has been opened by private parties. It does not exceed 2 feet in thickness, and contains a large amount of slate. Samples taken in 1885 coked remarkably well, notwithstanding the Northern Pacific Coal company's report that samples of the coal did not coke.

The Medicine Lodge field is at the foot of Medicine Lodge peak, along a stream of the same name, which empties into the Beaverhead river in Beaverhead county. The nearest railway station is Red Rock, on the Utah and Northern railway, 18 miles distant. Three seams of coal are reported to exist, although but one of them has been opened and that below water level. This shows about 5½ feet of lignite. It is owned by the Union Pacific railway.

Analyses taken in 1885.

	Hard coal.	Broken coal.
Water	10.00	10.35
Volatile matter	30.20	26.00
Fixed carbon	50.34	45.09
Ash	9.46	18.56
Totals	100.00	100.00

About 50 tons were taken out in 1885, for the purpose of testing its quality in bulk.

Mines known as the Horr coal mines have been opened at Cinnibar. The coal is reported to be of a good quality.

The other coal fields of Montana, so far as known, have been already described in the second volume of the "Mineral Resources." The total cost of the coal consumed on the Northern Pacific railroad for 1885 was $691,146.07. About one-half of the coal came from Dakota, Montana, and Washington Territory, collectively.

Coal production of Montana.

	Short tons.		Short tons.
1883.		1885.	
Timberline	10,489	Timberline	83,156
Bozeman	8,970	Bozeman	100
Maxey	236	Maxey	none.
		Trail Creek	609
Total	19,695	Sand Coulée	700
1884.		Belt Creek	1,200
		Anaconda	75
		Medicine Lodge	50
Timberline	55,664	Gardiner	500
Bozeman	7,612	Deer Lodge	50
Maxey	394		
Gardiner	485	Total	86,440
Lignite	16,221		
Total	80,376		

The value of the Territory's output in 1885 at $3.50 per ton is $302,540. The number of men employed in coal mining is about 500.

NEVADA.

A bed of coal was opened in September in the Pittsburgh district near Lewis, located in the Reese river section, by L. W. Getchell and others. It is said to be an old location reopened.

According to the late Prof. W. F. Stewart some of the earliest prospectors after silver and gold ledges reported that they found quite a large deposit of an inferior quality of coal in El Dorado cañon, a few miles east of Dayton, and a large amount of money was expended in the attempt to develop it, but in its deepest explorations no real coal suitable for commercial or domestic use was found. Several tons were hauled to this city and put into practical use, but both in cooking ranges and under steam boilers it was found deficient in heating properties; it cost too much for wood to make it burn. Similar coal beds with like result were opened beyond Como, in Whitman district. The "Whitman coal mines" are laid down on some of the earliest maps. But both quantity and quality were lacking.

In 1864 and 1865 extensive deposits of coal or lignite were opened and explored near Crystal peak, some miles above Reno, where the Truckee river passes out of the mountains. Some beds were several feet thick, but led to nothing better than bituminous shale. It would burn, but gave out too little heat.

Mr. F. F. Chisolm reports that about twenty miles from Battle mountain, Nevada, and near Lewis, new openings were made in 1885 on a coal outcrop which had been prospected previously to some extent. The bed, at the only place found, has been very much faulted and broken, and contains really little but bone. The coal is called anthracite.

Analysis of a carefully selected sample taken in 1885.

	Per cent.
Water	1.45
Volatile matter	7.55
Fixed carbon	63.54
Ash	27.46
Total	100.00
Sulphur	4.81

The coal seam is probably of little value.

NEW MEXICO.

The progress of coal mining in New Mexico in 1885 was characterized by nothing of general interest. The principal producers are the mines at Raton, through the Raton Coal and Coking company, and those near San Antonio through the San Pedro Coke company. These mines have been described already, on pages 57 and 58 of "Mineral Resources of the United States, 1883 and 1884." The output here shows an increase over that in former years, the mines having been worked steadily with no strikes to cause stoppages. The output of the Raton mines in 1885 was 135,833 short tons. The greater proportion of this coal is used by the Atchison, Topeka, and Santa Fé Railroad as fuel. The small amount sold for commercial purposes goes to New Mexico and to Raton, Las Vegas, and other towns on the line of the railway. The coal does not coke. The mines at San Pedro produce an excellent coke which is used generally by the New Mexico and Arizona smelters. The production of coal here in 1885 was 56,656 tons. The Cerrillos field, which produces both anthracite and bituminous coals, has been stagnant in 1885. The mines are some distance from the line of the Santa Fé railway, and being narrow and not easy to work, the coal cannot be put on the market profitably. About 1,000 tons were produced for local use in 1885.

The Monero mines, in Rio Arriba county, supply a portion of the fuel used on the Durango branch of the Denver and Rio Grande railway. The mine is capable of greater production, but the demand is limited. Production here in 1885 was 14,953 tons. In Bernalillo county the increased demand of the Atlantic and Pacific railway has caused a large increase in the production of the two principal mining companies operating here. Some small quantity of the coal is sold at Albuquerque and other points on the line of the road in New Mexico and Arizona. The three largest companies operating here are the Gallup Coal company, which produced, in 1885, 52,269 tons of coal; Bell & Co., who mined in 1885 43,300 tons, and W. A. Maxwell, who mined 2,186 tons, making a total for the locality of 97,755 tons.

The production of the Territory in 1885 was:

	Short tons.
Raton mines	135, 833
Gallup mines	97, 755
San Pedro mines	56, 656
Monero mines	14, 958
Los Cerrillos	1, 000
Total	306, 202

The production of the Territory since 1881 has been:

Years.	Raton.	Gallup.	Monero.	Cerrillos.	San Pedro.	Total.
1882	91, 798	33, 373	12, 000	3, 600	16, 321	157, 092
1883	112, 089	42, 000	17, 240	3, 000	37, 018	241, 347
1884	102, 513	62, 802	11, 203	3, 000	41, 039	220, 557
1885	135, 833	97, 755	14, 958	1, 000	56, 656	306, 202
Total	442, 233	235, 930	55, 401	10, 600	151, 034	895, 198

The value of the Territory's product in 1885, at $3 per ton, was $918,606. The total number of men employed is about 700.

NORTH CAROLINA.

The coal deposits of North Carolina have been examined by Dr. H. Martyn Chance under the direction of the North Carolina State Board of Agriculture, with the view of determining their commercial value.

There are two isolated Triassic areas in North Carolina, in which coal beds have been opened, one situated on the Deep river and the other on the Dan river.

The Deep River coals occur in a series of dark carbonaceous slates, shales, and fire-clays, with bands of phosphatic black-band iron ore. These shales form the middle member of the Triassic (Mesozoic), the upper and lower members consisting of red sandstones and shales, with some coarse conglomerates. They dip from 10° to 35° in a southeasterly direction, the average dip being from 20° to 30°. They present only one outcrop, the dip throughout being monoclinal. Coal has been found for a distance of 25 to 30 miles along the outcrop, the most northeasterly locality being near where the Deep and Haw rivers converge to form the Cape Fear; this locality is but a short distance from Farmville. There are five beds of coal lying close together. From the top of the uppermost to the floor of the lowest the distance is not more than 40 or 50 feet. Only two of these beds are of workable thickness, viz., the upper bed, containing 3 feet of good coal, and the lowermost, which is about 22 to 24 inches thick. The upper bed shows the following section:

	Feet.
Slate roof	
Coal, good	3 to 3.2
Blackband and slate	1.6 to 3
Coal, poor, slaty	1 to 2
Fireclay, floor	

The analyses of the upper bench made by the State chemist gave:

	1.	2.	3.(*a*)	4.(*b*)	5.(*c*)	6.(*d*)
	Per cent.	*Per cent*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture at 115° C	1.79	1.95	1.71	1.36	2.15	1.32
Volatile combustible matter	29.56	30.54	28.66	28.71	28.88	26.87
Fixed carbon	58.30	58.47	60.59	51.24	52.56	50.04
Ash	7.46	6.85	5.35	14.51	12.69	14.62
Sulphur	2.89	2.19	3.69	4.18	3.72	7.08
Total	100.00	100.00	100.00	100.00	100.00	100.00

a Picked lump coal obtained at depth of 18 feet.
b Average of several tons obtained at depth of 28 feet.
c Average of several tons obtained at depth of 18 feet.
d Picked lump coal mined at depth of 28 feet.

These results show uniform composition, for No. 1 was made from picked lumps, while No. 2 was an average of lump and slack, from a heap containing two or three tons. The lower bed (analyses 3 to 6) was opened at two places by shafts 18 and 28 feet deep, respectively, and from the latter about one hundred tons were mined and shipped to Raleigh for use under the steam boilers at the State exposition. It is undoubtedly a strong steam coal, but is somewhat high in sulphur.

These analyses furnish some food for thought. How can the analysis showing 3.69 of sulphur and only 5.35 of ash be accounted for? The fault is not in the analysis of this sample, at least, since there is reason for special confidence in it. The high ash percentages in Nos.

4 and 5 may be regarded with suspicion, as the coal in burning does not indicate the presence of nearly so large a percentage, and the sulphur percentage in No. 6 is undoubtedly accidental. Averaging the three analyses, Nos. 3, 4, and 5, we may safely assume the sulphur at about 3.86 per cent. The close agreement of the volatile matter in Nos. 3, 4, and 5, is also remarkable in the presence of such marked variations in ash. The physical character of this coal is similar to that of a true coal-measure coal. It has a well developed columnar structure, is hard, bright, and black, with very little pyrites; it burns with a strong flame, and cokes slowly, not commencing to coke until highly heated. The upper bed is much more friable, readily breaking down into fine slack, and cokes quickly and thoroughly. It is evident that only a small portion of the sulphur is in combination with iron as pyrites. The amount of pyrites is so small that it is difficult to detect its presence.

The expense of working the coal in seams two feet thick is estimated at $1.50, and in seams three feet thick at $1.20 per ton. In the mines of Tennessee and West Virginia, with which the North Carolina coal comes in competition, mining is carried on at the rate of 65 cents per ton. Combining these figures with the cost of transportation, it is shown that there would remain sufficient margin in favor of the Deep River coal to command the market in eastern North Carolina. This is favorable to the development of the Deep River deposits; still the fact that these mines have not been worked for many years is significant.

The Richmond coal field, which is of the same age and of the same general character as the Deep River deposit, has been a failure when the mining operations of the whole field are considered. It is evident, therefore, that there must be some sufficient reason why mining in these fields, which are in close proximity to good markets, has not succeeded. Dr. Chance enumerates some of the more obvious difficulties that present themselves in the Deep River area: There are variations in the thickness and quality of the seams, faults, trap-dykes, presence of explosive gas, water, spontaneous combustion, and absence of coal from certain areas. Nearly all of these obstacles are probably much more difficult to surmount in these mines than in the great coal fields to the westward, with which the North Carolina coal comes in competition.

OHIO.

The coal statistics for 1885 have been very fully compiled and reported by Mr. Thomas B. Bancroft, chief inspector of mines.

Notwithstanding the prevalence of local strikes and stoppages, and the influx of Pittsburgh coal into markets hitherto supplied by Ohio, the output for 1885 has exceeded that of 1884 by 166,117 tons. With this exception the production this year is less than for any year since 1880. The average time made by the mines of Ohio this year was 201 working days, or two days more than in 1884. The product for this year, as divided between the three inspecting districts, with the number of mines in each district employing more than ten men, is as follows:

Production of coal, &c., in 1885.

	Long tons.	Number of mines.	Number of employés.
First district	2,758,346	114	6,741
Second district	3,206,788	142	6,466
Third district	1,851,045	88	6,497
	7,816,179	344	19,704

Below will be found the tonnage of the State from 1872 to 1885.

Production of coal in Ohio.

Years.	Long tons.	Years.	Long tons.
1872	5,315,294	1879	6,000,000
1873	4,550,028	1880	7,000,000
1874	3,267,585	1881	8,225,000
1875	4,864,259	1882	9,450,000
1876	3,500,000	1883	8,229,429
1877	5,250,000	1884	7,640,062
1878	5,500,000	1885	7,816,179

In the following table of the coal produced by counties, for the years 1884 and 1885, the estimates are for the calendar years, and are calculated at 2,000 pounds to the ton:

Coal production in Ohio by counties in 1884 *and* 1885.

Counties.	Production 1884.	Production 1885.		
		Lump.	Nut.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Perry	1,379,100	1,055,500	204,092	1,259,592
Athens	627,944	677,487	145,652	823,139
Jackson	831,720	641,419	150,189	791,608
Belmont	643,129	650,640	93,806	744,446
Hocking	372,694	574,086	82,355	656,441
Columbiana	469,708	398,703	64,030	462,733
Stark	513,225	341,859	49,559	391,418
Guernsey	375,427	236,366	60,901	297,267
Tuscarawas	317,141	225,530	60,015	285,545
Mahoning	241,599	257,561	18,383	275,944
Jefferson	316,777	245,492	25,837	271,329
Trumbull	257,683	234,654	29,863	264,517
Meigs	248,436	199,584	35,172	234,756
Medina	77,160	136,121	16,600	152,721
Carroll	102,531	121,125	29,570	150,695
Lawrence	176,412	111,453	34,463	145,916
Summit	253,148	129,069	16,065	145,134
Coshocton	56,562	78,351	21,258	99,609
Muskingum	84,398	75,511	11,335	86,846
Wayne	120,571	74,062	7,445	81,507
Vinton	69,740	67,604	9,523	77,127
Portage	65,647	67,683	9,388	77,071
Gallia	20,372	13,477	2,906	16,383
Holmes	12,052	9,716	1,743	11,459
Morgan	7,636	5,536	....	5,536
Washington	5,600	4,000	1,000	5,000
Scioto	3,650	2,440	....	2,440
Total	7,640,062	6,635,029	1,181,150	7,816,179

The number of coal mines in the State and the employés by counties is given in the following table:

Number of coal mines and employés in Ohio, by counties.

Counties.	Commercial mines.	Country banks.	Miners.	Outside men.
Athens	27	8	1,760	162
Belmont	27	14	980	152
Columbiana	16	22	769	74
Coshocton	5	11	194	18
Carroll	11	....	318	36
Guernsey	12	5	704	83
Gallia	2	....	41	4
Holmes	1	11	49	8
Hocking	16	....	1,059	137
Jackson	46	3	1,758	179
Jefferson	13	7	407	92
Lawrence	5	21	364	32
Medina	4	2	539	46
Muskingum	10	46	330	63
Meigs	11	5	862	87
Mahoning	16	7	992	102
Perry	45	6	2,228	236
Portage	4	....	251	23
Summit	6	3	272	31
Stark	26	16	1,500	164
Trumbull	14	3	1,402	105
Tuscarawas	18	13	489	79
Vinton	6	8	232	36
Wayne	2	3	208	19
Washington	1	....	26	2
Total	344	214	17,734	1,970

OREGON.

The coal mines of Oregon are not now producing as much as formerly. The most important mines are those on Coos bay on the western coast, 40 miles north of Cape Blanc. Coal beds have been found on Coal creek, Cowlitz county, and 3 miles back of tidewater, on the creek. It is a lignite coal, has been tested and found good for blacksmithing purposes, and, it is believed, will make good gas. There are four beds, lying about 4 feet apart, with clay between them. One bed is 3½ feet thick, another 4 feet, and two others (each) 4½ feet thick. The beds are not being prospected. The total production for the year probably did not exceed 50,000 tons.

PENNSYLVANIA ANTHRACITE REGION. (a)

The anthracite region during 1885 produced 34,228,548 long tons.

The region has been grouped into five principal divisions, as follows:

(1) Southern or Pottsville field, extending from the Lehigh river, at Mauch Chunk, southwest to within a few miles of the Susquehanna river, directly north of Harrisburg, and embraced by Carbon, Schuylkill, and Dauphin counties. The eastern end of this field, known as the Lower Lehigh or Panther Creek basin, between Tamaqua, on the Little

a Contributed by Charles A. Ashburner, geologist in charge of the survey of the anthracite coal fields of Pennsylvania.

Schuylkill river, and Mauch Chunk, on the Lehigh river, has generally been included by the coal trade in the Lehigh field, from the fact that its coals resemble more closely the coals obtained in the Upper Lehigh region than those in the Pottsville field west of Tamaqua, and since the shipments to market have almost entirely been made through the Lehigh valley. Production 1885, 3,455,927 tons.

(2) Western Middle or Mahanoy and Shamokin field, lying between the easternmost headwaters of the Little Schuylkill river and the Susquehanna river and within Schuylkill, Columbia, and Northumberland counties. Production 1885, 8,152,937 tons.

These two coal fields (1 and 2) are frequently designated in a general way as the Schuylkill region, although parts of them are better known to the trade by names defining districts from which coals of special characteristics are mined.

(3) Eastern Middle or Upper Lehigh field, lying between the Lehigh river and Catawissa creek and principally in Luzerne county, with limited areas extending into Carbon, Schuylkill, and Columbia counties. Production 1885, 5,329,607 tons.

(4) Northern or Wyoming and Lackawanna field lies in the two valleys from which it derives its geographical name, and is embraced almost entirely by Luzerne and Lackawanna counties. A small area in the extreme northeastern end of the field extends into Wayne and Susquehanna counties. Production 1885, 17,215,066 tons.

(5) Loyalsock and Mehoopany field lies within the area drained by the headwaters of the Loyalsock and Mehoopany creeks, and is contained in Sullivan and Wyoming counties. This field is from 20 to 25 miles northwest of the western end of the northern field. Its geological structure resembles more closely that of the bituminous field, in which it has until recently been included, although the composition of many of its coals entitles them to rank with a number from the anthracite region. Production 1885, 75,011 tons.

The area of the region is about 1,700 square miles. The natural geological and topographical boundaries of this area are formed by the mountains and ridges made by the Pocono Sandstone No. X; no workable coal beds have been found stratigraphically below the Pottsville Conglomerate No. XII., the Lykens Valley or lowest anthracite beds being found in the latter formation. The greatest length of the region, from the northeastern end of the northern field to the southwestern end of the southern field, is about 115 miles, while the greatest width of the belt, containing the first four fields, is about 30 miles between Mauch Chunk and Shickshinny, near the western end of the northern field.

The region is divided into seven inspection districts, as follows:

First. That portion of the Wyoming coal field included in the counties of Lackawanna, Wayne, and Susquehanna. Production 1885, 7,258,753 tons.

Second. The county of Sullivan and that portion of the Wyoming coal field situated in Luzerne county east of and including Plains and Kingston townships. Production 1885, 3,848,549 tons.

Third. The remaining portion of the Wyoming coal field west of Plains and Kingston townships, including the city of Wilkesbarre and the boroughs of Kingston and Edwardsville. Production 1885, 6,182,775 tons.

Fourth. That part of Luzerne county lying south of the Wyoming coal field, together with Carbon county. Production 1885, 5,583,616 tons.

Fifth. That part of the Schuylkill coal field in Schuylkill county lying north of the Broad mountain and east of a meridian line through the center of the borough of Girardville. Production 1885, 4,769,080 tons.

Sixth. That part of the Schuylkill coal field in Schuylkill county lying north of the Broad mountain and west of a meridian line through the center of the borough of Girardville, together with Columbia, Northumberland, and Dauphin counties. Production 1885, 4,204,622 tons.

Seventh. All that part of the Schuylkill coal field in Schuylkill county lying south of the Mahanoy valley and the county of Lebanon. Production 1885, 2,381,153 tons.

The shipment of coal from the entire region since the commencement of mining in 1820 has been carefully reported by Mr. P. W. Sheafer and subsequently by Mr. John H. Jones. From these reports the following table has been compiled:

Annual shipments of anthracite coal in Pennsylvania since 1820, with the number of tons and percentage shipped from each region.

Years.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Long tons.	*Per cent.*	*Long tons.*	*Per cent.*	*Long tons.*	*Per cent.*	*Long tons.*
1820			365				365
1821			1,073				1,073
1822	1,480	39.79	2,240	60.21			3,720
1823	1,128	16.23	5,823	83.77			6,951
1824	1,567	14.10	9,541	85.90			11,108
1825	6,500	18.60	28,393	81.40			34,893
1826	16,767	34.90	31,280	65.10			48,047
1827	31,360	49.44	32,074	50.56			63,434
1828	47,284	61.00	30,232	39.00			77,516
1829	79,973	71.35	25,110	22.40	7,000	6.25	112,083
1830	89,984	51.50	41,750	23.90	43,000	24.60	174,734
1831	81,854	46.29	40,966	23.17	54,000	30.54	176,820
1832	209,271	57.61	70,000	19.27	84,000	23.12	363,271
1833	252,971	51.87	123,001	25.22	111,777	22.91	487,749
1834	226,692	60.19	106,244	28.21	43,700	11.60	376,636
1835	339,508	60.54	131,250	23.41	90,000	16.05	560,758
1836	432,045	63.16	148,211	21.66	103,861	15.18	684,117
1837	530,152	60.98	223,902	25.75	115,387	13.27	869,441
1838	446,875	60.49	213,615	28.92	78,207	10.59	738,697
1839	475,077	58.05	221,025	27.01	122,300	14.94	818,402
1840	490,596	56.75	225,313	26.07	148,470	17.18	864,379
1841	624,466	65.07	143,037	14.90	192,270	20.03	959,773
1842	583,273	52.62	272,540	24.59	252,599	22.79	1,108,412
1843	710,200	56.21	267,793	21.19	285,605	22.60	1,263,598
1844	887,937	54.45	377,002	23.12	365,911	22.43	1,630,856
1845	1,131,724	56.22	429,453	21.33	451,836	22.45	2,013,010
1846	1,308,500	55.82	517,116	22.07	518,389	22.11	2,344,003
1847	1,665,735	57.79	633,507	21.98	583,067	20.23	2,882,305

Annual shipments of anthracite coal in Pennsylvania since 1820, &c.—Continued.

Years.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Long tons.	*Per cent.*	*Long tons.*	*Per cent.*	*Long tons.*	*Per cent.*	*Long tons.*
1848	1, 733, 721	56.12	670, 321	21.70	685, 196	22.18	3, 089, 238
1849	1, 728, 500	53.30	781, 556	24.10	732, 910	22, 60	3, 242, 966
1850	1, 840, 620	54.80	690, 456	20.56	827, 823	24.64	3, 358, 899
1851	2, 328, 525	52.34	964, 224	21.68	1, 156, 167	25.98	4, 448, 916
1852	2, 636, 835	52.81	1, 072, 136	21.47	1, 284, 500	25.72	4, 993, 471
1853	2, 665, 110	51.30	1, 054, 309	20.29	1, 475, 732	28.41	5, 195, 151
1854	3, 191, 670	53.14	1, 207, 186	20.13	1, 603, 478	26.73	6, 002, 334
1855	3, 552, 943	53.77	1, 284, 113	19.43	1, 771, 511	26.80	6, 608, 567
1856	3, 603, 029	52.91	1, 351, 970	19.52	1, 972, 581	28.47	6, 927, 580
1857	3, 373, 797	50.77	1, 318, 541	19.84	1, 952, 603	29.39	6, 644, 941
1858	3, 273, 245	47.86	1, 380, 030	20.18	2, 186, 094	31.96	6, 839, 369
1859	3, 448, 708	44.16	1, 628, 311	20.86	2, 731, 236	34.98	7, 808, 255
1860	3, 749, 632	44.04	1, 821, 674	21.40	2, 941, 817	34.56	8, 513, 123
1861	3, 160, 747	39.74	1, 738, 377	21.85	3, 055, 140	38.41	7, 954, 264
1862	3, 372, 583	42.86	1, 351, 054	17.17	3, 145, 770	39.97	7, 869, 407
1863	3, 911, 683	40.90	1, 894, 713	19.80	3, 759, 610	39.30	9, 566, 006
1864	4, 161, 970	40.89	2, 054, 669	20.19	3, 960, 836	38.92	10, 177, 475
1865	4, 356, 959	45.14	2, 040, 913	21.14	3, 254, 519	33.72	9, 652, 391
1866	5, 787, 902	45.56	2, 179, 364	17.15	4, 736, 616	37.29	12, 703, 882
1867	5, 161, 671	39.74	2, 502, 054	19.27	5, 325, 000	40.99	12, 988, 725
1868	5, 330, 737	38.62	2, 502, 582	18.13	5, 968, 146	43.25	13, 801, 465
1869	5, 775, 138	41.66	1, 949, 673	14.06	6, 141, 369	44.28	13, 866, 180
1870	4, 968, 157	30.70	3, 239, 374	20.02	7, 974, 660	49.28	16, 182, 191
1871	6, 552, 772	41.74	2, 235, 707	14.24	6, 911, 242	44.02	15, 699, 721
1872	6, 694, 890	34.03	3, 873, 339	19.70	9, 101, 549	46.27	19, 669, 778
1873	7, 212, 601	33.97	3, 705, 596	17.46	10, 309, 755	48.57	21, 227, 952
1874	6, 866, 877	34.09	3, 773, 836	18.73	9, 504, 408	47.18	20, 145, 121
1875	6, 281, 712	31.87	2, 834, 605	14.38	10, 596, 155	53.75	19, 712, 472
1876	6, 221, 934	33.63	3, 854, 919	20.84	8, 424, 158	45.53	18, 501, 011
1877	8, 195, 042	39.35	4, 332, 760	20.80	8, 300, 377	39.85	20, 828, 179
1878	6, 282, 226	35.68	3, 237, 449	18.40	8, 085, 587	45.92	17, 605, 262
1879	8, 960, 829	34.28	4, 595, 567	17.58	12, 586, 293	48.14	26, 142, 689
1880	7, 554, 742	32.23	4, 463, 221	19.05	11, 419, 279	48.72	23, 437, 242
1881	9, 253, 958	32.46	5, 294, 676	18.58	13, 951, 383	48.96	28, 500, 017
1882	9, 459, 288	32.48	5, 689, 437	19.54	13, 971, 371	47.98	29, 120, 096
1883	10, 074, 726	31.69	6, 113, 809	19.23	15, 604, 492	49.08	31, 793, 027
1884	9, 478, 314	30.85	5, 562, 226	18.11	(a)15, 677, 753	51.04	30, 718, 293
1885	9, 488, 426	30.01	5, 898, 634	18.65	(a)16, 236, 470	51.34	31, 623, 530
	212, 365, 138	37.80	106, 495, 237	18.95	242, 974, 965	43.25	561, 835, 340

a Includes Loyalsock field.

No exact determination has been made of the area of the different anthracite coal basins. The general estimates contained in the following table will serve to give an idea as to their relative size:

Area and total production of individual coal fields.

Field.	Square miles (approximated).	1884.		1885.	
		Long tons.	*Percentage.*	*Long tons.*	*Percentage.*
Northern	200	16, 411, 277	50.28	17, 215, 066	50.29
Eastern middle	40	5, 098, 684	15.62	5, 329, 607	15.57
Western middle	90	7, 896, 049	24.19	8, 152, 937	23.82
Southern	140	3, 149, 471	9.65	3, 455, 927	10.10
Loyalsock	Unknown	86, 018	0.26	75, 011	0.22
Total	470+	32, 641, 499	100.00	34, 228, 548	100.00

Total production and shipment from the inspectors' districts for the years 1884 and 1885, with the colliery and local consumption.

District.	No.	Name of inspector.	1884. Shipment.	1884. Colliery and local consumption.	1884. Total production.
			Long tons.	*Long tons.*	*Long tons.*
First Schuylkill	1	Samuel Gay	1, 678, 455	100, 959	1, 779, 414
Second Schuylkill	2	Robert Mauchline	4, 246, 847	270, 792	4, 517, 639
Third Schuylkill	3	James Ryan	4, 280, 487	268, 865	4, 549, 352
Middle Carbon and Luzerne	4	G. M. Williams	7, 435, 816	446, 149	7, 881, 965
Eastern Carbon and Luzerne	5	Patrick Blewitt	8, 046, 521	482, 791	8, 529, 312
Southern Carbon and Luzerne	6	James E. Roderick	4, 777, 156	520, 643	5, 297, 799
Total production of hard anthracites			30, 465, 282	2, 090, 199	32, 555, 481
Loyalsock field (Sullivan county), soft anthracite			84, 551	1, 467	86, 018
Total production of all anthracites			30, 549, 833	2, 091, 666	32, 641, 499

Number of district under law of June 30, 1885.	Name of inspector.	1885. Shipment.	1885. Colliery and local consumption.	1885. Total production.
		Long tons.	*Long tons.*	*Long tons.*
First	Patrick Blewitt	6, 829, 977	428, 776	7, 258, 753
Second	Hugh McDonald	3, 686, 695	161, 854	3, 848, 549
Third	G. M. Williams	6, 036, 884	145, 891	6, 182, 775
Fourth	James E. Roderick	5, 055, 407	528, 209	5, 583, 616
Fifth	William Stein	4, 493, 075	276, 005	4, 769, 080
Sixth	James Ryan	3, 965, 959	238, 663	4, 204, 622
Seventh	Samuel Gay	2, 197, 424	183, 729	2, 381, 153
Total production of all anthracites		32, 265, 421	1, 963, 127	34, 228, 548

NOTE.—In 1885 a new inspector's district was added in the anthracite region and some of the old boundaries changed, so that the tables for 1884 and 1885 are not directly comparable. In 1885 the Loyalsock was included in the second district.

Railroad and colliery division of production of individual coal fields for 1885.

NORTHERN COAL FIELD, RAILROAD DIVISION.

Railroad.	Long tons.	Percentage.
Delaware, Lackawanna and Western, main line	2, 593, 180	36. 51
Delaware, Lackawanna and Western, Lackawanna and Bloomsburg division	3, 688, 617	
Delaware and Hudson Canal company	2, 584, 907	15. 02
Delaware and Hudson Canal company and Lackawanna and Bloomsburg division of Delaware, Lackawanna and Western railroad	795, 395	4. 62
Delaware and Hudson Canal company and Lehigh and Susquehanna	253, 745	1. 47
Delaware and Hudson Canal company and Lehigh Valley	52, 996	0. 31
Lehigh and Susquehanna	2, 436, 495	14. 15
Lehigh and Susquehanna and North and West branch	128, 899	.75
Lehigh Valley	1, 452, 254	8. 43
North and West branch (Pennsylvania)	1, 275, 765	7. 41
Pennsylvania Coal company	1, 304, 932	7. 58
Erie and Wyoming Valley	517, 718	3. 00
New York, Lake Erie and Western	84, 459	.49
Jefferson branch	12, 170	.07
Local sales (shipped by wagon)	33, 534	.19
Total	17, 215, 066	100. 00

Railroad and colliery division of production of individual coal fields for 1885—Cont'd.

NORTHERN COAL FIELD, COLLIERY DIVISION.

Operator.	Long tons.	Percentage.
Delaware, Lackawanna and Western	2, 168, 017	12. 60
Delaware and Hudson Canal company	3, 048, 237	17. 70
Delaware and Hudson and Delaware, Lackawanna and Western	192, 176	1. 12
Lehigh and Wilkesbarre Coal company	1, 716, 682	9. 97
Susquehanna Coal company	1, 466, 735	8. 51
Lehigh Valley Coal company	830, 755	4. 83
Pennsylvania Coal company	1, 711, 379	9. 94
Hillside Coal and Iron company	371, 867	2. 16
Individual operators	5, 709, 218	33. 17
Total	17, 215, 066	100. 00

EASTERN MIDDLE COAL FIELD, RAILROAD DIVISION.

Railroad.	Long tons.	Percentage.
Lehigh Valley	2, 991, 416	56. 12
Lehigh and Susquehanna	1, 282, 109	24. 06
Lehigh Valley and Lehigh and Susquehanna	728, 979	13. 67
Sunbury, Hazleton and Wilkesbarre	327, 103	6. 15
Total	5, 329, 607	100. 00

EASTERN MIDDLE COAL FIELD, COLLIERY DIVISION.

Operator.	Long tons.	Percentage.
Lehigh and Wilkesbarre Coal company	500, 391	9. 39
Individual operators	4, 829, 216	90. 61
Total	5, 329, 607	100. 00

WESTERN MIDDLE COAL FIELD, RAILROAD DIVISION.

Railroad.	Long tons.	Percentage.
Philadelphia and Reading	5, 525, 749	67. 78
Philadelphia and Reading and Northern Central	330, 272	4. 05
Lehigh Valley	1, 523, 256	18. 68
Northern Central	619, 271	7. 60
Lehigh Valley and Northern Central	24, 455	0. 30
Philadelphia and Reading, Northern Central, and Lehigh Valley	129, 934	1. 59
Total	8, 152, 937	100. 00

WESTERN MIDDLE COAL FIELD, COLLIERY DIVISION.

Operator.	Long tons.	Percentage.
Philadelphia and Reading Coal and Iron company	4, 417, 421	54. 18
Lehigh Valley Coal company	460, 814	5. 65
Mineral Railroad and Mining company	437, 167	5. 36
Individual operators	2, 837, 535	34. 81
Total	8, 152, 937	100. 00

Railroad and colliery division of production of individual coal fields for 1885—Cont'd.

SOUTHERN COAL FIELD, RAILROAD DIVISION.

Railroad.	Long tons.	Percentage.
Philadelphia and Reading	1,669,805	48.33
Lehigh and Susquehanna	1,224,468	35.44
Northern Central	561,654	16.23
Total	3,455,927	100.00

SOUTHERN COAL FIELD, COLLIERY DIVISION.

Operator.	Long tons.	Percentage.
Philadelphia and Reading Coal and Iron company	1,249,503	36.15
Lehigh Coal and Navigation company	1,224,468	35.43
Summit Branch Railroad company	344,480	9.97
Lykens Valley Coal company	217,174	6.28
Individual operators	420,302	12.17
Total	3,455,927	100.00

WESTERN NORTHERN COAL FIELD, RAILROAD DIVISION.

Railroad.	Long tons.	Percentage.
Lehigh Valley	75,011	100

WESTERN NORTHERN COAL FIELD, COLLIERY DIVISION.

Operator.	Long tons.	Percentage.
State Line and Sullivan Railroad company	75,011	100

Total production of coal fields, by counties.

Name of county.	1884.		1885.	
	Production.	Percentage.	Production.	Percentage.
	Long tons.		*Long tons.*	
Susquehanna	77,058	0.24	84,459	0.24
Lackawanna	7,093,190	21.73	7,174,294	20.96
Luzerne	13,382,912	41.00	14,329,645	41.86
Sullivan	86,018	0.26	75,011	0.22
Carbon	1,155,916	3.54	1,210,284	3.53
Schuylkill	7,165,532	21.96	7,700,065	22.49
Columbia	745,826	2.28	610,552	1.81
Northumberland	2,331,108	7.14	2,482,644	7.25
Dauphin	603,939	1.85	561,654	1.64
Total	32,641,499	100.00	34,228,548	100.00

Railroad division of shipments.

Railroad.	1884.		1885.	
	Shipments.	Percentage.	Shipments.	Percentage.
	Long tons.		*Long tons.*	
Philadelphia and Reading / Central of New Jersey	11, 163, 920	36. 34	11, 680, 780	36. 94
Lehigh Valley	5, 935, 254	19. 32	6, 107, 445	19. 31
Delaware, Lackawanna and Western	5, 204, 362	16 94	4, 987, 834	15. 77
Delaware and Hudson Canal company	3, 362, 680	10. 95	3, 301, 874	10. 44
Pennsylvania	3, 169, 287	10. 32	3, 393, 685	10. 73
Pennsylvania Coal Company	1, 397, 946	4. 55	1, 500, 686	4. 75
New York, Lake Erie and Western	484, 844	1. 58	651, 226	2. 06
Total	30, 718, 293	100. 00	31, 623, 530	100. 00

Distribution of shipments.

Destination.	1884.		1885.	
	Long tons.	Percentage.	Long tons.	Percentage.
Pennsylvania, New York, and New Jersey	20, 656, 297	67. 24	21, 132, 179	66. 82
New England States	5, 112, 825	16. 64	5, 172, 964	16. 36
Western States	2, 736, 099	8. 90	3, 029, 385	9. 58
Southern States, including Delaware, Maryland, and District of Columbia	1, 336, 070	4. 35	1, 362, 500	4, 31
Pacific coast	8, 839	0. 03	10, 700	0. 03
Dominion of Canada	837, 185	2. 73	878, 177	2. 78
Foreign ports	30, 978	0. 11	37, 624	0. 12
Total	30, 718, 293	100. 00	31, 623, 529	100. 00

The coals of the producing collieries during the year 1884(*a*) have been classified under the general heads in the following table:

Number of collieries producing each kind of coal, the amount in tons, and percentage of each.

Character of coal.	Number of collieries.	Production 1884.	Percentage of total production 1884.
		Long tons.	
Free-burning white ash	213	17, 109, 523	52. 41
Hard white ash	105	9, 206, 639	28. 20
Wyoming red ash	14	1, 727, 965	5. 30
Lehigh red ash	11	1, 510, 494	4. 63
Shamokin	29	1, 409, 854	4. 32
Lykens Valley red ash	8	1, 145, 008	3. 50
Schuylkill red ash	14	227, 467	. 71
Trevorton	2	116, 695	. 36
Lorberry red ash	4	101, 836	. 31
Bernice white ash	1	86, 018	. 26
Total	401	32, 641, 499	100. 00

Mr. Joseph S. Harris, in speaking of the characteristics of the coals produced from the properties of the Philadelphia and Reading Coal and

a The producing collieries have not as yet been similarly grouped during the year 1885. These tables for 1884 will be applicable, as far as the percentage column is concerned, to the coal production of 1885, since the number of collieries producing the different grades of coal has only imperceptibly varied.—C. A. A.

Iron company, in the western and southern fields, defines the characteristics of many of these different varieties. Although his definitions were not intended to include the coals from the eastern middle and northern fields, yet, in a general way, they may be considered equally applicable to the special coals from these latter fields. His definitions are as follows:

(1) *Hard white ash.*—"It is in great request for blast furnace and locomotive purposes, having, to an unusual degree, the qualities of resisting change of form under high heat and pressure, and, owing to its high percentage of carbon, it is valuable for producing steam; but for domestic use on a small scale, and for open-grate fires, it does not ignite readily enough to be a favorite."

(2) *Free-burning white ash.*—"The distinction between it and the hard-burning white-ash coal is that under such a fire as is ordinarily used for smelting metals or producing steam the impurities melt or clinker, which is not the case with the harder coal. This practical test is not, however, a very exact one. Some of the anthracites can be clinkered with a strong draught and with a thick bed of fire, and would, by a person who used them under such circumstances, be classed as free burning, while another, whose method of burning was more economical, would call them hard. Analysis shows that the free-burning white-ash coals are quite as rich in fixed carbon, and that they have even higher heating power, as tested by the amount of water evaporated, than the harder variety, but their limited range of usefulness, which is due to their clinkering, prevents their price rising as high as the hard white-ash coals."

(3) *Schuylkill red ash.*—"Is easily ignited, easy to keep burning, and where used in open grates makes less floating dust than white-ash coal, because its ash is composed of larger particles, and on account of the oxide of iron which constitutes its coloring matter has greater specific gravity than the ash of the white."

(4) *Shamokin.*—"It follows in hardness and in ease of ignition next after the free-burning white-ash coals, and is used still more especially for domestic purposes, its lower percentage of carbon making it ill-adapted for purposes requiring intense heat."

(5) *Lorberry red ash.*—"It burns with a little flame, and is much in request for domestic uses in the eastern market."

(6) *Lykens Valley red ash.*—"It burns with considerable flame, and is greatly liked in the eastern market for open grates, or other domestic uses, and for steam and heating purposes, wherever quick heat is required."

(7) *Trevorton or North Franklin white ash.*—"The coal is pure, but its heating properties are rather low, and it is of so friable a nature that it does not stand transportation well."

(8) The Wyoming red ash, (9) Lehigh red ash, and (10) Loyalsock white ash are not referred to in Mr. Harris's report. The Wyoming

red ash is similar in its general characteristics to the Schuylkill red ash. The Lehigh red ash is very similar to the hard white ash produced from the same region, with the exception of the color of the ash, due to the presence of iron, the same as in the softer red ash from Schuylkill, while the Bernice white ash, as a fuel, is rated by many coal men as being similar to the Lykens Valley coal, except in the color of the ash. The geological structure and physical characteristics of the Bernice and Lykens Valley beds are, however, quite different.

The following table shows the amount of the different kinds of coal produced in the different fields, the number of producing collieries in each field from which the different varieties of coals come, and the proportion produced, both in tons and per cent. of total production:

Coal field.	Character of coal.	Number of collieries.	Production, 1884.	Percenage of total production, 1884.
			Long tons.	
Northern	Free-burning white ash	155	14,683,312	44.98
	Wyoming red ash	14	1,727,965	5.30
Total		169	16,411,277	50.28
Eastern Middle	Hard white ash	44	3,588,190	10.99
	Lehigh red ash	11	1,510 494	4.63
Total		55	5,098,684	15.62
Western Middle	Hard white ash	46	4,572,762	14.01
	Free-burning white ash	20	1,796,738	5.50
	Shamokin	29	1,409,854	4.32
	Trevorton	2	116,695	.36
Total		97	7,896,049	24.19
Southern	Lykens Valley red ash	8	1,145,008	3.50
	Hard white ash	15	1,045,687	3.20
	Free-burning white ash	38	629,473	1.93
	Schuylkill red ash	14	227,467	.71
	Lorberry red ash	4	101,836	.31
Total		79	3,149,471	9.65
Western Northern	Lykens Valley white ash	1	86,018	0.26
Grand total		401	32,641,499	100.00

It is found in practice that after the coal is passed through the breaker and screened into different sizes for shipment, the purity of the different sizes, as regards fixed carbon and ash, is very different. This is indicated by the following analyses of specimens collected from the Hauto screen-building of the Lehigh Coal and Navigation company:

Kind of coal.	Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.	Total.	Color of ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
Egg	1.722	3.518	88.489	.609	5.662	100	Light cream.
Stove	1.426	4.156	83.672	.572	10.174	100	Cream.
Chestnut	1.732	4.046	80.715	.841	12.666	100	Cream.
Pea	1.700	3.894	79.045	.397	14.664	100	Cream.
Buckwheat	1.690	4.058	76.918	.714	16.620	100	Cream.

These coals are separated into different sizes according to the mesh of the screen over which they pass. The sizes noted in the above table passed over and through sieve meshes of the following dimensions:

	Through.	Over.
	Inches.	*Inches.*
Broken or grate	4	2.5
Egg	2.5	1.75
Stove	1.75	1.25
Chestnut	1.25	.75
Pea	.75	.50
Buckwheat	.50	.25

Price.—It is difficult to report the price at which anthracite coal has sold for any definite period. It is generally supposed that this can be obtained from the coal trade circulars; but although circular prices are named by the different companies, and mutually agreed upon, yet coal is often sold in the New York market for $1 and even $1.25 below circular prices.

The average prices of the different sizes of coal free on board at New York harbor, for each different month in 1885, are shown in the following table:

Prices of anthracite coal in Pennsylvania during 1885.

	Broken and egg.	Stove.	Nut.	Pea.
January	$2.90	$3.70	$3.00	$2.00
February	3.20	4.05	3.42	2.25
March	3.20	4.00	3.50	2.30
April	3.25	3.85	3.55	2.40
May	3.25	3.75	3.40	2.25
June	3.23	3.75	3.25	2.25
July	3,22	3.75	3.20	2.25
August	3.12	3.70	3.10	2.00
September	3.05	3.70	3.00	2.00
October	3.30	3.90	3.25	2.00
November	3.30	3.90	3,20	2.00
December	3.10	3.75	3.10	2.00
Averages	3.18	3.82	3.24	2.14

The Delaware, Lackawanna and Western railroad sold a great proportion of the coal which it mined at public auction from 1869 to 1879, and the average of the prices received by this company at that time may be considered a fair indication of the actual market value of the Wyoming and Lackawanna coals, free on board vessels, at New York shipping points. These prices are shown below. The prices in this table subsequent to 1879 and those in the next table are the average prices received approximately for the same classes of coal at private sale. Many of the variations in the monthly prices are due to the greater or less proportion of the dearer or cheaper sizes of coal which were sold during different months. The prices given are the averages of the sales of all sizes (from lump to pea, inclusive), whatever the proportion of each may have been.

Value in New York of Wyoming and Lackawanna coals.

Years.		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Average.
1869	Auction sales.	$5.21	$4.36	$4.58	$4.79	......	......	......	$6.76	$6.08	$6.41	$4.82	$5.18	$5.35
1870		4.42	4.32	4.77	4.59	$4.51	$4.57	$4.89	4.77	4.65	4.30	3.99	......	4.53
1871		......	......	......	......	5.11	4.85	4.87	5.01	5.29	4.45	4.40	4.31	5.29
1872		3.76	3.81	3.78	3.61	3 60	3.62	3.53	3.47	3.99	4.11	4.24	4.13	3.80
1873		4.49	4.46	4.57	4.65	47.6	4.90	5.11	5.17	5.17	5.18	5.16	......	4.81
1874		4.89	4.64	4.68	4.79	4.87	5.06	5.16	5.20	5.37	5.53	5.49	5.36	5.09
1875		5.43	5.45	......	......	......	......	......	......	......	......	......	......	......
1876		......	......	......	......	......	......	......	2.91	......	3.27	3.00	3.09	3.09
1877		3.07	3.13	2.93	3.03	2.53	2.37	......	......	......	2.57	2.35	2.69	2.70
1878		3.32	3.23	3.47	3.49	3.59	3.59	3.59	3.72	3.79	3.74	3.74	2.72	3.46
1879		2.50	2.45	2.35	2.28	2.24	2.40	2.56	2.24	2.19	......	......	......	2.33
1880		3.02	3.10	3.49	3.56	3.67	3.69	3.74	3.74	3.80	3.80	3.83	3.84	3.61
1881		3.86	3.83	3.71	3.76	3.70	3.64	3.71	3.77	3.76	3.79	3.79	3.84	3.77
1882		3.72	3.58	3.63	3.59	3.65	3.66	3.78	3.91	3.95	4.06	3.92	3.70	3.76
1883		3.88	3.70	3.89	3.79	3.64	3.67	3.70	3.78	3.83	3.75	3.74	3.66	3.75
1884		3.72	3.84	3.67	3 57	3.59	3.62	3.71	3.68	3.49	3.59	3.58	3.44	3.63
1885		3.13	3.39	3.40	3.38	3.39	3.21	3.23	3.09	3.20	3.28	3.04	2.81	3.21

Value of Wyoming and Lackawanna coal at private sale.

Months.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
January	$3.06	$2.57	$2.66	$2.91	$3.99	$3.72	$3.68	$3.47	$3.14
February	3.02	2.89	2.46	2.96	4.04	3.60	3.68	3.56	3.30
March	3.02	3.37	2.42	3.59	3.95	3.57	3.61	3.44	3.31
April	3.05	3.28	2.29	3.52	3.86	3.62	3.63	3.39	3.28
May	2.94	3.42	2.22	3.53	3.78	3.62	3.61	3.27	3.07
June	2.66	3.29	2.35	3.61	3.75	3.70	3.68	3.44	3.09
July	2.65	3.44	2.39	3.66	3.80	3.64	3.78	3.42	3.11
August	2.99	3.54	2.23	3.74	3.79	3.71	3.67	3.29	2.93
September	3.07	3.49	2.19	3.85	3.68	3.81	3.63	3 36	2.99
October	2.95	3.64	2.06	3.84	3.78	3.98	3.71	3.29	3.24
November	2.51	3.20	2.76	3.88	3.75	4.04	3.70	3.42	2.99
December	2.25	2.95	2.91	3.92	3.99	3.87	3.48	3.43	2.90
Average	2.79	3.23	2.32	3.55	3.84	3.73	3.65	3.41	3.12

Average monthly prices received for the different Lehigh coals for two and one-half years.

Months.	1883.	1884.	1885.
January	......	$4.07	$3.58
February	......	4 19	3.57
March	......	4.16	3.56
April	......	4.96	3.60
May	......	4.05	3.61
June	......	4.00	3.58
July	$4.23	4.02	3.52
August	4.20	4.01	3.43
September	4.21	3.97	3.46
October	4.25	3.91	3.50
November	4.16	3.87	3.55
December	4.10	3.72	3.46
Average	4.10	4.00	3.54

Average yearly prices for Schuylkill lump coal at Philadelphia, and Lehigh lump coal at Elizabethport, New Jersey, for the past fourteen years.

SCHUYLKILL LUMP COAL.

Years.	Price.	Years.	Price.
1872	$3.74	1879	$2.70
1873	4.27	1880	4.53
1874	4.55	1881	4.50
1875	4.39	1882	4.75
1876	3.87	1883	4.50
1877	2.59	1884	4.50
1878	3.25	1885	4.00

Average yearly prices for Schuylkill lump coal at Philadelphia, &c.—Continued.

LEHIGH LUMP COAL.

Years.	Price.	Years.	Price.
1872	$3.82	1879	$3.29
1873	4.71	1880	4.63
1874	5.05	1881	5.10
1875	5.00	1882	5.25
1876	4.71	1883	5.00
1877	3.60	1884	5.00
1878	3.50	1885	4.50

PENNSYLVANIA—BITUMINOUS.

No thoroughly reliable statistics are collected of the Pennsylvania bituminous coal mines. The inspectors report a production of 22,409,337 short tons for the fourteen months beginning November 1, 1884, and ending December 31, 1885. The Bureau of Industrial Statistics reports a total production for 1885 of 20,647,730 tons. From all the miscellaneous facts which can be collected relating to this region, it is believed that the production of all coal for 1885 was at least 26,000,000 tons. The only statistics which pretend to be complete are those of the Bureau of Industrial Statistics; although these returns are incomplete from the failure of some mines to report, yet they give a comparative idea of the bituminous trade, and the table is therefore inserted in this place.

Condition of the Pennsylvania bituminous coal mines in 1885.

Counties.	Number of mines.	Average number of days operated.	Number of persons employed.	Amount paid in wages.	Number of tons of coal mined.
					Short tons.
Allegheny	86	160	11,455	$3,271,819	3,588,244
Armstrong	4	212	284	92,268	139,327
Beaver	7	255	389	168,611	184,631
Bedford	5	195	232	85,646	107,694
Blair	5	160	836	146,045	205,075
Bradford	2	250	496	225,024	249,920
Butler	8	150	467	96,671	85,429
Cambria	64	200	1,807	560,358	1,037,000
Cameron	1	100	101	13,019	7,706
Centre	9	200	611	185,831	373,504
Clarion	9	212	626	204,195	299,216
Clearfield	64	200	5,154	1,761,615	3,368,671
Elk	7	220	958	421,181	537,826
Fayette	51	203	5,184	1,774,750	3,192,972
Greene	3	250	33	4,502	8,248
Huntingdon	8	235	543	236,620	247,424
Indiana	2	200	134	43,436	82,750
Jefferson	6	205	736	258,885	479,675
Lawrence	3	195	175	49,208	42,137
McKean	3	200	121	46,238	44,312
Mercer	15	140	901	296,898	378,508
Somerset	15	193	400	118,073	302,715
Tioga	8	200	2,553	969,309	1,067,021
Venango	1	280	16	6,851	7,000
Washington	33	195	3,064	833,917	836,633
Westmoreland	57	190	6,730	2,369,804	3,774,072
Total for 1885	476	195	44,006	14,240,774	20,647,720
Total for 1884	361	213	38,906	14,752,786	18,084,941
Increase	115	....	5,100	....	2,562,779
Decrease	....	18	....	512,012	....

The number of days represents the days actually worked by the majority of employés. About one-third of the employés averaged about one hundred and sixty days only. The annual wage fund, if divided share and share alike among all the employés, would give to each about $323 per annum, or about $27 per month. The highest average wages paid miners was $2 per day. The average wages paid miners was $1.70 per day. The highest average wages paid to common laborers was $1.60 per day. The average wages paid to same was $1.40 per day. Boys received about 60 cents per day.

In commenting upon the above returns, the report of the Bureau says that the total production of "run of mine coal" was about 25,000,000 tons, although this is about four and a half million tons more than is shown by their detail returns, yet it is believed to be at least 1,000,000 tons below the total amount of coal produced.

One of the most productive regions in the State is that known as the Clearfield, and the growth of this field can be appreciated from the following table:

Returns of the amount of coal carried over the Tyrone and Clearfield branch of the Pennsylvania railroad for the last twenty-four years.

Years.	Short tons.	Years.	Short tons.
1862	7,239	1874	639,630
1863	24,330	1875	928,297
1864	65,380	1876	1,281,861
1865	60,629	1877	1,374,927
1866	107,878	1878	1,295,201
1867	166,364	1879	1,631,120
1868	170,335	1880	1,739,873
1869	259,994	1881	2,401,987
1870	379,863	1882	2,838,970
1871	542,896	1883	2,857,710
1872	431,915	1884	3,173,363
1873	592,860	1885	2,901,613

The total production of Clearfield county for 1885 is estimated to be 4,446,637 tons. This includes that shipped over the Tyrone and Clearfield branch; 774,055 tons shipped over the Beech Creek, Clearfield and Southwestern railroad; 120,969 tons shipped by John Whitehead over the Keating and Karthouse branch; and about 200,000 tons shipped over the Bell's Gap railroad, besides some coal sold locally. It is reported that of the coal sent over the Tyrone road, 400,000 tons were sent to Baltimore, 800,000 tons to Philadelphia, and 900,000 to Amboy.

The Broad Top semi-bituminous coal is shipped over the Huntingdon and East Broad Top railroads. The shipment over these two roads respectively is given as follows:

Huntingdon and Broad Top railroad.

Years.	Short tons.	Years.	Short tons.
1873	350,245	1880	174,736
1874	236,693	1881	204,819
1875	204,921	1882	271,216
1876	159,779	1883	196,534
1877	140,143	1884	192,706
1878	150,204	1885	176,075
1879	141,594		

Coal carried by the East Broad Top railroad to the Pennsylvania railroad at Mount Union.

Years.	Short tons.	Years.	Short tons.
1875	43, 567	1881	91, 745
1876	66, 104	1882	99, 095
1877	54, 738	1883	44, 737
1878	63, 068	1884	43, 514
1879	67, 929	1885	51, 878
1880	72, 450		

Shipments of Cumberland coal over the Pennsylvania and Huntingdon and Broad Top railroads.

Years.	Short tons.	Years.	Short tons.
1873	114, 589	1880	242, 593
1874	67, 671	1881	313, 600
1875	175, 154	1882	208, 031
1876	145, 796	1883	471, 785
1877	187, 488	1884	394, 114
1878	163, 598	1885	460, 289
1879	171, 930		

The Monongahela region ships its coal both by railroad and boat by means of the slack-water navigation of the Monongahela river, the river being navigable for boats carrying 800 tons during all times of the year. The coal consumed in Pittsburgh is supplied mainly by railroad, and a large portion of the coal shipped by river goes to the markets along the Ohio and Mississippi rivers.

Shipments by the slack-water navigation since 1860.

Years.	Short tons.	Years.	Short tons.
1860	1, 517, 909	1873	2, 094, 312
1861	834, 630	1874	2, 503, 504
1862	743, 358	1875	2, 275, 265
1863	1, 134, 150	1876	2, 495, 800
1864	1, 402, 828	1877	2, 677, 460
1865	1, 580, 791	1878	2, 797, 530
1866	1, 704, 212	1879	2, 623, 232
1867	1, 202, 908	1880	3, 361, 934
1868	1, 812, 040	1881	3, 450, 186
1869	2, 100, 504	1882	4, 057, 384
1870	2, 303, 856	1883	4, 339, 492
1871	1, 944, 852	1884	3, 170, 900
1872	2, 291, 220	1885	3, 298, 200

The price of Monongahela coal has been very low in the Louisville and Cincinnati markets, where it has ranged from 5½ to 7½ cents per bushel, wholesale price. The average price for mining was 2½ cents per bushel, and the average value of the coal during the year was probably 5 cents per bushel at the point of delivery.

In Westmoreland county are located the celebrated Penn and Westmoreland gas coals, near Penn and Irving stations, on the line of the Pennsylvania railroad. This coal is much similar to that from the Youghiogheny mines on the Baltimore and Ohio railroad.

Westmoreland coal carried by the Pennsylvania railroad since 1874.

Years.	Short tons.	Years.	Short tons.
1874	952, 971	1880	943, 177
1875	796, 968	1881	982, 293
1876	906, 139	1882	1, 278, 121
1877	786, 039	1883	1, 399, 702
1878	692, 586	1884	1, 320, 186
1879	816, 302	1885	1, 293, 813

The Snowshoe coal region is located in Centre county. The Lehigh Valley Coal company is the operator in this region, and during 1885 there were 148,500 tons of coal and 25,643 tons of coke shipped from the district over the Pennsylvania railroad.

Shipments of coal since 1873.

Years.	Short tons.	Years.	Short tons.
1873	95, 257	1880	56, 020
1874	63, 540	1881	128, 263
1875	62, 426	1882	233, 708
1876	51, 399	1883	257, 230
1877	42, 985	1884	183, 271
1878	29, 168	1885	148, 500
1879	56, 654		

The collieries in Blair and Cambria counties, along the line of the Pennsylvania railroad and its branches, during 1885 produced about 150,000 tons.

In McKean county, in the northwestern part of the State, the production of coal is rapidly diminishing. The beds are much thinner and the coal much poorer than that in the counties to the south and southwest. The Bureau of Statistics reports the production of this county for 1885 as 44,312 tons.

Production of McKean county for the past ten years.

Years.	Short tons.	Years.	Short tons.
1875	33, 501	1881	110, 099
1876	81, 830	1882	73, 834
1877	73, 222	1883	84, 899
1878	72, 098	1884	78, 870
1879	85, 745	1885	(*a*) 44, 312
1880	100, 046		

a Reported by Bureau of Statistics.

In Jefferson and Elk counties rapid developments have been made in the coal fields during the past two years. In these two counties is reported some of the best and most available coal lands in western Pennsylvania, notable among which is the Shawmut tract. No detailed statistics are at hand, however, in regard to their production.

From the Myersdale district, in Somerset county, the production in 1885 is reported at about 200,000 tons, nearly 70,000 tons less than the amount produced in 1884.

In the Blossburg region, Tioga county, there were produced in 1885 1,074,581 tons, divided between the different companies as follows:

	Tons.
Blossburg Coal Company	264,452
Morris Run Coal Mining Company	400,722
Fall Brook Coal Company	409,407

This region was first developed in 1840. The total amount of coal which has been produced since that date by the principal companies, has been as follows:

	Tons.
Arbon Coal Company, 1840–'43	49,633
William H. Mallory, 1844–'57	405,113
D. S. Megee, 1856–'59	78,996
Tioga Transportation Company	323,174
Salt Company, of Onondaga, 1863–'66	267,809
Morris Run Coal Company, 1864–'85	6,450,663
Fall Brook Coal Company, 1860–'85	6,293,780
Blossburg Coal Company, 1866–'85	4,469,635
Total	18,338,803

Production of the Blossburg district since 1872.

Years.	Tons.	Years.	Tons.
1872	849,262	1879	874,010
1873	991,057	1880	921,555
1874	796,388	1881	1,178,581
1875	581,782	1882	1,165,604
1876	616,984	1883	1,217,870
1877	602,245	1884	1,018,342
1878	652,597	1885	1,074,581

In Bradford county the two principal operating companies are the Towanda Coal Company and the Long Valley Coal Company. The latter produced 48,814 tons during 1885.

Production of the Towanda Coal company since 1865.

Years.	Tons.	Years.	Tons.
1865	6,886	1876	160,343
1866	3,881	1877	164,344
1867	27,668	1878	165,025
1868	67,080	1879	237,608
1869	176,307	1880	246,064
1870	196,310	1881	223,172
1871	249,240	1882	210,917
1872	263,960	1883	226,806
1873	252,329	1884	181,786
1874	215,572	1885	246,397
1875	200,424		

Between 1856 and 1867 the Barclay Coal Company mined 412,640 tons of coal from their property, which was subsequently leased and worked by the Towanda Coal Company.

The Schrader Coal Company's property adjoins that of the Towanda Coal Company. It is now exhausted.

Production of the Schrader Coal Company from 1874 to 1884 inclusive.

Years.	Tons.	Years.	Tons.
1874	100, 219	1880	216, 802
1875	157, 686	1881	210, 654
1876	200, 795	1882	156, 956
1877	175, 755	1883	107, 870
1878	149, 285	1884	75, 074
1879	144, 946		

The mines of the McIntyre Coal Company at Ralston, in Lycoming county, Pennsylvania, on the line of the Northern Central railway, are now abandoned. The company began operations in the year 1870, 17,802 tons being shipped during that year, and operations ceased in October, 1884.

Production of the McIntyre Coal Company.

Years.	Tons.	Years.	Tons.
1871	166, 138	1878	154, 205
1872	171, 420	1879	127, 632
1873	212, 462	1880	216, 225
1874	138, 907	1881	236, 922
1875	164, 507	1882	209, 858
1876	208, 701	1883	184, 552
1877	183, 715	1884	84, 274

Coal and coke originating on the line of the Pennsylvania railroad division and forwarded from the districts named; also tonnage originating on other lines passing over the Pennsylvania railroad division for the year 1885.

	Coal.	Coke.	Total.
Originating on the line of Pennsylvania railroad division.	*Short tons.*	*Short tons.*	*Short tons.*
Snow Shoe, semi-bituminous	148, 500	25, 643	174, 143
Karthaus, semi-bituminous	120, 969	....	120, 969
Tyrone and Clearfield, semi-bituminous	2, 873, 876	....	2, 873, 876
Gallitzin and Mountain, semi-bituminous	550, 244	193, 091	743, 335
West Pennsylvania railroad, semi-bituminous	219, 750	64, 901	284, 651
Southwest Pennsylvania railroad, semi-bituminous	102, 689	1, 999, 923	2, 102, 612
Westmoreland region, semi-bituminous	1, 293, 813	252, 397	1, 546, 210
Monongahela region, semi-bituminous	267, 502	108, 706	376, 208
Pittsburgh region, semi-bituminous	236, 703	....	236, 703
North and West Branch railroad, anthracite	1, 294, 334	....	1, 294, 334
Sunbury, Hazleton and Wilkesbarre railroad, anthracite	321, 192	....	321, 192
Total	7, 429, 572	2, 644, 661	10, 074, 233
Originating off the line of the Pennsylvania railroad division.			
Anthracite	3, 087, 831	....	3, 087, 831
Semi-bituminous	1, 062, 193	57, 652	1, 119, 845
Total for 1885	11, 579, 596	2, 702, 313	14, 281, 909
Total for 1884	10, 454, 215	2, 846, 126	13, 300, 341

The roads covered by this statement are the main line from Philadelphia to Pittsburgh and the branches in Pennsylvania; the Philadelphia and Erie is not included. It will be seen that 64 per cent. of the coal carried, and 98 per cent. of the coke—71 per cent. of the entire tonnage—originated on the company's lines.

There is such sharp competition in the bituminous coal trade of the Atlantic seaboard and prices are so fluctuating that it is almost impossible to report an average price for the year of any one coal or the coals of any one State. The "Engineering and Mining Journal," referring to bituminous prices for 1885, says:

"Early in the season the announcement was made that the Pennsylvania and Baltimore and Ohio railroads had decided upon forming a pool, in which the former road would have 55 per cent. of the tidewater business and the latter 45 per cent. This arrangement was to go into effect on March 1. Under it shippers would be compelled to charge for their coal as follows: At Baltimore, $2.25 per ton free on board; at Philadelphia, $2.40 free on board; at New York, $3.25 alongside; and at Boston, $3.50 per ton. The railroad tolls were supposed, upon this basis, to leave shippers about 80 cents a ton for their coal at the mines, and the main line of railroads 3 mills per ton per mile. A commissioner to supervise the workings of the pool was appointed.

"The arrangement was said to have the sympathy of the Norfolk and Western, the Chesapeake and Ohio, and the Beech Creek roads, and this was natural, for it gave them a standard which they had only to 'cut' to take a large part of the trade. This was an opportunity they promptly availed themselves of, and the prices of coal throughout the early part of the season, and until all the usual large contracts had been placed, were quite irregular, and were in New York from 20 to 50 cents a ton below the 'pool prices.'

"Nominally the Baltimore and Ohio and Pennsylvania railroad shippers were to be deprived of low rates and otherwise punished if they 'cut' the pool prices; but the practical working of these arrangements is always understood by the favored few insiders, so that Clearfield and Cumberland coals were sold in New York at $3.15, while some other coals, such as Elk Garden, were sold even in February as low as $2.85 per ton alongside in this city, and in Boston this and other coals were offering at $3.15 to $3.40 a ton. By the end of the month this coal was selling alongside here at $2.75 a ton. About this time it was announced that the West Shore railroad had contracted with a Clearfield firm for 100,000 tons at 9 cents a ton less than the Beech Creek bid. About the middle of March it was reported that the Long Island railroad had contracted for from 25,000 to 40,000 tons of Clearfield coal to be delivered in gondolas at Long Island City at about $2.75.

"Before the end of the month the Pacific Mills contract for the Maryland Coal company's Cumberland coal at the pool price was announced and that of the Portland and Rochester railroad with the Consolidation Coal company at $3.45 a ton delivered. About the middle of April it was stated that the New York and New Haven railroad had contracted with Messrs. J. C. Scott & Co., of the Clearfield district, for 30,000 tons, and with the Pocahontas company for 50,000 tons.

"By this time it became evident that the pool was a failure, and it was said that Clearfield coal sold at $2.70 to $2.80 alongside in this city, and the announcement was made that the National line contract for about 40,000 tons was taken at $2.85. The Hamburg line contracted for about 60,000 tons at a low price. The Hoboken Ferry company secured from 12,000 to 15,000 tons of Clearfield coal at $2.90.

"Early in May Pocahontas coal was offered in Troy at $3.15 a ton. During the latter part of this month Clearfield coal was offered at Newark, New York, on the West Shore road, at very low prices. All rail coal sold in North Adams, Mass., at $3.25 per ton. At this time the Inman line contract for about 40,000 tons, and another with a sugar house for 15,000 tons, went to the Clearfield district. Early in June the Pacific Mail Steamship Company contracted for about 20,000 tons of Beech Creek coal at about $2.75 a ton.

"July opened with Beech Creek coal offered here at $2.60 a ton alongside. Outside of the Alexandre line contract for about 25,000 tons secured by a Clearfield firm, there was little of importance until September, when Beech Creek coal sold at $2.50 a ton alongside steamer. This, we believe, was the bottom of prices, and from this time until the end of the year the business was of an unimportant character, although aggregating a large amount. Under the improving condition of general business, scarcity of cars, &c., prices had a slight inclination to stiffen toward the close of the year, with a more marked tendency that way for the better classes of coals.

"Although there were exceptional cases of lower prices, Cumberland coal sold, as a rule, at $3.15 to $3.25 alongside, New York, and at $2.20 to $2.25 at Georgetown and Baltimore. Clearfield and Pocahontas coals brought about 25 cents less, and Beech Creek about 50 cents less.

"The pool was a complete failure, (1) because it did not include the Chesapeake and Ohio, Norfolk and Western, and the Beech Creek roads, which were waiting for any opportunity to increase their business at any cost, and (2) because of the attempt to fix prices.

"The result of the year's business was alike unsatisfactory to those in, as well as those out of the pool, and all are anxious for some arrangement that will bring about a higher range of prices. The companies outside of the pool made less money on a greatly increased business than they did the year before. Vessel freights became very low during last year, $1.25 to $1.05 being accepted from Baltimore to points east of the Cape."

TENNESSEE.

The mining of coal in Tennessee on any considerable scale, has been confined to the last fifteen or twenty years. Previous to 1860, coal was very little used outside of Nashville and Memphis, except for blacksmith purposes, and much of that then used was brought from Pittsburgh.

The mining law of the State makes no provision for the collection of statistics, and it is impossible to make any exact estimate of the amount of coal produced in the State, on account of the reluctance shown by the coal operators to furnish this information.

Mr. Saward reports that during 1885 the production was 1,440,957 tons. In this he has probably included the coal used for coke, since Mr. J. C. Guild, State mine inspector, reports the production of coal as 1,000,000 tons and of coke 268,425 tons. The following is Mr. Guild's report on the statistics of coal for 1885:

"District I includes those mines near the Nashville, Chattanooga and Saint Louis railway, namely, the Tennessee Coal, Iron and Railroad Company, and the Etna Coal Company. Coal produced, 162,370 tons; Coke, 115,605 tons.

"District II includes those on or near the line of the Cincinnati Southern railroad, namely, the Tabler-Crudup Coal and Coke Company, the Soddy Coal Company, Walden Ridge Mining Company, Dayton Coal and Iron Company, Roane Iron Company, Poplar Creek Coal Company, Mount Carbon Coal Company, Winter's Gap Coal Company, Eureka Coal Company, Oliver Coal Company, and Glen Mary Coal and Coke Company. Coal produced, 486,334; coke, 152,820 tons.

"District III includes the mines situated on the Knoxville and Ohio division of the East Tennessee, Virginia and Georgia railroad, namely, the Standard Coal and Coke Company, Jellico Mountain Coal and Coke Company, Knoxville Iron Company, Coal Creek Consolidated Mining company, Coal Creek Coal Company, New River Coal Company, and Heck and Petree. Coal produced, 351,296 tons.

"Twenty-two hundred miners alone, and about three thousand five hundred persons altogether, are given employment directly by the mining industry of the State of Tennessee. As near as can be estimated, between twelve thousand and fifteen thousand persons are dependent upon this industry.

The distribution of mines by counties is shown in the following table:

Distribution of coal mines in Tennessee, by counties.

District.	Counties.	County seat.	Number of companies.	Number of openings.
I	Grundy	Altamont	1	9
	Marion	Jasper	1	1
II	Hamilton	Chattanooga	3	6
	Rhea	Washington	1	3
	Rhone	Kingston	1	1
	Anderson	Clinton	5	5
	Scott	Huntsville	1	1
III	Campbell	Jacksboro'	2	2
	Anderson	Clinton	5	6
	Total		20	34

"The total production of coal in this State during the year 1885, amounted to 1,000,000 tons; coke, 268,425 tons. In District III no coal is coked, all being used for domestic and manufacturing purposes. Neither is any coke made at the Poplar Creek mines, in District III, which is also all sold for domestic purposes."

The coal and iron interests of this State are intimately associated; the coal mined at many of the mines being altogether used for the manufacture of coke as fuel for blast furnaces. This branch of the industry has shown the most marked improvement. In the year 1870, there were in the State only two companies using coke ovens, the Etna Coal Company, and the Roane Iron Company, at Rockwood, and both of these together had only thirty ovens. In 1883, there were 1,000 coke ovens in the State, showing a wonderful increase in thirteen years. At the present time there are about 1,254 ovens, which number will be considerably increased during the summer. These are distributed as follows:

	Ovens.
Tennessee Coal, Iron and Railroad Company	534
Etna Coal Company	65
Tabler-Crudup Coal and Coke Company	50
Walden Ridge Mining Company	25
Shoddy Coal Company	175
Dayton Coal and Iron Company	200
Roane Iron Company	180
Glen Mary Coal and Coke Company	25

These ovens produce 268,425 tons of coke per annum.

Wages paid for mining coal.– The wages paid the miners for mining coal in Tennessee are generally fair and just, though quite a number of strikes have occurred, which, in the majority of cases, have been settled by arbitration, the miners returning to work.

The price per ton differs greatly at the different mines, being fixed by the thickness of the coal and the ease with which it is mined.

Prices paid for mining coal in Tennessee.

	Cents per ton.		Cents per ton.
Tennessee Coal, Iron and Railroad company. (*a*)	39	Mount Carbon Coal Company	50 to 75
Etna Coal Company	70	Eureka Coal Company	50 to 75
Tabler-Crudup Coal and Coke Company	60	Oliver Coal Company	50 to 75
Shoddy Coal Company	55 to 60	Glen Mary Coal Company	75
Walden Ridge Mining Company	55 to 65	Standard Coal Company	75
Dayton Coal and Iron Company	60 to 100	Coal Creek Consolidated Mining Company	62½
Roane Iron Company	37½	Coal Creek Mining Company	62½
Poplar Creek Coal Company	50 to 75	New River Coal Company	62½
Knoxville Iron Company (*b*)	....	Heck and Petree	62½
Winter's Gap Coal Company	75		

a For run of mine. *b* All convicts.

Half a million dollars is paid annually in this State to miners for mining coal alone, exclusive of all money paid for outside labor. It is impossible to give any reliable figures as to the amount of money put in circulation by the mining industry, but the amount probably exceeds $1,000,000 annually in this State.

The mines of this State employ 3,500 men altogether, of whom 2,200 are miners for support. The coal miners can make from $1.50 to $5 per day, according to skill and industry. They are, as a class, prosperous and frugal.

The following table, compiled by Mr. Guild, gives analyses of coals from prominent openings and of coke made from certain coals:

Analyses of Tennessee coals.

Name of coal.	Fixed carbon.	Volatile matter.	Ash.	Sulphur.	Water.	Phosphorus.	
Coal Creek	57.520	38.82	3.090	0.200	1.040		
Do	57.690	37.80	2.550				
Poplar Creek	60.670	36.53	1.750	0.780	1.750		Potter & Riggs.
Do	59.470	40.00	0.530	1.260			Joliet I. and S. Co.
Careyville (new mine)	56.850	38.89	3.190		1.070		
Helenwood	54.240	41.29	2.640		1.830		
Jellico	60.600	36.44	1.600	1.160	2.360		Dr. Peter.
Poplar Creek	56.120	39.33	2.810		1.240		Regis Chauvenet.
Crooke Coal and Coke Company.	61.660	34.53	2.140	0.088	1.670	0.017	Furnished by Mr. H. S. Chamberlain, president Roane Iron Company. No analysis given.
Roane Iron Company (Rockwood).	60.110	26.62	11.520	1.049	1.750		
Roane Iron Company	60.750	32.59	5.270		1.390		
Stanley (near Chattanooga)	61.730	26.70	10.210	0.530	1.360		
Sewanee (Tracy mines)	62.000	25.41	10.820		1.770		Robertson.
Do	63.500	29.90	6.600	Trace.			H. T. Yaryan.
Soddy mines (Sewanee seam)	64.390	27.82	6.640		1.150		
Emery mines (Sewanee seam)	63.100	27.70	7.700	0.530	0.150		Prof. T.E. Wormley.
Etna mines (Kelly seam)	74.200	21.39	2.700	0.700	1.300	0.005	McCreath & Pohle.

Analyses of Tennessee cokes.

Name of coal.	Fixed carbon.	Ash.	Sulphur.	Moisture.	Phosphorus.	
Sewanee seam (Tracy City)	83.364	15.440	0.142			W. J. Land.
Etna (Kelly)	94.560	4.650	0.790		0.008	University of Cincinnati.
Rockwood	84.187	14.141	0.182			W. J. Land.
Dayton	84.150	14.880				
Poplar Creek	90.060	5.000	0.570	0.010	0.010	Potter & Riggs.
Do	95.240	4.760				Regis Chauvenet.

TEXAS.

It is estimated that the production of the coal mines of the State for 1885 was 150,000 tons. No detailed statistics are collected by any of the State departments upon which a more exact estimate can be based.

It is said that coal exists in 33 counties. Outside of the coal which has been worked in a small way for local use, mining has been confined to Webb, Milan, and Bexar counties. In the vicinity of Laredo, on the Rio Grande, extensive mines have been opened. The coal beds, however, are thin, being only 18 and 26 inches thick respectively. There is a report, however, that a coal bed exists beneath these two, which is 50 inches thick. Mining has been paid for at the rate of $1.50 per ton.

These mines being near the Rio Grande, it would appear that their production must still increase. The Rio Grande and Pecos railroad has recently been built and several coal mines have been opened along the line of the road, about 25 miles west of the city of Laredo. At Santo Tomas, 29 miles from Laredo, a mine is worked where the seam of coal is reported to be 30 inches in thickness.

In a report on the Brazos coal field, by Mr. C. A. Ashburner, geologist in charge of the Pennsylvania survey, he says:

"Coal has been reported to have been found in El Paso and Presidio counties along the Rio Grande, but nothing has been authentically stated as to the extent of the areas or the value of the beds.

"Tertiary lignites, or lignitic coals, are said to exist in the following counties: Rush, Harrison, Cass, Grayson, Bastrop, Fayette, Caldwell, and Guadalupe.

"The Brazos coal field is the southwestern limit of the Missourian or fourth bituminous coal basin of the United States. The coal measures of Stephens and Young counties belong to the Carboniferous age. The coal strata proper are 85 feet thick, and are included between an upper sandstone and conglomerate, representative of the Millstone grit or Pottsville conglomerate, No. XII. of the Pennsylvania series, and a lower gray limestone representative of the Mountain limestone or Chester and Saint Louis limestone of the Mississippi valley. The coal strata contain two coal beds of workable thickness. The upper bed, named Belknap, ranges from 2½ to 4 feet, and the lower, named Brazos, from 4 to 6 feet. The coals are high in ash and sulphur, but have never been thoroughly tested. The Brazos bed underlies a great area and will no doubt prove to be a valuable commercial coal in some localities."

UTAH.

The coal production of the Territory for the year was 213,120 tons, the bulk of which was mined from the San Pete County coal beds, located chiefly in Pleasant valley. This is bituminous coal of a fair quality, and has within the past two years taken the place, in the Utah market, of the Wyoming coals. The remainder of the coal product comes from the Grass Creek and Weber mines, in Summit county, the latter being owned by the Home Coal Company.

Product by companies.

Name.	Tons.
Pleasant Valley Coal Company	78,996
Utah Central Coal Company	42,865
San Pete Coal and Coke Company	17,000
Grass Creek Coal Company	52,000
Home Coal Company	22,259
Total	213,120

The Pleasant Valley company has four coal beds opened, three of them being at Winter Quarters and one at Mud creek on the line of the Denver and Rio Grande Western railway, and the product of these mines has been shipped to the coal mines, to the railroad company, and to the towns along the line of the road which reaches them, at an average cost of $5 per ton. The company employs an average of 150 men and pay 70 and 80 cents for breaking the coal, which is worth $2 per ton delivered on the cars.

The Utah Central company, whose mines are also located in Pleasant valley, finds a domestic ("house") market for all of its product. It employed an average of 75 men during the year, paid 70 and 80 cents for mining, and delivered its coal on the cars at $2 per ton.

The San Pete Coal and Coke Company, with its own road, 30 miles long, tapping its mines and connecting with the Utah Central railroad, has been unable to compete in the market with the other companies, because it is not owned and controlled by one of the large railroad companies, and is therefore kept out of the coal pool.

The Grass Creek mines are operated by the Union Pacific Coal Company, and the entire product of these mines is consumed in Utah. Twenty men are employed, and the price paid for breaking the coal is the same as in the Pleasant Valley mines. In the market this coal is known as the "Weber."

The Home Coal Company pays 90 cents per ton for mining, and loads its coal on cars for $2. The whole product of this company is shipped to Park City, in Summit county, where the bulk of it is used at the Ontario stamp mill.

A small amount of Coloradó hard coal finds a market in Utah, while Wyoming continues to supply about one-fourth of the coal consumed in the Territory.

VIRGINIA.

According to Maj. Jed. Hotchkiss, the production of coal in the State for 1885 was as follows:

Production of coal in Virginia in 1885.

	Short tons.
1. Semi-bituminous coking and steam coal, from Pocahontas mines, Tazewell county	511,575
2. Bituminous coal from Richmond basin, Chesterfield, Powhatan, and Henrico counties, about	50,000
3. Mines, in Vespertine (No. X.) anthracite, semi-anthracite, &c., mainly in southwest valley of Virginia, about	5,000
4. Bituminous coal, for local use, in Appalachian region of southwest Virginia, about	425
Total production	567,000

The coal mined from the Richmond basin occurs in the Triassic formation. Very thin seams (1 inch, more or less) of coal have recently been found in this same geological formation in the vicinity of Phœnixville, Pennsylvania. The Deep River and Dan River coal beds in North Carolina are found in the same Triassic formation.

WASHINGTON TERRITORY.

The coal of the Territory comprises its principal mineral resource. Outcrops of coal occur in almost every portion of western Washington, indicating its general distribution. On the Columbia river lignite or brown coal appears in thin seams, extending continuously northward; the quality improving toward the north. The experience of a quarter of a century demonstrates the value of Washington Territory coal for economical and commercial purposes; its mines have been profitably worked, and its coals rank among the best on the Pacific slope.

In the fall of 1852 coal was discovered on Bellingham bay. From the first mines 150 tons were shipped to San Francisco. The mine of the Bellingham Bay company was discovered in 1853, and opened the succeeding year. The San Francisco company which operated this mine continued the only exporter of coal from the Territory down to 1870. In 1871 the exportation of coal commenced at Seattle. As early as 1854, coal mining had been pursued on Black river by Dr. Bigelow, but to no great extent. Concerning the coal mines the *Oregonian* says: "The Seattle, Renton, and Talbot mines are in the vicinity of Seattle. The coal of all these mines is of the lignite variety, well adapted to steam and domestic purposes. The Seattle mine was discovered in 1866 by R. H. Lewis, who sold it for $30,000. The first shipment of coal was made to San Francisco in 1870, on the bark Moneyick, consisting of 405 tons. In 1874 the product was 50,000 tons; from July 1, 1878, to July 1, 1879, 155,900 tons. During the year ending December 31, 1879, 137,207 tons of coal were produced. In 1874 the Renton mine was opened, producing during 1875 and 1876 25,000 tons of coal annually. The Talbot mine, opened in 1875, produced, in 1879, 18,000 tons of coal."

The mining of coal is at present confined to King and Pierce counties. From January 1, 1884, to November 1, 1885, the King County coal mines yielded 413,315 tons. From January 1, 1884, to July 1, 1885, the Pierce county mines yielded 267,884 tons. From that date the Pierce county mines reduced their export until December, 1885.

The output of coal from Washington Territory mines during the year ended June 30, 1885, was 380,250 tons, from the following mines: Newcastle, 149,048; Renton, 30,397; Cedar River, 14,573; Black Diamond, 10,562; Carbon Hill, 135,926; South Prairie, 34,313; Tacoma, 5,431. The Newcastle, Renton, Cedar River, and Black Diamond mines are in King county; the Carbon Hill, South Prairie, and Tacoma mines in Pierce. During the year 1885, the *Oregonian* says, the King County mines yielded 204,480 tons; the Pierce county mines 175,770. The Cedar River and Black Diamond are new mines, the others are old ones. During the year 1886 the new Franklin mine will swell the production of King county coal.

About 2,500,000 tons of coal have thus far been mined in Washington Territory, 1,700.000 of which were from the mines of King county;

about half of the remainder from Pierce county, and the other half from Whatcom.

WEST VIRGINIA.

The following estimate of the coal production has been carefully made by H. J. Tucker, inspector of mines, from the most reliable data obtainable, and it is believed that it does not differ materially from the true amount. An effort was made to obtain from each operator a statement of the output of his mine, but in several cases such statements were not furnished. The production of such mines as failed to report have, however, been estimated and included in the totals.

There are a number of small mines in the State employing about ten or less miners each, from which the returns were too meager to make even an estimate of their production, and they were not considered in the calculation.

	Long tons.	
Output of the mines on the West Virginia and Pennsylvania railroad	400, 035	
Output of the mines in the northern part of the State, including the mines of Mason county	645, 500	
Total output of the northern part of the State		1, 045, 535
Output of the Flat Top (Mercer county) mines	147, 484	
Output of the Kanawha and New River mines	1, 815, 072	
Total output of the southern part of the State		1, 962, 556
Total		3, 008, 091

Coke production in West Virginia in 1885.

Coke produced in the northern part of the State	54, 671
Coke produced in the southern part of the State	112, 846
Total	167, 517

The following is an official statement of the coal and coke tonnage of the Chesapeake and Ohio railway during the year:

Kind of coal:	Short tons.	
Cannel	29, 260	
Gas	298, 251	
Splint and block	101, 315	
New River	526, 182	
Total quantity of coal		965, 008
Coke		112, 843
Total quantity of coal and coke		1, 077, 851

WYOMING.

No new coal field was opened in Wyoming during 1885. The amount of coal produced was not as great as in 1884, due to the disastrous strikes, arising from the Chinese riots at the Rock Spring mine in September. As a result of this strike, the product of the Colorado Coal and Iron Company's mines was increased by nearly 1,000 tons per day, sold to the Union Pacific railroad in Colorado during the strike, while a correspondingly large demand was made upon the Iowa coal mines to supply the Nebraska divisions of the road.

Many new openings of coal have been made, but their distance from railways and the want of superiority of the coal to that at the opened coal mines, has prevented any development.

The production of the various mines in Wyoming from the time of opening to the close of the year 1885 has been as follows:

Product of the Carbon mines, Wyoming.

Years.	Short tons.	Years.	Short tons.
1868	6,560	1877	74,343
1869	30,482	1878	62,418
1870	54,915	1879	75,424
1871	31,748	1880	100,433
1872	59,237	1881	156,820
1873	61,164	1882	200,123
1874	55,880	1883	248,380
1875	61,750	1884	319,883
1876	69,060	1885	226,863

Product of the Rock Spring mines, Wyoming.

Years.	Short tons.	Years.	Short tons.
1868	365	1877	146,494
1869	16,933	1878	154,282
1870	20,945	1879	193,252
1871	40,566	1880	244,460
1872	34,677	1881	270,425
1873	44,700	1882	287,510
1874	58,476	1883	304,495
1875	104,664	1884	318,197
1876	134,952	1885	328,601

Product of the Union Pacific mines at Almy, Wyoming.

Years.	Short tons.	Years.	Short tons.
1869	1,967	1878	59,096
1870	12,454	1879	71,576
1871	21,171	1880	100,234
1872	22,713	1881	110,157
1873	22,847	1882	117,211
1874	23,006	1883	111,713
1875	41,805	1884	150,880
1876	60,756	1885	164,441
1877	54,643		

Product of the Central Pacific mines at Almy, Wyoming.

Years.	Short tons.	Years.	Short tons.
1870	16,981	1878	57,404
1871	53,843	1879	60,739
1872	105,118	1880	82,684
1873	130,989	1881	90,779
1874	181,699	1882	94,065
1875	92,589	1883	78,450
1876	69,782	1884	68,471
1877	67,373	1885	70,216

The Twin Creek mine was worked for a short time only during 1885. The coal from this mine is much inferior to that from Rock Spring and Almy, containing large quantities of water and ash. The product at this mine has been as follows:

	Short tons.
1882	8,855
1883	36,651
1884	45,189
1885	17,207

RECAPITULATION.

Years.	Carbon.	Rock Spring.	Almy.		Twin Creek.	Total.
			Union Pacific mines.	Central Pacific mines.		
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1868	6,560	365				6,925
1869	30,482	16,933	1,967			49,382
1870	54,915	20,945	12,454	16,981		105,295
1871	31,748	40,566	21,171	53,843		147,328
1872	59,237	34,677	22,713	105,118		221,745
1873	61,164	44,700	22,847	130,989		259,700
1874	55,880	58,476	23,006	81,699		219,061
1875	61,750	104,664	41,805	92,589		300,808
1876	69,060	134,952	60,756	69,782		334,550
1877	74,343	146,494	54,643	67,373		342,853
1878	62,418	154,282	59,096	57,404		333,200
1879	75,424	193,252	71,576	60,739		400,991
1880	100,433	244,460	100,254	82,684		527,811
1881	156,820	270,425	110,157	90,779		628,181
1882	200,123	287,510	117,211	94,065	8,855	707,764
1883	248,380	304,495	111,713	78,450	36,651	779,689
1884	319,883	318,197	150,880	68,471	45,189	902,620
1885	226,863	328,601	164,441	70,216	17,207	807,328

The number of employés in the coal mines varies greatly from summer to winter. The greatest number of men employed is about 1,100. The wages paid vary from 90 cents to $1.10 per ton of coal. The value of the product of the Territory in 1885 at $3 per ton is $2,421,984.

THE MANUFACTURE OF COKE.

BY JOSEPH D. WEEKS.

The same restricted use of the word "coke" that has prevailed in previous reports obtains in this as well. The only coke reported upon is that made from bituminous coal in ovens, pits, ricks, or "on the ground," and which, for convenience, may be termed "oven coke." No attempt was made to gather the statistics of "gas coke," or that which is the residual product of the manufacture of gas.

The unit of quantity throughout this chapter is the short ton of 2,000 pounds.

The measures of the great Appalachian basin still furnish by far the largest proportion of the coal used in the manufacture of coke in the United States. Of the 8,071,126 tons of coal burned into coke in 1885 but 283,070 tons, or about 3 per cent., came from other coal fields. Of this 283,070 tons, 239,958 tons were from what may be termed the Colorado basin, including the coal fields of Colorado and New Mexico; 21,487 tons from the Illinois basin; 20,781 tons from the Missouri basin, which would include that used in Kansas and the Indian Territory; 544 tons from Washington Territory, and 300 tons from Montana. It will thus appear that all of the coal used in the manufacture of coke in the United States, with the exception of less than 50,000 tons, came from the Appalachian and Colorado coal fields.

In the production of coke Pennsylvania still stands the first, 3,991,805 tons, or 78 per cent. of the 5,106,696 tons produced in the United States coming from its ovens. As will also appear from an examination of the details of the manufacture of coke in this State, several of its coking districts produce a greater tonnage than most of the States, at least two of the ten coking districts into which it is divided, the Connellsville and the Irwin-Latrobe, each producing an amount in excess of that produced in any State except Pennsylvania. Of these districts the most important not only in Pennsylvania, but in the United States, is the Connellsville, a small trough some 50 or 60 miles long by 3 miles wide. In the Connellsville region 3,096,012 tons of the 5,106,696 tons, or 61 per cent. of the coke produced in the United States in 1885, was made. In the Irwin-Latrobe district, which includes the ovens along the line of the Pennsylvania railroad from Larimer to Blairsville, 319,297 tons of coke were produced.

Two of the districts in Pennsylvania have shown a marked increase during the past year in the production of coke, notwithstanding the general depression in trade. These are the Allegheny Mountain district and what is called in this report, the Reynoldsville-Walston. The production in the Allegheny Mountain district increased from 156,290 tons in 1884 to 212,242 tons in 1885, an increase of more than one-third; the production in the Reynoldsville-Walston district increased from 78,646 tons in 1884 to 114,409 tons in 1885, an increase of over 50 per cent. In no coking district in the country has there been such a growth in the past year, or such promise of growth for 1886 as in the last-named district. It will also appear from an inspection of the tables, given in connection with the other districts of Pennsylvania, that there has been a marked increase in production in the Snow Shoe district, but this is not at present as important as the others named.

Going southwardly there has been a gratifying increase in production in West Virginia, the amount of coke made increasing from 223,472 tons in 1884 to 260,571 tons in 1885, making last year's production some 3,000 tons in excess of the largest amount in any previous year. Should the developments in the Bluestone region fulfill their promise, this production may be largely increased during 1886.

The production of coke in Alabama is also the largest known in the history of its coke industry, it being 301,180 tons in 1885 as compared with 244,009 tons in 1884. Indeed, an inspection of the table of production will show that every year since 1880 has been marked by an increase in the production of coke in Alabama and that this is the only State of any prominence that has shown progress each year during this period.

In Ohio, Virginia, and Georgia, the other States in the Appalachian coal basin which produce coke, there has been a falling off in production during 1885 as compared with 1884.

But little need be said about the production of coke in the coal fields outside of the Appalachian. The production in the Colorado coal field, including in this field the ovens of Colorado and New Mexico, shows a slight increase, there being an increase of some 16,000 tons in Colorado, while that of New Mexico is about the same as in 1884. There has been a slight increase in the production of coke in the Missouri basin and a decrease in the production in the Illinois basin and in Washington Territory, but these districts are of but little moment at present.

Statistics of coking in the United States.—In the following table are consolidated the statistics of coking in the United States for the years 1880 to 1885. These relate not only to the production and value of coke, but also to the consumption of coal and its percentage yield in coke, as well as the number of establishments making coke, and the number of ovens built and building at the close of each year.

Statistics of the manufacture of coke in the United States, 1880 *to* 1885, *inclusive.*

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments..	186	197	215	231	250	233
Ovens built..................	12,372	14,119	16,356	18,304	19,557	20,116
Ovens building	1,159	1,005	712	407	812	432
Coal used, short tons........	5,237,741	6,546,662	7,577,648	8,516,670	7,951,974	8,071,126
Coke produced, short tons ..	3,338,300	4,113,760	4,793,321	5,464,721	4,873,805	5,106,696
Total value of coke at ovens.	$6,631,267	$7,725,175	$8,462,167	$8,121,607	$7,242,878	$7,629,118
Value of coke at ovens, per ton	$1.99	$1.88	$1.77	$1.49	$1.49	$1.49
Yield of coal in coke, per cent	63	63	63	64	61	63

From this table it appears that the number of establishments has increased in the six years covered by the report from 186 to 233; the number of ovens built from 12,372 to 20,116; the production of coke from 3,338,300 short tons to 5,106,696 short tons, and the coal consumed in the manufacture of the same, from 5,237,741 short tons to 8,071,126 short tons; the total value of the coke has increased from $6,631,267 to $7,629,118, but the average value per ton has decreased from $1.99 to $1.49, or 25 per cent.

While there has been this marked increase from 1880 to 1885 in all the items included in this table, except the average value of the coke per ton, the year 1885 is by no means the year of the highest production in the series. In 1883 the amount of coke produced, its total value, and the amount of coal consumed in its production were greater than during any other year before or since. The indications are that 1886 will show a production in excess of 1883.

Total number of coke works in the United States.—The following table gives the total number of establishments manufacturing coke in the United States at the close of each year from 1880 to 1885, inclusive. In this classification each separate coke works with its ovens and other associated plant is regarded as a separate establishment. In several instances, especially in the Connellsville coke region, it was found that an individual or a firm operated several contiguous coke works; while in other cases two or more works, operated by the same parties, were widely separated. Notwithstanding this ownership by the same party of more than one bank of ovens, each bank is regarded as an establishment, and is so classified. It has been difficult, in some cases, to determine whether ovens operated by the same owner on adjoining properties should be classified as one or more establishments. In such cases we have taken the report of the owner. The number of works, therefore, and the numbers of separate firms or owners are not the same.

Number of establishments in the United States manufacturing coke, from 1880 *to* 1885.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
Alabama	*a* 4	4	5	6	8	11
Colorado	1	2	5	7	8	7
Georgia	1	1	1	1	1	2
Illinois	6	6	7	7	9	9
Indiana	2	2	2	2	2	2
Indian Territory	1	1	1	1	1	1
Kansas	2	3	3	4	4	4
Kentucky	5	5	5	5	5	5
Montana	0	0	0	1	3	2
New Mexico	0	0	2	2	2	2
Ohio	15	15	16	18	19	13
Pennsylvania	124	132	137	140	145	133
Tennessee	6	6	8	11	13	12
Utah	1	1	1	1	1	1
Virginia	0	0	0	1	1	1
Washington	0	0	0	0	1	1
West Virginia	18	19	22	24	27	27
Total	186	197	215	231	250	233

a The number of establishments is the number December 31 of each year.

It will be noted from the above table that there has been a falling off in the total number of works at the close of 1885 as compared with the number at the close of 1884. This is due in part to the consolidation of works which in previous reports were regarded as separate establishments, but now are reported by their owners as one. In addition to these consolidations quite a number of works of but little importance, and usually in districts of but little rank as coke-producing centers, have passed out of existence. The chief reduction in the number of works is in Ohio and Pennsylvania, the number of establishments in the former State having been reduced from nineteen in 1884 to ten in 1885. The reduction in this State is chiefly due to the abandonment of works. In Pennsylvania the number of establishments has been reduced from 145 to 133. This reduction is due to both of the causes above named.

The number of establishments in the country for the years since 1850, for which there are any returns, was as follows:

Years.	Number.	Years.	Number.
1850 (census year)	4	1881, December 31	197
1860 (census year)	21	1882, December 31	215
1870 (census year)	25	1883, December 31	231
1880 (census year)	149	1884, December 31	250
1880, December 31	186	1885, December 31	233

Total number of coke ovens in the United States.—The following table gives the total number of coke ovens in the United States on December 31 of each of the years from 1880 to 1885, and also their distribution by States and Territories. In addition to the coke made in ovens some has been made in pits and on the ground; but as the number of pits varies greatly at different times, no attempt has been made to give their total number. The reports also show that much less "pit coke" was made in 1885 than in any of the previous years for which reports are given.

Number of coke ovens in the United States on December 31 *of each of the years from* 1880 *to* 1885.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
Alabama	316	416	536	767	976	1,075
Colorado	200	267	344	352	409	434
Georgia	140	180	220	264	300	300
Illinois	176	176	304	316	325	320
Indiana	45	45	37	37	37	37
Indian Territory	20	20	20	20	20	40
Kansas	6	15	20	23	23	23
Kentucky	45	45	45	45	45	33
Montana	0	0	0	2	5	2
New Mexico	0	0	0	12	70	70
Ohio	616	641	647	682	732	642
Pennsylvania	9,501	10,881	12,424	13,610	14,285	14,553
Tennessee	656	724	861	992	1,105	1,387
Utah	20	20	20	20	20	20
Virginia	0	0	0	200	200	200
Washington	0	0	0	0	0	2
West Virginia	631	689	878	962	1,005	978
Total	12,372	14,119	16,356	18,304	19,557	20,116

The number of coke ovens in the United States has increased during the year 1885 from 19,557, the number reported at the close of 1884, to 20,116. This increase is a small percentage, but it shows a gradual enlargement of the capacity of the country for the manufacture of coke. It will also be noted that in each of the years for which reports are given there has been an increase in the total number of ovens in existence over that of previous years.

The States having more than 1,000 ovens each in 1885 are Pennsylvania, with 14,553, or 76 per cent. of the total; Tennessee, with 1,387, or 6.9 per cent. of the total; and Alabama, with 1,075, or 5.3 per cent. of the total. West Virginia, which in 1884 had 5 over a thousand, now reports but 978, the relative position of this State and Alabama in respect to the number of ovens having changed.

Most of the ovens in use in the United States are of the beehive pattern, or a somewhat modified form of the beehive, known as the "drag," chiefly the former. The Belgian oven is held in much less favor in this country than formerly. Two quite large blocks of these ovens in western Pennsylvania that were reported in 1884 are now abandoned. At two other works in the same State where Belgian ovens have been built and tried, though the flue ovens have not been abandoned entirely, the new construction of the past two years has been of the beehive pattern. It is but fair to say, however, that with some West Virginia coal, the Belgian oven of the Soldenhof-Coppeé type, a bank of which is in operation at Hawk's Nest, is looked upon with favor. Mr. J. H. Bramwell, the mining engineer of the Bluestone Coal company, is of the opinion that this oven is well adapted to the coking of the coal from the Bluestone field. As yet no ovens of the Simon-Carvés type, or those adapted to the recovery of the waste products of combustion, have been built in this country, though some experiments have been made in coking American coal in them in England. The results of these experiments were fairly satisfactory, as far as relates to the recovery of the products and the yield of coke, but it was believed that the oven was too expensive in its first cost and possibly in its repairs to adapt it to economical use in view of the conditions prevailing in American coke fields.

Number of ovens building in the United States.—In the following table is given the number of ovens that were actually in course of construction in the United States at the close of each of the years from 1880 to 1885:

Number of coke ovens building in the United States at the close of each of the years from 1880 *to* 1885.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
Alabama	100	120	0	122	242	16
Colorado	50	0	0	0	24	0
Georgia	40	40	44	36	0	0
Illinois	0	0	0	0	0	0
Indiana	0	0	0	0	0	0
Indian Territory	0	0	0	0	0	0
Kansas	0	0	0	0	0	0
Kentucky	0	0	0	0	0	0
Montana	0	0	0	0	12	0
New Mexico	0	0	12	28	0	0
Ohio	25	0	0	0	0	0
Pennsylvania	836	761	642	211	232	317
Tennessee	68	84	14	10	175	36
Utah	0	0	0	0	0	0
Virginia	0	0	0	0	0	0
Washington	0	0	0	0	0	0
West Virginia	40	0	0	0	127	63
Total	1,159	1,005	712	407	812	432

There is no attempt in this table to show the increase in the total number of ovens, but only those building at the close of the year. The construction of ovens may have been undertaken and completed during the year, but this would not be shown in this table, but in the previous one, giving the total number of ovens at the close of the year. This table indicates in a slight degree the prospects of the industry at the close of the year. At the close of 1883, for example, there was but little encouragement for the building of works, and as a result there were but few ovens in course of construction when the report closed, December 31. At the close of 1880, however, the conditions were different and nearly three times as many were building. The close of 1885 finds about the same number building as at the close of 1883. Most of these are in Pennsylvania.

Total production of coke in the United States.—The production of coke in the United States for the years 1880 to 1885, inclusive, was as follows:

Amount of coke produced in the United States, 1880 *to* 1885, *inclusive, by States and Territories.*

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	60, 781	109, 033	152, 940	217, 531	244, 009	301, 180
Colorado	25, 568	48, 587	102, 105	133, 997	115, 719	131, 960
Georgia	38, 041	41, 376	46, 602	67, 012	79, 268	70, 669
Illinois	12, 700	14, 800	11, 400	13, 400	13, 095	10, 350
Indian Territory	1, 546	1, 768	2, 025	2, 573	1, 912	3, 584
Kansas	3, 070	5, 670	6, 080	8, 430	7, 190	8, 050
Kentucky	4, 250	4, 370	4, 070	5, 025	2, 223	2, 704
Montana	0	0	0	0	75	175
New Mexico	0	0	1, 000	3, 905	18, 282	17, 940
Ohio	100, 596	119, 469	103, 722	87, 834	62, 709	39, 416
Pennsylvania	2, 821, 384	3, 437, 708	3, 945, 034	4, 438, 464	3, 822, 128	3, 991, 805
Tennessee	130, 609	143, 853	187, 695	203, 691	219. 723	218, 842
Utah	1, 000	0	250	0	0	0
Virginia	0	0	0	25, 340	63, 600	49, 139
Washington	0	0	0	0	400	311
West Virginia	138, 755	187, 126	230, 398	257, 519	223, 472	260, 571
Total	3, 338, 300	4, 113, 760	4, 793, 321	5, 464, 721	4, 873, 805	5, 106, 696

The maximum production of coke in the United States was reached in 1883, when 5,464,721 tons were made. This declined in 1884 to 4,873,805 tons. The production of 1885 shows a gain upon that of 1884, the make in this year being 5,106,696 tons, or within less than 360,000 tons of the make in 1883.

Since coking became an industry in this country the bulk of the coke produced has been from the coals of Pennsylvania. The production of this State in 1884 was 78.4 per cent., in 1885 its production was 3,991,805 tons, or 78.2 per cent. of the total of 5,106,696 tons, showing a slight falling off during the past year in its percentage.

The following table gives the relative rank of the States and Territories in the production of coke in 1884 and 1885:

Rank of the States and Territories in production of coke in 1884 *and* 1885.

States and Territories.	1884.	1885.
Pennsylvania	1	1
Alabama	2	2
West Virginia	3	3
Tennessee	4	4
Colorado	5	5
Georgia	6	6
Virginia	7	7
Ohio	8	8
New Mexico	9	9
Illinois	10	10
Kansas	11	11
Kentucky	12	13
Indian Territory	13	12
Washington	14	14
Montana	15	15

The only changes are that Kentucky has dropped from the twelfth to the thirteenth place, and the Indian Territory, which occupied the thirteenth place in 1884, has risen to the twelfth.

Value and average selling price of coke.—In the following table are given the total value of coke produced in the United States and its average selling price per ton for each of the years from 1880 to 1885:

Total value at the ovens of the coke made in the United States in the years from 1880 to 1885, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
Alabama	$183, 063	$326, 819	$425, 940	$598, 473	$609, 185	$755, 645
Colorado	145, 226	267, 156	476, 665	584, 578	409, 930	512, 162
Georgia	81, 789	88, 753	100, 194	147, 166	169, 192	144, 198
Illinois	41, 950	45, 850	29, 050	28, 200	25, 639	27, 798
Indiana	0	0	0	0	0	0
Indian Territory	4, 638	5, 304	6, 075	7, 719	5, 736	12, 902
Kansas	6, 000	10, 200	11, 460	16, 560	14, 580	13, 255
Kentucky	12, 250	12, 630	11, 530	14, 425	8, 760	8, 499
Montana	0	0	0	0	900	2, 063
New Mexico	0	0	6, 000	21, 478	91, 410	89, 700
Ohio	255, 905	297, 728	266, 113	225, 660	156, 294	109, 723
Pennsylvania	5, 255, 042	5, 898, 579	6, 133, 698	5, 410, 387	4, 783, 230	4, 981, 656
Tennessee	316, 607	342, 585	472, 505	459, 126	428, 870	398, 459
Utah	10, 000	0	2, 500	0	0	0
Virginia	0	0	0	44, 345	111, 300	85, 993
Washington	0	0	0	0	1, 900	1, 477
West Virginia	318, 797	429, 571	520, 437	563, 490	425, 952	485, 588
Total	6, 631, 267	7, 725, 175	8, 462, 167	8, 121, 607	7, 242, 878	7, 629, 118

While this table gives the totals of the values as returned in the schedules, the figures do not always represent the same thing. A statement as to the actual selling price of coke at the ovens was asked for, and in most cases, including, possibly, 80 per cent. of all the coke produced, the figures are actual selling prices. In some cases, however, the value is an estimate. Considerable of the coke made in the United States is produced by the proprietors of blast furnaces for consumption in their own furnaces, none being sold. The value, therefore, given for this coke would be an estimate based, in some instances, where there are coke works in the neighborhood selling coke for the general market, upon the prices obtained for this coke. In other cases the value is estimated at the actual cost of coke at the furnace plus a small percentage for profit on the coking operation, while in still other cases the value given is only the actual cost of the coke at the ovens.

The preceding table gives the total value of the coke by States and Territories and also for the United States. In the following table is given the average value per short ton:

Average value per short ton at the ovens of the coke made in the United States in the years from 1880 to 1885, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
Alabama	$3 01	$3 00	$2 79	$2 75	$2 50	$2 50
Colorado	5 68	5 29	4 67	4 36	3 45	3 88
Georgia	2 15	2 15	2 15	2 20	2 13	2 04
Illinois	3 30	3 10	2 55	2 10	1 96	2 68
Indiana	0	0	0	0	0	0
Indian Territory	3 00	3 00	3 00	3 00	3 00	3 60
Kansas	1 95	1 80	1 70	1 96	2 02	1 65
Kentucky	2 88	2 89	2 83	2 87	3 94	3 14
Montana	0	0	0	0	12 00	11 72
New Mexico	0	0	6 00	5 50	5 00	5 00
Ohio	2 54	2 49	2 57	2 57	2 49	2 78
Pennsylvania	1 86	1 70	1 55	1 22	1 25	1 25
Tennessee	2 42	2 33	2 52	2 25	1 95	1 31
Utah	10 00	0	10 00	0	0	0
Virginia	0	0	0	1 75	1 75	1 75
Washington	0	0	0	0	4 75	4 75
West Virginia	2 30	2 30	2 26	2 19	1 19	1 86
Total average	1 99	1 88	1 77	1 49	1 49	1 49

As was explained in the report for 1884, the value of coke in certain localities in which but a small amount is produced, and that for local consumption, depends upon the price at which coke from other localities can be laid down. For example, the highest price per ton quoted in the table is $11.72, in Montana, while the lowest price is $1.25, in Pennsylvania. Intrinsically the Pennsylvania coke is superior to the Montana coke, and it is probable that the price of the Montana coke was regulated by the price at which Pennsylvania or Connellsville coke could be sold delivered to the smelters or founders of that Territory. It therefore by no means follows that the rate per ton at which coke sells is an evidence of its value as a fuel.

It is interesting to note that during the past three years there has been no change in the average value of the coke produced in the United States, it being $1.49 for this period. It hardly seems necessary to say that this average is obtained, not by taking the average of the prices given in this table, but by dividing the total value of the coke produced, given in the last preceding table, by the total number of tons of coke. In other words, the $1.49 is a true average price, not an average of prices.

Amount of coal consumed in the manufacture of coke.—In the following table is given the total number of tons of coal which entered into the manufacture of coke in the United States for the years from 1880 to 1885. In this statement is included all of the coal charged into the ovens, without any reference to its condition when so charged. A large proportion of the coal used is "run of the mine"; that is, all of the coal as it comes from the pit—lump, nut, and slack—is charged without screening into the ovens, the coal in these cases being mined only for the purpose of being made into coke. This is especially true of the Connellsville, the Alleghany Mountain, and the Reynoldsville-Walston districts in Pennsylvania, the New River district in West Virginia, and the Warrior district in Alabama, as well as several others. On the other hand, a large amount of coking, as will appear from the statement made in connection with the industry in different districts, is for the purpose of utilizing the slack coal produced in mining. This is true of the Pittsburgh district in Pennsylvania, as well as of many of the localities producing but a small amount of coke. It was not found practicable, however, as suggested above, to distinguish between the coal which was used as "run of the mine" and that which was used as "slack."

Amount of coal used in the manufacture of coke in the United States from 1880 to 1885, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	106, 283	184, 881	261, 839	359, 699	413, 184	507, 934
Colorado	51, 891	97, 508	180, 549	224, 089	181, 968	208, 069
Georgia	63, 402	68, 960	77, 670	111, 687	132, 113	117, 781
Illinois	31, 240	35, 240	25, 270	31, 370	30, 168	21, 487
Indiana	0	0	0	0	0	0
Indian Territory	2, 494	2, 852	3, 266	4, 150	3, 084	5, 781
Kansas	4, 800	8, 800	9, 200	13, 400	11, 500	15, 000
Kentucky	7, 206	7, 406	6, 906	8, 437	3, 451	5, 075
Montana	0	0	0	0	165	300
New Mexico	0	0	1, 500	6, 941	29, 990	31, 889
Ohio	172, 453	201, 145	181, 577	152, 502	108, 164	68, 796
Pennsylvania	4, 347, 558	5, 393, 503	6, 149, 179	6, 823, 275	6, 204, 604	6, 178, 500
Tennessee	217, 656	241, 644	313, 537	330, 961	348, 295	412, 538
Utah	2, 000	0	500	0	0	0
Virginia	0	0	0	39, 000	99, 000	81, 899
Washington	0	0	0	0	700	544
West Virginia	230, 758	304, 823	366, 653	411, 159	385, 588	415, 523
Wyoming	0	0	0	0	0	0
Total	5, 237, 741	6, 546, 662	7, 577, 646	8, 516, 670	7, 951, 974	8, 071, 126

It will be noted that during the past year there has been a small increase in the amount of coal consumed over that used in 1884, the production of coke having increased. The increase in coal consumed, however, is not as great proportionately as the increase in the production of coke, owing to the larger yield of the coal; that is, less coal was required per ton of coke made. The amount of coal necessary in 1885 to produce a ton of coke was 1.58 tons, or 3,160 pounds; in 1884 it was 1.63 tons, or 3,260 pounds.

Yield of coal in coke.—The table given below shows the average yield of the coal coked in the United States for the six years covered by this report. By the yield is meant the percentage of the constituents of the coal that remained in the coke after the process of coking.

Percentage yield of coal in the manufacture of coke in the United States in the years 1880 to 1885, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Alabama	57	59	58	60	60	59
Colorado	49	50	57	60	64	63
Georgia	60	60	60	60	60	60
Illinois	41	42	45	43	43	48
Indiana	0	0	0	0	0	0
Indian Territory	62	62	62	62	62	62
Kansas	64	64.4	65	62.9	62¼	53⅜
Kentucky	60	60	59	60	64	53
Montana	0	0	0	0	46	58½
New Mexico	0	0	66⅔	57¼	57½	56¼
Ohio	58	59	57	58	58	57
Pennsylvania	65	64	64	65	62	64.6
Tennessee	60	60	60	62	63	53
Utah	50	0	50	0	0	0
Virginia	0	0	0	64⅓	64¼	60
Washington	0	0	0	0	57½	57
West Virginia	60	61	63	63	62	63
Total average	63	63	63	64	61	63

Some of the percentages in this table are in part estimates. As has been stated, a great deal of the coal coked is slack, and this is frequently charged into the ovens without weighing. In such cases only an estimate of the amount used could be given.

There has been an increase in the average yield of coal in coke in 1885, as compared with 1884, of 2 per cent.; that is, the yield in 1884 was 61 per cent. and in 1885 63 per cent. This is due chiefly to the increased yield reported at the works in Pennsylvania. Attention was called in the last report to the fact that the apparent yield of coal in coke in this State dropped suddenly from 65 per cent. in 1883 to 62 per cent. in 1884. This, it was stated, was manifestly an error. As the yield in each of the years prior to 1884 was not less than 64 per cent., and in one case 65 per cent., it was estimated that the real yield in Pennsylvania in 1884 should be 64 per cent. The figures for 1885 justify this conclusion. It should be said in regard to these figures that they are the results obtained from the reports forwarded, and include the yield in the whole State, not in the best districts only.

Imports and exports of coke.—The following table gives the amount of coke imported and entered for consumption in the United States from 1869 to 1885, inclusive. In the statement is included, not only that entered for consumption, but the withdrawals from warehouse for consumption. The years are the Government fiscal years ending June 30. In the reports of the Treasury Department the quantities are long tons. These have been reduced to short tons to make the table commensurate with the other tables in this chapter.

Coke imported and entered for consumption in the United States, 1869 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Short tons.			*Short tons.*	
1869		$2,053	1878	6,616	$24,186
1870		6,388	1879	6,035	24,748
1871		19,528	1880	5,047	18,406
1872	9,575	9,217	1881	15,210	64,987
1873	1,091	1,366	1882	14,924	53,244
1874	634	4,588	1883	20,634	118,114
1875	1,046	9,648	1884	14,483	36,278
1876	2,065	8,657	1885	20,876	64,814
1877	4,068	16,686			

The imported coke goes chiefly to the Pacific coast, where it is mainly used in smelting the argentiferous lead ores; and the coke so imported is almost entirely English and Welsh. Some coke from Nova Scotia is also imported into New England.

The exports of coke are insignificant, as will be seen from the following table. What proportion, if any, is of foreign coke re-exported is not known.

Coke exported from the United States, 1882 *to* 1885, *inclusive.*

Fiscal years ending June 30.	Value.
1882	$1,123
1883	3,281
1884	4,042
1885	5,062

ALABAMA.

The healthy and rapid growth of the coke industry in Alabama, noted in the last volume of the "Mineral Resources," continued during the year 1885. At the close of 1884 there were 976 ovens in the State, and 242 more in process of construction. The close of 1885 finds 1,075 ovens built, and 16 in process of construction. While it thus appears that there has been marked progress, it is also true that the depressed condition of the iron trade, in the various processes of which most of the coke produced is consumed, has seriously interfered with the production of coke in Alabama during 1885, and has prevented the building of ovens and works that were in contemplation at the close of 1884. Notwithstanding this, however, it will be noted that there has been a considerable increase in the number of ovens and in the production of coke.

As noted above, the total number of ovens built up to December 31, 1885, was 1,075. Of these 914 were in the Warrior coal field; 100, with some pits, in the Cahaba field; and 61 in the Coosa or Broken Arrow region. The ovens at one of the works in the Warrior field were started at the close of the year. There are 6 ovens in process of construction in the Warrior field, and 10 in the Coosa.

The total production of coke in Alabama during the year 1885 was 301,180 short tons, of which 279,830 tons were produced at the 7 establishments in the Warrior field. There were used in the production of this coke 507,934 tons of coal, the yield of the coal in coke at the various establishments ranging from 50 to 66 per cent., the average being 59 per cent. The total value of this coke was $755,645, the range in value per ton being from $2.48 to $3 at the ovens, the most common price being $2.50 and the average but a fraction over $2.50.

The following are the statistics of the manufacture of coke in Alabama from 1880 to 1885:

Statistics of the manufacture of coke in Alabama, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	4	4	5	6	8	11
Ovens built	316	416	536	767	(a) 976	(a) 1,075
Ovens building	100	120	....	122	242	16
Coal used, short tons	106,283	184,881	261,839	359,699	413,184	507,934
Coke produced, short tons	60,781	109,033	152,940	217,531	244,009	301,180
Total value of coke at ovens	$183,063	$326,819	$425,940	$598,473	$609,185	$755,645
Value of coke at ovens, per ton	$3.01	$3.00	$2.79	$2.75	$2.50	$2.50
Yield of coal in coke, per cent	57	59	58	60	60	59

a One establishment made coke on the ground.

The coke from the Warrior field, chiefly from the Pratt vein, still holds its pre-eminence among Alabama cokes, 93 per cent. of the coke made in the State being from the coals of this field. The principal use of this coke is in the blast furnaces near Birmingham, but it goes to all of the large cities of the South and Southwest for manufacturing purposes. Some brands, the Black Creek coke especially, have an excellent reputation for foundry use. This Black Creek coke is also used, when properly prepared, for domestic consumption.

At the close of 1884 but five coke works were in operation in the Warrior field. A sixth was started early in the following year, and a seventh—that of the Warrior Coal and Coke company, at Warrior—fired its ovens late in December, making the first shipment of foundry coke December 31. The following are analyses of the coal and coke from the mines and ovens of this company:

Analyses of Warrior coal and coke.

Coal.	Per cent.	Coke.	Per cent.
Fixed carbon	65.12	Carbon	93.86
Volatile matter	32.24	Moisture	2.55
Ash	1.27	Ash	2.98
Sulphur	.56	Sulphur	.61
Total	99.19	Total	100.00

In the Cahaba field but little coke was made in 1885. The ovens of the Pratt Coal and Iron company, at Helena, were in blast but a short time. The Cahaba Coal Mining company also made some coke in pits on the ground. The coke from this field is too high in ash for iron making. It is also an inferior fuel in other respects.

In 1884 the only coke made in the Coosa field was in an experimental way. At the close of 1885, however, 61 ovens were in operation in the Broken Arrow district, and 10 Thomas ovens, 7 feet by 36 inches, were in course of construction. The coke from this district is used in the Cherokee furnace at Cedartown, Georgia, a charcoal furnace which at times uses coke.

The Broken Arrow vein, in the Coosa field, is from 38 inches to 43 inches thick; the Browning, 32 to 38 inches. All of the coal in the Coosa field must be washed before coking. The Broken Arrow coal is only used for coking, its coking or caking qualities being so good as to preclude its use for steam purposes. It is low in sulphur (0.65 per cent.), but carries considerable ash, part of which can be removed by washing, for which purpose a washer is being erected, no coke being made at present at the Broken Arrow works.

Only the slack from the Browning coal is used in coking. It carries considerable sulphur in the form of pyrites, which washing removes to a large extent. A "plunger and trough" washer, Thomas system, with a crusher, has been erected, and the coke much improved. Water pumped from the mine is used for washing. A late analysis shows: ash, 8.35 per cent.; sulphur, 0.78 per cent. The physical tests by Mr. John Fulton, of Johnstown, Pennsylvania, give about the same results as Connellsville coke. This coke is used at the Cherokee furnace, making No. 1 foundry iron. There are three other charcoal furnaces contiguous to this district that contemplate using coke. Some 300 tons of coal are raised daily at this mine, the slack from which (50 per cent. of total) is washed and coked. Forty cents a ton is paid for mining. The total cost of coal in cars is 68 cents. The coal from the Browning vein was used during the late war by the Confederate government in their foundry at Selma, Alabama. The coal was run in on a tram-car to the Coosa river and floated down to Selma. It was also made into coke on the ground at the mines. Pieces made at that time are still found, as bright, apparently, as ever.

COLORADO.

Coking coal occurs in three localities or districts in the Colorado coal field, which may be termed the El Moro, the Crested Butte, and the Durango. The first district includes the ovens at El Moro and Starkville; the second, those at Crested Butte and at Aspen; and the third, those at Durango and Rico.

The most important of these districts is the first, the El Moro, situated in Las Animas county, near the boundary line of New Mexico. This, as well as the Crested Butte district, was quite fully described in the "Mineral Resources" for 1883 and 1884. There has been no increase in the number of ovens in the district during the year. The production for 1885 shows a slight falling off from that of 1884. No statement as to the value of coke made in this district was given. Its value has been estimated, in the absence of this statement, at $3 a ton.

In the Crested Butte district there are two works, the Crested Butte, with 74 ovens, an increase during the year of 24, and the Jerome Park, with 5 ovens. The latter works also made some coke on the ground. The Crested Butte works were described in the last report. The Jerome Park Coal company's ovens are at Garfield, on Edgeton creek, about 40 miles north of Aspen. The vein of coal at this point is 5½ feet thick and cokes well. An analysis of the coal is as follows:

Analysis of Jerome Park Coal company's coal.

	Per cent.
Carbon	57.0
Volatile matter	37.9
Water	2.5
Ash	2.6
	100.0

The coke is used in smelting at Aspen, by the Aspen Mining and Smelting company.

In the Durango field there are three small coke works, making coke for use locally in smelting ores. The largest works has but 8 ovens, one of the others, 6; and the smallest, 4. Most of the coke in this district is high in ash, but the transportation charges on the cokes of other sections are so heavy as to make it more profitable to use these local cokes, though they are inferior fuels.

As will be seen from the following table, there were seven coke works in Colorado at the close of 1885, a loss of one during the year. There were 434 ovens, an increase of 24, which were building at the beginning of the year. The make of coke in 1885 was 131,960 tons, an increase of 16,241 tons. Its value in 1885 was $512,162, or $3.88 per ton, as against $409,930, or $3.45 a ton in 1884.

The statistics of the manufacture of coke in Colorado for the years from 1880 to 1885 are as follows:

Statistics of the manufacture of coke in Colorado, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	1	2	5	7	8	7
Ovens built	200	267	344	352	409	434
Ovens building	50	0	0	0	24	0
Coal used, short tons	51,891	97,508	180,549	224,089	181,968	208,069
Coke produced, short tons	25,568	48,587	102,105	133,997	115,719	131,960
Total value of coke at ovens	$145,226	$267,156	$476,665	$584,578	$409,930	$512,162
Value of coke at ovens, per ton	$5.68	$5.29	$4.67	$4.36	$3.45	$3.88
Yield of coal in coke, per cent	49	50	57	60	64	63

Some of the coke produced in 1883 and 1885 was made in heaps on the ground.

GEORGIA.

Though all of the coke ovens in this State are owned by one company, and are usually reported as but one works, there are really two distinct works, one with 286 ovens, and the other with 14 ovens, some two miles distant. This latter bank of ovens has not been in operation during the past year. The coke reported, therefore, was made at the works with 286 ovens. But little of the coke made is sold, the company using most of it at its two furnaces, the Rising Fawn and Chattanooga.

The statistics of the manufacture of coke in this State for the years 1880–1885, inclusive, are as follows:

Statistics of the manufacture of coke in Georgia, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	1	1	1	1	1	2
Ovens built	140	180	220	264	300	300
Ovens building	40	40	44	36	0	0
Coal used, short tons	63,402	68,960	77,670	111,687	132,113	117,781
Coke produced, short tons	38,041	41,376	46,602	67,012	79,268	70,669
Total value of coke at ovens	$81,789	$88,753	$100,194	$147,166	$169,192	$144,198
Value of coke at ovens, per ton	$2.15	$2.15	$2.15	$2.20	$2.13	$2.04
Yield of coal in coke, per cent	60	60	60	60	60	60

ILLINOIS.

The year 1885 was by no means a successful one to the Illinois coke manufacturer. The number of coke works in this State was the same at the close of 1885 as at the close of 1884, but the number of ovens had fallen off five, and the production of coke from 13,095 tons in 1884, to 10,350 tons in 1885. The total value of the coke produced in 1885, however, was greater than in 1884.

The causes of the failure of the attempts at coke making in this State, notwithstanding the extensive deposits of coal which it possesses, have been pointed out in previous reports. They are: an inferior coal, and the relations of the markets in which the coke must be sold to other sources of supply. The coke is as a rule quite impure, though at one of the works a good coke in this respect is made, and the coal is not the best as to coking qualities. The demand for it depends upon the price of the better cokes of the Connellsville and West Virginia regions. With the prices of the past year, but little Illinois coke could be sold at rates that would pay the cost of manufacture and transportation. As a result, of the 9 works reported as in existence, 5, embracing 175 ovens, were idle during the entire year; one of the others ran but a few weeks. At another, with only 100 ovens, only 18 were run regularly, and operations at the other works were not continuous.

The coking of the Streator coal, noticed last year, has been continued, the coke being used at the wire mills at Joliet, and at the Streator glass works. It is stated to be an excellent soft coke, but here, as in the other sections of the State, the cheapness of the Connellsville and other Pennsylvania cokes has reduced demand, as well as prevented a contemplated enlargement of the works.

The following are the statistics of the manufacture of coke in Illinois for the years from 1880 to 1885:

Statistics of the manufacture of coke in Illinois, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	6	6	7	7	9	9
Ovens built	176	176	304	316	325	320
Ovens building	0	0	0	0	0	0
Coal used, short tons	31,240	35,240	25,270	31,170	30,168	21,487
Coke produced, short tons	12,700	14,800	11,400	13,400	13,095	10,350
Total value of coke at ovens	$41,950	$45,850	$29,050	$28,200	$25,639	$27,798
Value of coke at ovens, per ton	$3.30	$3.10	$2.55	$2.10	$1.96	$2.68
Yield of coal in coke, per cent	41	42	45	43	43	48

The range of prices at the several works reported was from $2 a ton to $3.78; the average, as given, $2.68. The yield of coal in coke was from 45 to 50 per cent., with an average of 48 per cent.

INDIANA.

No coke has been made in Indiana since 1879. There are, however, nominally two coke works in the State, with 12 ovens at one works in a condition to resume operations with slight repairs, should it ever be deemed advisable. At the other, where there are 25 ovens, work has been abandoned. As the ovens are still in existence, however, they are still reported, giving a total in the State of 37 ovens.

INDIAN TERRITORY.

The number of ovens at the only works in this Territory has been doubled during the year, there being 40 at the close of 1885 as against 20 at the close of 1884. There has been a considerable increase in the production of coke during 1885, the make being 3,584 tons as compared with 1,912 tons in 1884. Only slack is used. The following analysis of the coke by Regis Chauvenet & Bro., differs somewhat from that given in the last report:

Analysis of coke from McAlister, Indian Territory.

	Per cent.
Fixed carbon	87.02
Volatile matter	2.45
Moisture	0.21
Ash	10.32
	100.00
Sulphur	1.22
Phosphorus	0.03

The statistics of the manufacture of coke in the Territory for the years 1880 to 1885 are as follows:

Statistics of the manufacture of coke in Indian Territory, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	1	1	1	1	1	1
Ovens built	20	20	20	20	20	40
Ovens building	0	0	0	0	0	0
Coal used, short tons	2, 494	2, 852	3, 266	4, 150	3, 084	5, 781
Coke produced, short tons	1, 546	1, 768	2, 025	2, 573	1, 912	3, 584
Total value of coke at ovens	$4, 638	$5, 304	$6, 075	$7, 719	$5, 736	$12, 902
Value of coke at ovens, per ton	$3	$3	$3	$3	$3	$360
Yield of coal in coke, per cent	62	62	62	62	62	62

In the returns received no statement as to coal used was included. A yield of 62 per cent. has been assumed.

KANSAS.

But little coke is made in Kansas, and that chiefly to utilize the slack coal from the mines in the southeastern part of the State. The works are small, and the coke produced, with the exception of that from one bank of ovens, is made by zinc smelters for use in their own furnaces. The coke from the only establishment not so operated is used for domestic purposes and for drying brick. The coke is only fair, containing considerable ash, and at times as much as 4 per cent. of sulphur, which, of course, unfits it for foundry use.

There has been no change in the number of works or ovens during 1885. There has been a slight increase over 1884 in the amount of coke made, but a decrease in its value. At one of the four works, with three ovens, no coke was made during the year.

The statistics of the manufacture of coke from 1880 to 1885 are as follows:

Statistics of the manufacture of coke in Kansas, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	2	3	3	4	4	4
Ovens built	6	15	20	23	23	23
Ovens building	0	0	0	0	0	0
Coal used, short tons	4, 800	8, 800	9, 200	13, 400	11, 500	15, 000
Coke produced, short tons	3, 070	5, 670	6, 080	8, 430	7, 190	8, 050
Total value of coke at ovens	$6, 000	$10, 200	$11, 460	$16, 560	$14, 580	$13, 255
Value of coke at ovens per ton	$1. 95	$1. 80	$1. 70	$1. 96	$2. 02	$1. 65
Yield of coal in coke, per cent	64	64. 4	65	62. 9	62. 5	53⅔

Some of the coke reported made in 1880 and 1881 was produced at one establishment in pits.

KENTUCKY

Though Kentucky possesses extensive beds of coal, some of which are coking, it can hardly be said to produce coke. So far as reported, all of the coke made in this State in 1885 was from slack coal from other States. No coke has been made in the western field, and as far as has been learned the good coking coals said to exist in the eastern part of the State have not been utilized. In this eastern field has been found what is supposed to be the identical horizon of the Connellsville district. This Kentucky field Mr. Procter, the State geologist, has called the "Elkhorn" coking coal, from the name of the creek on which it was first discovered. The coal is found in veins from 7 to 11 feet thick.

The number of works is the same as at the close of 1884. Of these two were idle the entire year. The number of ovens has decreased by twelve. There has been a slight increase in the amount of coke made, but a decrease in the value.

The following are the statistics of the manufacture of coke in Kentucky for the years from 1880 to 1885. As no coke was made in the western district in 1885, but one table is made. In this district there are two works with nine ovens:

Statistics of the total manufacture of coke in Kentucky, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	5	5	5	5	5	5
Ovens built	45	45	45	45	45	33
Ovens building	0	0	0	0	0	0
Coal used, short tons	7,206	7,406	6,906	8,437	3,451	5,075
Coke produced, short tons	4,250	4,370	4,070	5,025	2,223	2,704
Total value of coke at ovens	$12,250	$12,630	$11,530	$14,425	$8,760	$8,499
Value of coke at ovens per ton	$2.88	$2.89	$2.83	$2.87	$3.94	$3.14
Yield of coal in coke, per cent	60	60	59	60	64	53

MONTANA.

But little information relative to the coke made in this Territory, other than that contained in the last report, has been received. All of the works may be regarded as purely experimental, and though there are constant rumors of enterprises of considerable magnitude being in contemplation or in progress, the close of 1885 finds fewer ovens than in 1884. One report from this Territory says that the coke made thus far "has simply been experimental, and results have not warranted the erection of a larger plant." The firm of Quealy & Hoffman, the largest producers in 1884, made coke for a little while in 1885 and then abandoned its manufacture entirely. At the Northern Pacific Coal Company's works experiments in washing the coal are in progress. The reresults justify the belief that the high percentage of ash, which the unwashed coal carries, can be so reduced as to justify coke manufacture on a larger scale.

At Anaconda some little coke has been made as an experiment. The coal requires washing, but the coke made is reported to be bright, silvery, of a somewhat open structure, and carrying small bits of slate.

It is reported that recent tests have proved that the Sand Couleé coal makes good coke. Experiments with coal from Arnold & Potts's mine, near Maiden, are also reported as giving satisfactory results. Of the details of these tests no statement has been received.

The statistics of the manufacture of coke in Montana from 1880 to 1885 are as follows:

Statistics of the manufacture of coke in Montana, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	0	0	0	1	3	2
Ovens built	0	0	0	2	5	2
Ovens building	0	0	0	0	12	0
Coal used, short tons	0	0	0	0	165	300
Coke produced, short tons	0	0	0	0	75	175
Total value of coke at ovens	0	0	0	0	$900	$2, 063
Value of coke at ovens, per ton	0	0	0	0	$12	$11. 72
Yield of coal in coke, per cent	0	0	0	0	46	58. 5

NEW MEXICO.

No ovens were built in New Mexico during the year 1885. The San Pedro Coal and Coke Company, at San Antonio, on the Rio Grande, remains the only works with ovens in the Territory. This is also the only works at which, so far as could be learned, any coke was made in 1885, none being produced in the Cerrillos mining district.

The following are the statistics of the manufacture of coke in New Mexico from 1880 to 1885. The value of the coke is an estimate:

Statistics of the manufacture of coke in New Mexico, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	0	0	2	2	2	2
Ovens built (*a*)	0	0	0	12	70	70
Ovens building	0	0	12	28	0	0
Coal used, short tons	0	0	1, 500	6, 941	29, 990	31, 889
Coke produced, short tons	0	0	1, 000	3, 905	18, 282	17, 940
Total value of coke at ovens	0	0	$6, 000	$21, 478	$91, 410	$89, 700
Value of coke at ovens per ton	0	0	$6	$5. 50	$5	$5
Yield of coal in coke, per cent	0	0	66⅔	57¼	57¼	56¼

a At one works there are ten stone pits, with an average capacity of 10 tons each.

OHIO.

The statistics of the manufacture of coke in Ohio in 1885 show a marked decline in this industry as compared with 1884. While most of the coal of the State is classed as coking coal, but little of it makes as good a coke as the Connellsville or New River. Some of the cokes of Ohio are lower in ash than that made in Pennsylvania, but, as has been stated elsewhere, relative purity is not always an indication of the economic value of a coke. The Ohio cokes are usually soft, brittle, high in sulphur, and in many cases in ash also, though this is not always true. The Steubenville coke is low in ash, but is a very weak coke, breaking easily and not bearing transportation, a large part of it becoming dust even in transporting it but a few hundred yards from the ovens to the blast furnace. The Washingtonville coke, made at

Leetonia, is also a pure coke, not as compact as Connellsville, will not stand transportation as well, but is regarded as better than Connellsville in smelting the native ores, and is equal to it in carrying burden. It will be found that when Connellsville coke can be placed at blast furnaces at the prices ruling the past year but little blast furnace coke will be made in this State.

In the last report four coking districts were named: Washingtonville, Steubenville, Hocking Valley, and Cincinnati. Some coke was also formerly made near Zanesville, where there are four ovens, and some in the Hanging Rock region, but none has recently been produced in either of these localities.

Washingtonville district.—The following are the statistics of the manufacture of coke in this district, which includes the ovens near Leetonia, for the years 1880 to 1885:

Statistics of the manufacture of coke in the Washingtonville district, Ohio, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	3	3	3	3	3	2
Ovens built	204	204	204	204	204	267
Ovens building	0	0	0	0	0	0
Coal used, short tons	76,321	66,972	67,516	57,785	53,363	43,887
Coke produced, short tons	43,433	39,718	36,646	31,304	29,933	24,089
Total value of coke at ovens	$128,608	$119,383	$110,617	$87,651	$68,806	$66,245
Value of coke at ovens per ton	$2.96	$3.01	$3.01	$2.80	$2.90	$2.75
Yield of coal in coke, per cent	57	59	54	54	57	55

At one works in this district, with ten ovens, coke making has been abandoned. A second works, with fifty ovens, has been idle the entire year, so that all the coke was made at one establishment.

Steubenville district.—In this district are included the ovens in the vicinity of Steubenville, as well as those near Bellaire.

The following are the statistics of the manufacture of coke in this district from 1880 to 1885:

Statistics of the manufacture of coke in the Steubenville district, Ohio, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	7	7	8	9	10	5
Ovens built	360	385	391	401	451	273
Ovens building	25	0	0	0	0	0
Coal used, short tons	77,486	111,561	92,199	57,961	21,217	7,929
Coke produced, short tons	45,835	65,752	54,161	35,313	13,356	4,365
Total value of coke at ovens	$83,789	$122,953	$106,971	$70,631	$25,691	$7,605
Value of coke at ovens per ton	$1.83	$1.87	$1.98	$2	$1.92	$1.74
Yield of coal in coke, per cent	59	59	59	61	63	55

It will be seen from the table that there has been a most decided falling off in the coke industry in this locality during the past year. Five works, with one hundred and seventy-eight ovens, have gone out of existence, and only about one-third as much coke has been made in 1885 as in 1884. Indeed, the present insignificance of this district as compared with former years, with 1881, for example, when 65,753 tons were made, is evident. The blast furnaces of this section are too near Connellsville.

All of the coke made was from three works, both of the banks of ovens connected with blast furnaces being idle the entire year. All of the coke was made from slack coal.

Hocking Valley district.—No coke was made in this district in 1885. As was stated in the last report, the coke made at Happy Hollow, the only locality at which there are ovens, while fairly firm, was too high in sulphur for smelting purposes. Experiments demonstrated that this sulphur could be removed with proper machinery, and until this is erected it is not probable that any more coke will be made at these works. As it is the intention to erect this, however, the report is carried along.

Statistics of the manufacture of coke in the Hocking valley, Ohio, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	1	1	1	1	1	1
Ovens built	20	20	20	20	20	20
Ovens building	0	0	0	0	0	0
Coal used, short tons	2,505	1,905	2,175	2,778	1,450	0
Coke produced, short tons	1,002	762	870	1,111	580	0
Total value of coke at ovens	$1,253	$953	$1,088	$1,388	$725	0
Value of coke at ovens per ton	$1.25	$1.25	$1.25	$1.25	$1.25	0
Yield of coal in coke, per cent	40	40	40	40	40	0

Cincinnati district.—All the coke made in Cincinnati is from the screenings and small coal of the coal yards and boats. Most of the coal coming to Cincinnati is brought by the Ohio river in boats and barges, from which it is elevated into the numerous coal yards of the city. Large amounts of fine and small coal result from the weathering and hauling, and this is coked. Though made in Ohio, therefore, but little of the coal used is from this State. The following are the statistics of the manufacture of coke in this district from 1880 to 1885:

Statistics of the manufacture of coke in the Cincinnati district, Ohio, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	4	4	4	5	5	5
Ovens built	32	32	32	57	57	82
Ovens building	0	0	0	0	0	0
Coal used, short tons	16,141	20,607	19,687	33,978	32,134	17,480
Coke produced, short tons	10,326	13,237	12,545	20,106	18,840	10,962
Total value of coke at ovens	$42,255	$54,439	$47,437	$65,990	$61,072	$35,873
Value of coke at ovens per ton	$4.09	$4.11	$3.78	$3.28	$3.24	$3.27
Yield of coal in coke, per cent	64	64	64	59	59	63

Total production in Ohio.—In the following table the statistics of coke making in the several districts of Ohio for the years 1880 to 1885 are consolidated:

Statistics of the manufacture of coke in Ohio, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	15	15	16	18	19	13
Ovens built	616	641	647	682	732	642
Ovens building	25	0	0	0	0	0
Coal used, short tons	172,453	201,045	181,577	152,502	108,164	68,796
Coke produced, short tons	100,596	119,469	103,722	87,834	62,709	39,416
Total value of coke at ovens	$255,905	$297,728	$266,113	$225,660	$156,294	$109,723
Value of coke at ovens per ton	$2.54	$2.49	$2.57	$2.57	$2.49	$2.78
Yield of coal in coke, per cent	58	59	57	58	58	57

PENNSYLVANIA.

For convenience of reference the coke ovens of Pennsylvania have been arranged in ten districts, as follows:

1. Connellsville.
2. Irwin-Latrobe (Pennsylvania railroad).
3. Alleghany Mountain and Somerset.
4. Snow Shoe.
5. Broad Top.
6. Pittsburgh.
7. Beaver.
8. Alleghany Valley.
9. Reynoldsville-Walston.
10. Blossburg.

These divisions are, in part, based upon geological and topographical distinctions, and in part upon the routes to market of the coke produced. Each district will be discussed and its statistics given separately.

In all of the six principal basins, into which the coal fields of western Pennsylvania were divided by Professor Rogers, coke was made in 1885. The bulk of the product, however, was from the Connellsville and its northwardly extension, the Irwin-Latrobe. Most of the coke was made from the coal of the great Pittsburgh seam, which is, on the whole, the most extensive and important coal bed in the Appalachian basin. It is the main seam worked at Pittsburgh, on the Monongahela and Youghiogheny rivers, at Connellsville, Wheeling, and many other places, and is estimated to underlie, in the States of Pennsylvania, Ohio, and West Virginia, 14,000 square miles. In southwestern Pennsylvania Professor Lesley estimates that this bed, after all the erosion it has undergone, is found over an area of somewhat less than 3,000 square miles, so situated that every square yard of it can be reached. This bed does not everywhere show the same thickness as in western Pennsylvania, where it is generally about 8 feet, gradually increasing eastwardly to the Cumberland (Maryland) region, where it is 14 feet; nor does it always make as good coke as that of the Connellsville region, where it is seen at its best.

Total coke production in Pennsylvania.—Consolidating the statistics of the different districts of Pennsylvania given below, the following are the statistics of the production of coke in Pennsylvania from 1880 to 1885:

Statistics of the manufacture of coke in Pennsylvania, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	124	132	137	140	145	133
Ovens built	2, 501	10, 881	12, 424	13, 610	14, 285	14, 553
Ovens building	836	761	642	211	232	317
Coal used, short tons	4, 347, 558	5, 393, 503	6, 149, 179	6, 823, 275	6, 204, 604	6, 178, 500
Coke produced, short tons	2, 821, 384	3, 437, 708	3, 945, 034	4, 438, 464	3, 822, 128	3, 991, 805
Total value of coke at ovens	$5, 255, 042	$5, 898, 579	$6, 133, 698	$5, 410, 387	$4, 783, 230	$4, 981, 656
Value of coke at ovens per ton	$1. 86	$1. 70	$1. 55	$1. 22	$1. 25	$1. 25
Yield of coal in coke, per cent	65	64	64	65	62	64. 6

The Connellsville district.—The Connellsville region or basin, the great coke-producing center of the country, is situated in the southwestern part of Pennsylvania, in the counties of Westmoreland and Fayette, some 50 or 60 miles from Pittsburgh. It is a slender prong separated from the Upper Coal Measures, and may be regarded as extending from near Latrobe, on the Pennsylvania railroad, in a southwesterly direction to the Virginia line, forming a basin some 3 miles wide and 50 long, almost without a fault, the beds yielding from 8 to 10 feet of workable coal. The same trough that contains the Connellsville coal extends northwesterly from Latrobe through the remainder of Westmoreland county, and through Indiana and Clearfield counties, but the Connellsville region is regarded as extending no farther north than the vicinity of Latrobe.

In this district 3,096,012 tons of the 5,106,696 tons, or 60½ per cent., of the coke produced in the United States in 1885 were made. This coke is the typical coke of the country, silvery, cellular, with a metallic ring, tenacious, comparatively free from impurities, and capable of bearing a heavy burden in the furnace. Its porosity and ability to "stand up" in the furnace are what have given it such a reputation as a blast-furnace fuel, and have created such a demand for it for mixing with anthracite and bituminous coal in the East and West, especially where an open iron, such as is used in the Bessemer process, is needed. This region and its coal and coke have been described so fully in the last report as to render any further statement unnecessary.

The following are the statistics of the manufacture of coke in the Connellsville region proper from 1880 to 1885:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	67	70	72	74	76	68
Ovens built	7, 211	8, 208	9, 283	10, 176	10, 543	10, 471
Ovens building	731	654	592	101	200	48
Coal used, short tons	3, 367, 856	4, 018, 782	4, 628, 736	5, 355, 380	4, 829, 054	4, 683, 831
Coke produced, short tons	2, 205, 946	2, 639, 002	3, 043, 394	3, 552, 402	3, 192, 105	3, 096, 012
Total value of coke at ovens	$3, 948, 643	$4, 301, 573	$4, 473, 789	$4, 049, 738	$3, 607, 078	$3, 776, 388
Value of coke at ovens per ton	$1. 79	$1. 63	$1. 47	$1. 14	$1. 13	$1. 22
Yield of coal in coke, per cent	65½	65⅝	65¾	66⅓	66. 1	66. 1

There is an apparent reduction in the number of works at the close of 1885 as compared with 1884, but this is due to a consolidation of works rather than to any actual reduction. The number of ovens usually given as in existence in this region is 10,832. The returns show but 10,471. In view of the number of ovens in this region, this difference is not remarkable. Some of these three hundred and sixty-one ovens are old and dilapidated and are not regarded as ovens. It is also a fact, frequently noted by gatherers of statistics, that two reports of the same works, given by the same person but a few days apart, will show differences.

As compared with 1884 the returns show a slight falling off in production. This has been due to the operations of the Pittsburgh syndicate, an organization of the four largest coke producers, who have associated themselves together for the purpose of controlling the production and price of coke. These four firms, at the close of the year, owned 6,453 ovens and controlled the production directly of 1,206 more, and indirectly of all but a small percentage of the balance which sold coke in the open market. Most of the production, outside of that controlled by the syndicate, was by blast furnace proprietors for their own use.

As the demand seemed to require it, the syndicate would order a reduction or increase of production.

Restrictions during the year, and days worked in each month.

Months.	Total days worked.	Restrictions.		
		Percentage of ovens idle.	Total shut down.	Total days idle.
January	21	58 per cent	4 Wednesdays, 2 Thursdays	6
February	23	9th, 50 per cent.; 18th, 40 per cent.; 26th, 20 per cent.	1 Wednesday	1
March	24	30 per cent	1 Wednesday	1
April	19	30 per cent	5 Wednesdays, 2 Saturdays	7
May	20	30 per cent.; 10th, 40 per cent	2 Saturdays, 4 Wednesdays	6
June	22	40 per cent	3 Wednesdays, 1 Thursday	4
July	21	40 per cent.; 30th, 50 per cent	4 Wednesdays, 2 Saturdays	6
August	19	50 per cent	3 Saturdays, 4 Wednesdays	7
September	21	50 per cent	5 Wednesdays	5
October	23	50 per cent.; 13th, 47 per cent.; 28th, 40 per cent.	2 Wednesdays, 2 Thursdays	4
November	22	40 per cent.; 7th, 35 per cent.; 9th, 30 per cent.; 18th, 20 per cent.	2 Thursdays, 2 Wednesdays	4
December	26	20 per cent.; 8th, 10 per cent.; 29th, 5 per cent.	1 Friday	1
Total	261			52

This table needs but little explanation. The column of "total days worked" gives the number of days the ovens were run during each month; the columns "total shut down" the number of days the ovens were idle. These two totals, with the fifty-two Sundays when the ovens were not drawn, makes the three hundred and sixty-five days in the year. The percentage given under the head of "restrictions" gives the percentage of restriction during the days the ovens were run. For example: In January the ovens were idle six days out of the twenty-seven working days, and for twenty-one days there was a restriction of 58 per cent. This 58 per cent. restriction continued until the 9th of February, when it was reduced to 50 per cent.; still further reduced on the 18th to 40 per cent., and on the 26th to 30 per cent., where it remained until the 10th day of May, when it was increased to 40 per cent. The subsequent changes are noted in the table. The year closed with a restriction of only 5 per cent.

During most of the year coke has sold, free on board, on the cars at the oven for $1.20 for blast-furnace coke and $1.40 for foundry. The producers, not members of the syndicate, but whose product is controlled and sold by the syndicate, pay it 9 cents a ton for selling, so that it nets but $1.11 to these works, free on board. The average price to the consumer, free on board, at ovens during the year was a small fraction over $1.22. During the past five years the prices, by months, of blast-furnace coke, free on board, at ovens have been as follows:

Monthly prices of Connellsville blast-furnace coke, free on board, at ovens.

Months.	1881.		1882.		1883.		1884.	1885.
January	$1.50 to	$1.75	$1.70 to	$1.80	$1.15 to	$1.20	$1.00	$1.10
February	1.50	1.75	1.70	1.80	1.20	1.10	1.00	1.10
March	1.50	1.75	1.70	1.75		1.05	1.00	1.10
April	1.60	1.75	1.70	1.75		1.05	1.10	1.20
May	1.60	1.65	1.65	1.70	0.95	1.05	1.10	1.20
June	1.60	1.65	1.50	1.65		0.90	1.10	1.20
July	1.50	1.60	1.35	1.50		0.90	1.10	1.20
August		1.60		1.35		0.90	1.10	1.20
September		1.60	1.25	1.35		1.00	1.10	1.20
October	1.60	1.65		1.25		1.00	1.10	1.20
November	1.60	1.65	1.25	1.35		1.00	1.10	1.20
December	1.60	1.70	1.15	1.35		1.00	1.10	1.20

It will be noted that the yield of coal in coke is placed at the same figures as last year, 66.1 per cent. There has been considerable discussion over this question of yield. At some important establishments, where the coal is weighed as it is charged, the yield is claimed to be in excess of this. A recent analysis of a coal used at a large number of ovens gave the following:

Analysis of Connellsville coal.

	Per cent.
Fixed carbon	60.30
Volatile matter	31.38
Ash	7.24
Phosphorus	.01
Sulphur	1.09
Total	100.02

The object in burning coke is to drive off the volatile matter; a small amount of the sulphur will also be volatilized, the ash and phosphorus remaining as in the coal. Assuming all the volatile matter is driven off and the sulphur is reduced to 0.69 per cent., and that no carbon is lost, the coal will yield as follows in coke:

Theoretical yield of Connellsville coke.

	Per cent.
Fixed carbon	60.30
Ash	7.24
Phosphorus	.01
Sulphur	.69
	68.24

This is the greatest possible yield. Now some of the fixed carbon is burned in the coking operation, and some little volatile matter left in; how much, depends upon the perfection of the process; but the actual percentage will not be far from 66 per cent.; possibly, with good work, more, with poor work less.

There has been considerable discussion near the close of 1885 as to the actual cost of coke to the producer. I have before me three statements of cost. Two are for actual workings for the month of November; the third is the estimate of a miner. They are as follows:

	No. 1.	No. 2.
Average cost of coal to ton of coke, including royalty	$0.767	$0.818
Average labor at ovens	.270	.328
Average supplies	.073	.070
Average repairs	.062	.029
	$1.172	$1.245

The above are actual costs, not estimates, and may be taken to fairly represent the average, not the best located, works. The items of repairs may vary somewhat, as well as the cost of coal; but No. 1 is a fair cost, including royalty, which in these two cases is 16 cents a ton of coke. It will be noted that in neither case is anything allowed for interest on investment, nor for "sinking" the cost of the ovens when the coal is exhausted.

The miners' figures of cost are as follows. They represent the daily expenses of a bank of forty ovens, twenty being drawn each day:

Cost of coal (on royalty one-half cent per bushel)	$12.35
Seventy cars of coal (mining 27 cents a car)	18.90
Boss's wages	2.00
Oil, posts, rails, etc	1.50
Charging ovens	2.00
Leveling	1.60
Drawing twenty ovens	11.00
Interest on capital	2.50
Syndicate's commission	6.30
	58.15
Production, 58$\frac{8}{10}$ tons coke, at $1.20	70.56
Less daily expense	58.15
	12.41

It will be noted that this makes the cost of getting the coke on the cars ready for shipment $98\frac{2}{10}$. It will be seen that this estimate allows only $1.50 for supplies, or less than 3 cents a ton, as against 7 cents in the above operators' cost. Nothing is allowed for repairs, which are at least 5 cents to 7 cents—as an average, say 6 cents. Nor is there any allowance for labor in mining and hauling the coal other than the miners' wages. Add all these to the miners' cost and it would not come much below the operators' cost.

The Irwin-Latrobe (Pennsylvania railroad) district.—One of the most important coking districts in the country, second in point of production to the Connellsville, is what is termed the Irwin-Latrobe (Pennsylvania railroad) district. The production of this district in 1885 was greater than that of any State, except Pennsylvania, and among the districts of this State it was only surpassed by the Connellsville.

This district includes the ovens along the line of the Pennsylvania railroad from Larimer to Blairsville. At many of these ovens coal from the more northerly portion of the Connellsville trough is used. At other ovens the slack from the Pittsburgh bed, in the mines of the Irwin sub-coal basin. One small bank of ovens used slack coal from the mines of the Greensburg basin.

The following are the statistics of the manufacture of coke in the Irwin-Latrobe district for the years 1880 to 1885:

Statistics of the manufacture of coke in the Irwin-Latrobe (Pennsylvania railroad) district, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	8	10	11	11	11	11
Ovens built	757	986	1,118	1,118	1,118	1,168
Ovens building	0	0	0	0	0	40
Coal used, short tons	319,927	588,924	650,174	668,882	496,894	555,735
Coke produced, short tons	229,433	343,728	375,918	389,053	294,477	319,297
Total value of coke at ovens	$397,945	$548,362	$536,503	$422,174	$311,665	$346,168
Value of coke at ovens per ton	$1.73	$1.60	$1.43	$1.08	$1.06	$1.08
Yield of coal in coke, per cent	59	58	58	58	59	57

In this district it will be noted that the number of establishments remain the same as in 1884, but there has been an increase of fifty in the number of ovens. The production of coke has increased during the year 24,820 tons; the value, by 2 cents a ton; while the yield of coal in coke, according to the reports, has fallen off 2 per cent.

There is considerable controversy as to the value of the coke from this district as compared with that from Connellsville. There is no question but that the coal, as it comes from the mine, is not as pure as the Connellsville. In some cases it will not coke well at all unless it is crushed and washed, but it is claimed that the washing to which it is subjected removes the impurities, and in some cases makes a coke that is even better than Connellsville, being harder, lower in ash, and with a greater calorific efficiency. An analysis of the coke from the ovens of the Latrobe Coal company, situated in Unity township, Westmoreland county, shows 89.119 per cent. fixed carbon. Mr. A. S. McCreath says of it: "This coke represents an excellent furnace fuel, carrying rather more than the average percentage of fixed carbon. * * * The physical structure of the coke seems to be very good, and it should be strong enough to carry a heavy burden in the blast furnace." That this coke finds a ready market is evident from the statistics given above, and the increase in production during the past year, though small, could not have taken place at all, in such a depressed condition of trade, had not the coke been a good fuel.

Alleghany Mountain district.—The third in importance of the coking districts of Pennsylvania is the Alleghany Mountain. In this district are included the ovens along the line of the Pennsylvania railroad, east of Blairsville, in Cambria and Blair counties and those of Somerset county. In this region were produced 212,242 tons of the 3,991,805 tons of coke made in Pennsylvania, not a very large percentage, but the total amount is in excess of the production of any of the States, except Pennsylvania, Alabama, and West Virginia, and equal to that of Tennessee.

The statistics of the manufacture of coke in the Alleghany Mountain and Somerset district of Pennsylvania for the years from 1880 to 1885 are as follows:

Statistics of the manufacture of coke in the Alleghany Mountain district of Pennsylvania, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	8	9	10	10	12	11
Ovens built	291	371	481	532	614	523
Ovens building	0	0	0	0	0	82
Coal used, short tons	201, 345	225, 563	284, 544	200, 343	241, 459	327, 666
Coke produced, short tons	127, 525	144, 430	179, 580	135, 342	156, 290	212, 242
Total value of coke at ovens	$289, 929	$329, 198	$377, 286	$240, 641	$203, 213	$286, 539
Value of coke at ovens per ton	$2. 27	$2. 28	$2. 10	$1. 78	$1. 30	$1. 30
Yield of coal in coke, per cent	63	64	63	68	65	65

Thirty of the ovens reported in 1885 were Belgian. In addition to the ovens some pits were used during all the years covered by this statement. The one hundred Belgian ovens at Johnstown, included in reports of former years, have been torn down. This accounts for the reduced number of ovens, as well as the loss of one establishment. It will be noted that the production of coke in this region has increased fully one-third, a result obtained by no other coking district of any importance in the country, except the Reynoldsville-Rochester district of Pennsylvania.

The character and coking qualities of the coals in this district, as well as the character of the coke, were so fully described in the last volume of "Mineral Resources" as to call for but little in addition. As pointed out in that report, the distance from Johnstown to Altoona, less than 40 miles, is one of the most interesting coking districts in the country.

The coal varies from a true coking coal, making in the beehive oven an admirable blast-furnace coke, to a dry burning coal that cannot be coked to advantage in the beehive oven, requiring the heat of the Belgian oven to coke it properly. In this same district can be studied the three typical methods of coking—in pits, in beehive ovens, and in Belgian (Coppée) ovens. The experiments made for the Cambria Iron Company by Mr. John Fulton, its mining engineer, in the use of different coals and methods of coking, as well as those relating to the value of cokes, have been the most careful and thorough of any made in this country. They have already been of great value, and must be of increasing importance.

Most of the coke made is for blast furnace use, being in demand not only at the furnaces in this section, but at the anthracite furnaces of the East. The coal chiefly used is from bed B, or the Miller seam. This coke resembles the Connellsville, is sonorous, cellular, and tenacious, reasonably pure, and has great heating power. Analyses of these cokes were given in "Mineral Resources for 1883–1884." Another, made by the Gallitzin Coal and Coke Company, from samples taken by Mr. McCreath from shipments to the Pennsylvania Steel Company, at Steelton, is as follows:

Analysis of Gallitzin (Pennsylvania) coke.

	Per cent.
Moisture	.108
Volatile matter	.790
Fixed carbon	90.687
Sulphur	.927
Ash	7.488
	100.000

At Conemaugh station, at the spiegel furnace of the Cambria Iron Company, there is a bench of thirty Belgian ovens making coke from the Lemon coal bed. This is a dry coal, making rather a soft coke, which could not be used in a blast furnace making ordinary pig iron, but is well adapted to use in the manufacture of spiegel.

The Snow Shoe district.—There has been a marked increase both in the number of ovens and the make of coke in the Snow Shoe district in 1885 over any previous year since coke making began to be an industry in this region in 1880. During the year the Irvona Coal Company has erected ovens at Coalport, and has begun coking coal from what is known locally as the Big Moshannon vein. The vein as mined by this company is 4½ to 5½ feet thick. The coal is run over a 2-inch screen 20 feet long, the screenings being coked. The company has eighty ovens.

Analyses of the coal and coke, by Booth, Garrett & Blair, chemists, are as follows:

Analysis of Irvona coal (Big Moshannon vein).

	Per cent.
Fixed carbon	71.752
Volatile matter	21.600
Ash	5.615
Water at 212° F	1.033
	100.000

Analysis of Irvona (Pennsylvania) coke.

	Per cent.
Fixed carbon	88.994
Volatile matter	.670
Ash	10.173
Water at 212° F	.163
	100.000
Sulphur	.775

This coke is used entirely in the eastern markets, and on account of the unappreciable amount of phosphorus which it is claimed to have is practically adapted to the manufacture of Bessemer pig iron.

In May of 1885 the ovens reported upon last year, which were operated by Berwind, White & Co., passed into the possession of the Lehigh Valley Coal Company, which increased their number to one hundred and sixty-five.

The following is an analysis of the coke, Booth, Garrett & Blair being the chemists, and making their own selection for analysis:

Analysis of the Lehigh Valley Coal Company's Snow Shoe (Pennsylvania) coke.

	Per cent.
Fixed carbon	90.27
Volatile matter	.46
Ash	8.91
Moisture	.36
	100.00

From the following statement it will be seen that the number of ovens at the close of 1885 in the Snow Shoe district was two hundred and forty-five, an increase over 1884 of one hundred and eighty-five. The make of coke was 48,103 short tons, an increase over 1884 of 24,672 tons, or over 100 per cent. The statistics of the manufacture of coke in the Snow Shoe district of Pennsylvania for the years from 1880 to 1885 are:

Statistics of the manufacture of coke in the Snow Shoe district, Pennsylvania, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	1	2	1	1	1	2
Ovens built	0	50	50	60	60	245
Ovens building	0	0	0	0	0	0
Coal used, short tons	200	20, 025	25, 000	26, 500	33, 000	69, 720
Coke produced, short tons	100	13, 350	17, 160	18, 696	23, 431	48, 103
Total value of coke at ovens	$200	$22, 695	$27, 406	$28, 044	$32, 849	$70, 331
Value of coke at ovens, per ton	$2	$1. 70	$1. 60	$1. 50	$1. 40	$1. 46
Yield of coal in coke, per cent	50	67	69	71	71	69

Broad Top district.—This district, and its coals and cokes, were quite fully described in the last report. In it are included all of the works in Bedford and Huntingdon counties. At these five works there were, at the close of 1885, a total of five hundred and thirty-seven ovens, an increase during the year of eighty-four. Of the five hundred and thirty-seven ovens, two hundred and five are Belgian, or flue ovens, the others beehive. The Belgian oven is not held in such high esteem for coking the coal of this district as formerly. One of the works that has been operating Belgian ovens built eighty-four beehive ovens during the year. One establishment with eighty-eight ovens has been idle the entire year. It will be noticed that there has been a falling off in the production during 1885. This is due to the idleness of the Kemble Iron Company the entire year. The coke made in this district is without exception for use in the blast furnaces with which the coke works are connected.

The statistics of the production of coke in the Broad Top region of Pennsylvania in the years from 1880 to 1885 are as follows:

Statistics of the manufacture of coke in the Broad Top region, Pennsylvania, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	5	5	5	5	5	5
Ovens built	188	188	293	343	453	537
Ovens building	105	105	50	110	0	0
Coal used, short tons	92, 894	111, 593	170, 637	220, 932	227, 954	190, 836
Coke produced, short tons	51, 130	66, 560	105, 111	147, 154	151, 959	112, 073
Total value of coke at ovens	$123, 748	$167, 074	$215, 079	$271, 692	$264, 569	$185, 656
Value of coke at ovens, per ton	$2. 40	$2. 51	$2. 05	$1. 84	$1. 74	$1. 65
Yield of coal in coke, per cent	55	59	62	66	66	58

The value given in the above table is in some cases the cost at the ovens; in others, an assumed price over cost. So little of the coke is sold that no market price can be given. The prices for 1880 range from $2.25 to $3.05; for 1881, from $2.25 to $2.95; for 1882, from $1.64 to $2.86; for 1883, from $1.53 to $2.61; for 1884, from $1.48 to $2.61, and for 1885, from $1.34 to $2 per ton.

It is claimed that the coke from Broad Top coal is equal in furnace work to the Connellsville.

Some analyses were given in the last volume of "Mineral Resources." The following are additional ones from another establishment:

Analyses of Broad Top (Pennsylvania) cokes.

	Powelton pit coke.	Powelton oven coke.
	Per cent.	*Per cent.*
Fixed carbon	89.91	89.43
Volatile matter	.25	2.13
Moisture	.20	.43
Ash	9.13	7.20
Sulphur	.51	.69
Total	100.00	99.88

In the Belgian ovens, at the Powelton works, 24, 48, 60, and 72 hour coke is made, and all seem equally good. In the beehive 48 and 72 hour only are made.

The Pittsburgh district.—In this district are included the coke ovens in Allegheny and Washington counties, and those on the Monongahela river in Fayette county. But little coke has been made for some years on the Monongahela river above Pittsburgh, though considerable slack coal from the mines of the First, Second, and Third pools is coked at Pittsburgh. For this reason, as most of the ovens are in ruins, they are regarded as abandoned.

In this district no lump coal or run of the mines is used in coking, with possibly the exception of one works. The coal is from the slack of the Pittsburgh bed. While the coke is as pure as that made at Connellsville, which is from the same bed, indeed it is freer from ash, its physical properties are not as good. It is too porous and not as strong a fuel.

The statistics of the manufacture of coke in the Pittsburgh district of Pennsylvania are as follows for the years from 1880 to 1885:

Statistics of the manufacture of coke in the Pittsburgh district, Pennsylvania, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	21	21	21	20	20	17
Ovens built	534	538	557	542	535	416
Ovens building	0	0	0	0	0	4
Coal used, short tons	194,393	178,509	114,956	110,310	97,367	91,101
Coke produced, short tons	105,974	96,310	64,779	66,820	53,357	46,930
Total value of coke at ovens	$254,500	$206,965	$134,378	$126,020	$99,911	$72,509
Value of coke at ovens, per ton	$2.40	$2.15	$2.07	$1.89	$1.87	$1.55
Yield of coal in coke, per cent	55	54	61	56	55	51.5

At one of the works in this district persistent efforts have been made, through a series of years, to use some form of the Belgian flue oven, and after many trials some measure of success was attained by using a modified form. These have now been abandoned, however, and beehive ovens erected in their stead. The cost of repairs on the Belgian ovens was too large to make the coke produced in them an economical fuel.

Beaver district.—The coke industry in the Beaver district, in which are included the ovens in Beaver and Lawrence counties, is of but little importance. The largest bank of ovens, and the only one of any size, that at New Castle, which comprises eighty of the eighty-nine ovens in the district, has not been in operation for some years. The ovens at the Wampum furnace, at Wampum, have been idle for a long time, and are now in ruins. Even the eighty ovens at New Castle could not be operated without extensive repairs, practically without rebuilding. The only ovens in operation the past year were four at two works in Beaver Falls, which were run to supply a local trade. Even these were idle at the close of the year, natural gas having entirely superseded coal and coke as fuels in these markets.

The following are the statistics of the manufacture of coke in the Beaver district of Pennsylvania for the years from 1880 to 1885:

Statistics of the manufacture of coke in the Beaver district, Pennsylvania, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	5	5	5	5	4	4
Ovens built	106	106	106	107	89	89
Ovens building	0	0	0	0	0	0
Coal used, short tons	8, 013	6, 887	11, 699	19, 510	2, 250	686
Coke produced, short tons	4, 880	4, 833	7, 960	12, 395	1, 390	438
Total value of coke at ovens	$10, 150	$9, 013	$15, 124	$21, 062	$2, 168	$696
Value of coke at ovens, per ton	$2. 08	$2. 08	$1. 90	$1. 70	$1. 56	$1. 59
Yield of coal in coke, per cent	61	63	68	64	62	63

Alleghany Valley district.—In this district are included the coke works in Armstrong and Butler counties, and one of those in Clarion county, the other ovens in the latter county being included in the Reynoldsville-Rochester district.

In Armstrong county three works were reported as in existence at the time of the last report. At but one of these, that of the Kittanning Iron Company, Limited, are there ovens, the coke at the other two having been made on the ground. As the furnaces at which it was used have been out of blast for some years, these two works are dropped from the list.

In Butler county there are two works, one of which, the Keystone Coal and Coke Company, at Roy, was completed late in 1885. At this works the coke made is from washed slack, a Stutz three-sieved washer, with a capacity of 500 tons a day, being used. The coke is hard and firm, and has an excellent reputation. The chief markets are Buffalo, New York, and New Castle, Pennsylvania. Its chief uses are for foundry and blast-furnace purposes. It is stated that the New Castle furnace men have a standing order for all they can get. The others works in the county, the Union Coal and Coke Company, limited, at Coaltown, has been in operation since 1882. The coke finds a market in northwestern Pennsylvania and eastern Ohio, at foundries, iron works, etc.

The only works in Clarion county included in this district, the Red

Bank, has made no coke for more than two years, the blast furnace in which it is used having been idle for that time.

The following are the statistics of the manufacture of coke in the Allegheny Valley district of Pennsylvania for the years from 1880 to 1885:

Statistics of the manufacture of coke in the Alleghany Valley district, Pennsylvania, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	5	5	6	6	7	5
Ovens built (*a*)	97	109	159	159	209	208
Ovens building	0	0	0	0	0	0
Coal used, short tons	45, 855	55, 676	76, 000	64, 810	55, 110	28, 630
Coke produced, short tons	23, 470	29, 650	41, 897	34, 868	31, 430	15, 326
Total value of coke at ovens	$49, 068	$64, 664	$80, 294	$62, 982	$54, 859	$30, 151
Value of coke at ovens, per ton	$2. 10	$2. 18	$1. 92	$1. 81	$1. 75	$1. 97
Yield of coal in coke, per cent	52	53	55	54	57	53. 5

(*a*) Two establishments have no ovens, burning their coke in ricks.

The Reynoldsville-Walston district.—In the last report this district was called the "Low Grade or Bennett's Branch," from the fact that most of the ovens were along the Low Grade division of the Alleghany Valley railroad. It is believed that the name now given, the Reynoldsville-Walston, from the localities of its chief banks of ovens, will more correctly describe it.

In this district are included all the ovens on the Rochester and Pittsburgh railroad, as well as those on the Low Grade division of the Alleghany Valley railroad. It is among the most interesting and growing of the coking districts of the country. The coke from this section is crowding the Connellsville out of some markets that it at one time held exclusively, and is competing with it in others, as at Chicago.

The following are the statistics of the manufacture of coke in the Reynoldsville-Walston district of Pennsylvania for the years from 1880 to 1885:

Statistics of the manufacture of coke in the Reynoldsville-Walston district, Pennsylvania, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	3	4	5	6	7	8
Ovens built	117	125	177	229	321	600
Ovens building	0	2	0	0	0	143
Coal used, short tons	45, 055	99, 489	87, 314	76, 580	159, 151	183, 806
Coke produced, short tons	28, 090	44, 260	44, 709	37, 044	78, 646	114, 409
Total value of coke at ovens	$46, 359	$80, 785	$80, 339	$65, 584	$113, 155	$153, 795
Value of coke at ovens, per ton	$1. 65	$1. 85	$1. 80	$1. 77	$1. 44	$1. 34½
Yield of coal in coke, per cent	62	44	51	48	49	62

The great increase in the yield of coal in coke, shown in the table, is no doubt due to the fact that in former years the production was to some extent experimental, and also that a much larger proportion of the coke made was from washed slack.

The coals and cokes of the Low Grade division of the Alleghany Valley railroad were described quite fully in the last report. In addition, the following analysis of Du Bois coke, from the works of Bell, Lewis & Yates, may be given:

Analysis of Du Bois (Pennsylvania) coke.

	Per cent.
Fixed carbon	87.294
Volatile matter	.804
Water	.096
Ash	10.624
Sulphur	1.182
	100.000
Phosphorus	.011

The market for this coke is chiefly at Buffalo and in Canada, though it is sent to Chicago, where it competes with Connellsville.

Of the six coke works along the Low Grade division, two made no coke the entire year, and two others but little until September.

Along the line of the Rochester and Pittsburgh railroad there are two coke works, one built in 1885 in Elk county, and the other, that of the Rochester and Pittsburgh Coal and Iron Company, at Walston, Jefferson county. Outside of the Connellsville region this is the largest coke works in Pennsylvania, and with the exception of some in the Connellsville region, and of the Tracy City works of the Tennessee Coal, Iron and Railroad Company, the largest in the United States. At the close of 1885 it was running three hundred and fifty-seven ovens. This number is to be increased to five hundred in the spring of 1886. The growth of this works is remarkable, in view of the depression in the trades consuming coke. On December 31, 1883, this company had fifty-one ovens in operation; at the close of 1884 the number was one hundred and fifty, and three hundred and fifty-seven at the close of 1885.

The Walston Coke Works, of the Rochester and Pittsburgh Coal and Iron Company, are located in the Punxsutawney coal field in Jefferson county. The coal used is from the Lower Freeport bed, which in the mines of this company is 6 feet thick, without slate partings and displaying unusual coking qualities. Unlike much of the coke made in this district, the coal is not washed, but coked in its natural state, as is the Connellsville. The water used in drenching the coke as it comes from the ovens is from two wells, 300 feet deep, sunk near the ovens.

The Walston coke is claimed to possess the characteristics of a good coke in an eminent degree, having a bright silvery luster (indicating freedom from sulphur); a resonant metallic ring when struck (indicating hardness); an open cellular structure, without sacrifice of weight, which facilitates its impregnation with the furnace gases; hardness and tenacity, sustaining without crushing the blast and heavy burden of a high furnace stack, and a composition as dry and as free as possible from impurities, and especially from phosphorus. To what extent it has these characteristics will be evident from the following tables which show the results of some physical tests of the coke, and also its chemical composition. The physical tests were made by Mr. John Fulton, of the Cambria Iron Company, and the chemical analyses by Mr. A. S. McCreath and and Mr. T. T. Morrell. The samples of Walston coke tested were both 48-hour and 72-hour:

TESTS OF 72 HOUR WALSTON (FOUNDRY) COKE.

Physical analysis.

Locality.	Grams in one cubic inch.		Pounds in one cubic foot.		Percentage.		Compressive strength per cubic inch (¼) ultimate strength.	Height of furnace charge, supported without crushing.	Order in cellular space.	Hardness.	Specific gravity.
	Dry.	Wet.	Dry.	Wet.	Coke.	Cells.					
Standard coke, Connellsville.	12.46	20.25	47.47	77.15	61.53	38.47	284	114	I	3.5	1.500
Walston coke	16.63	23.4	63.36	89.15	71.07	28.93	270	109	I	3.7	1.900

Chemical analysis.

Locality.	Fixed carbon.	Moisture.	Ash.	Sulphur.	Phosphorus.	Volatile matter.
Standard coke, Connellsville	87.46	0.49	11.32	0.69	0.029	0.011
Walston coke (A. S. McCreath, 72-hour coke)	88.476	.148	9.731	.951	.008	.692

Coke analyses.

	No. 1.	No. 2.	No. 3.
	Per cent.	Per cent.	Per cent.
Water	0.064	0.234	0.145
Volatile matter	.794	.552	.731
Fixed carbon	88.293	88.869	88.266
Sulphur	1.017	1.012	.826
Ash	9.832	9.333	10.032
Totals	100.000	100.000	100.000
Phosphorus	....	.0085	.0080

Walston coal.

	Per cent.
Water	0.983
Volatile matter	30.933
Fixed carbon	60.916
Sulphur	1.063
Ash	6.105
	100.000
Phosphorus	0.0065

Regarding this coke Mr. Fulton states: "These tests show a compact, hard-bodied coke, harder than the average Connellsville standard. This coke has been carefully prepared and cannot be distinguished from Connellsville coke. The cells are a little less than the Connellsville, but the difference is not large enough to induce any marked change in blast furnaces. This coke is capable of sustaining fast driving in the largest blast furnaces. It will prove an excellent fuel for this and kindred uses."

The other establishment in this district is at Dagus mines in Elk county. At this works there are thirty-six ovens, twenty-four of which were erected in 1885. The coal is washed with a Stutz washer. The plant is, in a measure, experimental. About one third of the production is sold as crushed coke.

The Blossburg district.—This district, and its coals and cokes, were so thoroughly described in the last report as to render unnecessary any description here. The Blossburg coal field is one of the small detached basins into which the northern limit of the Appalachian field is broken.

At the close of 1885 but two hundred and ninety-six ovens were reported in this district, as against three hundred and forty-four at the close of 1884. One of the works that in 1884 gave the number of its ovens as one hundred and forty-four returns but ninety-six in 1885. There also has been a decline in the production of coke in 1885.

The following are the statistics of the manufacture of coke in the Blossburg district of Pennsylvania for the years from 1880 to 1885:

Statistics of the manufacture of coke in the Blossburg district, Pennsylvania, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	1	1	1	2	2	2
Ovens built	200	200	200	344	344	296
Ovens building	0	0	0	0	32	0
Coal used, short tons	72, 520	88, 055	100, 119	71, 028	62, 365	46, 489
Coke produced, short tons	44, 836	56, 085	64, 526	44, 690	39, 043	26, 975
Total value of coke at ovens	$134, 500	$168, 250	$193, 500	$122, 450	$93, 763	$59, 423
Value of coke at ovens, per ton	$3	$3	$3	$2. 74	$2. 40	$2. 17
Yield of coal in coke, per cent	62	64	64	63	63	58

TENNESSEE.

Tennessee held the same relative rank, the fourth, in the list of coke-producing States in 1885 as in 1884. Since the close of 1884 there has been an increase in the number of ovens in the State, the coke product, however, remaining about the same as in 1884.

The statistics of the manufacture of coke in Tennessee for the years 1880 to 1885 are as follows:

Statistics of the manufacture of coke in Tennessee, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	6	6	8	11	*a*13	12
Ovens built	656	724	861	992	1, 105	1, 387
Ovens building	68	84	14	10	175	86
Coal used, short tons	217, 656	241, 644	313, 537	330, 961	348, 295	412, 538
Coke produced, short tons	130, 609	143, 853	187, 695	203, 691	219, 723	218, 842
Total value of coke at ovens	$316, 607	$342, 585	$472, 505	$459, 126	$428, 870	$398, 459
Value of coke at ovens, per ton	$2. 42	$2. 38	$2. 52	$2. 25	$1. 95	$1. 82
Yield of coal in coke, per cent	60	60	60	62	63	53

a One works made coke in pits.

The most noticeable feature in the report for 1885, as compared with that for 1884, is the reduction in percentage yield of coal in coke from 63 per cent. in 1884 to 53 per cent. in 1885. There is no explanation to offer as to the great difference. In both cases the statements are based upon returns from the producers. The figures for 1885 are corroborated by a remark in a letter from one of the largest producers in the State: "Two tons of coal yield, in Tennessee, one ton of coke."

At three of the works, with an aggregate of one hundred and sixty ovens, no coke was made during the year; at others, only a part of the ovens were in operation at any time, while others ran very irregularly. Most of the coke made in this State is for use in blast furnaces, and the depression in the iron industry has had its effect upon the coke business. At one works, that of the Tennessee Coal, Iron and Railroad Company, at Tracy City, one hundred and thirty-five ovens have been built during the year. The ovens of this same company, at Victoria, were not lighted the entire year, and their number has been reduced from one hundred and ten to seventy. The ovens of the Dayton Coal and Iron Company, limited, have been fired during the year, but have not produced near their capacity.

As indicated above, most of this coke is for blast-furnace consumption; but the product of certain works has an excellent reputation for foundry purposes, and some also goes to the smelters of Arizona and New Mexico.

There has been considerable discussion during the past year as to the quality of Tennessee coke. Prof. H. E. Colton, in a letter to the *Iron Age*, speaking of the coals and cokes of this State, says: "No coke of commercial importance which could take the place of standard Connellsville has yet been manufactured in the South. There are cokes of local importance of good quality, but, with a less distance to the great West, and a possibility of lower freight rates, Connellsville still has no formidable rival from the southern division of the Appalachian coal field. Whether this is ever to be changed is a matter of doubt. The State of Tennessee was the first in the South to turn coal into coke for the manufacture of iron, and the success at Rockwood began a new era in the coal industry of the South. The State has an area of 5,100 square miles underlaid with coal, in a large part of which there are fully eleven workable seams, yet for all commercial consideration it may be said that all the coke made is from one seam, and that one the same from which it was first made at Rockwood. Every one acquainted with iron making in Tennessee knows that it is not a first-class coke. The seam of coal from which it is made is known as the Sewanee seam, it is the corelative of Seam B of the Pennsylvania classification, and covers a greater area and is available at more points than any seam of coal in the southern States. It is only about 30 feet above the great conglomerate, ranges from 2 to 7 feet (usually about 3½ feet) in thickness, and is everywhere easily and cheaply mined. It occurs both in the horizontal formation and in the pitched rocks of Molder's ridge from Dayton to Cumberland Gap. In chemical composition the coal contains from 62 to 64 per cent. of fixed carbon, 26 to 29 per cent. of volatile matter, and 9 to 11 per cent. of ash. The coke made from it usually contains 83 to 84 per cent. of carbon and 14 to 15 per cent. of ash. It is very free from sulphur and contains but little phosphorus. Why, then, is it not a first-class coke? Even if its proportion of ash were less it would not be, for it has not the physical structure. If it has the porosity, it has not the coherence. But it is an important factor in the iron making, present and future, of Tennessee.

"The equivalent of the Pittsburgh coal bed in the Tennessee series is the seam now worked at Coal creek and at Poplar creek, and which was once worked at Caryville. It does not exist to any great extent, if at all, southwest of Emory river, and it is beneath water level from Caryville 10 miles northwestward, where it ceases in that direction. As opened in Tennessee, it has the characteristics of the Pittsburgh bed in its western part, at Irwin, for instance; but so far no part of it has been positively determined as having identity with the seam in the region classed as Connellsville. It is claimed, however, that in its northwestern prolongation on the Crooked Fork, in Morgan county, the coal of this seam resembles Connellsville in structure. As existing at Coal creek, and mined there, this seam is from 4 to 5 feet in thickness of clear coal, there being several shale partings. The top is a hard coal which does not coke well, while the lower layer makes a first-class coke. No sufficient test of this coal for coke making has ever been made. Badly-constructed and badly-managed experimental ovens have at intervals been erected, but as a natural consequence no good results have been attained. There is no reason why as good coke should not be made there as is made at Irwin, Pennsylvania, the works near which place supply nearly half of the coke used at the blast furnaces of Carnegie Bros. & Co.

"At Poplar creek more systematic operations for making coke from this seam of coal have been conducted. The Oakdale Iron Company converted this coal into coke for use in its furnace for more than a year, and the stoppage of the furnace was in no way due to the character of the coke. Yet the stack was comparatively a low one, and nothing was proved going toward a solution of the problem whether it was a coke that would work well continuously in tall stacks and carry heavy burdens. Its appearance indicated that with proper handling the physical structure would be good, but unfortunately no proper tests were made on this point. The chemical composition of the Coal Creek and Poplar Creek coals is very similar to Connellsville, they having from 57 to 60 per cent. of fixed carbon, but in volatile matter they are higher and in ash much lower. There is every possibility, however, that the difference mainly exists from the mode in which the samples were taken, Connellsville having been taken by Mr. McCreath from a thorough cut of the whole seam, and the Coal and Poplar Creeks, no doubt, a picked and isolated lump. The Oakdale Company had sixty-four ovens, and also made considerable coke in pits. The coke made broke into long pieces, had no cross cracks, and the cells appeared sufficiently open for good working in the furnace without giving a spongy texture and weakness. The record of the furnace is not a test, as it was for much of the time badly handled; the books, however, show one month's run with an average of 67 bushels of coke to the ton of pig. This coke was never transported any distance in quantity, so that no test of loss in that way was had. It is possible, as stated, that the northwestern extension of this seam will afford a coal from which a coke nearly or quite the equal of standard Connellsville can be made.

"Above this seam of coal exist at least seven others over 3 feet in thickness. Whether in any of these is a coal which will make a coke the equal of Connellsville is unknown. They are practically unopened and unexplored. During investigations for a private company I found one seam which, from its size, could have been mined cheaply, and the physical structure of the coal indicated that it would make a good coke, while this idea was strengthened by experiments in the open air. Two barrels of this coal were sent to Mr. A. S. McCreath for analysis. His result was:

	Per cent.
Volatile hydrocarbons	39.023
Fixed carbon	48.229
Sulphur	3.208
Ash	8.275
Phosphorus	.020

"The coke made contained:

	Per cent.
Carbon	82.656
Sulphur	3.163
Ash	14.181
Phosphorus	.034

"His comments on this are: 'The physical character of the coke is fair, although it may prove rather spongy and weak for use in large furnaces, but chemically it carries an excessive amount of both sulphur and ash. The sulphur exists in the coal for the most part as iron pyrites, sometimes in masses one-quarter of an inch in thickness. Its general occurrence is such as to lead to the impression that it may be present in the form of a "sulphur tinder," near either the roof or floor of the coal bed. Much of the coal is comparatively free from sulphur. A different sampling of the coal bed might therefore result in locating the excessive amount of iron pyrites in a particular part or bench of the bed, which could be rejected in mining operations. This would not only eliminate a large portion of the sulphur, but it would materially affect the percentage of ash, for, assuming all the sulphur to be present in the form of iron pyrites, nearly one-half of the ash must consist of oxide of iron, resulting from the iron pyrites.'

"His remarks as to the sampling and position of the iron pyrites are correct. The pyrite exists in plates and balls in a slate, parting about 1 foot from the bottom, and can be easily taken out in mining, but in sending the sample a full cut from top to bottom of the seam was made without effort at selection. This seam of coal is 6 feet thick, has an excellent roof and floor, and can be mined at very low cost; hence, if not too high in volatile matter, it offers an opportunity for the production of a cheap coke. The owners of the land from which the above sample was taken have not chosen to pursue the investigation further, and the seam, though known to exist, has not yet been opened on any other property. If in this or some other of the seams above Coal H, of Coal creek and Poplar creek and Crooked Fork, there does not exist a good coking coal, there is not any such to be had in the Tennessee field, unless it mayhap be discovered in the unexplored Walnut Mountain field, which is the southwest extension of the Flat Top coal field of Virginia. In the future the cost of producing and characteristics of the cokes noted, as well as of some minor seams not here mentioned, will be discussed also as far as possible to ascertain their action in the furnaces."

In a further communication Professor Colton says:

"Some have already taken exception to my statement that there is not any first-class coke of commercial importance in the South. In further explanation of that statement it may be said that no coke of first-class quality is manufactured in the South in suffieient quantities to make any appreciable competition against the product from the Connellsville region. It is admitted that the Etna Company, in Tennessee, make a coke of very superior quality for foundry use, but if they were to attempt to produce a coke for blast furnaces they would do so at a loss, for it could not be sold at a price low enough to admit of any blast furnace using it. The seam of coal there mined is on the average thin as well as variable in its thickness. The product of these coke works is only about 8,000 tons per annum. Again, a very good blast-furnace coke has been made at the Crooke Coal Company's mines, near Glen May, on the Cincinnati Southern railway. The amount made, however, has been small, and it could not be placed in Chattanooga at a price which would justify any furnace in using it solely. It probably approaches nearer to a standard coke than any yet made in Tennessee. Until a coal is found which will make a coke that has the qualities possessed by the Connellsville product, and that coal is of such thickness that it can be cheaply mined and the coke produced can be sold at such a minimum price that it can be sent South, West, or North in competition with the Connellsville product, until then no coke in the South is of sufficient importance to be calculated in the estimate for commercial supply for the country at large."

Replying to Professor Colton's statement as to Poplar Creek coke, a correspondent of the same journal, who signs himself E. C. L., says: "He is certainly in error in his judgment in regard to the coke made from Poplar Creek coal and used at the Oakdale Iron Works. The writer was frequently at the works during the time the furnace was in blast, and gave especial attention to the working of the coke in the furnace, and can safely say it answered all expectations, carrying a burden said to be fully equal to that of Connellsville coke. That the coke made by us was perhaps not as solid and compact as Connellsville coke we do not deny, but the cause of this was that the coke was put into the ovens just as it came from the mines, in lumps frequently so large that they had to be forced through the oven openings, a peculiarity of the coal being that when the lumps became heated the coal disintegrated, like slacking lime. The coke became fingery, and, while it probably would not have borne transportation a long distance, it answered every purpose for the furnace. Several experiments were made by using only the slack coal free from lumps. The product was a solid, compact mass of coke which would bear transportation to almost any distance and carry a burden equal to any made. The following is the analysis made by Messrs. Potter & Riggs, of Saint Louis:

	Coal.	Coke.
	Per cent.	*Per cent.*
Moisture	1.62	0.27
Volatile matter	39.25	.95
Fixed carbon	57.67	90.06
Ash	1.48	8.76
Sulphur	.445	1.643

The following is a report made by Regis Chauvenet & Bro.:

	Coal.
	Per cent.
Moisture	1.24
Volatile matter	39.83
Fixed carbon	56.12
Ash	2.85

"This coal will yield 58.93 per cent. coke, containing fixed carbon, 95.24, and ash, 4.76. It will be seen that there is some difference in the analyses made by Mr. McCreath and those of the above. During the past summer we had several ovens of coke made from the coal mined from our new entry, which we are driving at Poplar creek, under what is known as Big Bushy mountain. We have had no analysis made of the coke."

UTAH.

As was stated in the previous reports, the attempts to manufacture coke in Utah on a commercial scale have so far proved unsuccessful. Some years ago twenty coke ovens of the Belgian (Coppée) type were erected in the San Pete valley, and some coke made, but these ovens have not been operated for three years. The Territory possesses large bodies of iron ore, and many investigations have been undertaken to ascertain the probabilities of successful iron manufacture, using as fuels cokes from the coals which exist in several localities, but so far without finding a coke that seemed to answer the purpose of a blast-furnace fuel.

At the Pittsburgh meeting (February, 1886) of the American Institute of Mining Engineers, Prof. George W. Maynard, of New York, gave the following analyses of coals and cokes from two localities in this Territory:

Analyses of Utah coals and coke.

	Cedar City.	Castle-dale.
	Per cent.	*Per cent.*
Water at 212° Fahrenheit	3.502	3.426
Volatile matter	43.669	42.814
Fixed carbon / Sulphur	43.102	47.810
Ash	9.727	5.950
	100.000	100.000
Coke	52.835	53.760
Color of ash	Pink gray.	Reddish gray.

The Cedar City coal was quite coherent and hard; the Castledale much less coherent. The analysis of Cedar City coke was as follows:

	Per cent.
Water and volatile matter	1.417
Fixed carbon	76.706
Sulphur	5.270
Ash	16.607

This coke is of but little value as a fuel, because of the large amount of ash it contains and because of the excessive percentage of sulphur.

The statistics of the manufacture of coke in Utah for the years 1880 to 1885 are as follows:

Statistics of the manufacture of coke in Utah, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	1	1	1	1	1	1
Ovens built (all Coppée)	20	20	20	20	20	20
Ovens building	0	0	0	0	0	0
Coal used in ovens, short tons	2,000	0	500	0	0	0
Coke produced, short tons	1,000	0	250	0	0	0
Total value of coke at ovens	$10,000	0	$2,500	0	0	0
Value of coke at ovens, per ton	$10	0	$10	0	0	0
Yield of coal in coke, per cent	50	0	50	0	0	0

VIRGINIA.

The only coke made in Virginia in 1885, from coal mined in the State, was at Pocahontas, from Flat Top coal, by the Southwest Virginia Improvement Company. There is, in addition to the Pocahontas ovens, a bank of one hundred and fifty ovens at Low Moor, in Alleghany county, just across the border from West Virginia, but as these ovens draw their entire supply of coal from the New River district of West Virginia, being located, only for convenience, at Low Moor, near the blast furnace in which their product is consumed, their product is reported in West Virginia.

The Pocahontas coal and the coke made from it were described at length in the last report. There has been no increase in the number of ovens during the year. The production has fallen off about 22 per cent. by reason of the decreased demand for blast-furnace coke.

The statistics of the manufacture of coke in Virginia, from Virginia coal, for the years from 1880 to 1885 are as follows:

Statistics of the manufacture of coke in Virginia, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	0	0	0	1	1	1
Ovens built	0	0	0	200	200	200
Ovens building	0	0	0	0	0	0
Coal used, short tons	0	0	0	39,000	99,000	81,899
Coke produced, short tons	0	0	0	25,340	63,600	49,139
Total value of coke at ovens	0	0	0	$44,345	$111,300	$85,993
Value of coke at ovens, per ton	0	0	0	$1.75	$1.75	$1.75
Yield of coal in coke, per cent	0	0	0	65	64¼	60

An analysis of Pocahontas coke, representing "an average of the charge of a 12 by 6 feet beehive oven coked seventy-two hours," is given in *The Virginias.* It is by Dr. Henry Frœhling, of Richmond:

Analysis of Pocahontas (Virginia) coke.

	Per cent.
Fixed carbon	93.84
Volatile combustible matter	.59
Moisture	.29
Ash	5.28
Total	100.00

The analysis of the ash is as follows:

	Per cent.
Silica	2.780
Alumina	1.009
Ferric oxide	.881
Lime	.341
Magnesia	.016
Phosphoric acid	.018
Sulphuric acid	.158
Potash	.068
Manganese	Trace.
	5.271

Mr. Austin Farrell, superintendent of the Glamorgan Iron Company at Lewiston, Pennsylvania, speaks of Virginia coke from the Pocahontas coal as being fairly strong and dense, but intimates that its quality could be greatly improved by a little more care in the preparation of the coal and in conducting the coking process. He gives the following as the average of several analyses of this coke covering the deliveries of a period of six months:

Analysis of Pocahontas (Virginia) coke.

	Per cent.
Fixed carbon	90.02
Volatile matter	1.35
Water	.21
Ash	7.75
Sulphur	.67
Total	100.00

Mr. Farrell also gives the following comparison, taken from the records of the Lynchburg Iron Company, of the work performed by Pocahontas and Connellsville cokes in the Lynchburg furnace:

Working of furnace on all Pocahontas coke from September 18, 1884, *to December* 31, 1885.

	Tons.
Coke used per ton of iron made	1.49
Ores used per ton of iron made	2.02
Limestone used per ton of iron made	.88

Working of furnace on all Connellsville coke from September 5, 1885, *to December* 31, 1885.

	Tons.
Coke used per ton of iron made	1.50
Ores used per ton of iron made	2.01
Limestone used per ton of iron made	1.03

The average daily yield of iron, including time of blowing in, stops, etc., was 40.8 long tons. Mr. Farrell, as the result of this comparison, gives it as his opinion, "that the coke produced in Virginia from Pocahontas and Flat Top coals is fully equal to Connellsville, at least so far as furnaces of moderate height are concerned."

WASHINGTON.

The only coke works on the Pacific coast, so far as has been ascertained, is that of the Tacoma Coal Company, at Wilkeson, Pierce county, Washington Territory. The coal and the coke made from this establishment were described in the last volume of the "Mineral Resources." In 1884 only pits were used; most of the coke made in the present year has also been made in pits. Two ovens, however, have been built and operated for a short time. The coke is used at various places on the

Pacific coast from San Francisco northwardly, with as good satisfaction, it is claimed, as the English and Welsh cokes. The company propose to erect twenty-five or more beehive ovens during 1886.

The report received contained no statement as to the value of the coke. The price in 1884, $4.75 per ton, has been assumed.

The following are the statistics of the manufacture of coke in Washington Territory for the years 1884 and 1885, the only years in which coke has been made:

Statistics of the production of coke in Washington Territory in 1884 *and* 1885.

	1884.	1885.
Number of establishments	1	1
Number of ovens built	0	2
Number of ovens building	0	0
Coal used in the production of coke, short tons	700	544
Coke produced, short tons	400	311
Total value of coke at ovens	$1,900	$1,477
Value of coke at ovens, per ton	$4.75	$4.75
Yield of coal in coke, per cent	57½	57

Pits were used entirely in 1884, and in part in 1885.

WEST VIRGINIA.

The localities in which coke is made in West Virginia may for convenience be divided into three districts, the Kanawha, the New River, and the Northern. The first two are compact and continuous. They include the ovens along the line of the Chesapeake and Ohio railroad, from Low Moor, in Virginia, to the Kanawha valley. The Low Moor ovens, though located in Virginia, are included among those of West Virginia, for the reason that all the coal used in them is from mines in West Virginia. The division between the two districts, the New River and Kanawha, is at Hawk's Nest, and is based, in part, upon locality and in part upon the coal used, the New River coals being No. XII. of Rogers's classification, the Kanawha coals No. XIII.

The third district, the Northern, is a scattered one, including the ovens in Preston, Taylor, Harrison, and Marion counties, and those at Wheeling, in Ohio county.

Total coke production in West Virginia.—Consolidating the statistics of the different districts given below, the following are the statistics of the production of coke in West Virginia from 1880 to 1885:

Statistics of the manufacture of coke in West Virginia, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	18	19	22	24	27	27
Ovens built	631	689	878	962	1,005	978
Ovens building	40	0	0	0	127	63
Coal used, short tons	230,758	304,823	366,653	411,159	385,588	415,533
Coke produced, short tons	138,755	187,126	230,398	257,519	223,472	260,571
Total value of coke at ovens	$318,797	$429,571	$520,437	$563,490	$425,952	$485,588
Value of coke at ovens, per ton	$2.30	$2.30	$2.26	$2.19	$1.91	$1.86
Yield of coal in coke, per cent	60	61	63	63	62	63

Though there have been changes in the number of establishments in the several districts, old ones being abandoned and new ones coming into existence, the total number in the State remains the same as at the close of 1884, the changes balancing each other. There has been a slight reduction in the number of ovens reported, but in view of the depressed condition of the iron trade, a gratifying increase in production, over 17 per cent.

The field of coking coals on the Kanawha river, and especially that part of it worked on its branch, the New river, including the coal of the Flat Top region, coked in Virginia, is one of the most important and valuable of the Appalachian basin. The coke made from these coals is a most excellent fuel, and though it has not, as yet, and may not obtain as wide a market as the Connellsville, it will not be because of its inferiority. It contains, as a rule, less ash and is nearly if not quite as strong and vigorous as a furnace fuel. As a rule, the veins of the New river are not as thick, nor as uniform in their thickness, as those of Connellsville, nor as well located for economy of handling between the mine and ovens. It is, however, one of the two most important areas of first-class coking coal in the country.

The Kanawha district.—Included in this district are all of the ovens from Ansted down the Kanawha, all drawing their coal from formation No. XIII. of Rogers's classification. These coals were so fully described in the last report as to require but little further statement.

The coke from these coals is used in the blast furnaces of the Ohio River, Hocking Valley (Ohio) and Columbus (Ohio) districts, and is regarded with great favor by the furnace managers in these localities. The Great Kanawha Colliery Company, limited, is building an addition of twenty-one ovens to its plant, and contemplates a greater increase early in 1886. At the Gaymont mines, near Hawk's Nest, a new works with twelve ovens is building, and at the Mount Carbon mines another new establishment with thirty beehive ovens is under construction, to be completed early in 1886.

The following analysis by Prof. W. N. Lord is of a coke made in this district by the Saint Clair Company, near Eagle:

Analysis of Saint Clair (West Virginia) coke.

	Per cent.
Carbon	90.88
Ash	8.55
Sulphur	.57
Total	100.00

The following are the statistics of the production of coke in the Kanawha, West Virginia, district, for the years 1880 to 1885:

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	4	4	5	5	6	7
Ovens built	18	18	(*a*) 138	(*a*) 147	(*a*) 177	(*b*) 181
Ovens building	0	0	0	0	15	63
Coal used, short tons	6,789	11,516	40,782	58,735	60,281	65,348
Coke produced, short tons	4,300	6,900	26,170	37,970	39,000	37,551
Total value of coke at ovens	$9,890	$16,905	$62,808	$88,090	$76,070	$63,082
Value of coke at ovens, per ton	$2.30	$2.45	$2.40	$2.32	$1.95	$1.68
Yield of coal in coke, per cent	63⅓	60	64	64⅝	64⅝	57

a Eighty of these ovens are Coppeé, the balance beehive.
b Sixty of these ovens are Coppée, the balance beehive.

During the year there has been a decrease of one in the number of works and an increase of two new establishments, making a total increase of one. At three of the seven works no coke was made in 1885, two being in course of construction and one idle the entire year.

New River district.—The New River coking district includes the ovens along the line of the Chesapeake and Ohio railroad from Low Moor, in Virginia, to Nuttall. At Nuttall the coals of the New River, the No. XII. of Rogers, the Pottsville Conglomerate of the Pennsylvania survey, begin to be utilized for coking purposes, and from this point, along the cañon of New river to where the lowest bed of the series goes into the air at Quinnimont, the coals of all three beds of these measures are used for coking, making a coke high in carbon, low in ash, strong and vigorous, and giving the best results as a furnace fuel. Indeed, no better coking coal is found in the whole Appalachian basin from Pennsylvania to Alabama. So much has been written about the coals and cokes of this district as render unnecessary any extended remarks here In the last volume this district and its cokes were very fully discussed.

The statistics of the manufacture of coke in the New River district of West Virginia from 1880 to 1885 are as follows:

Statistics of the manufacture of coke in the New River district, West Virginia, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	6	6	6	6	8	8
Ovens built	468	499	518	546	547	519
Ovens building	40	0	0	0	12	0
Coal used, short tons	159,032	219,446	233,361	264,171	219,839	244,769
Coke produced, short tons	98,427	136,423	148,373	167,795	135,335	156,007
Total value of coke at ovens	$239,977	$334,652	$352,415	$384,552	$274,988	$325,001
Value of coke at ovens, per ton	$2.44	$2.45	$2.38	$2.29	$2.03	$2.08
Yield of coal in coke, per cent	62	62	64	64	62	63¾

The increase in production during the year has been about 16 per cent. There also has been a slight appreciation in the value of this coke per ton. The record shows a decrease in the number of ovens during the year. The same remarks as to the yield of coal in coke can be made as were made last year. The yield per ton of coal is 1 per cent. greater this year than last. The range of yield reported is from 60 per cent. to 66⅔ per cent., and the average 63¾ per cent.

All of the ovens in this district are beehive of the ordinary pattern. The charge of coal is 3 tons, the time of coking forty-eight and seventy-two hours. Forty-eight hour coke is generally considered to be worth appreciably less in the manufacture of pig iron than seventy-two hour coke, but Mr. J. H. Skelding, the founder of Low Moor furnace, Alleghany county, Virginia, states to *The Virginias* that after numerous trials he finds he always gets better results from the forty-eight hour coke, made from New River semi-bituminous coal in the ovens at that furnace, than from the seventy-two hour from the same coal and ovens.

The Northern district.—In this district are included the ovens in a group of counties lying along the Baltimore and Ohio railroad on the headwaters of the Monongahela river—Preston, Taylor, Harrison, and Marion—and those of Ohio county, in the northern part of the "Pan Handle." The coke made at Wheeling, in Ohio county, is made in small amounts, to supply a local demand from glass works.

As yet coking in this district is carried on in a limited way. But one of the twelve works has over thirty-three ovens, and seven have twenty or less. Though the works are small the industry is a growing one, production of the past year having increased nearly 40 per cent. The number of works in existence has decreased one. Three of the twelve works regarded as in existence during the year, with fifty-four ovens, were idle the entire year, while few of the others were run to their full working capacity.

The statistics of the production of coke in the Northern district of West Virginia for the years from 1880 to 1885 are as follows:

Statistics of the manufacture of coke in the Northern district, West Virginia, 1880 *to* 1885.

	1880.	1881.	1882.	1883.	1884.	1885.
Number of establishments	8	9	11	13	13	12
Ovens built	145	172	222	269	281	278
Ovens building	0	0	0	0	100	0
Coal used, short tons	64,937	73,863	92,510	88,253	78,468	105,416
Coke produced, short tons	36,028	43,803	55,855	51,754	49,139	67,013
Total value of coke at ovens	$68,930	$78,014	$105,214	$90,848	$74,894	$97,505
Value of coke at ovens, per ton	$1.91	$1.78	$1.88	$1.76	$1.52	$1.45
Yield of coal in coke, per cent	55	59	60	59	63	63½

The Bluestone district.—What has come to be known as the Bluestone district is a portion of the great Flat Top coal field of the Virginias, but is located chiefly, if not entirely, in West Virginia, as the Pocahontas portion of the same field is in Virginia. Indeed, this entire Flat Top coal is but a continuation of the New River coal of West Virginia, the Pocahontas seam in the Flat Top having been correlated with the Quinnimont seam in the New River series. As yet, there are no ovens in this district, but as some very interesting experiments have been made with the Bluestone coals, and as two hundred ovens are projected for 1886, it becomes of importance to refer to its coals and the cokes made from them.

The coals with which the experiments to be described were made were from Mercer county, West Virginia. The Bluestone Coal Company owns a large tract of these Flat Top coals in this section, but does not itself operate collieries, leasing on royalties to operators. The coal experimented upon was from No. III., or the Pocahontas seam, which, as is stated above, has been identified as the equivalent of the Quinnimont seam in the New River. The coal used for the test, and that at Pocahontas are identical and from the same seam, but a few miles apart, exhibiting precisely the same chemical analysis. The object of the test was to determine whether the modified form of the Belgian coke oven, known as the Soldenhof-Coppée, would yield a coke superior to that now being made in the ordinary "beehive" oven at the works of the Southwest Virginia Improvement Company at Pocahontas, Virginia, from the same coal.

The improvements in the coke sought, and hoped to be obtained, by these ovens, as explained by Mr. J. H. Bramwell, engineer of the Bluestone Coal Company, in a letter to *The Virginias*, were:

"1. A greater degree of hardness, so as to resist the dissolving action of the ascending currents of carbonic acid at too early a period in the reductions of the blast furnace.

"2. Firmness and coherence, to overcome the excessive loss from disintegration in drawing the oven charges and in the subsequent handling and transportation, owing to its unusual tenderness and friability.

"3. Uniformity of structure, to counteract the disposition exhibited by the coals low in volatile matter toward a spongy inflation, particularly the case in burning 48-hour coke where rapid combustion is required to insure coking within the given time; 72-hour coke exhibits this tendency to a very much less extent.

"The Flat Top (Pocahontas) coals lack a sufficiency of bitumen to enable them to agglutinate properly in coking in the 'beehive' oven, and when the charge is drawn a considerable proportion of coke is found to break into fragments too small for shipment, and consequently a total loss, materially decreasing the percentage of yield. Evidences of a more than ordinary disposition to disintegrate and crumble can be seen in the accumulation of fine coke and braze both on the coke yards and in the furnace stock houses.

"Another difficulty is experienced in maintaining hot ovens, as it frequently requires a sacrifice of fixed carbon in the coals that are being coked to restore the heat requisite to hold the ovens at a proper coking temperature. Furthermore, in quenching an oven, preparatory to drawing, great care must be exercised or 'cold bottoms' and 'black ends' ('nigger head') coke will result, and for the several succeeding charges careful attention will be necessary to bring the ovens up to a proper working heat.

"As we cannot change the nature of our Flat Top coals, and as it is altogether unlikely that we can secure a more desirable coking coal, therefore it becomes a necessity—if after two years' trial with 'beehive' ovens we have failed to obtain as satisfactory results as are desired—to try other methods of coking than the one that has been tried and that has been found peculiarly adapted to coals possessing high coking attributes but differing greatly in composition and character from these Flat Top coals. As the Soldenhof-Coppée and other ovens of Belgian type have succeeded elsewhere in yielding results highly satisfactory with coals of a constitution resembling the Flat Top coals, it seemed quite possible that we might also succeed; but to what extent and in what particular direction our efforts should be specially prosecuted only practical experiments can determine.

"To learn how to improve the quality and to lessen the cost of production of our coke, that we may eventually extend our trade in it beyond the consuming points not absolutely dependent upon its district, were the objects specially had in view in undertaking the experiments in the ovens at Hawk's Nest. The results of these experiments, as given below, I think highly gratifying; in my opinion they conclusively demonstrate the superiority of the Soldenhof-Coppée ovens for coking the dry, low-volatile-matter coals of the Flat Top field over the beehive ovens.

"It is not claimed that we have as yet succeeded in realizing the highest attainable results, but that we have ascertained certain facts which, with further experiences and experiments will undoubtedly lead to the introduction of a system of coking in a class of ovens better adapted to these coals than are the ordinary beehive ovens.

"It does not follow because a given coal will not yield a good coke in a beehive oven that it is not a good coking coal, for if it did many of our iron industries would have to depend on coal fields too remote for consideration and quietly succumb for want of good fuel. The proper policy to adopt is that of intelligence, practical experiment, and inquiry, similar to that of the German, French, and Belgian coke makers and iron masters who sought relief from their difficulties with inferior coking coals through improved coking processes rather than in vainly seeking that which nature had failed to provide, that is a coal that would coke well in a beehive oven. The results of their efforts are seen in the huge and successful industrial establishments of John Cockerill, at Seraing, in Belgium; of the Krupps, at Essen, in Germany; and those of Creusot, Terrenoire, and St. Etienne, in France.

"The coal used in the test was two weeks on its way to the ovens. The exposure during this interval of two weeks undoubtedly diminished to some extent the coking power of this coal. The coal was shipped in the following kinds and proportions, from the three collieries now operated by lessees of the Bluestone Coal Company:

	Slack.	Run of mine.	Total.
	Pounds.	*Pounds.*	*Pounds.*
John Cooper & Co	42,900		42,900
Freeman & Jones	43,250	46,850	90,100
William Booth & Co	42,650		42,650
Total pounds shipped			175,650

"As the best results from any coking process can be best secured from material in a uniform physical condition, these coals passed through a crusher previous to being charged into the Soldenhoff-Coppée ovens. This reduction to a uniform degree of fineness is a more important factor than is generally supposed, as it is evident that the greater surface exposure of fine coal will cause it to evolve its volatile constituents more quickly and to coke more rapidly than the lumps of coal, if any be present. The quality of coke made from coal previously crushed appears to be more regular and compact than that made from uncrushed coal.

"*Tests, giving the charges, the time of discharging the ovens, the percentages of yield, etc.*

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Number of ovens charged	6	4	4	6	9
Tons charged in each oven	3	2.5	2.5	2.75	2.5
Total tons charged in test	18	10	10	16.5	2.5
Time of coking, hours	36	24	30	48	36

Total yield of coke from all tests, tons	51.54
Average percentage of coke per ton of coal coked	67.5

"No. 1 test, made July 9, produced a coke not sufficiently coked through to the center; the charge was pushed out with difficulty.

"No. 2 test, made July 10, gave a coke apparently well coked, but dull in color.

"No. 3 test, made July 10, yielded a coke very uniformly coked, and bright and compact.

"No. 4 test, made July 11, furnished a bright, compact coke, but there was considerable ash left at the doors of the ovens.

"No. 5 test, made July 12, furnished a coke bright, regular, and uniform throughout."

Samples of the coke so made were submitted to Mr. A. S. McCreath, chemist of the Second Geological Survey of Pennsylvania, for analysis, and to Mr. John Fulton, general mining engineer of the Cambria Iron Company, for physical tests. The results of these investigations were communicated to Mr. F. J. Kimball, president of the Norfolk and Western railroad, and by him furnished *The Virginias*, as follows:

Mr. McCreath reports: "The sample of Flat Top coke received from you July 27 yields on analysis the following results:

	Per cent.
Fixed carbon	91.110
Moisture at 212° F.	.542
Ash	7.021
Sulphur	.839
Volatile matter	.488
	100.000
Phosphorus	.006

"An average sample was submitted to Mr. John Fulton for his report on its physical properties as compared with the standard Connellsville coke. His report in full is herewith submitted. It shows that while the Flat Top coke is inferior to Connellsville in hardness and cell development its burden-bearing strength is much greater, the ratio being 114 to 134. Chemically considered, the Flat Top coke is much superior to the Connellsville, showing, as it does, fully 4 per cent. less ash and over 3 per cent. more fixed carbon, while the phosphorus is very much lower. Mr. Fulton's report is so complete that I submit it without further comment."

Mr. Fulton's report is accompanied by the following table, exhibiting the physical and chemical properties of Connellsville standard coke and this Flat Top coke in comparison, from Mr. Fulton's own tests and Mr. McCreath's analyses:

	Connellsville.	Flat Top.
Grams in 1 cubic inch:		
Dry	12.46	15.30
Wet	20.25	23.39
Pounds in 1 cubic foot:		
Dry	47.47	58.31
Wet	77.15	89.12
Percentage of:		
Coke	61.53	65.42
Cells	38.47	34.58
Compressive strength per cubic inch, one-fourth ultimate strength	284	335
Height of furnace charge supported without crushing	114	134
Order in cellular space	1	1.25
Hardness	3.5	2.8
Specific gravity	1.50	1.73
Fixed carbon	87.46	91.11
Moisture	.49	.54
Ash	11.32	7.02
Sulphur	.69	.84
Phosphorus	.029	.006
Volatile matter	.011	.488

Mr. Fulton, under date of August 1, 1885, reports as follows to Mr. McCreath: "As you requested, I have carefully examined the physical properties of the sample of coke you forwarded July 27. The coke is reported to have been made from unwashed slack coal. The coal came from the Flat Top region of Virginia, and was coked in Coppée's coke ovens, thirty-six hours' coke, at Hawk's Nest, New river, Virginia. The chemical analysis shows a coke low in ash, sulphur, and phosphorus, and consequently high in fixed carbon. So far as these determinations show it is cleaner fuel than the standard Connellsville. The number of little disks of slate in this coke would lead an observer to expect more ash. The Tioga, Pennsylvania, coke is similarly marked, holding considerable ash. The coke has a dull color, and is much softer than the standard. The volatile matter, 0.488 per cent., indicates a want of heat in the oven or time to complete coking. The physical structure of this coke is dense, not hard; while the ratio of cells and pores to body of coke indicates this, there is an evident repression of cell development in the operation of coking. The compressive or burden-bearing strength of this coke is quite high. Three cubes were broken in a Gill testing machine, and the average result is given in the table. There is a toughness in this coke which is not found in the standard or similar hard-bodied samples. The softness of this coke is the principal deficiency for use in blast furnaces. It has been shown that soft coke, in smelting iron, is more easily attacked by carbonic acid than hard coke. That is, soft coke is set on fire by the ascending carbonic acid gas high up in the furnace; its destruction above the zone of its real work is not only of no value, but it disarranges the regular operations of the furnace. I would hesitate to assure the success of this quality of coke in competition with other cokes in this section of Virginia which I have examined, especially the Fire Creek and Pocahontas. Practically, the inquiry arises here, How can this coal be coked to insure a hard-bodied fuel, with well developed cells? A test in a hot beehive oven should be made before final conclusions are accepted. Should such a test not produce better results in the coke it would become a serious question whether some more desirable coking coal should be secured. The broad principle has been laid down that the coal determines the quality of the coke, not the special kind of oven. Hence the first requirement is a known good quality of coking coal. The Coppée is one of a large family of Belgian ovens. It was especially designed to coke a soft, friable, inferior coking coal. It differs slightly from the other members of this family in the arrangement of its flues. It, in common with the whole class of such ovens, retains heat, and can coke coal low in hydrogenous matter. It produces a larger percentage of coke than the beehive family, but the product is much denser and usually softer than the product of the latter class of ovens.

"The whole range of coke ovens comes under two distinct classes: Those heated internally, the beehives, and those heated externally, the Belgians. The former class produce the best metallurgical coke, but are somewhat wasteful and less economic in operation. The latter afford a larger yield of coke at a reduced cost of operating, but the original cost of these ovens is double that of the beehives, and the coke inferior in hardness and cell development. Sir I. L. Bell has proved in a paper read before the London meeting of the Iron and Steel Institute, published in the *Iron Age* of May 28 last, that 22½ cwt. of coke made in beehive ovens was equal to 25 cwt. of Simon-Carves oven-made coke, both cokes from coal taken from the same coal bed. 'In other words, the extra yield of coke (in Simon-Carves ovens) will bring little profit to the coke burner.' These results are controverted by some, but the great principles that govern the furnace coke makers are unchanged: that all coking operations should be directed to produce a hard-bodied cellular coke. Aside from the economy of the percentage of coke produced, there is no discussion that the beehive or internally heated ovens produce the best metallurgical coke. The narrow-chambered Belgian oven family, of whatever name, compress the fusing mass of coke and make dense coke. Now, the most dense furnace fuel known is anthracite coal—a natural coke. But the yield of an anthracite furnace is, say, 500 tons of pig iron per week, while a coke furnace will produce 700 or 800 tons of pig metal in the same time. Why should coke makers endeavor to imitate this slow furnace fuel? Anthracite furnacemen are rapidly increasing the use of coke in their furnaces. The Tioga coke ovens, using a dry coal, found it a decided improvement to construct double floors of brick in their beehive ovens, so as to secure a 'store of heat.' This, with the improved beehive door, increases the hardness of body of coke and yield in the beehive ovens."

PETROLEUM.

By S. H. Stowell.

Petroleum has been known to exist in this country almost from its first settlement. The records of travels, especially through the region west of the Appalachian chain, in what was then known as the Great Ohio Valley, contain constant evidences of the existence of this material in the reports of burning springs and the oil that accompanied them. It was not, however, until 1859, at the time of the drilling of Drake's first well, that it began to assume any commercial importance. The excitement attending the discoveries in the Pennsylvania oil field led to explorations in many States, and developed the fact that petroleum existed in many localities. These localities are chiefly on the western slopes of the Appalachian chain, reaching from Petrolea in Ontario to just across the Tennessee State line in Alabama. Some quite extensive fields are also found in California and in Wyoming, and later evidences of the existence of oil have been discovered in other States, but the Appalachian and the California oil fields are at present the only ones of commercial importance.

The most important of these fields are what are described further on as the Pennsylvania and New York oil fields. Next in importance to these is the Macksburg field in Ohio, near Marietta, the third in importance being the California field. West Virginia produces some small amounts of heavy oil for lubricating purposes, its light oil having been comparatively exhausted some years since. There are also oil fields that with better facilities for transportation might be of importance in both Tennessee and Kentucky. The Wyoming oil fields described further on in this report are also of importance in the amount of petroleum that can some day be made available, but of this field, as of all others outside of the Pennsylvania and Macksburg regions, with the exception of California, it will be found that the expense of producing and transporting the oil to market will effectually prevent any great production in these fields until the price of Pennsylvania petroleum shall materially advance. Full descriptions of these fields will be found either in the subsequent pages of this report or in the previous volumes of "Mineral Resources."

In the following table will be found a consolidation of the statistics of the production of petroleum in the various fields of the country and

Canada, so far as the same could be obtained from the beginning of operations in these fields:

Production of crude petroleum in the United States and Canada from 1859 *to* 1885, *inclusive.*

Years.	Pennsylvania and New York.	West Virginia.	Ohio.	Kentucky and Tennessee.	California.	Canada. (a)
	Barrels. (b)	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1859	2,000					
1860	500,000					
1861	2,113,609					
1862 (c)	3,056,690					11,775
1863	2,611,309					82,814
1864	2,116,109					90,000
1865	2,497,700					110,000
1866	3,597,700					175,000
1867	3,347,300					190,000
1868	3,646,117					200,000
1869	4,215,000					220,000
1870	5,260,745					250,000
1871	5,205,341					269,397
1872	5,939,003					308,100
1873	9,890,964					365,052
1874	10,950,730					168,807
1875	8,787,506	(d) 3,000,000	(d) 200,000		(d) 175,000	220,000
1876	8,968,906	120,000	31,763		12,000	312,000
1877	13,135,671	172,000	29,888		13,000	312,000
1878	15,165,462	180,000	38,179		15,227	312,000
1879	19,741,661	180,000	29,112		19,858	575,000
1880	26,032,421	179,000	38,940		40,552	350,000
1881	27,858,210	151,000	33,867		99,862	275,000
1882	30,053,500	128,000	39,761		128,636	275,000
1883	23,128,389	126,000	47,632		142,857	250,000
1884	23,772,209	90,000	90,081		262,000	250,000
1885	20,776,041	91,000	650,000		325,000	250,000
Total	281,870,293	4,417,000	1,229,223	175,000	1,233,992	5,821,945

a There are no reliable statistics of production for Canada. Those given are the estimates of parties intimately connected with the industry.
b All barrels in this table are of 42 gallons.
c In addition to the above it is estimated that for want of a market some 10,000,000 barrels ran to waste in and prior to 1862 from the Pennsylvania and Canada fields; also a large amount from West Virginia and Tennessee.
d Including all production prior to 1876.

Outside of the Pennsylvania oil fields the above production is made up from data which are only complete enough to present as an approximation. The same may be said of the Pennsylvania oil fields for the first four or five years; since that time a very satisfactory record has been preserved.

PENNSYLVANIA AND NEW YORK.

Owing to their intimate connection in a commercial way, it is almost impossible to make an exact separation between the oil produced in New York and that from the wells of Pennsylvania. In the early history of the northern district no such separation was attempted. Almost from the first the Bradford district included some wells in New York, but this was all run into Pennsylvania and distributed through the distributing agencies of that State. The amount was small, however, and, commercially, no account was taken of the State in which the oil was produced. Latterly, however, the Allegany field has been regarded as a district by itself. To the oil that is reported in such a way as to make it beyond question that it is from New York is added an estimate of that about which there is some doubt, and the reports of the Allegany field may be regarded as including all the oil produced in New York.

So far as any division is made of the Pennsylvania and New York oil fields, four districts are given in this report: (1) Allegany or Richburg, (2) Bradford, (3) Warren and Forest, and (4) Lower.

These districts were fully described in the report for 1883–'84. It may be well, however, to say that the Allegany field lies wholly in Allegany county, New York, and is of irregular shape, with an average length of some 20 miles. Outlying this district in the same county are three smaller fields, of which one, about a mile from the town of Niles, and bearing its name, is the farthest north of any development. The Wirt field, midway between Niles and the main field, is larger, but produces more gas than oil.

The Bradford district lies chiefly in Pennsylvania, in the county of McKean, but the main field extends at least 5 miles into the State of New York, and an outlying basin of oil rocks, which properly belongs to the Bradford basin, is contained for the greater part in Carrollton township, in Cattaraugus county, New York.

The Middle oil field—the Warren and Forest—is located in the two counties from which it takes its name. It includes the three white-sand pools of Cherry Grove, Balltown, and Cooper; the close-pebble district of Stoneham, Clarendon, and Tiona, together with Kinzua, and the recently developed field of Kane and the older pool at Grand Valley.

The Lower field begins with a few pools in the southwestern corner of Warren and the western end of Forest counties, and embraces all of the oil-producing territory to the southward, including the fields in Venango, Clarion, and Butler, with its Thorn Creek pool; the field on the Ohio river, in Beaver county; the Slippery Rock field, along Slippery Rock creek in Lawrence county; the Pleasant Unity field, in Westmoreland county; the deposits in Greene county; the Shousetown, in Allegheny; the Washington, the Mount Nebo, and other smaller fields. The statistics of production given under the head of the oil fields of Pennsylvania and New York include all of the crude from these several districts.

More than 50 per cent. of all the oil produced in the United States is from the Bradford and Allegany fields, these two districts being credited with 11,099,512 of the 21,842,041 barrels produced in the country in 1885. The production in these fields, however, is kept up only by the liberal use of nitro-glycerine, and even with the use of explosives to an extent before unknown the production is falling off, and it is a question if the vigor of these old fields can be restored.

The interest in the drilling operations in the territory included in the Pennsylvania and New York district in 1885 began in the Washington section with the Gantz well. The results following the opening of this well were not encouraging, but later in the year a new productive horizon at some depth below the formation in which the Gantz well occurred revived the interest in this field, indicating a producing district that will prove of some importance during the year 1886. The total production of Washington county in 1885 was some 10,500 barrels.

During the early part of 1885 the Thorn Creek subdistrict in Butler county attracted considerable attention. The highest development in this field in 1885 was in April. On the 11th of that month 89 wells were producing some 12,290 barrels of oil; on July 18, 156 wells were producing but 2,956 barrels, and on August 22 the number of wells had increased to 157, but the production had dropped to 2,174 barrels. An evidence of the great decline in this district is seen in the fact that in November, 1884, with but 18 wells, one day's production was 15,445 barrels.

Cogley run, in Clarion county, assumed considerable importance in 1885. The initial well was tubed January 8, and its first two weeks' production was but 150 barrels. A pool some 5 miles in length has been developed since this first well, and the production credited to Cogley run in 1885 was over 700,000 barrels.

The Clarendon district, in Warren county, has been greatly enlarged on all sides during the past year. The wells are small, but their aggregate production reaches a considerable figure. Kinzua village has produced several gushers in the past twelve months. The Kane well furnished the pretext for a heavy "bear" movement, but the indications at the close of the year in this field were not very flattering.

Production.—In the following table is given a statement of the production of the Pennsylvania and New York oil fields during the year 1885, by months and districts. As is stated elsewhere, it is well nigh impossible to give the exact proportion of this production that should be credited to Pennsylvania and New York respectively. The production of the Allegany district is, to a near approximation, that of New York. The remainder is the production of Pennsylvania.

Total production of crude petroleum in the Pennsylvania and New York oil fields for the year 1885, by districts and months.

Months.	Allegany district.	Bradford district.	Warren district.	Lower district.	Total.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	217, 744	719, 758	183, 086	531, 588	1, 652, 176
February	182, 672	622, 104	152, 964	480, 144	1, 437, 884
March	213, 776	700, 290	180, 885	543, 182	1, 638, 133
April	221, 880	707, 700	205, 050	645, 660	1, 780, 290
May	229, 276	731, 290	211, 885	598, 920	1, 771, 371
June	235, 170	720, 930	218, 280	592, 830	1, 767, 210
July	230, 454	732, 406	213, 001	599, 943	1, 775, 804
August	224, 254	701, 406	203, 701	576, 600	1, 705, 961
September	224, 520	686, 280	212, 130	589, 860	1, 712, 790
October	237, 460	709, 497	222, 580	704, 568	1, 874, 105
November	212, 490	686, 610	198, 090	664, 470	1, 761, 660
December	228, 315	723, 230	228, 966	718, 146	1, 898, 657
Total	2, 658, 011	8, 441, 501	2, 430, 618	7, 245, 911	20, 776, 041

Assuming that the production of the Allegany district represents that of New York State, the production of crude petroleum in New York in 1885 would be 2,658,011 barrels, and that of Pennsylvania in the same year 18,118,030 barrels. The production of each State on the basis assumed for the past four years is as follows:

Years.	Pennsylvania.	New York.
	Barrels.	*Barrels.*
1882	23,367,769	6,685,731
1883	19,124,799	4,003,590
1884	21,540,852	3,231,357
1885	18,118,030	2,658,011

This table indicates the great falling off in the production of the New York field in the four years for which totals are given, the decline being from six and two-third millions barrels in 1882 to two and two-third millions barrels in 1885. There has also been a marked decline, some 5,000,000 barrels, in the production of the Pennsylvania field in the same period, but the percentage decline is not so great as in New York.

The following table gives the total production of the Pennsylvania and New York oil fields for each year since 1859. There is a difficulty in ascertaining just what proportion of these two States should be credited to each. The collections and deliveries of the pipe lines are so arranged that the best that can be done is to make an estimate. The facts upon which to base this estimate, however, are so many and so complete as to justify the belief that the estimate is a very close one.

Total production of crude petroleum in the Pennsylvania and New York oil fields for the years from 1859 *to* 1885, *inclusive.*

Years.	Production.	Years.	Production.
	Barrels.		*Barrels.*
1859	2,000	1873	9,890,964
1860	500,000	1874	10,950,730
1861	2,113,609	1875	8,787,506
1862	3,056,690	1876	8,968,906
1863	2,611,309	1877	13,135,671
1864	2,116,109	1878	15,165,462
1865	2,497,700	1879	19,741,661
1866	3,597,700	1880	26,032,421
1867	3,347,300	1881	27,358,210
1868	3,646,117	1882	30,053,500
1869	4,215,000	1883	23,128,389
1870	5,260,745	1884	23,772,209
1871	5,205,341	1885	20,776,041
1872	5,939,003		

The maximum of production was reached, it will be observed, in 1882. This was a most phenomenal year in the history of petroleum production. It was the year of the development of the Cherry Grove field, by the opening of which the average daily production was increased in July, 1882, to 105,102 barrels, the largest ever reached. In this month this field yielded above 30,000 barrels daily, at the close of the year the yield of Cherry Grove was less than 4,000, and the total average daily yield had fallen from 105,120 barrels in July to 61,210 barrels. The production of 1885 was some 9,300,000 barrels less than in 1882, but it is still in excess of any year prior to 1880.

During 1885 the average daily production of all wells in this district, by months, was as follows:

Average daily production of wells in the Pennsylvania and New York oil fields in 1885.

Months.	Average daily product.	Months.	Average daily product.
	Barrels.		*Barrels.*
January	53, 296	August	55, 031
February	51, 353	September	57, 093
March	52, 843	October	60, 455
April	59, 343	November	58, 722
May	59, 141	December	61, 247
June	58, 907		
July	57, 284	Average	56, 921

This average for the year of 56,921 barrels is not the average of the averages, but is obtained by dividing the total products of the year by 365, the number of days in the year.

It will be noted that the average daily production at the close of the year is considerably less than the average of 1884, but in excess of the average for December of that year. The year's average daily product was 56,921 barrels in 1885; the average for December, 1885, 61,247, or 4,326 barrels in excess of the average. The average daily production for December, 1884, was 58,794 barrels.

The average daily production for each month since 1872 and the daily average for the entire year are given farther on.

Shipments.—The following table shows the number of barrels of crude petroleum, and of refined petroleum reduced to crude equivalent, shipped out of the Pennsylvania and New York oil regions in 1885. A considerable portion of this is shipped as refined oil. This is reduced to its equivalent in crude, a barrel of refined being regarded as 1⅓ barrels of crude.

Shipments of crude petroleum, and of refined petroleum reduced to crude equivalent, out of the Pennsylvania and New York oil regions for the year 1885.

Months.	Total shipments.	Months.	Total shipments.
	Barrels.		*Barrels.*
January	1, 804, 028	August	2, 049, 099
February	1, 895, 021	September	2, 116, 659
March	1, 887, 034	October	2, 050, 150
April	1, 823, 726	November	1, 857, 080
May	2, 097, 099	December	2, 138, 253
June	2, 034, 025		
July	1, 961, 152	Total	23, 713, 326

The shipments out of this region during the past year were but little in excess of those of 1884—less than 60,000 barrels. The reduction in stocks, noted elsewhere, therefore, is not due to increased shipment, but to a decreased production.

The total shipments from this region for each year since 1866 are as follows:

Shipments of crude petroleum, and of refined reduced to crude equivalent, from the Pennsylvania and New York oil regions, 1866 *to* 1885, *inclusive.*

Years.	Shipments.	Years.	Shipments.
	Barrels.		*Barrels.*
1866	2, 986, 667	1876	10, 164, 452
1867	3, 166, 257	1877	12, 832, 573
1868	4, 039, 541	1878	13, 676, 000
1869	4, 207, 548	1879	15, 886, 470
1870	5, 235, 931	1880	15, 677, 492
1871	5, 664, 791	1881	20, 284, 235
1872	5, 899, 947	1882	21, 900, 314
1873	9, 499, 775	1883	21, 979, 369
1874	8, 821, 500	1884	23, 657, 597
1875	8, 942, 938	1885	23, 713, 326

It will be noted that the shipments out of the Pennsylvania and New York oil fields in 1885 are greater than during any preceding year, being 23,713,326 barrels, as before stated, about 60,000 barrels in excess of the shipments of 1884, which were the next largest. Indeed, it will be seen by inspecting the table that, without reference to the production, there has been a continuous increase year by year in the shipments, with the single exception of 1880, the shipments for 1880 being some 200,000 barrels less than in 1879.

Stocks.—In the following table will be found a statement of the total stocks held by all the pipe lines in the Pennsylvania and New York oil regions at the close of each month during 1885:

Stock of crude petroleum in the Pennsylvania and New York oil regions at the close of each month of the year 1885.

Years.	Stocks.	Years.	Stocks.
	Barrels.		*Barrels.*
January	37, 214, 274	July	35, 686, 909
February	36, 757, 137	August	35, 343, 771
March	36, 508, 236	September	34, 939, 902
April	36, 464, 800	October	34, 763 857
May	36, 139, 072	November	34, 668, 437
June	35, 872, 257	December	34, 428, 841

An inspection of this table shows that there has been a gradual reduction of stocks during the entire year, the close of each month showing less stock on hand than the close of the preceding month. As the stock December 31, 1884, was 37,366,126 barrels, and that December 31, 1885, 34,428,841 barrels, the reduction in stocks during the year 1885 was 2,937,285 barrels. This was 58,883 barrels less than the decrease in production of 1885, which decrease was 2,996,168 barrels. The exports during 1885 were more than this amount in excess of those of 1884, but the home trade was less.

In the following table will be found a statement of the total stocks held n the Pennsylvania and New York oil regions at the close of each year since 1867, the year of the building of the first iron tank:

Total stocks of crude petroleum held in the Pennsylvania and New York oil fields at the close of each year from 1867 *to* 1885, *inclusive.*

Years.	Stocks December 31.	Years.	Stocks December 31.
	Barrels.		*Barrels.*
1867	289,100	1877	3,127,837
1868	559,100	1878	4,615,299
1869	264,805	1879	8,470,490
1870	340,154	1880	18,928,430
1871	537,751	1881	26,019,704
1872	1,084,423	1882	34,596,612
1873	1,625,157	1883	35,745,632
1874	3,705,639	1884	37,366,126
1875	3,550,207	1885	34,428,841
1876	2,551,199		

For the first time since 1876 the stocks in this district at the close of the year show a reduction, the stocks at the close of 1885 being 34,428,841 barrels, some 3,000,000 less than at the close of 1884 and 1,300,000 less than at the close of 1883.

Prices.—The following table gives the monthly average price of pipe-line certificates for each month during 1885:

Average price of pipe-line certificates in 1885.

Months.	Average price pipe-line certificate.	Months.	Average price pipe-line certificate.
	Per barrel.		*Per barrel.*
January	$0.70⅞	August	$1.00¼
February	.72⅜	September	1.00¾
March	.80⅛	October	1.05½
April	.78½	November	1.04⅜
May	.79	December	.89⅞
June	.82		
July	.92½	Average	.87⅞

These averages, it is understood, are not true average prices, that is, averages that consider both price, and quality sold at that price, but are the averages of the prices obtained. This is the only average that can be obtained, and does not vary greatly from the true average price.

The lowest point touched by pipe-line certificates during the year was January 29, when they sold at one time during the day for 68¼ cents. The highest price was $1.12⅜, on October 20. The price December 31, 1885, was $0.87⅛ and $0.88⅜.

Both the range and the average of prices during 1885 were in excess of those of 1884, the highest average of 1884 being $1.04⅜ per barrel, in February, and the lowest average $0.63½, in July. The highest average in 1885 was $1.05½, in October, the lowest $0.70⅞, in January. The average for 1884 was 83½ cents per barrel. In 1885 it was $0.87⅞, or 4⅜ cents in excess of that of 1884.

The year has entirely baffled the expectations and predictions of many. It was believed that it would show a range of prices much lower than the preceding year. This expectation was not realized. There was a reduction of production, and even the figure attained was only possible through the most strenuous exertions—only by prosecuting field work in all locations, promising or unpromising, with a vigor seldom known in the history of the petroleum trade. As is also shown in connection with the statement concerning stocks, the average production has not been sufficient to supply the consumption demand, and considerable oil was drawn from the reserve supply during 1885. All of these facts would indicate that the price should have advanced even more rapidly than it has done.

The average prices of refined oil per gallon in New York for the months of 1885 were as follows:

Months.	Prices, in cents, per gallon.	Months.	Prices, in cents, per gallon.
January	$7\frac{5}{8}$	July	$8\frac{1}{4}$
February	$7\frac{5}{8}$	August	$8\frac{3}{8}$
March	$7\frac{7}{8}$	September	8 [illegible]
April	$7\frac{7}{8}$	October	$8\frac{1}{2}$
May	$7\frac{3}{4}$	November	$8\frac{1}{2}$
June	$7\frac{7}{8}$	December	$7\frac{7}{8}$

The average pricess of pipe-line certificates or crude oil at the wells since 1860 will be given farther on.

Producing wells.—The number of producing wells at the close of each month in this district, and the average for the close of each month during the year 1885, is as follows:

Number of producing wells in the Pennsylvania and New York oil fields at the close of each month in 1885.

Months.	Number producing wells.	Months.	Number producing wells.
January	21,950	August	22,688
February	21,987	September	22,775
March	22,042	October	23,062
April	22,093	November	23,295
May	22,223	December	23,519
June	22,384		
July	22,524	Average	22,546

Compared with the table for previous years given below, and the tables of production, this is a most interesting table. During 1885, as noted elsewhere, there has been a steady decline in production as compared with 1884, amounting during the year to 2,996,168 barrels, and yet the number of producing wells increased each month during the year, the number at the close of 1885 being 23,519, as compared with 21,909 at the close of 1884, an increase of 1,610 during the year. The average number of producing wells at the close of each month in 1885 was 22,546. In 1884 it was 21,526, an increase of 1,020 during 1885. Notwithstanding this the production decreased. The production per well in 1885 and 1884, taking the average daily product and average number of wells producing, was, in 1884, $3\frac{15}{100}$ barrels a day, and in 1885 but $2\frac{57}{100}$. Ten years ago (1875) the average number of producing wells was but 3,098, and the average daily product 24,078 barrels. This was an average daily production per well of about $7\frac{8}{10}$ barrels, more than double what it was in 1884, and three times what it was in 1885.

The following table gives the number of producing wells in this district at the close of each year from 1867, as well as the average number producing at the close of each month during each year:

Number of producing wells in the Pennsylvania and New York oil fields 1867 *to* 1885, *inclusive.*

Years.	Producing wells December 31.	Average number of producing wells at the close of each month.	Years.	Producing wells December 31.	Average number of producing wells at the close of each month.
1867	1,020	....	1877	8,458	7,383
1868	1,246	....	1878	10,337	9,561
1869	1,325	....	1879	11,960	11,283
1870	2,906	2,490	1880	14,700	13,234
1871	3,775	3,275	1881	18,300	16,668
1872	4,553	4,205	1882	18,009	19,027
1873	3,358	4,109	1883	20,606	17,918
1874	3,270	3,276	1884	21,909	21,526
1875	3,078	3,098	1885	23,519	22,546
1876	6,000	4,694			

Drilling wells.—In the following table is given by districts the number of wells drilling at the close of each month in the year 1885, in the Pennsylvania and New York oil fields:

Number of wells drilling at the close of each month in the year 1885, *in the Pennsylvania and New York oil fields, by districts.*

Months.	Allegany district.	Bradford district.	Warren district.	Lower district.	Total.
January	7	11	17	62	97
February	11	12	17	69	109
March	10	28	23	78	139
April	22	36	35	97	190
May	28	19	55	126	228
June	31	36	44	98	209
July	41	41	49	111	242
August	58	56	73	121	308
September	45	73	82	182	382
October	53	66	77	159	355
November	70	76	78	135	359
December	30	62	81	104	277

The same condition exists in regard to drilling wells as is noted elsewhere in connection with wells completed, the close of 1885 showing a largely increased number of wells drilling as compared with 1884, the wells drilling in December, 1885, were also in excess of the number drilling at the beginning of 1884 and very much in excess of the number drilling at the close of that year. There were drilling in December, 1885, 277 wells as compared with 78 drilling in December, 1884. It can also be remarked that though the average number of wells drilling at the close of each month in 1885 is in excess of the average number drilling at the close of each month in 1884, it is still less than the averages of any year since 1875.

The following table shows the average number of wells drilling during the years since 1871, and also the number drilling in December of each year:

Number of drilling wells in the Pennsylvania and New York oil fields at the close of December and averages for the years 1871–'85.

Years.	December.	Yearly averages.	Years.	December.	Yearly averages.
1871	394	329	1879	440	357
1872	318	347	1880	408	495
1873	60	242	1881	468	423
1874	54	121	1882	138	276
1875	168	112	1883	263	243
1876	493	363	1884	78	168
1877	426	463	1885	277	241
1878	218	292			

Wells completed.—In the following table will be found a statement of the number of wells completed in each district in the Pennsylvania and New York oil fields during each month of the year 1885. This statement shows the total number completed, the number producing oil, and the number of dry holes in each district for each month, together with the totals of these several items for the entire year:

Number of wells completed during each month of the year 1885 *in the Pennsylvania and New York oil fields, by districts.*

Months.	Allegany district.			Bradford district.			Warren district.			Lower district.			Totals.		
	Total number.	Producing.	Dry holes.	Total number.	Producing.	Dry holes.	Total number.	Producing.	Dry holes.	Total number.	Producing.	Dry holes.	Total number.	Producing.	Dry holes.
January	9	7	2	7	7	0	17	15	2	31	25	6	64	54	10
February	4	2	2	15	14	1	16	15	1	27	24	3	62	55	7
March	5	4	1	14	14	0	24	20	4	39	30	9	82	68	14
April	10	10	0	24	24	0	29	25	4	53	47	6	116	106	10
May	26	23	3	38	35	3	67	60	7	82	72	10	213	190	23
June	33	32	1	40	38	2	66	57	9	103	72	31	242	199	43
July	29	28	1	36	35	1	56	47	9	96	70	26	217	180	37
August	33	31	2	35	35	0	96	87	9	119	91	28	283	244	39
September	60	53	7	67	64	3	82	73	9	147	126	21	356	316	40
October	59	59	0	62	60	2	104	93	11	172	145	27	397	357	40
November	51	47	4	68	65	3	93	83	10	172	135	37	384	330	54
December	54	51	3	62	59	3	95	89	6	134	104	30	345	303	42
Totals	373	347	26	468	450	18	745	664	81	1,175	941	234	2,761	2,402	359

While the total number of wells completed during the year 1885, 2,761, is 496 greater than in 1884, it is still less than the total number completed in any preceding year since 1875. As compared with 1884, however, there is this difference to be noted: there was a decline in the number of wells completed in the previous year as the years drew to a close, there being but 66 wells completed in December, 1884, as compared with 229 completed in January of the same year. The year 1885 shows just the opposite condition of affairs, there being 345 wells completed in December, 1885, as compared with 64 completed in January of the same year. The maximum number of wells completed during the year, however, was in October, being 397. This larger number of wells completed accounts in part for the increased daily production towards the close of 1885.

The following table shows the total number of drilling wells completed in this district for each of the years from 1872, and also the number completed in December of each year:

Number of drilling wells completed in the Pennsylvania and New York oil fields in December and for the years 1872–'85.

Years.	December.	Totals.
1872	105	1,183
1873	98	1,263
1874	120	1,317
1875	230	2,398
1876	272	2,920
1877	382	3,939
1878	165	3,064
1879	261	3,048
1880	302	4,217
1881	406	3,880
1882	122	3,304
1883	272	2,847
1884	66	2,265
1885	345	2,701

The average production of the wells completed in 1885 was smaller than for any year since 1878. The following table exhibits the average production per well for the years named:

	Barrels.		Barrels.
1876	11.3	1881	20.0
1877	13.4	1882	35.0
1878	13.4	1883	15.4
1879	24.0	1884	29.2
1880	25.0	1885	16.2

The average per well was maintained very steadily in the three years of Bradford's highest development—1879, 1880, and 1881. In 1882 Cherry Grove increased the average largely. Cooper and Balltown gave but a small average in 1883, because there was enough drilling in the small well territory to keep it down. Thorn creek and Wardwell gave a large average in 1884, and last year the number of small wells completed kept down the average of Thorn creek and Cogley.

The highest average daily production of new wells during 1885 was in February when it was 41.3 barrels; the lowest in July, 10.3 barrels.

In the following tables will be found the statistics of petroleum production, shipments, stocks, and prices for the Pennsylvania and New York oil fields for a series of years, the tables giving the average and totals by months as well as by years:

PRODUCTION STATISTICS.

Total production of crude petroleum in the Pennsylvania and New York oil fields for the years 1871–'85, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1871	418, 407	372, 568	400, 334	385, 980	408, 797	410, 340	456, 475	462, 582	461, 940	485, 243	464, 610	477, 958	5, 205, 234
1872	583, 575	462, 985	461, 590	462, 090	537, 106	491, 130	517, 762	549, 909	500, 430	442, 432	638, 610	645, 575	6, 293, 194
1873	632, 617	608, 300	665, 291	641, 520	776, 364	793, 470	867, 473	936, 138	954, 270	942, 493	991, 470	1, 084, 380	9, 844, 744
1874	1, 167, 243	835, 492	883, 438	778, 740	895, 745	921, 750	1, 033, 447	931, 519	840, 630	919, 739	861, 060	858, 142	10, 926, 945
1875	852, 159	719, 824	789, 539	675, 060	696, 508	696, 210	788, 361	718, 766	698, 940	731, 073	700, 200	720, 874	8, 787, 506
1876	712, 225	668, 885	718, 177	701, 490	735, 351	723, 600	763, 623	782, 223	780, 600	809, 162	786, 480	787, 090	8, 968, 906
1877	842, 890	873, 216	901, 697	972, 810	1, 127, 594	1, 130, 790	1, 189, 005	1, 273, 759	1, 214, 910	1, 269, 326	1, 173, 420	1, 256, 058	13, 135, 475
1878	1, 203, 296	1, 094, 856	1, 208, 380	1, 195, 890	1, 264, 862	1, 217, 250	1, 283, 865	1, 341, 928	1, 315, 710	1, 369, 797	1, 348, 950	1, 318, 678	15, 163, 462
1879	1, 369, 921	1, 261, 935	1, 499, 315	1, 530, 450	1, 644, 922	1, 675, 650	1, 637, 767	1, 892, 302	1, 856, 700	1, 836, 378	1, 710, 480	1, 769, 356	19, 785, 176
1880	1, 904, 113	1, 870, 008	2, 015, 992	2, 015, 700	2, 228, 931	2, 158, 440	2, 248, 430	2, 341, 027	2, 346, 300	2, 385, 636	2, 274, 420	2, 238, 634	26, 027, 631
1881	2, 244, 090	1, 913, 128	2, 274, 532	2, 205, 780	2, 393, 293	2, 377, 860	2, 372, 678	2, 331, 727	2, 193, 420	2, 323, 171	2, 266, 830	2, 480, 000	27, 376, 509
1882	2, 353, 551	2, 131, 332	2, 482, 170	2, 402, 790	2, 486, 572	2, 825, 940	3, 258, 162	3, 104, 495	2, 620, 380	2, 297, 658	2, 192, 940	1, 897, 510	30, 053, 500
1883	1, 948, 319	1, 756, 188	1, 830, 674	1, 816, 530	1, 962, 052	1, 977, 900	2, 020, 394	1, 879, 437	1, 913, 370	2, 076, 659	1, 958, 340	1, 988, 526	23, 128, 389
1884	1, 825, 838	1, 880, 650	2, 052, 262	2, 065, 860	2, 381, 854	1, 862, 190	2, 059, 950	2, 099, 165	1, 948, 260	1, 961, 866	1, 811, 700	1, 822, 614	23, 772, 209
1885	1, 652, 176	1, 437, 884	1, 638, 133	1, 780, 290	1, 771, 371	1, 767, 210	1, 775, 804	1, 705, 961	1, 712, 790	1, 874, 105	1, 761, 660	1, 898, 657	20, 776, 041

Shipments of crude petroleum, and refined petroleum reduced to crude equivalent, out of the Pennsylvania and New York oil fields for the years 1871–'85, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1871	437, 691	347, 718	383, 890	389, 147	587, 375	501, 754	541, 137	528, 134	551, 075	505, 071	480, 977	410, 822	5, 664, 791
1872	476, 966	407, 606	276, 220	428, 512	510, 417	529, 228	591, 238	621, 954	541, 607	607, 468	477, 945	430, 786	5, 899, 947
1873	573, 124	527, 440	668, 374	708, 191	768, 176	696, 414	814, 449	864, 768	952, 955	1, 010, 852	959, 589	955, 443	9, 499, 775
1874	843, 663	501, 220	518, 246	803, 409	899, 027	815, 413	940, 281	793, 865	1, 014, 570	543, 341	546, 117	602, 348	8, 821, 500
1875	453, 095	327, 776	693, 918	729, 581	681, 679	745, 986	904, 537	882, 089	1, 109, 392	871, 917	671, 066	871, 902	8, 942, 938
1876	677, 289	519, 193	623, 762	603, 037	646, 150	921, 862	1, 228, 539	1, 203, 402	1, 164, 549	524, 190	871, 496	1, 190, 983	10, 164, 452
1877	743, 461	484, 904	913, 919	903, 526	1, 234, 324	1, 391, 124	1, 096, 951	1, 425, 943	1, 563, 797	1, 268, 971	1, 205, 634	600, 019	12, 832, 573
1878	775, 791	774, 234	741, 512	846, 632	960, 894	1, 135, 119	1, 330, 454	1, 655, 651	1, 434, 225	1, 747, 390	1, 281, 410	992, 688	13, 676, 000
1879	663, 998	702, 729	973, 879	1, 136, 188	1, 331, 469	1, 369, 314	1, 625, 035	1, 808, 239	1, 627, 120	1, 662, 269	1, 453, 645	1, 532, 585	15, 886, 470
1880	1, 650, 409	1, 395, 151	1, 613, 371	842, 268	1, 095, 259	975, 083	1, 231, 611	1, 394, 129	1, 252, 635	1, 665, 933	1, 226, 030	1, 335, 613	15, 677, 492
1881	1, 061, 617	915, 028	1, 276, 746	1, 348, 398	1, 563, 436	1, 729, 697	1, 925, 532	2, 214, 877	2, 131, 950	2, 080, 467	2, 066, 906	1, 969, 581	20, 284, 235
1882	1, 657, 067	1, 787, 909	1, 718, 956	1, 678, 134	1, 827, 356	2, 172, 685	2, 402, 970	2, 047, 545	1, 992, 171	2, 089, 428	1, 404, 640	1, 121, 453	21, 900, 314
1883	1, 357, 815	1, 250, 824	1, 641, 899	1, 908, 379	1, 995, 634	1, 747, 789	1, 634, 407	2, 086, 478	2, 325, 574	2, 215, 421	2, 065, 602	1, 749, 547	21, 979, 369
1884	1, 686, 961	1, 723, 261	1, 873, 890	1, 643, 336	1, 899, 329	1, 827, 553	1, 740, 021	2, 000, 371	2, 292, 087	2, 510, 283	2, 078, 261	2, 382, 244	23, 657, 597
1885	1, 804, 028	1, 895, 021	1, 887, 034	1, 823, 726	2, 097, 099	2, 034, 025	1, 961, 152	2, 049, 099	2, 116, 659	2, 050, 150	1, 857, 080	2, 138, 253	23, 713, 326

Number of drilling wells in the Pennsylvania and New York oil fields at the close of each month for the years 1871–'85, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly averages.
1871	140	173	240	279	356	303	329	330	439	486	477	394	329
1872	363	369	313	302	386	391	359	392	301	311	354	318	347
1873	361	349	227	177	228	395	340	267	197	163	137	60	242
1874	37	55	99	213	225	210	180	128	107	82	57	54	121
1875	40	40	45	64	127	162	118	96	132	170	179	168	112
1876	142	151	230	267	307	340	353	374	511	565	618	493	363
1877	457	463	395	448	512	395	365	417	535	573	565	426	463
1878	334	326	379	409	376	266	188	185	240	282	297	218	292
1879	265	323	406	468	460	384	329	258	270	313	372	440	357
1880	540	535	577	580	460	440	452	515	491	469	475	408	495
1881	383	420	437	446	470	408	379	352	388	445	475	468	423
1882	422	438	408	405	381	226	240	194	177	184	154	138	276
1883	126	151	205	199	216	228	262	315	314	341	301	263	243
1884	270	273	260	284	244	123	123	91	79	100	86	78	168
1885	97	109	139	190	228	209	242	308	382	355	359	277	241

Number of drilling wells completed in the Pennsylvania and New York oil fields each month for the years 1872–'85, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1872	37	120	89	121	135	84	128	118	82	100	64	105	1,183
1873	93	94	100	105	102	130	114	120	106	101	100	98	1,263
1874	102	104	110	113	109	101	121	107	104	120	106	120	1,317
1875	190	187	195	186	172	190	200	210	201	220	217	230	2,398
1876	240	231	242	200	202	261	248	270	209	273	272	272	2,920
1877	281	241	291	269	320	403	317	255	322	467	391	382	3,939
1878	274	226	211	409	470	269	203	186	174	229	248	165	3,064
1879	156	132	238	270	402	330	327	283	210	232	227	261	3,048
1880	320	230	367	500	426	310	338	368	356	364	336	302	4,217
1881	222	220	271	316	406	374	336	332	312	322	363	406	3,880
1882	347	340	385	432	469	340	185	253	164	117	150	122	3,304
1883	125	126	142	209	231	228	261	309	321	321	302	272	2,847
1884	229	227	256	298	311	244	268	145	89	59	73	66	2,265
1885	64	62	82	116	213	242	217	283	356	397	384	345	2,761

Number of producing wells in the Pennsylvania and New York oil fields at the close of each month for the years 1872–'85, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly averages.
1872	3,892	3,936	3,943	3,967	4,085	4,144	4,245	4,423	4,475	4,475	4,529	4,553	4,205
1873	4,485	4,490	4,411	4,265	4,317	4,400	4,420	4,163	3,940	3,654	3,413	3,358	4,109
1874	3,311	3,235	3,308	3,301	3,266	3,298	3,293	3,287	3,254	3,270	3,220	3,270	3,276
1875	3,132	3,112	3,060	3,052	3,080	3,084	3,067	3,088	3,112	3,125	3,174	3,078	3,098
1876	3,314	3,638	3,670	3,772	3,930	4,527	4,774	6,047	5,285	5,552	5,809	6,000	4,694
1877	6,283	6,441	6,666	6,846	7,037	7,352	7,564	7,684	7,872	8,061	8,323	8,458	7,383
1878	8,616	8,725	8,848	9,071	9,400	9,605	9,776	9,884	10,012	10,188	10,276	10,337	9,561
1879	10,462	10,582	10,692	10,782	11,045	11,223	11,461	11,585	11,760	11,860	11,960	11,960	11,283
1880	12,000	12,072	12,222	12,572	12,972	13,172	13,275	13,500	13,825	14,100	14,400	14,700	13,234
1881	14,900	15,050	15,500	15,769	16,150	16,700	17,000	17,250	17,562	17,799	18,040	18,300	16,668
1882	18,400	18,600	18,850	19,150	19,350	19,500	19,570	19,600	19,600	19,000	18,700	18,000	19,027
1883	17,600	17,300	17,250	17,100	17,100	17,050	17,100	17,100	17,300	19,100	20,406	20,606	17,918
1884	20,756	20,930	21,000	21,242	21,494	21,658	21,844	21,916	21,900	21,859	21,859	21,909	21,531
1885	21,950	21,987	22,042	22,093	22,223	22,384	22,524	22,688	22,775	23,062	23,295	23,519	22,546

Average daily production of crude petroleum in the Pennsylvania and New York oil fields each month for the years 1872–'85, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly averages.
1872	18,825	15,965	14,890	15,403	17,326	16,371	16,702	17,739	16,681	4,272	21,287	20,825	17,194
1873	20,407	21,725	21,461	21,384	25,044	26,449	27,983	30,198	31,809	30,403	33,049	34,980	27,106
1874	37,653	29,839	28,598	25,958	28,895	30,725	33,337	30,049	28,021	29,669	28,702	27,682	29,937
1875	27,489	25,708	25,469	22,502	22,468	23,207	25,431	23,186	23,298	23,583	23,340	23,254	24,075
1876	22,975	23,065	23,167	23,383	23,721	24,120	24,633	25,233	26,020	26,102	26,216	25,390	24,505
1877	27,190	27,979	29,087	32,427	36,374	37,693	38,335	41,089	40,497	40,946	39,114	40,518	35,988
1878	38,816	39,102	38,980	39,863	40,802	40,575	41,415	43,288	43,857	44,187	44,965	42,538	41,544
1879	44,191	43,515	48,365	51,015	53,062	55,855	56,057	61,042	61,890	59,238	57,016	57,076	54,206
1880	61,423	64,552	65,032	67,190	71,901	71,948	72,530	75,517	78,210	76,956	75,814	72,214	71,114
1881	72,390	68,326	73,372	73,526	77,203	79,262	76,538	75,217	73,114	74,941	75,561	80,000	75,004
1882	75,921	76,119	80,070	80,093	80,212	94,198	105,102	100,145	87,346	74,118	73,098	61,210	82,338
1883	62,849	62,721	59,054	60,551	63,292	65,930	65,174	60,627	63,779	66,989	65,278	64,146	63,365
1884	58,898	64,850	66,202	68,862	76,834	62,073	66,450	67,715	64,942	63,286	60,390	58,794	65,129
1885	53,296	51,353	52,843	59,343	59,141	58,907	57,284	55,031	57,093	60,455	58,722	61,247	56,921

[Yearly average is total production divided by the number of days in year, *not* average of monthly averages.]

Total stocks of crude petroleum in the Pennsylvania and New York oil fields for the years 1871–'85, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Averages.
1871	537,751	587,021	642,000	771,000	605,000	554,000	511,220	530,146	541,300	495,102	502,960	532,000	567,158
1872	532,971	579,793	662,497	877,832	950,803	1,010,302	990,229	997,166	951,410	914,423	886,909	1,084,423	869,896
1873	1,183,728	1,265,373	1,244,657	1,178,643	1,192,541	1,324,493	1,433,620	1,513,890	1,521,185	1,452,777	1,493,875	1,625,157	1,369,191
1874	1,948,919	2,283,032	2,648,210	2,623,534	2,594,286	2,701,625	2,279,479	2,932,444	2,758,504	3,134,902	3,449,845	3,705,639	2,755,035
1875	4,011,703	4,546,188	4,592,364	4,537,843	4,552,672	4,502,896	4,386,720	4,223,397	3,812,945	3,672,101	3,701,235	3,550,207	4,174,189
1876	3,585,143	3,734,835	3,829,250	3,900,703	3,989,904	3,791,642	3,326,726	3,304,405	2,930,456	3,040,108	2,955,092	2,551,199	3,411,622
1877	2,604,128	2,860,636	3,210,454	3,279,731	3,173,008	2,912,674	3,004,728	2,852,544	2,503,657	2,504,012	2,471,798	3,127,837	2,875,434
1878	3,555,342	3,875,964	4,342,832	4,692,090	4,996,058	5,078,189	5,031,600	4,717,877	4,599,362	4,221,769	4,289,309	4,615,299	4,501,308
1879	5,321,222	5,813,663	6,318,099	6,689,111	6,980,064	7,263,150	7,353,382	7,114,195	7,620,525	7,794,634	8,051,469	8,470,490	7,065,834
1880	8,724,194	9,004,062	9,606,683	10,780,153	11,916,577	13,099,934	14,116,753	15,063,651	16,157,316	16,877,019	18,025,409	18,928,430	13,541,682
1881	20,110,903	21,108,003	22,105,789	22,963,171	23,793,028	24,441,191	24,888,337	25,005,187	25,066,657	25,309,361	25,509,285	26,019,704	23,860,051
1882	26,716,188	27,059,611	27,822,825	28,547,481	29,206,697	29,859,952	30,715,144	31,772,094	32,400,303	32,608,533	33,728,555	34,596,612	30,419,499
1883	35,187,116	35,692,480	35,881,255	37,789,406	35,755,824	35,985,935	36,371,922	36,164,881	35,752,677	35,613,915	35,506,653	35,745,632	35,953,975
1884	35,884,509	36,041,898	36,220,270	36,642,794	38,631,203	38,665,838	38,985,767	39,084,561	38,740,734	38,192,317	37,925,756	37,366,126	37,698,481
1885	37,214,274	36,757,137	36,508,236	36,464,800	36,139,072	35,872,257	35,686,909	35,343,771	34,939,902	34,763,857	34,668,437	34,428,841	35,732,291

Monthly and yearly average price of pipe-line certificates or crude petroleum at well for the years 1860–'85.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Averages.
1860	$19.25	$18.00	$12.62½	$11.00	$10.00	$9.50	$8.62½	$7.50	$6.62½	$5.50	$3.75	$2.75	$9.59
1861	1.00	1.00	1.00	.62½	.50	.50	.50	.25	.20	.10	.10	.10	.49
1862	.10	.15	.22½	.50	.85	1.00	1.25	1.25	1.25	1.75	2.00	2.25	1.05
1863	2.25	2.50	2.62½	2.87½	2.87½	3.00	3.25	3.37½	3.50	3.75	3.85	3.95	3.15
1864	4.00	4.87½	5.50	6.56	6.87½	9.50	12.12½	10.12½	8.87½	7.75	10.00	11.00	8.06
1865	8.25	7.50	6.00	6.00	7.37½	5.62½	5.12½	4.62½	6.75	8.12½	7.25	6.50	6.59
1866	4.50	4.40	3.75	3.95	4.50	3.87½	3.00	3.75	4.50	3.39	2.10	2.12½	3.74
1867	1.87½	1.85	1.75	2.07½	2.35	1.90	2.62½	3.15	3.40	3.55	2.50	1.87½	2.41
1868	1.95	2.00	2.55	2.82½	3.75	4.50	5.12½	4.57½	4.00	4.12½	3.75	4.35	3.62½
1869	5.75	6.95	6.00	5.70	5.35	4.95	5.37½	5.57½	5.50	5.50	5.80	5.12½	5.63¾
1870	4.52½	4.52½	4.45	4.22½	4.40	4.17½	3.77½	3.15	3.25	3.27½	3.22½	3.40	3.86
1871	3.82½	4.38	4.25	4.01	4.60	3.85½	4.79	4.66	4.65	4.82½	4.25	4.00	4.34
1872	4.02½	3.80	3.72½	3.52½	3.80	3.85	3.80	3.58½	3.25	3.15	3.83½	3.32½	3.64
1873	2.60	2.20	2.12½	2.30	2.47½	2.22½	2.00	1.42½	1.15	1.20	1.25	1.00	1.83
1874	1.20	1.40	1.60	1.90	1.62½	1.32½	1.02½	.95	.95	.85	.55	.61½	1.17
1875	1.03	1.52½	1.75	1.36½	1.40	1.26½	1.09	1.13	1.33	1.32½	1.44	1.55	1.35
1876	1.80	2.60	2.01	2.02½	1.90½	2.01¾	2.24½	2.71⅜	3.81	3.37½	3.11	3.73	2.56¼
1877	3.53¼	2.70	2.67½	2.58	2.24	1.94⅝	2.07½	2.51	2.38	2.56¾	1.91	1.80	2.42
1878	1.43	1.65¼	1.59	1.37½	1.35¼	1.14	.98¾	1.01	.86⅝	.82⅛	.89⅜	1.16	1.19
1879	1.03	.98	.86½	.78½	.76	.68⅜	.69⅞	.67⅛	.69⅜	.88⅛	1.05⅝	1.18⅛	.85⅞
1880	1.10¼	1.03½	.88¾	.78	.80	1.00	1.06¼	.91	.96	.96⅞	.91⅞	.91⅝	.94½
1881	.95½	.90⅜	.83⅜	.86¼	.81⅞	.81¼	.76⅞	.78⅛	.97 3/16	.91¼	.85¼	.84⅜	.85⅞
1882	.83⅛	.84½	.81⅜	.78⅜	.71½	.54⅜	.57 4/10	.58⅝	.72⅛	.93¾	1.14	.96	.78⅞
1883	.93¾	1.01	.97⅝	.92⅜	1.00⅛	1.16⅜	1.05⅞	1.08½	1.12½	1.11⅛	1.14½	1.14¾	1.05¾
1884	1.11	1.04⅜	.98⅛	.94	.85⅝	.6[illegible]⅝	.63⅛	.81⅛	.78	.71⅛	.72½	.74⅜	.82½
1885	.70⅞	.72[illegible]	.80⅛	.78½	.79	.82	.92½	1.00¼	1.00¾	1.03¼	1.04⅜	.89⅞	.87⅞

10.M.R

OHIO.

Petroleum has been found in a number of localities in Ohio, in Lorain, Trumbull, Washington, Noble, Morgan, Columbiana, and Knox counties. By far the most important of these localities are the Macksburg, in the neighborhood of Marietta, in Washington county.

One of the earliest wells bored in the Macksburg district was in 1860. This well was 56 feet deep and yielded many thousand barrels of heavy lubricating oil. Reports would indicate that the daily yield at first was from 100 to 200 barrels. The Buell well, in the same locality, produced oil steadily for a number of years. A well a short distance east of the Buell well, yielded at first 150 barrels a day. This Macksburg region assumed, however, but little importance until the spring of 1884, when a number of successful wells were bored. During 1885 the production in this district increased rapidly, the runs through the Macksburg pipe lines being 613,822 barrels. It is evident, however, that the Macksburg district under present conditions has reached its highest point of development, the production of this field having shown a steady decline for some months past. In August, 1885, the daily production was 2,382 barrels; in September, 2,270; in October, 2,053, and in November, 2,031.

Mecca, Trumbull county, yields a few hundred barrels per year from the shallowest of wells. The oil is brought up by hand in sand pumps. Its lubricating quality gives it value. The production in this section is continuous. Source, Berea Grit. The oil is sold to farmers and country stores, so that it cannot be traced.

Grafton, Lorain county, yields a few score of barrels of same or similar quality to the Mecca. Production, however, is almost at an end; the source is the Berea Grit.

Athens county and Morgan county yield a little shallow oil from a coal-measure sandstone. The wells are worked by hand. The oil is hauled away in barrels or sold to the farmers of the neighborhood. The production is insignificant.

The new field of Limestone oil is centered at Lima. It is now yielding several hundred barrels per diem.

WEST VIRGINIA.

Petroleum has been known to exist in Virginia from the earliest times. As far back as 1771 Jefferson gave an interesting description of a burning spring and the oil connected with it in the Great Kanawha valley. Up to 1865, however, no oil had been produced, except in a speculative way in attempts to develop the resources of the State. In this and the succeeding year, operations commenced almost simultaneously at Burning Spring, Oil Rock, California House, Volcano, Sand Hill, and Horse-Neck. Considerable quantities were found at all of these points, light oil being obtained at all of these places except at Volcano and Sand Hill. These two localities produced heavy oils.

The light-oil regions ran a rapid course, giving a large yield during their productive career, and have ceased to be of importance. The heavy-oil districts, however, still continue to produce.

In 1876 it was estimated that the production of oil in West Virginia up to that time had been three million barrels, varying in specific gravity from 27 to 45 degrees Beaumè, the greater portion varying from 27 to 33 degrees. At present the production of oil in this State is small and entirely of the lubricating variety.

KENTUCKY.

Little can be added to the statement contained in the last volume of "Mineral Resources" as to the occurrence of petroleum in Kentucky. The wells near Glasgow have yielded steadily a small quantity of oil for a number of years, and, being convenient to the Louisville and Nashville railroad, it is very probable they were worked with profit. The product was refined by Chess, Carley & Co., Louisville, Kentucky.

TENNESSEE.

The oil territory of Tennessee occupies the extreme southern end of the great oil belt, which extends in a southwesterly direction, at least from the wells near Petrolea in Ontario to just across the Tennessee line in Alabama. Indications of oil have been found in many counties in the State, but chiefly in Overton, Clay, Putnam, Jackson, and Fentress. These counties belong mainly to the Highland Rim, or that portion of the State which surrounds, like the rim of a dish, a great central basin in the interior of the State.

The most productive of the oil developments of this State, and probably of the South below West Virginia, was in Overton county, but the wells are too far from market to make the production of oil profitable at the prices that have been ruling in Pennsylvania for years. From a recent article by Prof. H. E. Colton, on the petroleum of this State, we extract the following:

"In 1865 and 1866 thirteen wells were sunk in Overton county, which produced good quantities of oil; of these the first, called the Newman well, produced 2,600 barrels of oil at a depth of 20 feet; at 51 feet it produced an immense quantity of oil which was lost. This well flowed steadily for three months. Colonel Irwin reports that he shipped 5,000 barrels to Nashville in 1866. It is impossible to say how much oil this well produced, but it was a large quantity.

"In 1866 three other wells were sunk near the above. No. 1 at 52 feet yielded 30 barrels per day for four weeks. The flow lessening, it was sunk to 68 feet, and a yield of 110 barrels per day obtained, which continued for two years and three months by being pumped. It was abandoned on account of costly transportation. No. 2 was bored to a depth of 55 feet, and oil reached. It yielded by pumping 25 barrels per day for about three years. In No. 3, oil was reached at 53 feet and 160 barrels per day pumped out for over a year, when an accident caused the abandonment of the well. A number of other wells were bored in the neighborhood; in some, small quantities of oil were obtained, in others none. It has been estimated that 15,000 barrels of oil were lost at the Newman well. From the other three noted there are records of the shipment of 6,813 barrels.

"At other points in Overton county wells were bored and oil obtained, as also in counties on the northeast and southwest. In many of the wells bored immense quantities of gas were struck, in some to such an extent as to force out the tools used in boring. In Cannon county in an ordinary well oil accumulates so rapidly that two or three barrels can be gathered daily. It is an excellent article of lubricating oil. A similar oil was found in the northeast part of Sumner county.

"The Dickson County oil region was on Jones's creek, about 6 miles from the Nashville, Chattanooga and Saint Louis railroad. While the Overton wells were none of them sunk below the black shale, and all the oil obtained above it, the wells of Dickson were all sunk in strata below it, and the oil there obtained, apparently in a bed of gravel. Just below the black shale in this region exists a sandrock similar to the oil sandstones of Pennsylvania, and it is heavily charged with petroleum. At its outcrop, however, it is only about 5 feet thick. Four wells were bored in this region, most of them yielding an immense quantity of gas. The greater part of the oil was obtained from wells 100 to 150 feet deep. About 300 barrels are said to have been saved from these wells and hauled to Nashville, about 30 miles. Some parties are now boring there for natural gas."

It is evident from these statements that but little oil has ever been produced and utilized in this State.

CALIFORNIA.

From the time of the first settlement of California by the whites there have been evidences, in the form of springs and seepage from the asphaltum beds, of the existence of petroleum in the State. No attempts, however, were made to utilize these deposits until the excitement following the Pennsylvania oil discoveries led to prospecting these surface deposits and the eager searching for others. During the years 1865 and 1866 upwards of seventy companies, each with a large nominal capital, were incorporated in California for the purpose of searching for petroleum. While a majority of these companies proceeded no further than to organize, having never expended any money in actual operations, some of them began active operations, sinking wells and driving tunnels in their search. Most of the work at this time was in Humboldt, Colusa, Contra Costa, Santa Clara, and Los Angeles counties.

A large amount of money was spent, but no considerable deposit of oil was found. The most promising field was developed in Los Angeles county.

Discouraged at the result of these first efforts, search for oil after a year or two was almost entirely abandoned, but little attention having been given to this industry for the next ten years. The opinion of Whitney and other eminent geologists, to the effect that no such deposits of petroleum as those developed in Pennsylvania would be found in California, added to this discouragement. This opinion was based on the absence in California of extensive coal beds. The tilted condition of the rock, consisting largely of slate, was thought not to admit of the retention of large quantities of oil in pools, such as occur in the horizontal sandstone strata of New York and Pennsylvania.

Faith was not, however, wholly lost in the petroleum resources of California. Some still believed them to be considerable, their argument being that where so much oil appeared on the surface it could not all escape downward through the vertical strata, and that only deeper borings were required to demonstrate the existence of heavier deposits than had yet been found, but few of these pioneer wells having reached a greater depth than 400 or 500 feet.

Although experience has not fully borne out this last conclusion, many of the wells since sunk having yielded liberally at no great depths, still it strengthened the determination of the oil men to persevere in the work of exploration, and drilling was kept up, though in a feeble and desultory way, for seven or eight years after it had been generally abandoned. A good many wells were sunk, chiefly in Ventura and Los Angeles counties. Some of the borings here were carried to considerable depths. Most of these wells yielded oil in small quantities, usually from 6 or 8 to 10 or 12 barrels per day. A number of small refineries were also put in operation at different localities, but they all proved short-lived, not being able to make the business profitable, and, with the exception of a demand from the Central Pacific Railroad company for some 200 barrels per month for lubricating purposes, there was little market for the crude material.

About 1875 the oil business in California began to revive. Two wells put down that year yielded some 15 or 20 barrels each per day. Drilling by steam began to be more generally used in place of the spring pole. In 1877 the Ventura and the Pico Cañon wells produced daily 80 and 40 barrels respectively. Some 20 barrels of refined oil were made daily at the Pico refinery at the latter place. The next year 60 barrels of crude oil were for a number of days taken from the Boyer well, in the Santa Cruz mountains, every 24 hours. The oil here, as in most cases in California, was brought to the surface by pumping, no flowing wells having as yet been struck in the State.

From this time there has been a steadily increasing output of oil in California. The annexed table, showing the annual and total production of petroleum in this State from 1878 to 1885, inclusive, indicates the progress made and the proportions to which this industry has there attained:

Production of petroleum in California since 1878.

Years.	Barrels.
1878	15,227
1879	19,858
1880	40,552
1881	99,862
1882	128,636
1883	142,857
1884	262,000
1885	325,000
Total	1,033,992

Added to the above, say 200,000 barrels to cover the output prior to 1878, we have as the total product of petroleum in California to the close of 1885, 1,233,992 barrels.

The quantity of refined petroleum brought into California from eastern seaports during the past five years has been as follows:

Years.	Gallons.
1881	1,534,354
1882	1,048,290
1883	3,073,000
1884	2,986,738
1885	4,320,820

The exports of petroleum from the port of San Francisco have averaged, of late years, about 3,000,000 gallons per annum. These exports are mainly to China, Japan, British Columbia, Asiatic Russia, and the Pacific islands, San Francisco being the distributing point for the countries lying along, and adjacent to, the Pacific coast to the north and the south of that port.

The consumption of petroleum in California amounts annually to about 6,000,000 gallons. Importations are made both overland and by sea. The principal importers are the Standard Oil Company and the Beacon Light Oil Company.

The principal producer and refiner in California is the Pacific Coast Oil Company, which, besides its own product, control that of most of the smaller companies, but few of which have any longer an individual existence. The Pacific Coast Company is the owner of 21 wells, the most of which are producing. It keeps up in the oil territory, which it owns or controls, what amounts to 64,000 acres in Los Angeles county, 62,000 acres in Ventura, and about 32,000 in Santa Cruz, Santa Clara, and San Mateo counties. This covers, probably, the most valuable of the petroleum deposits in the State. Commencing active operations in 1875, this company has since expended, in the purchase of lands, sinking wells, erecting refineries, laying down pipe lines, and in making other improvements a sum approximating $3,000,000. In addition to the lands and wells mentioned, this company has two refineries—one located at Newhall, in Los Angeles county, the other at Alameda Point, on the opposite side of the bay, and distant 6 miles from the city of San Francisco. These latter works were erected at a cost of nearly $200,000, and are quite extensive and complete. The present refining capacity of these works is 500 barrels per day, but they have been planned with a view to their easy enlargement to six times that capacity when future requirements may call for it. This company last year put down 40 miles of 2-inch iron pipe, extending from Newhall to Santa Paula, where it connects with a similar pipe laid by the Mission Transfer Company and reaching from Santa Paula 20 miles south to the port of San Buena Ventura, making a continuous pipe line 65 miles in length. This last improvement cost the company, pumping plant included, $65,000. They have also 6 miles of pipe laid for conveying the oil from their wells in Pico cañon to their refinery at Newhall. For transporting the oil to their works at Alameda Point two methods are in use—one by steamer from Buena Ventura, and the other by rail from the town of Newhall—large storage tanks having been erected at each of these points.

The Pacific company produce an average of about 600 barrels of crude petroleum per day. The only other companies that are producing in any quantity in California are the Mission Transfer, the wells of which are located in Ventura county, and the firm of Rowland & Lacey, with a well at Fuente, 22 miles east of the city of Los Angeles. The production of the latter well is 15 barrels per day; of the Mission company about 75 barrels; all of which is handled by the Pacific company. It is not refined, but sold in its natural state for fuel, for which it is better adapted than for refining. The use of crude petroleum and the residuum of the refineries for generating steam, manufacturing gas, etc., is rapidly extending in California, the cost of coal and other fuels, more especially in the southwestern portions of the State and in the adjoining Territory of Arizona, greatly favoring its introduction there. The Central Pacific Railroad companies have for the past year been using it as fuel on their large ferry steamers plying on the bay of San Francisco. It is also used as fuel on some of the Sacramento river boats and freight steamers on the bay. Some of the tug-boats use it also. The success of the liquid fuel has induced the company to try it as fuel on locomotives, and experiments are now being made by Master Mechanic Stevens with freight locomotives. He informs the writer, however, that he is not yet prepared to make the results public, as the tests are not concluded.

Crude petroleum must always be a cheap commodity in California, having a wide distribution. It has been found in eighteen of the fifty-two counties of the State and will probably yet be found in some others. Although the deposits thus far developed have not, except in two or three counties, proved very abundant or permanent, there is a chance that many of them may improve in this respect on greater depths being reached.

The principal oil belt in this State, so far as development and production are concerned may be said to commence at Santa Paula, in Ventura county, and to extend thence in a southeasterly direction about 60 miles to Fuente, in Los Angeles county, taking in the Sespe and other wells in Ventura county, Pico cañon, Newhall, etc., this belt having a variable width of two or three miles, there being many oil indications and unimportant deposits on either side of it.

The life of an oil well in California has not yet been determined, none of the larger producing wells having entirely failed. Generally they fall off in a few years to the extent of 35 per cent., continuing afterwards to produce at about that rate. The Pico well in the San Fernando district, opened 9 years ago, and which has since produced a total of 160,000 barrels of oil, continues to yield at the rate of 12,000 to 14,000 barrels per annum. The largest yield of any well opened was 110 barrels per day. This was in the San Fernando district, where not more than five or six of the many wells sunk failed to yield some oil. While it costs twice as much to sink a well in California as in Pennsylvania, the value of a producing well is three times as much in the former as in the latter State.

Although comparatively few wells are now being sunk in California, all the larger companies continue the work of prospecting and boring, a number of small companies and individuals are also similarly engaged; nor is it at all unlikely that the business of searching after the earth oils will, before long, undergo some revival in that State. Some oil has been found in San Mateo county and also in Alameda county, at both of which places companies are now boring and prospecting in the endeavor to find paying wells.

In the latter part of 1885 workmen sinking a well in the city of Los Angeles encountered a flow of natural gas. The locality, though not within the limits of the more productive oil belt, being in the vicinity of heavy deposits of asphaltum and other oil signs, encourages the hope that other and stronger flows of this natural gas will yet be struck in that district, where it could be utilized to great advantage.

WASHINGTON TERRITORY.

As yet no valuable deposits of petroleum or its concomitant asphaltum have been found anywhere in the far West, except in California. Recently encouraging indications of mineral oil are reported to have been met with at Puyallup, in Washington Territory. These have been so encouraging as to lead to the organization of a local company to prospect the deposits. This company having procured suitable machinery, commenced boring towards the end of the year, and at last accounts had passed through several strata of gravel, yielding more or less oil, and felt confident that they would, at no great depth, strike a paying deposit. This well is being sunk on the bank of the Puyallup river, a few miles above the town of Puyallup. In many places in this neigborhood, natural gas escapes from the ground upon making holes. This gas on being ignited burns freely.

WYOMING.

The year 1885 has been marked in the Wyoming oil regions by a great amount of work in development, and some results which are remarkable as evidencing the extent of the oil field and the large amount of oil to be obtained, if not over the whole field, at any rate in places quite distant from each other.

There are, as far as now known, two oil fields in this Territory, probably originally the same, but now divided by the range of mountains in which the headwaters of the North Platte and Wind rivers find their sources. The field at the head of the North Platte and Wind rivers may be called the North Platte field. It occupies parts of Johnson, Fremont, and Carbon counties, the nearest point on the railway at present being Rawlins, on the Union Pacific.

The area and outline of the oil-bearing region have been only approximately determined by the occurrence of oil springs or springs whose waters are contaminated with petroleum products. The continuity of the oil-bearing sands is also fairly well determined. The area of the North Platte field, it is stated by prospectors in this section, is about 132 by 72 miles, or 5,500 square miles—enough, if petroleum is found throughout it, to supply an unlimited future demand.

The oil is found in two strata, the upper a black sand averaging generally 70 feet in thickness. The other is a "black pebble" or dark conglomerate varying in thickness according to various authorities from 400 to 800 feet. All the oil heretofore found by boring is in the upper or 70-foot sand.

The only producing wells heretofore obtained have been on what is known as the Graff property, at the head of the south branch of the Little Wind river, in Fremont county. The company owning the ground is styled the Wyoming Central Oil and Transportation Company. Through the energy and perseverance of the late Dr. George B. Graff, of Omaha, four wells were sunk to the upper oil-bearing sand. The depth of these wells and their product is as below:

Well.	Depth in feet.	Flow per day in barrels.*a*
No. 1	85	85
No. 2	100	100
No. 3	350	325
No. 4	1,200	825
Total	....	1,335

a As these wells are plugged, and as the only accurate gauge of wells is obtained when the oil is run into tanks and measured, these figures of flow must be taken with some allowance.

All these wells are now plugged. The general dip of the strata here is about 5°, and the close connection between the depth of the well and the amount of oil flowing is readily observable.

The flow of oil from the deeper wells is accompanied by large quantities of gas, and the oil rises above the derricks. The tubing generally adopted throughout this section is 5⅝ inches in diameter.

On the head of the North Platte, on the Poison Spider and other creeks several other companies have prosecuted development work with no great amount of success so far. The Denver and Wyoming Land and Improvement Company has one well to the upper sand but no oil. The Denver Land and Placer Company and the Wyoming Central Association have no wells down. The Wyoming Central Syndicate has a well in Johnson county down 650 feet, but no oil yet.

Small incorporated operators are sinking elsewhere, but so far the development has not proceeded far enough to secure good results. The work of practical sinking was begun only during the summer of 1885, and the time for development has been but short.

The oil obtained here is a black oil, unsuitable for lubricating. Some tests of it have been made, but not enough to establish its uniform character definitely.

Some of the oil taken from surface springs is heavy, but that from the wells is much lighter and thinner. Tests made in December, 1885, of some of the oil from the wells showed a specific gravity of 24 degrees Baumé.

The other field in which fair results have been reached by boring is on the Bear river, in Uinta county. North of Evanston some little boring has been done, but no definite information has been obtained except with regard to one well on Twin creek, one mile from Fossil Station, on the Oregon Short Line railway. This well was visited personally in the summer of 1885, and found to be only about 100 feet deep. All the boring had been done with a spring pole.

There was a large flow of brackish water with which the oil globules came up. No attempt had been made to save the oil beyond the construction in a little ravine of two small earthen reservoirs, the water being drained away below.

Some gallons of the oil had been taken by the Union Pacific to be tested, with the following result:

Test of oil from Clark & Tisdell's well at Fossil, Wyoming.

	Beaumé.
Specific gravity	26.75
Flashing point	1.70
Burning point	2.20
After 10 *hours heating at* 200°.	
Gravity	24.75
Flashing point	2.40
Burning point	2.68
Comparative value of crude oil as—	
Lubricant (No. 1 lard oil=100)=	85
Value of oil (standard=100)=	84.695

The oil is heavy, black and apparently suitable for lubricating purposes. Its economic value to the Union Pacific railway will be great on account of the proximity of the track to the well.

NATURAL GAS.

By Joseph D. Weeks.

The term "natural gas" is the one almost universally applied to that mixture of several gases found by drilling in certain sections of the country; chiefly, and in the largest quantities, in western Pennsylvania and northern Ohio. This gas is also found escaping from some springs, the banks of rivers, and other similar localities.

As will appear in discussing its composition and analysis, this gas is chiefly marsh gas, ethane, hydrogen, and nitrogen. The name "natural gas" was applied to it to distinguish it from the artificially prepared gases of commerce, especially from ordinary illuminating gas, and from producer fuel gases, which, as well as water gas, are made from coal.

The propriety as well as the exactness of the name has recently been called in question, and other names have been used. Prof. Edward Orton, State geologist of Ohio, speaks of it usually as natural gas, but also as "inflammable gas"; while Prof. J. P. Lesley, State geologist of Pennsylvania, following the analogy of the name petroleum, applies to it the name "rock gas."

While it is true that the name "natural gas" does not exclusively belong to the gas we are considering, it seems to be as fairly descriptive of it as the other names suggested. If there are other "natural gases", there are also other "inflammable" and other "rock" gases, and as the adjective "natural" is descriptive of one of its characteristics and is so universally in use, there seems to be no good and sufficient reason why it should be discarded for any substitute that has yet been suggested.

TOTAL CONSUMPTION OF GAS.

It is simply impossible to ascertain the total production in cubic feet of natural gas in the United States. The data do not exist for such a statement. But few wells have been accurately measured and even these measurements when made, only give the rate of production for the moment when the observations are taken. This rate changes not only from day to day, but from hour to hour, and even from moment to moment. It is usually greater at certain times of the day, as in the morning, than at others. It varies with the weather and with the state of the barometer.

Nor is it essential to ascertain this total production of all wells. The only production that has any commercial importance is that which is utilized. The amount that is wasted has no commercial value, at least that can be considered. Only that gas which has been consumed in doing useful work will be taken into consideration in this statement of total consumption. The waste cannot be considered.

The basis of the calculation of consumption is the amount of coal displaced by the gas. When coal is not used in the locality, or where it furnishes only a portion of the fuel, the value of wood or other fuel used is regarded as the value of coal displaced, and an estimate of the tonnage of coal that would be displaced is made, based on the selling price of coal in the locality.

The total displacement of coal by gas and the value of the same is as follows:

Amount of coal displaced by natural gas in 1885 *and its value.*

Locality.	Coal displaced, short tons.	Value.
Pennsylvania:		
Allegheny county	2,000,000	$2,500,000
Balance Pittsburgh district	500,000	750,000
Western Pennsylvania outside Pittsburgh district	500,000	1,250,000
New York	56,000	196,000
Ohio	50,000	100,000
West Virginia	20,000	40,000
Illinois	600	1,200
Elsewhere	5,000	20,000
Total	3,131,600	$4,857,200

As indicating the methods by which this estimate was reached, it may be stated that the estimate for Allegheny county is the result of several methods of computation. In the first place, the charges for the use of natural gas are based upon the amount of coal displaced, so that the natural gas companies can approximate to the coal displacement, knowing how many consumers they have and for what purposes the gas is used. A number of persons connected with these companies are of the opinion that when the mills and factories were in full operation the coal displaced by natural gas was 10,000 tons daily in 1885. Sundays, holidays, stoppages, partial time, and light running would make the time equal to say two hundred days full time and the coal displacement 2,000,000 short tons a year.

A very careful estimate of the actual amount of coal consumed at each of the iron and steel mills and glass works and other large establishments using gas gave an aggregate of a little less than 50,000,000 bushels; one estimate is 48,000,000 bushels. Add to this amount 3,500,000 bushels of coal displaced by gas in domestic use and small establishments, and the total displacement would be from 51,500,000 to 53,500,000 bushels yearly. Now, 53,000,000 bushels are equivalent to 2,000,000 short tons, so that these two methods give about the same results.

Estimated amounts of coal displaced by gas daily at individual iron and steel works in Pittsburgh.

Name of company.	Coal displaced daily by gas.	Name of company.	Coal displaced daily by gas.
	Bushels.		*Bushels.*
Oliver Bros. & Phillips	15,000	Phillips, Uimick & Co	3,800
Jones & Laughlins, limited	15,000	Keystone Rolling Mill Company	3,800
Graff, Bennett & Co	14,000	Brown & Co	3,500
J. Painter & Sons	10,000	Dilworth, Porter & Co	3,000
Carnegie Bros. & Co. (Union mills)	10,000	Wm. Clark & Co	3,000
Park Bros. & Co	8,000	Moorhead Bros. & Co	3,000
Hussey, Howe & Co	8,000	Singer, Uimick & Co	3,000
Shoenberger & Co	7,000	Chess, Cook & Co	2,600
Miller, Metcalf & Parkin	6,000	H. Lloyd, Sons & Co	2,500
A. M. Byers & Co	5,000	J. W. Friend & Co	2,000
Lindsay & McCutcheon	5,000	Republic Iron Works	2,000
Zug & Co	5,000	Everson, Hammond & Orr	2,000
Spang, Chalfant & Co	4,500	Spang Steel and Iron Works	2,000
Elba Iron and Bolt Works	4,000	La Belle Steel Works	2,000
Morehead, McCleane & Co	4,000		

It is estimated that window glass works require on an average 400 bushels of coal daily, flint and bottle houses 200 bushels. Domestic consumption is placed at 700 bushels a year per house. These items are given as showing the basis of the estimates.

As showing the number of consumers the following is given as the number supplied at the close of 1885 in Pittsburgh by the Philadelphia company alone:

Iron and steel works	46
Glass works	33
Oil refineries	9
Various manufactories	101
Houses and stores	2,637

It may be stated that at the close of 1885 the estimated displacement of coal by the gas of the Philadelphia company was 9,000 tons and the consumption of gas daily 182,400.000 cubic feet.

In reaching an estimate of the amount consumed outside of Allegheny county and the Pittsburgh district, a computation similar to that given in connection with the New York oil fields was used. As great a proportion of the oil wells of western Pennsylvania are neither pumped nor drilled with gas as in New York, but there is a larger consumption for other purposes. In addition to this method of computation the consumption was checked by some twenty reports from different localities as to coal displaced. It is believed that 500,000 tons of coal displacement is as close an estimate as it is possible to make.

At Fredonia, New York, the total production of gas is stated to have been 6,000,000 cubic feet in 1885, an amount which is estimated by Mr. E. J. Crissey, superintendent of the Fredonia Natural Gas Light company, to have displaced 50 tons of coal valued at $5 a ton. Some wood was also displaced; including this, the total gas would be equal to about 150 tons of coal displaced at $5 a ton. At Westfield the gas is only used for illumination, the total consumption in 1885 being but some 500,000 cubic feet, about equal to the displacement of 13 tons of coal at $5 a ton. From the Allegany oil field only estimates of consumption can be given. Here as in the Pennsylvania oil regions, and even to a greater extent than in some of the Pennsylvania districts, gas is used in drilling and pumping oil wells and at the oil pipe-line pumping stations. During the year 1885, 468 oil wells were completed in the Allegany district, New York. It is estimated that it requires 30 tons of coal on an average to drill a well, so that each well drilled with steam made by gas would displace 30 tons of coal worth say $3.50 a ton or more. In this same district there were 3,677 producing oil wells at the close of 1885; most, if not all, of which were pumped, and chiefly with gas as fuel for making steam. In addition to this, gas is almost the only fuel at the pipe-line pumping stations. One station would consume 10 tons of coal a day. Outside of the Allegany field a portion of the Bradford field is in New York, and to the consumption of gas in oil production and transportation in Allegany must be added that of the portion of the Bradford district in New York, to get the total displacement of coal by gas in that State. To all this must be added the consumption for domestic and manufacturing purposes. As the result of the best information I have been able to secure, it is estimated that the consumption of natural gas produced in New York in 1885 is equal to the displacement of 56,000 tons of coal worth $3.50 a ton, or $196,000.

As is stated elsewhere, the notable high-pressure gas wells of Ohio were not struck in time to bring their production and the consumption of their gas within the limits of time covered by this report. A very much larger amount of gas will be utilized in 1886 than in 1885. It is believed that 50,000 tons will cover the coal displaced by the gas consumed in this State. This may be valued at $2 a ton.

From the best data at hand it is estimated that the coal displaced by gas in West Virginia will not exceed 20,000 tons at $2 a ton.

Though quite a number of natural gas localities are reported from Illinois, the actual consumption was quite small in 1885. From but one place in this State, Litchfield, was any considerable number of consumers reported. From most localities gas enough to supply one family, and in one case as many as four, is all that was reported as actually used. An estimated consumption of gas in 1885 equal to the displacement of 600 tons of coal at a value of $2 a ton is believed to be sufficient to cover all used.

Outside of the localities for which estimates of consumption have already been given, it is believed that 5,000 tons at $4 a ton will cover the coal displaced by gas.

Though considerable difficulty has been experienced in using gas in glass furnaces, it is probable that this difficulty arises not from any want of adaptability of the gas to glass making, but from failure to adapt the furnace to its use. It is evident to the most careless observer that a furnace so constructed as to throw the gas flame or the air draft sharply against the pots and benches must inevitably ruin them in a very short time. The heat is so intense, and the driving action of the gas gives something in the nature of a blow-pipe flame, which must very soon cut down the pots. The best success in the use of natural gas in glass furnaces has been obtained in flint-glass rather than in window-glass works. In flint-glass furnaces the pots are set around a circular opening through which the flame ascends; in a window-glass furnace the pots are set on the sides of a rectangular oblong furnace. A furnace of this character is not so easily heated as the round flint furnace.

The following statement gives the comparative results of the use of coal and gas at a flint-glass furnace for a year, working with each fuel.

Cost of fuel (coal) for forty-five weeks in 1883 *at a flint-glass works at Pittsburgh.*

Slack coal	$2,809.78
Coke	1,288.29
Benzine	1,584.48
Labor (not needed with gas)	2,200.00
Total	7,882.55
Average per week	$175.17

Cost of fuel (gas) for forty-seven weeks in 1885 *at a flint-glass works at Pittsburgh*

Total cost of gas	$4,468.0[illegible]
Average per week	94.96

Or nearly 46 per cent. less than when working on coal.

The rates charged consumers in Findlay, Ohio, differ somewhat from those charged at Pittsburgh. They are as follows:

Cooking-stoves	per month		$1.00
Sitting-room stoves	do		1.50
Grates	do	$2.00 to	2.50
House lights	do	.15 to	.30
Boilers	and upwards, per year		150.00
Patent lime-kilns (draw-kilns)	do		100.00

CHARGES TO CONSUMERS FOR GAS.

The charges to consumers for gas vary greatly in different localities, depending usually, in the absence of competition, upon the cost of other fuel at the point of consumption and upon the work for which it is consumed. In the presence of competition, however, no consideration is given to the value of the gas as a fuel or to the value of the other fuel it displaces. Prices are made without the least reference to cost or value. In one instance in the presence of competition in a locality where coal is worth, say, $5 a ton, a company offered to supply gas for cooking and heating stoves at 50 cents a month each. In other cases gas companies have put the fittings into houses and agreed to supply gas for one year free. Such competition is not only ruinous but absurd.

The usual basis of charges for gas is not per 1,000 cubic feet but a given sum per month, or per ton, kiln, pot, or some other unit based upon the product or some apparatus of the industry in which it is used.

In iron making the charge is per ton of iron puddled, heated or rolled; in glass works, per pot of glass melted; in brick making, per 1,000 burned; for steam, per boiler, varying with the size.

It is not necessary to give in detail the rates charged for gas at all points in the country; a few will suffice. The rates of the Philadelphia company at Pittsburgh, which may be taken as fairly representing the ruling rates in that city, are as follows:

Rates for furnishing natural gas.

Iron and steel:			
Puddling	long ton..	.....	$1.00
Heating (each heat)	do....	$0.40 to	0.60
Boilers	per month..	50.00 to	100.00
Total cost of gas per ton iron, single heated	long ton..	1.80 to	2.10
Sheet iron or steel	do....	2.25 to	2.60
Hoop iron or steel	do....	2.25 to	2.60
Open-hearth melting	do....	.....	.70
Crucible steel melting	do....	.....	.50
Hammer furnaces	per day..	1.00 to	1.60
Glass:			
Flint, each 10-pot furnace	per month..	.....	160.00
each large glory hole	do....	.....	30.00
each small glory hole	do....	15.00 to	20.00
each lear	do....	.....	25.00
each steam-boiler	do....	35.00 to	50.00

Average cost of gas about $28 per pot per month.

Window-glass.—Average $33.33 per pot per month, blowing furnaces, flattening ovens, sand furnaces, and boilers included.

Green bottle glass same as window-glass.

Boilers in general works range from $20 to $150 per month.

Oil stills	per month..	35.00 to	100.00
Brick kilns and drying floors	per thousand..	.....	1.00
Fire brick	do....	1.00 to	1.40

Domestic use.—This is based on the number of square feet heated, the basis being $10 a year for 15 square feet. The charge for heating stoves is $2.50 a month; for open grates, $2.

One or two illustrations as to the relative cost of natural gas and coke in connection with the industries named above may not be without interest. Bituminous coal costs, delivered at the mills in Pittsburgh, from 4½ to 6 cents per bushel of 76 pounds, or from $1.32 to $1.77 per ton of 2,240 pounds.

From 30 to 35 bushels of coal are required to puddle a ton of iron. This, at 5 cents a bushel, would make the cost of fuel for puddling $1.50 to $1.75. The charge for puddling under the tariff of the Philadelphia company, given above, is $1.

To single heat a ton of muck bar for rolling into bar iron requires, say, 15 bushels of coal, which, at 5 cents a bushel, would cost 75 cents a ton for coal as against 40 to 60 cents per ton for gas. In neither case is the coal for making steam included. It is estimated that the entire amount of coal used to make a ton of common bar iron, including steam, heating up furnaces, fuel for puddling and heating is 55 to 60 bushels, which at 5 cents a bushel would make the cost of fuel to a ton of iron, single-heated, $2.75 to $3. The total cost of gas per ton of iron, single-heated, is, as given above, from $1.80 to $2.10, a saving in the cost of fuel of about one-third.

In addition to this there are large economies with gas. There is a large saving in expense in repairs of furnace. There is no expense for removing ashes, which is by no means an inconsiderable amount; there is less waste to the iron when the gas is properly manipulated. It will thus be apparent that the saving in fuel is not the only economy in the use of gas in the Pittsburgh iron mills.

By the use of gas the work in the iron mills is very much less laborious.

The Findlay Gas-Light and Coke Company, which makes the above rates, uses natural gas for illuminating. Regarding the charges and economies in its use, Mr. E. B. Philipp, the superintendent, says:

"A direct comparison between coal gas and natural gas, as to relative cost, may be of interest from a financial standpoint. A dry goods store, the annual coal-gas bills for which amounted to between $400 and $500, now uses natural gas at a cost of $144 per year. A saloon and restaurant with yearly coal-gas bills from $300 to $400 now pays $120 per year. A private residence, with bills formerly at $30 to $35 per year, is now lighted at a cost not exceeding $7 to $8. In making these comparisons the fact must be borne in mind that no meters being used from 50 to 100 per cent. more gas is now consumed than when coal gas was used, metered and sold by the thousand cubic feet. On account of this it is used very lavishly and without regard to economy. Storerooms, where every economy was exercised in the use of coal gas, being only sufficiently lighted for the ordinary wants and requirements of business, are now a blaze of light. Private residences, with formerly a burner here and there, as few as possible, are now brilliant from garret to cellar. The streets, formerly lighted with tips using 4 or 5 feet of gas per hour, on the lamp posts, are now lit up as if the town were illuminated for some special occasion."

OCCURRENCE OF NATURAL GAS.

A catalogue of the localities in which natural gas had been found was given in the "Mineral Resources" for 1883 and 1884. This catalogue also practically covers all the territory in which natural gas had been found at the close of 1885. It is true there has been some extension of gas fields and areas, but in but few cases could these be called new fields. They were rather extensions of old localities. By reason of this catalogue in the last report it will therefore not be necessary to enter as fully into details as to the localities in which natural gas is found.

In general it may be said that natural gas is found in varying quantities all through the territory from the Hudson river on the east to California on the west. In New York, Pennsylvania, West Virginia, Ohio, Kentucky, Tennessee, Alabama, Louisiana, Indiana, Illinois, Missouri, Iowa, Wisconsin, Kansas, Colorado, Dakota, Utah, Wyoming, and California its existence is reported. The most important fields are those of western Pennsylvania, and Findlay, Ohio.

At the present time, the most important natural gas territory is what is known broadly as the Pittsburgh district of western Pennsylvania, including Murraysville and Grapeville subdistricts in Westmoreland county, the Washington, Cannonsburg, and Hickory subdistricts in Washington county, and Bull Creek subdistrict in Allegheny county. From the wells of these counties in southwestern Pennsylvania the gas territory stretches towards the northeast, following the general trend of the Alleghanies to and into the State of New York. In every county of western Pennsylvania north and east of these, with the exception of Lawrence, Mercer, and Jefferson, gas is found, and it is by no means decided that it will not be discovered in these three. In Beaver, Butler, Armstrong, Indiana, Clarion, Venango, Crawford, Forest, Elk, McKean, Warren, and Erie counties gas is found either in gas wells separate and distinct from oil wells or in connection with them.

The most important of these western Pennsylvania fields is the Murraysville; it is situated some 18 miles east of Pittsburgh, on the western edge of Westmoreland county. On a narrow strip of territory, about 5 miles long, over 30 wells have been drilled without a single failure. The first of these wells, Haymaker No. 1, was put down in 1878, and for 5 years its product was allowed to go to waste. In 1883 other wells were drilled and pipe lines were laid to East Liberty and Pittsburgh, which mark the beginning of the present extensive use of natural gas in that city.

Southeast of Murraysville, near Greensburgh, is the Grapeville district, which at the close of 1885 had very little importance as a gas-producing district, but which has since assumed very extensive proportions. The gas from this is chiefly used in Greensburgh and Johnstown.

The Homewood district lies within the limits of the city of Pittsburgh. The first well was struck here by Mr. George Westinghouse, jr., in May, 1884, and gave promise of an immense yield. In experimenting to shut off the salt water the volume of gas decreased, and the record of the well as a producer has ever since been very unsatisfactory. Some fourteen holes have been drilled in this locality, though but few of them appear to be profitable producers.

In Washington county there are several fields. In the Hickory district the first well, known as the McGuigan, was struck in March, 1882. The gas was allowed to waste for more than a year when a 6-inch main was laid to Birmingham, a part of Pittsburgh, situated on the south side of the Monongahela. The line was 22 miles long. In 1884 two other wells were struck and later two more. The supply from these four wells is enormous. A second portion of the Washington county field is the Cannonsburgh. Some five wells had been drilled at the close of 1885, and others were in progress. In the town of Washington five gas wells have been drilled. These supply the town with fuel, and have not as yet been piped to Pittsburgh. The gas from the wells of the Hickory, McGuigan, and Cannonsburgh districts, all lying a little northwest of Washington, have been piped to Pittsburgh.

In Beaver county, lying northwest of Pittsburgh, what is known as the Bridgewater field has given the best show of gas. It was opened in 1884. Philipsburgh, Beaver, Rochester, New Brighton, and Beaver Falls are supplied with gas from this district.

Returning to Allegheny county, and going north from Pittsburgh up the Allegheny river, there is what is known as the Bull Creek district, which was first tapped by the well of Graff, Bennett & Co., in June, 1878. Over 20 wells have been drilled in this district, considerable of the gas from which is used in manufacturing establishments at Natrona, Tarentum, and Creighton. The Philadelphia company is also piping large quantities to Pittsburgh, about 22 miles.

Still farther to the north from this field is the Lardentown or Harvey field, supplying the works of Spang, Chalfant & Co., at Etna, to which reference has already been made. The old Harvey well has ceased to be a producer, having been drowned out with water. Twelve additional wells have been drilled, seven of which have been abandoned, leaving five connected with a pipe supplying Etna. These five wells together are probably not furnishing as much gas as the Harvey well itself produced ten years ago. At Saxon City, in Butler county, there is a well that has been utilized for making lampblack, while in the neighborhood of Butler, the Burns, Delamater, and other wells have been sunk. The gas from these is used in Butler and the vicinity, and will soon be utilized also at Shields plate-glass works, in process of erection. In Armstrong county there are several localities; at Leechburg, already noted, at Freeport and Apollo, which may be regarded as the same locality, some 12 wells have been put down, but they are all of moderate capacity. Two or three wells just north of Kittanning furnish that town with heat and light, and other wells three miles west, in Franklin township, furnish the gas for the Kittanning Rolling Mill company. At Stewardson Furnace, in the northern part of the county, is a well, the gas from which is being made into coke for manufacture into electric light carbons and other purposes.

The most easterly gas-producing locality in Pennsylvania is at Shingle House post-office, in Sharon township, the extreme northwestern township of Potter county. Gas is also found at several other places in the northwestern portion of this county.

Going westward, along the border of New York, we come to what is known as the Bradford oil district, which has been very prolific in gas. Regarding the gas of this locality, Professor Carll states: "Unrestricted consumption and waste have very materially reduced its pressure and volume. At first the town of Bradford had an ample supply from wells near the city and on the northwestern edge of the oil field; but when this failed, pipes were run to the Rixford gas pool, which reinforced the supply for some time. Later, however, it became necessary to lay a new line, of over twenty miles, to connect with the Wilcox gas pool near the southern line of McKean county, where there is a large deposit, capable no doubt of responding to all demands that can be made upon it for many years to come. The Wilcox wells have also produced some oil in what is considered to be the equivalent of the Bradford sand; but not enough to make them remunerative as oil wells. The oil sand lies here about 20 feet below ocean level, and more than 400 feet lower than at Bradford."

Gas has been found in considerable quantities in Elk county, at Johnsonburg station, Ridgeway, Kane City, Wetmore, and the Roy and Archer gas pool. At Kane City and at Wetmore an abundance of gas can be had for drilling, and Professor Carll states that even in this region of forests it is found cheaper to use gas than wood for fuel. On the border of Warren and McKean counties is one of the most prolific gas pools in the county, known as the Sheffield. This well has a remarkable history on account of the trouble encountered by the formation of ice in the hole. Regarding some experience with these wells Professor Carll makes the following statement: "After the two-inch tubing had been put in to test the well for oil, it was partly filled with water to buoy up the sucker-rods while being inserted and to lighten the labor of putting them in. When about two-thirds of the rods had been lowered some obstruction was met, and, after ineffectual attempts to force them further, it was concluded that the tubing was imperfect and would have to be withdrawn. Preparations were made to pull the rods, but on attempting to run them up, they were found to be immovable; hence rods and tubing had to be taken out together, a very difficult and undesirable task. When the lower joints of sucker-rods and working-valves were reached, they were seen to be solidly frozen in the tubing. The water at and near the point where gas came into the well had frozen, the ice-core stopped the rods in their downward passage, and, while endeavoring to force the obstruction, new ice set around the valves and rods and held them firmly. These phenomena were considered remarkable at the time, but since then several wells in the Cooper district have been in like manner seriously embarrassed by ice both in drilling and sand-pumping."

It is impossible to give in detail a statement of all the gas localities in Pennsylvania. In the city of Erie a large number of wells have been drilled; in the Venango oil district many large gas wells have been found, and the same is true of Clarion. In Jefferson county, near Brookville, wells of some capacity have been struck, supplying a small amount for heating and lighting purposes, while in Indiana county the gas from the Snyder well, struck in 1883, is piped about 5 miles to Punxsutawney. In the western part of Butler county, near Harrisville and Centreville, gas is found, which is being piped to New Castle and Youngstown, Ohio.

Professor Lesley's conclusions as to where natural gas is likely to be found in Pennsylvania are of interest. In answering the question, Shall I bore for gas at my works? Professor Lesley says:

"First of all, there can be no gas stored up in the oldest rocks. This at once settles the question in the negative for the whole southeastern third of Pennsylvania. To bore for gas in Bucks, Montgomery, Philadelphia, Delaware, Chester, Lancaster, York, or Adams counties would be simply absurd.

"Second. There can be no gas left under ground where the old rocks have been turned up on edge and overturned, fractured and recemented, faulted and disturbed in a thousand ways. If there ever was any it has long since found innumerable ways of escape into the atmosphere. This settles the question in the negative for all the counties of the great valley—Northampton, Lehigh, Berks, Lebanon, Dauphin, Cumberland, and Franklin—as any one can see by looking at the present condition of their limestone, slate, and sandstone formations.

"Third. There is not the least chance that any gas is left under ground in the greatly folded, faulted, crushed, and hardened formations of the middle belt of the State—Carbon, Schuylkill, Lehigh, Luzerne, Columbia, Montour, Northumberland, Union, Snyder, Lycoming, Perry, Juniata, Mifflin, Centre, Clinton, Huntingdon, Blair, Bedford, and Fulton. Where the oil and gas rocks rise to the surface in these counties, as they do in a thousand places, they show that all their oil and gas have escaped long ago.

"Fourth. Where the rock formations lie approximately horizontal and have remained nearly undisturbed over extensive areas, as in Wayne and Susquehanna, parts of Pike and Lackawanna, Wyoming, Bradford, Tioga, Potter, and all the counties west of the Alleghany mountains, there is always a chance of finding gas (if not oil) at some depth beneath the surface determined by the particular formation which appears at the surface; but as yet we have no satisfactory evidence of the existence of quantities of rock gas in any of these counties east of Potter.

"Fifth. Wherever the bituminous coal beds have been changed into anthracite or semi-bituminous coal it is reasonable to suppose that the same agency which produced the change, whatever it was, must have acted upon the whole column of formations including any possible gas rock at any depth.

"Sixth. Wherever rock oil has been found there and in the surrounding region rock gas is sure to exist."

In the northwestern portion of Allegany county, near the border line of Pennsylvania, is situated what is known as the Allegany oil field. In connection with the oil there is produced an immense amount of gas, which is utilized throughout the field under boilers for raising steam for drilling and pumping wells, and also for domestic purposes. It is also, in addition, piped outside of the oil field proper to Olean, Cuba, Friendship, and other localities in New York, and used for heating, lighting, cooking, and manufacturing. Some little gas is also produced at the oil wells in the northern part of the Bradford field, which reaches over into the southeastern portion of Cattaraugus county.

Gas has also been discovered at West Bloomfield, and even as far east as along the Hudson river, but none of the localities in New York had developed any commercial importance at the date of this report other than those in the three western counties named, Chautauqua, Cattaraugus, and Allegany.

In Ohio the most important gas field is the Findlay, situated in Hancock county, in the northwestern part of the State. There have been surface indications of natural gas in this county from its earliest settlement, and it has been utilized in a small way for more than forty years. In 1884 a company was organized to drill for natural gas, and in November of that year the Findlay Natural-Gas Company struck gas in the limestone rock at a depth of 1,100 feet below the surface. In 1885 this company put down a second gas well, and a third and fourth well were put down the same year. The most important of the eleven wells yielding gas in this district was finished about January 20, 1886. The measured flow of this well is more than 12,000,000 cubic feet daily.

Due north from the Findlay field, at Bowling Green, in Wood county, is another locality, drilling having begun here in February, 1885. At Fremont, in Sandusky county, a well was drilled in the summer of 1885, gas being found in small amount, the first well yielding, a month after it was completed, less than 10,000 cubic feet. The gas is adapted to domestic use, but the wells lack the force and vigor necessary for a manufacturing supply. At many other towns in the western half of Ohio, inspired by the success in obtaining gas at Findlay and oil at Lima, many wells have been put down, a number of which have turned out dry and others are alleged to be unsuccessful, and in a large number oil and gas have been found. The producing ones, however, have yielded but a few hundred or thousand feet of gas per day.

In the upper Ohio valley, at East Liverpool, the utilization of natural gas began in 1874, gas having been discovered in boring for salt water as early as 1859 and 1860. The supply is very moderate at the present time. Quite a number of wells have been bored, the largest of which is yielding but 35,000 cubic feet per day, and others falling as low as 10,000 cubic feet.

In the same section as the East Liverpool wells, that is, in the upper Ohio valley, is what is known as the Wellsburg gas field. This embraces territory on both sides of the river, in West Virginia and Ohio, but the center of production is at or near Wellsburg, though wells have been drilled as far north as Steubenville and south to Wheeling and Bellaire. More than 50 wells have been put down in this territory within the last three years. The first, known as the Barclay well No. 1, was drilled in December, 1882, and yielded in July, 1885, 30,620 cubic feet of gas a day. A second well, drilled near, in April, 1883, known as Barclay No. 2, was also a vigorous producer, yielding in July, 1885, 469,000 cubic feet a day. The entire supply of this district, however, is reported as decreasing.

The Neff wells are referred to elsewhere. These were bored for oil twenty years ago. Two of the wells have become widely known as large gas producers.

The first well bored in the Macksburg oil field in 1877 yielded dry gas, though this locality is chiefly valuable as an oil field.

It is impossible to mention in detail the localities in this State in which gas has been produced. It is almost impossible to put down the drill anywhere in this State without finding gas in greater or less quantities. Outside of the localities, however, in which the Berea grit and the Trenton limestone have been found the gas is produced in very small quantities. In the Ohio shales a daily yield of 80,000 feet is the highest reported, while wells of one-fourth of this production are counted good, and many range only from 1,000 to 5,000 cubic feet per day.

In West Virginia the important gas fields are those of New Cumberland, on the opposite side of the Ohio river from East Liverpool, and of Wellsburg. There are promising fields in the Kanawha valley also, but they have but little commercial importance at present.

Gas has been found in Illinois in the following counties: Champaign, La Salle, Bureau, Livingston, McLean, De Witt, Macon, Coles, Clark, Montgomery, and Madison, having been first discovered at Champaign in 1853. One field of some importance, and several others that may possibly prove so, have been developed in this State. The most important wells are at Urbana, Champaign county; Mendota, La Salle county; and Litchfield, Montgomery county. The Illinois wells, as compared with the great wells in Pennsylvania, are shallow, occurring for the most part in drift, and though some have yielded gas for years, they they are gradually giving out.

The well at Litchfield, in Montgomery county, is the only one in the State at which gas and oil have been found under geological conditions similar to those of the Pennsylvania wells. At Litchfield, gas and oil are found at a depth of about 650 feet, below the Lower Coal Measures, bordering on the Devonian. Gas was first discovered at this place in 1882, but was not piped into Litchfield until the fall of 1885. The Litchfield well is the only one from which gas has been piped for public consumption, some 4 miles of pipe being laid. The gas now furnished the town is from two wells, drilled in the fall and winter of 1885. The wells, which are situated 2 miles from the town, are in the vicinity of a large gas well struck three years ago, the pressure of which was between 400 and 450 pounds to the square inch. This well was spoiled by salt water about a year ago. The well was drilled dry, and cased at 580 feet, with no salt water found in the gas sand; but after drilling down 200 feet further a heavy vein of salt water was struck. This could not be successfully plugged off, and finally drenched out the gas, which was reached at 640 feet. The present wells have a pressure of about 125 pounds. The country has never been tested to the south, but in May a well was reported as drilling about a mile south of first developments. The country developed is prairie, while towards the south and east it is rough and broken.

At Clinton, in De Witt county, several water wells furnish gas at intervals. Near Hallsville post-office, in the same county, gas has been found. It was utilized for several months, when the well was ruined by sand in the drift. At Decatur and vicinity, in Macon county, where gas is found in the drift and rising in the springs and from the bed of the Sangamon river, its flow has been destroyed in the same way. At Mount Zion, 12 miles east of Decatur, gas has been found in a water well and is still flowing. At Westfield, in Clark county, gas and oil were found in limited quantities some years ago, their first discovery dating back twenty-five years. In Champaign county a score or more of wells in the drift, averaging 100 feet in depth, have been utilized for some years, though there are no deep borings.

About 1871 gas was struck some 3 miles north of Edwardsville, Madison county, at a depth of 90 feet. The pressure of the gas was quite strong, when lighted making a flame 50 feet high. The well was piped, but soon plugged up, in which condition it remains at present.

At several localities in Kansas gas has been found in sufficient quantities to use for heat and light, especially at Paola and Fort Scott. In 1882 a company was formed to drill for oil in Miami county, near Paola, and at a depth of 325 feet struck gas with 50 pounds pressure. The experience and funds were limited, and for some reason the well was neglected, only being used in heating and lighting the house on the farm on which it was found. In the fall of 1885 the county decided to test the practicability of bringing it into Paola, and laid a 3½-inch pipe about 7 miles. It proved a complete success. About the middle of July, 1886, another well was sunk and struck the gas at the same depth. The quality and pressure were found to equal if not excel those of the first well. In the mean time some fifty or more families have used it for fuel and light, and also several manufacturing establishments, and it is expected that its use will soon be universal, as there is from these two wells gas enough for Paola, with 4,000 inhabitants, and many manufactories that may want it, while it is believed that a greater abundance may be had by drilling. Many shallow wells in the county, dug for house use, have gas in greater or less quantities.

Three wells have been put down one mile northwest of Fort Scott, two of which proved successful, gas being found at a depth of from 195 to 200 feet. At the third no gas was found. More wells are reported as drilling.

It is reported that in August, 1885, in Sully county, Dakota, some 30 miles from the Missouri river, natural gas was liberated in a well which was being sunk for water. The gas was found in a vein of gravel 5 feet thick and 140 feet below the surface, the pressure being so great as to send up gravel from the bottom of the vein. The gas when lighted showed a blue-green flame, but would only burn when a hot iron rod or burning brand was held over the escape-pipe. The flame reached about 5 feet in height.

For information relative to other fields, reference should be made to the report for 1883 and 1884.

HISTORY OF THE USE OF NATURAL GAS IN THE UNITED STATES.

The earliest economic use of natural gas in this country was probably in lighting the village of Fredonia, Chautauqua county, New York, in 1821. For many years prior to this, even as early as the date of the survey of the Holland Land Company, gas had been observed issuing from the crevices of the slate rocks along the banks of the Canadaway creek, on which Fredonia is built. In 1821 a well, 1½ inches in diameter and 27 feet deep, was put down near the Main street bridge which crosses this creek; this was probably the first well sunk for the purpose of obtaining natural gas. This well produced gas sufficient for some 30 burners, the burner being made by drilling a hole, the size of a small knitting needle, in a pipe. The light from one of these "burners" was regarded as equal to that of "two good candles;" gas of 2-candle power would hardly answer the demand of to-day. The gas was conveyed from the well to the buildings in which it was used in wooden pipes. In 1824, on the occasion of Lafayette's visit, the village was lighted with natural gas.

In 1825 a small gasometer was put in and the wooden pipes replaced with lead ones, which so improved the conditions that the Fredonia "Censor" of December, 1825 says: "We witnessed last evening the burning of 66 beautiful, clear gas-lights, and 150 lights could be supplied from this gasometer. There is now sufficient gas to supply another one as large."

The existence and utilization of this gas at Fredonia became widely known, both in this country and abroad, and excited the liveliest interest among scientific men, but so little suspected was the presence of the enormous volume of gas since developed that it was pronounced "unparalleled on the face of the globe," and Humboldt is quoted as declaring it the eighth wonder of the world.

This well of 1821, which was afterwards drilled to the depth of 70 feet into the black shales of the Marcellus beds, was the only one producing gas in the village until 1858, though another well was sunk in 1850. It yielded water as well as gas and required constant pumping, the gas not having pressure enough to force itself through the water. This well was in uninterrupted use until 1885, when some repairs to Tefft's mill, adjoining, made it necessary to tear away the pumping machinery. The product of gas is but a trifle less than when it was first completed, 65 years ago.

In 1859 a well of a peculiar character was sunk, or rather the second well, that of 1850, was enlarged. A shaft 30 feet deep, 6 feet in diameter at the top and 14 feet at the bottom, was dug. From the bottom, lateral and two vertical borings, one 100 feet deep, the other 150 feet, were put down. A production of 4,500 feet of gas a day was secured, supplying 200 burners. In 1871 a still larger well was bored to the depth of 1,200 feet. In 1885 the total yield of these wells was 6,000,000 cubic feet.

Shortly after gas was found at Fredonia, Judge Campbell, of Westfield, New York, used natural gas from a spring near by for the lighthouse at Barcelona, a small harbor on Lake Erie. The contract was abandoned in 1856, though the gas is still used, supplying all the churches, public halls, schools, and about twenty families. In 1827 a contract was made by Walter Smith, of Dunkirk, New York, with the Government to supply the light-house at that place for a term of years, and a ½-inch lead pipe was laid 2½ miles from the Matteson gas spring at Fredonia, but, owing to the size of the pipe, no flow was obtained, and after many trials of other means of transportation the enterprise was abandoned.

The existence of marsh gas, the modern natural gas, was well known to the earliest explorers of the Kanawha valley. In 1775 Washington, while on a visit to the Kanawha to locate lands granted him for his military services, set apart and deeded to the public forever a square acre of land in which was located a "burning spring." Through some informality his intention in this gift was frustrated. The "burning spring" mentioned by Mr. Jefferson in his "Notes on Virginia" was probably this same spring.

The boring for salt water in the Kanawha valley, which was begun in the winter of 1807–'8, not only resulted in finding brine, but nearly every salt well became a gas well, the gas in many cases jetting the water into the air and taking fire. From wells only 15 to 20 feet deep the gas escaped in quantities, burning a long time. As early as 1815 a gas well was struck within the present city limits of Charleston. This well was bored for salt, and upon striking the gas reservoir it gave out a great volume of gas, which caught fire from a grate near at hand. The gentlemen boring the well conceived that it would be reckless to bore deeper, and abandoned the well, which afterwards passed into the possession of the Charleston Gas-Light Company.

It is worthy of notice that many of the methods and appliances that have made deep well boring possible were developed and perfected at these salt gas wells. The chisel-bit, the "jar," sectional tubing, made then of tin and soldering, instead, as now, of iron with screw joints, the "seed bag," were all used at the Kanawha Valley salt wells before oil was found in western Pennsylvania.

So far as has been ascertained the first use of natural gas in manufacturing was in "boiling salt," in the Kanawha valley of West Virginia, by William Tompkins, in 1841, some twenty years after its use for lighting at Fredonia, New York. While boring a well for salt a short distance up the Kanawha river from the "burning spring," above alluded to, he struck a large and steady flow of gas, which was strong enough to force the salt water into a reservoir from which it could be distributed to his furnace pans. He determined to use this gas as a fuel to "boil his furnace," and for this purpose extemporized a gasometer from a hogshead placed over the reservoir. Into this primitive receptable he carried the escaping water and gas, the water falling into the reservoir. The gas conveyed through a pipe to the mouth of his furnace, a "salt block" 100 feet long by 6 deep and 4 wide, produced an intense heat under the whole row of kettles.

In 1843 gas was struck, in a well bored near Tompkins's, at the depth of 1,000 feet. The force of the gas was so great as to throw a column of salt water 150 feet above the mouth of the well. This is the first "gasser" and "roarer" on record.

From the beginning of the drilling of oil wells in Pennsylvania in 1859 natural gas has been obtained in greater or less quantities, either accompanying the oil or in wells that were true gas wells, that is, yielding little or no oil. In most of the flowing oil wells the pressure which forces up the oil is this gas. The attention of oil producers was first directed to the danger connected with this gas by the explosion of the Rouse well in Oil creek, one of the first flowing wells struck. Eighteen persons lost their lives by the explosion of gas at this well.

At first this gas was considered not only of no value, but a dangerous nuisance, and was carefully led away from the wells in pipes and burned to get rid of it. After a little, however, it began to be used for fuel under the boilers in drilling and pumping and for light and fuel in the towns and villages in the immediate vicinity of the wells. The proportion of the gas so used, however, until some two years since, was very small. The apparatus for collecting this gas for use in raising steam in drilling was at first quite simple. The oil and gas as they came from the well were led in a barrel or hogshead, the oil being drawn off by a pipe at the bottom and the gas by a pipe at the top.

The so-called Leechburg gas well, the gas from which was the first used in iron making, was bored for oil in 1870 and 1871, the gas vein being struck in the latter year, at a depth of 1,200 feet. This well is situated on the south side of the Kiskiminetas river, in Armstrong county, Pennsylvania, opposite Leechburg. For some months the gas was allowed to escape without any attempt to utilize it, until, in April, 1873, Messrs. Rogers & Burchfield bought the well and piped the gas across the river to their works on the north bank. The gas was accompanied by a large flow of salt water. To separate the gas from the water it was conveyed from the well by a 5⅝-inch pipe into a common cylindrical boiler, furnished with an ordinary safety valve. The water was drawn off at the bottom of the boiler through a quarter-inch pipe, it being forced out in a spray. From the top of this boiler receiver the gas was led across the river and distributed by a net work of pipes through the mill. As noted above, this was the first use of gas in iron works.

The first gas piped any considerable distance was from what is known as the Harvey well, near Larden's mills, in Butler county, Pennsylvania.

This, at the time it was bored, in the fall of 1874, was the most powerful gas well in the section. In 1875 it was purchased by the Natural Gas Company, limited, the first natural gas company formed, and piped 17 miles, through a 6-inch pipe made of iron ¼ inch thick, to the mill of Messrs. Spang, Chalfant & Co., at Etna, near Pittsburgh. The gas was turned into the pipe in October, 1875, and traversed the 17 miles in twenty minutes, the pressure at the wells observed being 119 pounds.

The first use of gas in glass making appears to have been at the Rochester tumbler works, at Rochester, Pennsylvania. The date it has not been possible to learn.

In 1883 Mr. J. B. Ford, at the Pittsburg plate glass works, at Creighton, Pennsylvania, succeeded in securing a supply of gas for his glass works, since which time these works have been run entirely by natural gas, as will also be a new and larger works building near the Pittsburgh plate glass works, and a third one in course of construction at Butler, in the same State.

It was not until 1883, with the piping of the gas of the Murraysville district to Pittsburgh, and the stiking of gas in the Westinghouse well, at Homewood, Pittsburgh, that natural gas began to be used extensively as a fuel. Prior to this time its use had been exceptional and at isolated works, but with the piping of this gas, and the striking of the Westinghouse well, the extension of its use became instant and well nigh universal for manufacturing purposes in the neighborhood of Pittsburgh. Its introduction into the rolling mills of Wilson, Walker & Co. and Shoenberger & Co., and the flint-glass furnace of the Fort Pitt glass works, was rapidly followed by its adoption in other establishments, until now few of the important manufactories of Pittsburgh that are so situated as to obtain a supply of gas cheaply, use any other fuel.

It is unnecessary to follow the history of the use of natural gas in and around Pittsburgh, as it was quite fully detailed in the article on natural gas published in "Mineral Resources" for 1883–'84.

Gas first began to be utilized in manufacturing in Erie, Pennsylvania, about 1868, by the Jarecki Manufacturing Company. The first well was put down some 600 feet, and yielded largely at first, but the amount steadily decreased. This has been the history of all the wells in this region, the pressure at some being at first as much as 50 pounds to the square inch, but rapidly falling off and becoming extremely irregular. At the Erie furnace of Messrs. Rawle, Noble & Co. an attempt was made in 1874 to use natural gas in a blast furnace. This gas was from a well 800 feet deep, with a pressure of 25 pounds. It was driven into the furnace by its own pressure, through a ⅜-inch pipe inserted in the tuyeres. Its use was not a success.

In Ohio the first use of natural gas appears to have been for domestic purposes at Findlay. Natural gas had been known to exist in this place from its first settlement, and was met with in digging cellars, wells, and sewers, and in springs and rock crevices. Explosions in excavations were by no means infrequent. The gas collected from a well dug for water was introduced into a house in Main street in 1838, and has been burning ever since. Some sixteen years ago Gen. J. S. Casement drilled a well at Painesville, which yields enough gas for ordinary household use.

The first discovery of natural gas in the neighborhood of East Liverpool, Ohio, a locality noted for its manufacture of pottery, was in 1860, while drilling for oil. Gas was found at several places in the vicinity about the same time. At Jethro, a locality within the town limits of East Liverpool, two gas wells were struck; also one on Ball's island, in the Ohio river, opposite the east end of the town; one on McKinnon farm, east of the Cleveland railroad depot; one on the Virginia shore directly across the river from this depot, and several others of but little note. The gas was struck at 400 to 600 feet from the surface.

The Jethro well produced strong salt water in abundance, which was thrown out in large volume by the pressure of the gas. A short time after the well was struck, evaporating pans were put up and the gas utilized in evaporating salt water, which was also thrown out of the well by its pressure. Shortly after this utilization of the gas at the Jethro well, the gas from another well, at Little Beaver bridge, 4 miles east of East Liverpool and near the Pennsylvania State line, was utilized in the same way. It appears from this, therefore, that as early as 1860 natural gas was used in evaporating salt in the East Liverpool district.

In October, 1873, Mr. Homer Laughlin sunk a well at his pottery, within the town limits, this being the first well bored especially for natural gas. Its product was also the first gas utilized in the East Liverpool region for fuel and light, with the exception of the gas from the two wells above mentioned, which was utilized in salt manufacture. Two years later, or in 1875, other parties in East Liverpool bored wells, the gas from which was also used for fuel and light.

These wells, however, have never been large producers, and have only furnished gas for light and fuel for small fires. Some years ago, at a time when a number of wells had been freshly bored, the gas from them was used in firing a very few kilns of pottery, a large number of the best wells, owned by different parties, being coupled or connected together.

The supplies from these old wells have been gradually falling off, until at present the entire product will only furnish gas sufficient for light and fuel for a few stoves and house fires. Recently, however, a very productive gas territory has been opened some 6 miles south of East Liverpool, in West Virginia, the gas from which has just been piped to this town, and is being used in the potteries for all purposes for fuel and light. At the present time it is the only fuel used in these establishments.

NATURAL GAS AS AN ILLUMINANT.

As has already been stated, the first use of natural gas was as an illuminant at Fredonia, New York, and yet, as indicated by analysis and practical tests, it is, under the ordinary methods of use, a heating rather than an illuminating gas. The illuminating hydrocarbons are either low or wanting. There is occasionally a little olefiant gas, rarely exceeding 1 per cent. of the total. These illuminants are so small a proportion, therefore, that they can be ignored in discussing its value for lighting purposes. The gas, as has been shown, can be regarded as chiefly marsh gas and hydrogen. The hydrogen flame is a heating flame, bluish white, and giving intense heat, but very little light. The marsh gas is also high in heating power, but burns with a yellowish flame, giving much more light than the hydrogen. It will be evident, therefore, that as the proportion of these two elements varies, so will the lighting power, under ordinary conditions of burning, vary—the more hydrogen, the less light.

And yet, as a rule, the lighting power of natural gas is by no means low, though lower than the coal gas usually furnished to consumers. The candle power of the natural gas of the Pittsburgh district is usually given as 8 candle power; of the Findlay, Ohio, from 12 to 14, and of the Mendota, Illinois, as "about 12."

The most careful and interesting experiments that have been made in the use of natural gas as an illuminant have been made at Findlay, Ohio, under the direction of Mr. E. B. Philipp, superintendent. The results of these experiments, briefly stated, are that the best form of burner for natural gas, as for coal gas, is the argand. With a 36-hole lava tip argand burner, an accurate corrected candle power of 12.57 was obtained. Where a flat flame was desired various flat-flame Bray burners were used, which gave a corrected candle power of 10.85. A special bat's-wing burner made by the American Meter Company gave a corrected candle power of 11.57. These tests were made with the crude gas, but by partially purifying it by passing it through lime boxes, removing the carbonic acid and sulphureted hydrogen, the candle power was increased to 13.77. Mr. Philipp, writing regarding the results obtained and the cost of gas for illumination at Findlay, says:

"The best general results are obtained in using burners consuming from 8 to 9 cubic feet per hour. When burned thus it gives a good, satisfactory light, excelling in a number of instances some qualities of coal gas.

"Summing up our entire experience in the matter, we must admit that, contrary to our expectations, contrary to what we considered in the beginning good judgment, we shall continue to furnish natural gas as an illuminant as long as it lasts, and can say that natural gas, so far as Findlay is concerned, and so far as any other locality may be concerned where the gas is similar to the Findlay gas, will most undoubtedly become an active competitor of coal gas, as it can be metered at a good profit at less price per thousand than it now costs for the mere distribution of coal gas."

In addition to the argand burners, which seem to have given such good results at Findlay, various forms of regenerative burners have been used, chief among which are the Siemens and the Haupt. The Haupt seems in some respects better adapted to burning natural gas than even the Siemens. These are too well known to need description. Besides these, what is known as the Todd burner has given most excellent results. This burner is constructed on the principle that there is not enough carbon in the gas to give sufficient illumination under ordinary methods of burning; hence the air, before it comes in contact with the gas, is heated to a very high degree, and, striking the gas, burns the hydrogen at once and makes the carbon incandescent. The air is heated by passing through three saucer-shaped perforated steel plates, placed concentrically, attached at the rims, but separate elsewhere through their outer and inner surface, and so arranged that the perforations in two consecutive plates are not opposite each other. This is attached to the gas service pipe immediately under the burner, which is simply a cap placed on top of the service pipe, the pipe having holes drilled immediately under this cap. The flame plays around the cap like the flame of an argand burner, and heats the steel plates, through which the air passes immediately beneath it. Of course the air passing through the small perforations of the steel regenerator is split up and highly heated.

PRESSURE AND PRODUCTION OF WELLS.

Until quite recently the published figures of the pressure and production of gas have been largely estimates, usually based upon no accurate measurements. Even when there have been observations and measurements, no uniform system has been adopted, so that, though a statement as to the pressure or production of a given well may be a fairly correct approximation as to that well under the conditions of the test, yet a comparison of the results at this well with those from another one, made under different conditions, would be without the least value.

Most of the statements as to production are the results of calculations of but little value, based upon an observed or calculated pressure of a well when closed for a given time. Early in the history of natural gas wells of high pressure, it was observed that if the well was closed it rapidly accumulated pressure, in some cases the gauge showing a pressure so great that it was not deemed wise to keep the well closed. It is doubtful, however, if a maximum closed pressure of 1,000 pounds per square inch has yet been found. It will also be evident that as the flow of gas for consumption is not under closed pressure, but open pressure, any calculations as to production based upon this closed pressure must be erroneous.

The Ohio Geological Survey, under the direction of Professor Orton, has devoted considerable attention to the problem of gas pressure and production, and has secured the best results thus far obtained.

Two methods have been adopted—the anemometer for small wells yielding 1,000,000 cubic feet or less a day, and a modification of Pitot's tubes for larger wells. The use of the anemometer for this purpose was first suggested, so far as is known, by Mr. E. McMillon, of the Columbus, Ohio, Gas-Light Company, and was first used in measuring the Adams well, at Findlay, in June, 1885. The measurements obtained have been compared with those obtained by other methods, and their reliability established.

The use of the modified form of Pitot's tubes was devised and worked out by Prof. S. W. Robinson, of the Ohio State university. A complete statement regarding this use will be found in Van Nostrand's Magazine for August, 1886.

The most carefully observed pressures and productions have been made in Ohio. In the Findlay field the actual product of wells varies from 80,000 cubic feet, at the Adams well, to 12,080,000 cubic feet, at the Karg well. The closed pressure at the wells of this district is about 375 pounds to the square inch. In the first wells it registered 450 pounds. In none does the limit now exceed 400. It has been found that all wells of a district great and small attain finally the same pressure, some reaching the maximum or average pressure sooner than others. The Karg well in the Findlay district reaches it in 1½ minutes; the smaller ones may require hours. The actually observed daily production of four wells in this district, as given by Professor Orton, are as follows:

	Cubic feet.
Karg well	12,080,000
Cory well	3,318,000
Briggs well	2,565,000
Jones well	1,159,200

No accurate statements of production and pressure of Pennsylvania wells have been obtained. The estimated production of some of the "gassers" of the Murraysville district is 30,000,000 cubic feet a day. The partially open pressure in this district is from 150 to 200 pounds. In the Wilcox district the closed pressure reaches 575 pounds and there remains stationary. In some parts of Butler county it is 250 pounds.

In Allegany county, New York, the closed pressure is 450 pounds.

In Illinois a pressure of 400 to 450 pounds is reported at the Litchfield wells when first drilled, but this has been reduced to 125 pounds. At Urbana the pressure at one well is but 10 pounds; at a second, 25 pounds.

THE STORAGE OF GAS.

The waste of gas, especially in western Pennsylvania and in the Ohio fields, in which high-pressure gas is found, has been simply enormous, the amount reaching a total so marvelous that it is impossible to form any accurate conception of it. It is estimated, for example, that the waste of gas at the Haymaker well No. 1, the first struck in the Murraysville district, during the five years when it was not used, was the equivalent of 1,000 tons of coal a day. The Harvey well, the gas from which was piped to Spang, Chalfant & Co.'s in 1875, blew millions of feet of this valuable fuel into the air before it was utilized, and the gas from the McGuigan well in the Washington County district of western Pennsylvania was not used for over a year after it was struck.

Various methods have been suggested for storing the gas. As oil was stored in tanks, it was very natural that tanks should be suggested, but such a suggestion could only have come from those unacquainted with the enormous pressure and volume of gas from great wells. This system was, of course, applicable where the production was very small and the pressure limited, as in the case of the shale gas in Ohio; but where the greatest waste is—that is, in western Pennsylvania and parts of Ohio—the suggestion is simply absurd.

It was also very natural to seek to confine the high-pressure gas by placing caps with gates upon the top of the well casing, but it was found in many instances that the pressure rapidly accumulated to a point where there was danger of blowing the casing out of the well, and this system was temporarily abandoned.

Two methods have been adopted recently for storing gas; one adapted to territory where the prospect of obtaining gas by drilling is reasonably certain, and the other applicable to all wells of ordinary pressure. The first consists simply in drilling as near as possible to the depth at which the gas reservoir is supposed to be, and then "holding the well," as it is termed, and bringing it in by drilling a little deeper whenever the demand for gas or the decrease in other wells requires it. Recently, however, a method of storage by packing the wells has been adopted. This confines or stores the gas in its own reservoirs. The packer most largely in use is the same that is used in oil wells, only in putting the packer together for gas wells it is necessary to use extra precautions to prevent the gas from blowing off the rubber. This is done by fitting the rubber tightly to the inner pipe and wiring the end securely in place. One packer used is a rubber annulus from 8 to 20 inches in length, with an outside diameter half an inch less than the bore of the well. The inside diameter is large enough to permit it to go over the tubing used in the well. The pipe going through the rubber is screwed into a flange at the upper end, the flange being large enough to cover the end of the rubber. Then another flange is slipped over the lower end of the pipe the same size as the rubber, thus making a slip point. The outside of the lower flange is threaded so as to screw on to a sleeve, which is large enough for a coupling to slide in. The coupling is screwed on to the lower end of the pipe going through the rubber. The coupling makes a pipe to engage with the shoulder on the flange which supports the anchor or lower part of the tubing while being lowered into the well or removed from the well, thus making a telescopic joint. Enough tubing is screwed together before the packer is screwed on to bring the packer as high from the bottom of the well as is desired. Then the packer is screwed on the tubing, then the balance on top of the packer, until the bottom of the well is reached. One joint of the anchor or lower tubing is perforated, to admit the oil or gas into it when the packer is expanded to the wall of the well. When the anchor strikes the bottom of the well the weight of the tubing above the packer comes on the rubber and forces the pipe into the sleeve or telescopic joint and presses the rubber between the two flanges and out to the wall of the well, thus making the oil or gas below the packer go into the tubing at the perforation and thence to the top through the pipe. Of course the casing of the well is anchored down to prevent blowing out. While it may be fairly assumed from the statements and evidence that gas can be retained in a well without wasting, no means as yet seems to have been devised for saving the gas that escapes from the pipes after it has left the well.

EXHAUSTION OF GAS.

That the supply of gas is limited, and that it ultimately will be exhausted, does not admit of question. In this belief all unite. How long the supply will last is the subject of argument. The advocates of the storage theory assert that the supply will be exhausted when the gas stored in the storage reservoirs is exhausted, while no advocate of the continuous production theory, so far as we are aware, believes that the present rate of outflow can be maintained by any probable rate of production that is at present going on in the earth's interior. The latter theorists of course hold that, as production is continuous, the day of exhaustion is further in the future than is admitted by the advocates of the storage theory, and that even when the vast storehouses are exhausted production will still continue and gas be supplied, but in smaller quantities.

Experience furnishes some information relative to the exhaustion of certain fields, and supplies an imperfect basis of calculation as to the ultimate failure of the supply, but, after all, there are but few data upon which to rest any reasonable prediction. It is found, as a rule, for example, that "shallow wells," whatever may be the pressure or supply when first struck, give out much sooner than what are known as "deep wells." In certain districts the supply at individual wells is soon exhausted, and the amount furnished by new wells when first bored is a constantly decreasing quantity as compared with that supplied by the earlier wells. In other districts the life of wells is longer, but the earlier wells are now quite weak or exhausted, and new wells sunk do not produce any such amount of gas as those at first drilled. In still other districts, however, the great "gassers" at first struck have been pouring out gas by the million feet per day for years without any apparent diminution in pressure or volume.

Dr. Chance has made a calculation of the amount of gas stored in the rocks underlying western Pennsylvania, which is based upon an assumed proportion of productive to non-productive territory, and an application of this ratio to the Pittsburgh gas region. On the basis of this calculation, estimating the consumption at 600,000,000 cubic feet daily, and the waste at 100,000,000 cubic feet, the gas territory within 30 miles of Pittsburgh would be exhausted in about eight years. This estimate is, of course, a fanciful one, and other conditions might be assumed with some appearance of correctness which would bring the day of exhaustion nearer, while others would carry it farther away. Professor Lesley states, regarding gas areas, that they are evidently small, scattered irregularly, hemmed in by water areas and oil areas, and not absolutely stationary, but shift their position slowly. This shifting, he suggests, will become comparatively rapid as the stock of gas is drawn off in the direction of the working wells, and what was at first a gas field becomes changed to an oil or water field. Professor Lesley also suggests, as a contribution to this question of the exhaustion of wells, a carefully recorded rate of decline in the gauge pressure at each well. To this end automatic self-registering vacuum gauges should be lowered to the bottom of every gas well at regular intervals of time, and records of their readings kept.

IRON.

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

BY JAMES M. SWANK,
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The beginning of the manufacture of Bessemer steel in the United States at Wyandotte, Michigan, late in 1864, and at Troy, New York, early in 1865, marks the opening of a new and remarkable period in the history of our iron and steel industries, the statistical features of which period it is proposed to make the subject of the present paper. As the important metallurgical event referred to was cotemporaneous with the close of the civil war, after which all the industries of the country were compelled to rely upon a normal demand for their products, the propriety of beginning this statistical inquiry with 1865, just twenty-one years ago, is doubly justified. Statistics to be valuable must be comparative, and the longer the period over which they extend the more valuable and suggestive they become. It is preferred to give the record of twenty-one years rather than to dwell entirely upon the statistical results of the last two or three years.

The following table of the production of the leading articles of iron and steel in the United States during the period above-mentioned is compiled from the statistics of the American Iron and Steel Association. In the column devoted to steel rails it will be noticed that no figures are given for 1865 and 1866, the explanation being that steel rails were only made experimentally in these two years. The first Bessemer steel rails ever made in the United States were rolled at the North Chicago rolling mill on the 24th of May, 1865, from ingots made at the experimental steel works at Wyandotte; but the first steel rails ever rolled in this country in the way of regular business, to fill an order, were rolled by the Cambria Iron Company, at Johnstown, in August, 1867, from ingots made at the works of the Pennsylvania Steel Company, at Harrisburg.

***Production of leading articles of iron and steel in the United States from* 1865 *to* 1885.**

Years.	Short tons of 2,000 pounds.						
	Pig iron.	Rolled iron, including nail plates, but excluding iron rails.	Iron rails.	Steel rails.	Rails of all kinds.	Steel ingots and other steel.	Blooms from pig and scrap iron and iron ore.
1865	931, 582	500, 048	356, 292	....	356, 292	15, 262	63, 977
1866	1, 350, 343	595, 811	430, 778	....	430, 778	18, 973	73, 555
1867	1, 461, 626	579, 838	459, 558	2, 550	462, 108	22, 000	73, 078
1868	1, 603, 000	598, 286	499, 489	7, 225	506, 714	30, 000	75, 200
1869	1, 916, 641	642, 420	583, 936	9, 650	593, 586	35, 000	69, 500
1870	1, 865, 000	705, 000	586, 000	34, 000	620, 000	75, 000	62, 259
1871	1, 911, 608	710, 000	737, 483	38, 250	775, 733	82, 000	63, 000
1872	2, 854, 558	941, 992	905, 930	94, 070	1, 000, 000	160, 108	58, 000
1873	2, 868, 278	1, 076, 368	761, 062	129, 015	890, 077	222, 652	62, 564
1874	2, 689, 413	1, 110, 147	584, 469	144, 944	729, 413	241, 614	61, 670
1875	2, 266, 581	1, 097, 867	501, 649	290, 863	792, 512	436, 575	49, 243
1876	2, 093, 236	1, 042, 101	467, 168	412, 461	879, 629	597, 174	44, 628
1877	2, 314, 585	1, 144, 219	332, 540	432, 169	764, 709	637, 972	47, 300
1878	2, 577, 361	1, 232, 686	322, 890	559, 795	882, 685	819, 814	50, 045
1879	3, 070, 875	1, 627, 324	420, 160	693, 113	1, 113, 273	1, 047, 506	62, 353
1880	4, 295, 414	1, 838, 906	493, 762	968, 075	1, 461, 837	1, 397, 015	74, 589
1881	4, 641, 564	2, 155, 346	488, 581	1, 355, 519	1, 844, 100	1, 778, 912	84, 606
1882	5, 178, 122	2, 265, 957	227, 874	1, 460, 920	1, 688, 794	1, 945, 095	91, 293
1883	5, 146, 972	2, 283, 920	64, 954	1, 295, 740	1, 360, 694	1, 874, 359	74, 758
1884	4, 589, 613	1, 931, 747	25, 560	1, 119, 291	1, 144, 851	1, 736, 985	57, 005
1885	4, 529, 869	1, 789, 711	14, 815	1, 079, 400	1, 094, 215	1, 917, 350	41, 700

In this table will be found much information that is worthy of thoughtful attention. From 1865 to 1882 our production of pig iron increased from 931,582 tons to 5,178,122 tons. From 1865 to 1883 our production of rolled iron increased from 500,048 tons to 2,283,920 tons. Owing to the substitution of steel rails for iron rails our production of iron rails decreased from 905,930 tons in 1872, the highest aggregate that has ever been reached, to 14,815 tons in 1885. From 1867 to 1882 our production of steel rails increased from 2,550 tons to 1,460,920 tons. From 1865 to 1881 our production of rails of all kinds increased from 356,292 tons to 1,844,100 tons. From 1865 to 1882 our production of steel of all kinds, principally Bessemer steel, increased from 15,262 tons to 1,945,095 tons. These are certainly very remarkable results. No other country can present a record of such rapid growth in its iron and steel industries as is shown in this table. It is true that the figures for very recent years show a shrinkage in all the branches of production enumerated, but it is noticeable that this shrinkage in the United States was in sympathy with a world-wide depression in the manufacture of iron and steel and other staple manufactured products, and it is also noticeable that our iron and steel industries have already rebounded from the depressing influences which decreased their production, although the increase in prices, except in the case of steel rails, has not yet been very marked.. The production of pig iron, steel, and steel rails will certainly be larger in 1886 than in 1884 or 1885, and larger than in any year of our history.

The preceding table gives the aggregate production of leading articles of iron and steel in the country at large for the years mentioned. The production by States and Territories of pig iron, rails, all rolled iron, cut nails, and all kinds of steel for the six years which begin with 1880 will now be presented.

Pig iron.—Iron in the form of pig iron has been produced in the last six years in twenty-six States and two Territories. In the early part of this century it was still customary to run the melted iron in the blast furnace directly into stoves and domestic and mechanical castings, as well as into pig iron, but now only pig iron is made at our furnaces, except in connection with a few of our Bessemer steel works, where the product of the furnace is run directly into the Bessemer converters. For statistical purposes this special product may be treated as pig iron. Our production of pig iron in the last six years has been distributed as follows:

Production of pig iron in the United States, by States and Territories, in the last six years.

States and Territories.	Short tons of 2,000 pounds.					
	1880.	1881.	1882.	1883.	1884.	1885.
Maine	3, 578	4, 400	4, 100	4, 400	....	440
Vermont	1, 800	2, 796	1, 210	....	....	....
Massachusetts	19, 017	18, 318	10, 335	10, 760	4, 902	869
Connecticut	22, 583	28, 483	24, 342	19, 976	14, 174	17, 500
Total New England States	46, 978	53, 997	39, 987	35, 136	19, 076	18, 809
New York	395, 361	359, 519	416, 156	331, 964	239, 486	160, 157
New Jersey	170, 049	171, 672	176, 805	138, 773	82, 935	73, 667
Pennsylvania	2, 083, 121	2, 190, 786	2, 449, 256	2, 638, 891	2, 385, 402	2, 445, 496
Total middle States	2, 648, 531	2, 721, 977	3, 042, 217	3, 109, 628	2, 707, 823	2, 679, 320
Maryland	61, 437	48, 756	54, 524	49, 153	27, 342	17, 299
Virginia	29, 934	83, 711	87, 731	152, 907	157, 483	163, 782
North Carolina	....	800	1, 150	....	435	1, 790
Georgia	27, 321	37, 404	42, 440	45, 364	42, 655	32, 924
Alabama	77, 190	98, 081	112, 765	172, 465	189, 664	227, 438
Texas	2, 500	3, 000	1, 321	2, 381	5, 140	1, 843
West Virginia	70, 338	66, 409	73, 220	88, 398	55, 231	69, 007
Kentucky	57, 708	45, 973	66, 522	54, 629	45, 052	37, 553
Tennessee	70, 873	87, 406	137, 602	133, 963	134, 597	161, 199
Missouri	105, 555	109, 799	113, 644	103, 296	60, 043	51, 408
Total southern States	502, 856	581, 339	690, 919	802, 556	717, 642	764, 243
Ohio	674, 207	710, 546	698, 900	679, 643	567, 113	553, 963
Indiana	12, 500	7, 300	10, 000	9, 950	2, 568	6, 634
Illinois	150, 556	251, 781	360, 407	237, 657	327, 568	327, 977
Michigan	154, 424	187, 043	210, 195	173, 185	172, 834	143, 121
Wisconsin	96, 842	102, 029	85, 859	51, 893	52, 815	24, 632
Minnesota	3, 520	7, 442	8, 126	8, 000	....	....
Total western States	1, 092, 049	1, 266, 141	1, 373, 487	1, 160, 328	1, 122, 898	1, 056, 327
Colorado	....	6, 396	23, 718	24, 680	15, 837	5, 481
Utah Territory	....	....	57	....	....	....
Oregon	5, 000	6, 100	6, 750	7, 000	3, 640	3, 832
California	....	4, 414	987	5, 327	2, 157	....
Washington Territory	....	1, 200	....	2, 317	540	1, 857
Total far western States	5, 000	18, 110	31, 512	39, 324	22, 174	11, 170
Grand total	4, 295, 414	4, 641, 564	5, 178, 122	5, 146, 972	4, 589, 613	4, 529, 869

The leadership of Pennsylvania as the producer of about one-half the pig iron that is yearly made in the United States has long been known, and the steadiness of its production for a long series of years is fairly illustrated in the table, but in the other States and in the Territories there has been less constancy in production, and this, too, is illustrated in the table. A great shrinkage in the last six years is observable in New England, New York, New Jersey, Maryland, Wisconsin, and Missouri, while there has been a great increase in the same time in Virginia, Alabama, Tennessee, and Illinois. Various causes have contributed to these changes, most prominent among which is the greater cheapness with which the raw materials of manufacture can be brought together in the States which show progress than in those which have fallen behind. The division of the table which includes the southern States shows an increase in production during the past six years of nearly 52 per cent., while the production of the middle and western States has been practically stationary, and that of New England has declined about 60 per cent. In one of the southern States, Virginia, the increase from 1880 to 1885 was from 29,934 tons to 163,782 tons, or 447 per cent.; in another southern State, Tennessee, the increase was from 70,873 tons to 161,199 tons, or 127 per cent.; and in another southern State, Alabama, the increase was from 77,190 tons to 227,438 tons, or 194 per cent. Nine new furnaces are now in course of erection in Alabama and other southern States. In the Rocky Mountain and Pacific division the manufacture of pig iron is making slow progress, but it must grow with the lapse of years. The whole number of blast furnaces in the United States at the close of 1885, not including those which had been abandoned or were not likely ever again to be put in blast, was 591, of which 276 were then in blast and 315 were out of blast. The furnaces out of blast were generally the smallest and least favorably situated.

Rails.—In the following table the production of iron and steel rails during the last six years is given. Only thirteen States and one Territory made rails in 1885, whereas nineteen States and one Territory made rails in 1880, and twenty States and one Territory in 1881. Pennsylvania, as the table shows, made a larger proportion of the total quantity of rails in late years than in preceding years. Several States have absolutely and others have virtually dropped out of the list as producers of rails, a result which is due to the general substitution of steel for iron rails. Other States, particularly New York and Ohio, which have made steel rails for many years, show a greatly decreased production of rails in late years, which is partly explained by the fact that the low prices which have ruled for steel rails have made the manufacture of steel in other finished forms in these States more profitable, and partly by the fact that the decreased demand for steel rails in 1883, 1884, and 1885 has tended to restrict their production in the States referred to, as well as in the other States.

Production of iron and steel rails in the United States, by States and Territories, in the last six years.

States and Territories.	Short tons of 2,000 pounds.					
	1880.	1881.	1882.	1883.	1884.	1885.
Pennsylvania	670, 198	891, 179	850, 908	857, 818	775, 872	743, 761
Illinois	322, 883	433, 420	362, 250	232, 005	294, 458	312, 042
Ohio	133, 487	153, 596	113, 806	62, 518	25, 175	14, 387
Massachusetts	9, 672	2, 622	15, 707	12, 465	5, 862	6, 781
New York	109, 921	109, 283	105, 021	76, 020	81, 625	6, 580
California	4, 722	6, 035	8, 200	7, 460	2, 937	8, 393
Colorado	4, 500	1, 643	18, 217	19, 688	4, 030	2, 907
Indiana	41, 523	44, 645	28, 173	16, 309	1, 844	1, 914
Alabama	300	2, 300	728	680	500	1, 000
Wisconsin	30, 207	41, 165	24, 685	1, 259	250	448
West Virginia	2, 155	3, 152	1, 436	775	899	351
Texas	....	....	....	....	200	250
Wyoming Territory	9, 421	11, 886	13, 253	6, 845	282	220
Tennessee	18, 552	32, 660	25, 390	2, 650	500	181
Kentucky	14, 336	5, 005	2, 000	....	300	....
Virginia	107	640	....	....	95	....
Missouri	35, 746	64, 226	85, 528	64, 142	22	....
New Jersey	....	244	....	60	....	....
Vermont	17, 650	15, 200	26, 100	....	....	....
Kansas	29, 085	19, 016	7, 067	....	....	....
Maine	....	2, 183	325	....	....	....
Georgia	485	4, 000	....	....	....	....
Maryland	6, 887	....	....	....	....	....
Total	1, 461, 837	1, 844, 100	1, 688, 794	1, 360, 694	1, 144, 851	1, 094, 215

Rolled iron.—With the exception of a few hundred tons of bar iron which are annually made in a few old-fashioned forges in the mountainous districts of two or three southern States what is called finished iron is now produced in this country entirely by rolling. The substitution of rolled iron for hammered iron in the United States is entirely the work of the last seventy years, and it is within the recollection of many persons that hammered iron was long preferred by many blacksmiths to rolled iron. In the last six years thirty States and one Territory have manufactured iron in rolling mills. This branch of our iron industry is even more widely distributed than the manufacture of pig iron. In the following table our production of all kinds of rolled iron, including iron rails, is given.

Production of all kinds of rolled iron in the United States, by States and Territories, in the last six years.

States and Territories.	Short tons of 2,000 pounds.					
	1880.	1881.	1882.	1883.	1884.	1885.
Maine	7, 639	7, 616	10, 862	10, 662	9, 638	8, 219
New Hampshire	3, 100	3, 000	3, 508	2, 158	4, 314	500
Vermont	1, 650	....	....	....	....	....
Massachusetts	114, 250	116, 846	111, 388	100, 418	77, 560	75, 074
Rhode Island	7, 632	10, 769	11, 877	14, 405	14, 000	13, 723
Connecticut	16, 046	17, 589	20, 676	18, 541	15, 054	15, 054
Total New England States	150, 317	155, 820	158, 311	146, 184	120, 566	112, 570
New York	147, 601	123, 366	138, 541	105, 644	86, 955	79, 853
New Jersey	64, 622	71, 286	96, 441	76, 109	61, 046	49, 573
Pennsylvania	1, 032, 602	1, 254, 866	1, 123, 886	1, 081, 163	913, 046	940, 865
Delaware	29, 806	34, 275	38, 261	35, 384	28, 015	28, 721
Total middle States	1, 274, 631	1, 483, 793	1, 397, 129	1, 298, 300	1, 089, 062	1, 099, 012

Production of all kinds of rolled iron in the United States, &c.—Continued.

States and Territories.	Short tons of 2,000 pounds.					
	1880.	1881.	1882.	1883.	1884.	1885.
Maryland and District of Columbia	41,208	33,034	33,807	29,099	33,856	17,581
Virginia	37,734	41,002	40,044	30,751	28,286	31,989
Georgia	1,507	7,000	....	....	....	....
Alabama	6,604	11,072	9,188	8,336	17,895	24,850
Texas	....	....	....	....	1,000	1,000
West Virginia	63,601	75,547	66,107	79,894	64,632	9,992
Kentucky	51,406	29,915	61,096	58,263	29,212	21,736
Tennessee	25,402	33,793	38,770	22,454	15,217	11,344
Missouri	26,558	16,641	18,145	15,833	18,580	11,547
Total southern States	254,020	248,004	267,157	244,630	208,678	130,039
Ohio	308,566	345,727	361,608	377,962	310,568	269,263
Indiana	80,428	82,430	71,626	55,887	39,028	35,540
Illinois	109,429	148,818	93,943	121,702	95,815	80,356
Michigan	19,804	20,605	11,824	11,900	9,571	12,840
Wisconsin	64,890	88,643	64,296	40,195	53,628	38,959
Minnesota	....	....	....	....	200	1,200
Kansas	37,985	29,544	17,867	....	....	....
Iowa	....	....	....	....	....	800
Nebraska	3,000	1,583	3,000	3,250	2,000	3,000
Total western States	624,102	717,350	624,164	610,896	510,810	441,958
Colorado	4,500	3,949	4,739	7,844	5,619	5,538
Wyoming Territory	9,821	15,172	16,488	11,288	1,745	2,430
California	15,277	19,839	25,843	29,732	20,827	12,979
Total far western States	29,598	38,960	47,070	48,864	28,191	20,947
Grand total	2,332,668	2,643,927	2,493,831	2,348,874	1,957,307	1,804,526

This table shows that a large number of States and Wyoming Territory have greatly decreased their production of rolled iron. This result has in almost every instance been due to the almost total destruction of the iron-rail industry and to the general tendency to substitute steel for iron, even Pennsylvania, which heads the list of producers of rolled iron, in late years falling behind its previous record. As will appear by a table which will be given hereafter, most of the States which show a marked decline in the production of rolled iron have greatly increased their production of steel. In Georgia and Vermont the manufacture of rolled iron has entirely ceased, and in Kansas it has been entirely suspended.

Nails.—The following table shows the States which made cut nails within the last six years, 17 in all, Pennsylvania, as usual, leading all her sister States. Wire nails and railroad spikes are not included in the table. Down to 1883 all the cut nails made in this country were made of iron. In that year we made 18,224 kegs of steel nails; in 1884 were made 393,482 kegs; and in 1885, 1,823,127 kegs, each year including a small quantity of combined iron and steel nails. The rapid progress in the manufacture of steel nails in 1884 and 1885 is as notable as that of steel rails in earlier years.

Production of cut nails in the United States, by States, in the last six years.

States.	Kegs of 100 pounds.					
	1880.	1881.	1882.	1883.	1884.	1885.
Pennsylvania	1,737,560	1,914,706	1,949,405	2,430,552	2,281,676	2,457,916
Ohio	824,683	860,665	796,857	1,249,700	1,310,715	920,539
West Virginia	1,025,155	1,241,102	1,023,711	1,327,484	1,098,611	778,069
Massachusetts	532,299	525,089	592,276	677,540	557,195	654,318
Illinois	290,132	352,643	462,956	526,108	712,650	376,361
Indiana	289,948	326,496	394,682	413,380	443,234	274,271
Virginia	123,728	127,566	169,806	161,279	207,678	226,437
California	....	....	....	111,500	129,332	203,567
New Jersey	294,122	248,521	360,340	338,107	305,307	181,680
Alabama	....	....	....	20,000	100,000	137,000
Kentucky	120,900	69,000	149,382	144,686	41,522	135,628
Tennessee	64,503	94,495	171,413	212,358	120,164	98,851
Wisconsin	....	....	....	....	162,851	86,257
Colorado	....	....	16,103	62,969	55,944	64,310
Nebraska	60,000	31,667	60,000	65,000	40,000	60,000
New York	7,482	2,256	166	14,768	14,500	41,611
Maine	....	....	....	7,306	....	....
Total	5,370,512	5,794,206	6,147,097	7,762,737	7,581,379	6,696,815

Steel.—The following table gives the production of all kinds of steel in the steel-making States in the last six years. Seventeen States appear in the table. The great stride made by Pennsylvania in the manufacture of steel in this period will be noticed. The marked advance made by West Virginia in 1884 and 1885 was due to the substitution of steel for iron in the manufacture of nails.

Production of all kinds of steel in the United States, by States, in the last six years.

States.	Short tons of 2,000 pounds.					
	1880.	1881.	1882.	1883.	1884.	1885.
New Hampshire	5,000	5,000	3,753	3,180	6,100	2,610
Vermont	3,800	4,700	4,300	....	....	....
Massachusetts	11,860	15,620	18,023	15,313	12,208	21,292
Connecticut	632	2,260	460	1,997	1,772	2,481
Total New England States	21,292	27,580	26,536	20,490	20,080	26,383
New York	101,213	125,037	129,353	117,341	62,680	47,903
New Jersey	13,120	19,500	17,800	13,539	16,999	12,072
Pennsylvania	755,632	976,267	1,068,706	1,179,974	1,157,376	1,251,172
Total middle States	869,965	1,120,804	1,215,859	1,310,854	1,237,055	1,311,147
Maryland	....	....	....	....	....	900
West Virginia	....	....	....	....	16,945	49,712
Kentucky	600	150	....	....	....	....
Tennessee	4,000	4,000	4,000	3,750	8	20
Missouri	45,794	80,810	107,210	79,452	....	6,969
Total southern States	50,394	84,960	111,210	83,202	16,953	57,601
Ohio	144,369	159,032	163,280	157,482	105,389	138,280
Illinois	310,995	386,536	404,697	279,637	347,130	371,939
Michigan	....	....	....	....	1,833	3,000
Total western States	455,364	545,568	567,977	437,119	454,352	513,219
Colorado	....	....	23,513	22,694	6,097	2,300
California	....	....	....	....	2,448	6,700
Total far western States	....	....	23,513	22,694	8,545	9,000
Grand total	1,397,015	1,778,912	1,945,095	1,874,359	1,736,985	1,917,350

During 1884 and 1885, but particularly in the latter year, there was great activity in this country in the erection of new steel works. These works were generally Clapp-Griffiths and other "Little Bessemer" plants, but some standard Bessemer plants and a few open-hearth plants were also erected. This activity still continues, and there will be many new steel plants erected before the close of the year 1886. There is particularly noticeable a revival of interest in the manufacture of steel by the open-hearth process. We are making very little progress in the extension of our facilities for the manufacture of crucible steel. The manufacture of blister steel as a commercial product is virtually an extinct industry in this country.

On the 19th of April 1886, the South Tredegar Iron Company of Chattanooga, Tennessee, made in a small converter the first Bessemer steel ever made in the southern States south of West Virginia. It was made by the original Bessemer process from southern ore, which had been smelted into pig iron by the Cranberry Iron and Coal Company of North Carolina. The product of this converter is to be used in the manufacture of steel nails. Another and larger standard Bessemer steel plant is at once to be erected at Chattanooga by the Roane Iron Company, for the manufacture of steel rails.

Detailed statistics for twelve years.—Comprehensive as the foregoing tables are, it is possible to supplement them with another table which gives in detail the production of certain forms of iron and steel for the twelve years which begin with 1874 and end with 1885.

Production in detail of leading articles of iron and steel in the United States, from 1874 to 1885.

Years.	Short tons of 2,000 pounds.							
	Spiegeleisen, included in pig-iron statistics.	Kegs of cut nails and spikes.	Bessemer steel rails.	Open-hearth steel rails.	Crucible steel ingots.	Open-hearth steel ingots.	Bessemer steel ingots.	Miscellaneous steel.
1874....	....	4,912,180	144,944	....	36,328	7,000	191,933	6,353
1875....	7,832	4,726,881	290,863	....	39,401	9,050	375,517	12,607
1876....	6,616	4,157,814	412,461	....	39,382	21,490	525,996	10,306
1877....	8,845	4,828,918	432,169	....	40,430	25,031	560,587	11,924
1878 ..	10,674	4,396,130	550,398	9,397	42,906	36,126	732,226	8,556
1879....	13,931	5,011,021	683,964	9,149	56,780	56,290	928,972	5,464
1880....	19,603	5,370,512	954,460	13,615	72,424	112,953	1,203,173	8,465
1881....	21,086	5,794,206	1,330,302	25,217	89,762	146,946	1,539,157	8,047
1882...	21,963	6,147,097	1,438,155	22,765	85,089	160,542	1,696,450	3,014
1883....	24,574	7,762,737	1,286,554	9,186	80,455	133,679	1,654,627	5,598
1884....	33,893	7,581,379	1,116,621	2,670	59,662	131,617	1,540,595	5,111
1885....	34,671	6,696,815	1,074,607	4,793	64,511	149,381	1,701,762	1,696

Production of iron ore.—In a paper contributed to the special report on the mineral resources of the United States for 1883 and 1884, the domestic production of iron ore in 1884 which went into consumption in that year was estimated at 7,718,129 long tons. By the same method of calculation which was then observed the domestic iron ore which was produced and consumed in 1885 may be estimated at 7,600,000 tons. To ascertain the total quantity of iron ore which was consumed in these two years the quantity imported in each year must be added to the above figures.

The production of iron ore by all the iron-ore mines of the country cannot be obtained except in census years. The production by the leading mines in the last three years has, however, been carefully ascertained and the statistics are given below. They embrace more than half the production of the whole country in each of the years mentioned.

Production of iron ore in certain leading districts of the United States in 1883, 1884, *and* 1885.

Districts.	Long tons of 2,240 pounds.		
	1883.	1884.	1885.
Marquette range, of Lake Superior	1,305,425	1,557,389	1,430,422
Menominee range, of Lake Superior	1,047,863	895,634	680,435
Vermillion Lake mines, of Minnesota	Not opened.	62,124	225,484
Gogebic mines, of Michigan	Not opened.	1,022	111,661
Miscellaneous mines, of Lake Superior	....	1,879	441
Total production of Lake Superior mines	2,353,288	2,518,048	2,448,443
Missouri	295,430	233,225	234,162
Cornwall, Pennsylvania	363,143	412,320	508,864
Chateaugay mines, near Lake Champlain	194,704	214,394	143,278
Other Lake Champlain mines, including the Port Henry and Crown Point mines	305,300	290,500	235,799
New Jersey	521,416	393,710	330,000
Salisbury district, Connecticut	35,000	25,000	32,000
Hudson River Ore and Iron Company, New York	20,000	90,000	55,000
Cranberry mines, North Carolina	19,377	3,998	17,839
Tennessee Coal, Iron and Railroad Company's Inman mines	36,437	70,757	94,319
Total of all the above districts	4,144,095	4,251,952	4,099,704

The development of the new iron-ore fields in Minnesota and Michigan which commenced in 1884 was continued with great energy in 1885. The shipments of iron ore from the Vermillion district in Minnesota increased from 62,124 long tons in 1884 to 225,484 tons in 1885. The shipments from the Gogebic district in Michigan increased from 1,022 tons in 1884 to 111,661 tons in 1885. The ores of these two districts are adapted to the manufacture of Bessemer steel by the original process. During 1885 a rich manganiferous iron-ore field near Batesville, in Arkansas, attracted the attention of capitalists, who have since vigorously undertaken its development. The ore is being used in the manufacture of spiegeleisen and ferro-manganese, our production of which aggregated only 34,671 short tons in 1885, but which it is now expected will be largely increased. The production of iron ore by the Cranberry mines of North Carolina amounted to 17,839 long tons in 1885. The ore from these mines is adapted to the manufacture of steel by the original Bessemer process, and pig iron made from this ore is now used in the manufacture of steel by this method at Chattanooga.

Imports of iron ore.—The importation of iron ore in the last seven calendar years has been as follows:

Imports of iron ore, 1879 *to* 1885.

Years.	Long tons.	Years.	Long tons.
1879	284,141	1883	490,875
1880	493,408	1884	487,820
1881	782,887	1885	390,786
1882	589,655		

Previous to 1879 the imports of iron ore did not exceed 100,000 tons annually. In the present year they will probably amount to 1,000,000 tons, the largest annual importation in our history.

Causes of the activity of the United States in the manufacture of iron and steel.—The mechanical genius and the restless energy of the American people lie, of course, at the foundation of all our industrial achievements. In the development of our iron and steel industries the possession of all the necessary raw materials of manufacture gave opportunity for the employment of the national traits just mentioned. The rapid growth of the country in population created an active demand for iron and steel for ordinary domestic and mechanical purposes, but the stimulus given to the building of railroads after 1850 gave to the manufacture of these products its greatest opportunity. More than one-half of all the iron and steel that has been produced in this country since 1865 has gone into the construction and equipment of our railroads. We have to-day more miles of railroad than the whole of Europe, and more than two-fifths of all the railroad mileage of the world. The greatest activity in the building of railroads in this country has prevailed, however, during the last twenty-one years. At the beginning of 1865, when our tables begin, we had about 34,000 miles of railroad in operation; at the present time we have about 130,000 miles. Another cause that has greatly contributed to the wonderful development of our iron and steel industries during the period under review in these pages is the economic and fiscal policy of the National Government in discouraging by customs duties the importation of iron and steel from other countries.

American imports of iron and steel.—It has been sufficiently shown that this country is a large producer of iron and steel. The statistics of our production of these articles do not, however, show the magnitude of their consumption by our people. We export only very small quantities of iron and steel, principally in the form of machinery, but have been large importers of iron and steel in all forms, which we have consumed in addition to the large quantities we haue ourselves produced. Our imports of iron and steel during the last fifteen calendar years have been as follows. The quantities of pig, bar, band, plate, and sheet iron, rails, old iron, and tin plates are given for every year mentioned, and for 1882 and succeeding years the quantities of other iron and steel which could not be obtained for preceding years are added:

Imports of iron and steel, 1871 to 1885.

Years.	Long tons.	Years.	Long tons.
1871	1,141,933	1879	769,984
1872	1,183,066	1880	1,886,019
1873	640,858	1881	1,180,749
1874	301,647	1882	1,192,296
1875	239,712	1883	694,330
1876	204,211	1884	654,696
1877	211,408	1885	578,478
1878	211,102		

In the following table the quantities and values of pig iron and iron and steel rails which have been imported during the last thirty-one fiscal years are given:

Quantities and values of pig iron and iron and steel rails imported into the United States from 1855 to 1885.

Fiscal years.	Pig iron.		Iron and steel rails.	
	Long tons.	Values.	Long tons.	Values.
1855	98,925	$1,979,463	127,516	$4,993,900
1856	59,012	1,171,085	155,495	6,179,280
1857	51,794	1,001,742	179,305	7,455,596
1858	41,986	739,949	75,745	2,987,576
1859	72,517	1,049,200	69,965	2,274,032
1860	71,498	1,005,865	122,175	3,709,376
1861	74,026	979,916	74,490	2,162,695
1862	22,247	285,323	8,611	222,967
1863	31,007	435,194	17,088	540,494
1864	102,223	1,288,424	118,714	3,904,017
1865	50,652	806,552	77,518	2,903,828
1866	102,392	1,683,186	78,007	2,806,390
1867	112,042	1,831,465	96,272	3,317,862
1868	112,133	1,778,977	151,097	4,373,162
1869	136,975	2,138,030	237,703	7,305,845
1870	153,283	2,509,280	279,765	9,669,571
1871	178,138	3,106,490	458,055	17,360,297
1872	247,528	5,122,318	531,536	22,056,635
1873	215,495	7,203,769	357,629	19,740,702
1874	92,041	3,288,022	148,918	10,758,435
1875	53,748	1,458,668	42,082	2,932,311
1876	79,455	1,918,547	4,708	321,020
1877	67,922	1,556,415	30	1,464
1878	55,000	1,250,057	11	530
1879	87,576	1,924,128	2,611	70,071
1880	754,657	14,654,227	152,791	4,952,286
1881	417,849	8,766,461	302,294	10,331,768
1882	496,045	9,213,556	295,666	9,440,943
1883	433,602	7,944,982	118,062	3,834,740
1884	283,172	4,932,598	7,971	252,446
1885	151,959	2,689,263	4,203	104,494

The above table exhibits the magnitude of our imports of iron and steel in a light that may well startle the reader. And yet it embraces only three products, pig iron and iron and steel rails. Full statistics of all our imports of iron and steel for the whole period covered by the table are not available. In the following table are given the imports of old iron rails, old iron, and scrap iron for the fifteen calendar years from 1871 to 1885. Iron in these forms takes the place of pig iron.

Imports of old rails, old iron, and scrap iron, 1871 *to* 1885.

Years.	Long tons.	Values.	Years.	Long tons.	Values.
1871	196, 732	$4, 845, 092	1879	221, 812	$3, 700, 200
1872	248, 444	7, 617, 463	1880	619, 887	14, 704, 879
1873	97, 177	3, 061, 759	1881	184, 917	2, 705, 072
1874	86, 279	949, 752	1882	146, 956	2, 736, 483
1875	25, 846	498, 682	1883	64, 286	1, 014, 863
1876	12, 633	236, 596	1884	26, 957	340, 420
1877	9, 735	140, 593	1885	13, 821	151, 714
1878	5, 558	65, 619			

Our imports of tinplates have in recent years assumed extraordinary proportions. The following table shows their growth in the calendar years from 1871 to 1885. All our imports of tinplates come from Great Britain. We do not ourselves make one pound of tinplates.

Imports of tinplates, 1871 *to* 1885.

Years.	Long tons.	Values.	Years.	Long tons.	Values.
1871	82, 969	$9, 946, 373	1879	154, 250	$13, 227, 659
1872	85, 629	13, 893, 450	1880	158, 049	16, 478, 110
1873	97, 177	14, 240, 868	1881	183, 005	14, 886, 907
1874	79, 778	13, 057, 658	1882	213, 987	17, 975, 161
1875	91, 054	12, 098, 885	1883	221, 233	18, 156, 773
1876	89, 946	9, 416, 816	1884	216, 181	16, 858, 650
1877	112, 479	10, 679, 028	1885	228, 596	15, 991, 152
1878	107, 864	9, 069, 967			

In the following table are given the values of all imports of iron and steel, including pig iron, iron and steel rails, bar iron, plate and sheet iron, old rails, scrap iron and scrap steel, cotton ties, steel in miscellaneous forms, tinplates, wire rods and wire, firearms, hardware, cutlery, machinery, &c., in the fifteen calendar years from 1871 to 1885.

Summary of iron and steel imports, 1871 *to* 1885.

Years.	Values.	Years.	Values.	Years.	Values.
1871	$57, 866, 299	1876	$20, 016, 603	1881	$61, 555, 077
1872	75, 617, 677	1877	19, 874, 399	1882	67, 075, 125
1873	60, 005, 538	1878	18, 013, 010	1883	47, 506, 306
1874	37, 652, 192	1879	33, 331, 569	1884	37, 078, 122
1875	27, 363, 101	1880	80, 443, 362	1885	31, 144, 530

The above values aggregate $674,542,910, a sum so large that in the absence of the accompanying statistics of production which have been presented it would seem to the uninformed reader that our iron and steel industries had not been fully developed during the last fifteen years.

That this country is not likely to become in the immediate future a large exporter of iron and steel in competition with countries which possess cheap labor, and which find the raw materials in the manufacture of these products in closer proximity than they are found with us, is a proposition which does not require further verification than is afforded in the following extract from Sir Lowthian Bell's recent volume on "The Iron Trade of the United Kingdom":

"The geographical position of iron ore and fuel in the United States, as at present known, renders it impossible that the iron trade, as carried on in the northern portion of the Union, can ever become one of a largely exporting character, so far as pig iron, rails, and other cheap forms of the metal are concerned. The disadvantage entailed upon the manufacture of iron by the distance at which the minerals lie apart is increased by the expense of sending the produce to a seaport, and, so far as the present time is concerned, by the very high price of labor. To what extent the southern States may be able to compete with Europe in an export trade time only will show. Admitting, however, that all the expectations regarding Alabama, Georgia, and Tennessee be realized, this can, in my opinion, only be done successfully when the cost of reaching the port of delivery is considerably below that from European iron works."

British exports of iron and steel.—In this connection the decline in the exports of all leading articles of iron and steel from Great Britain to all countries in the last four years is worthy of notice, and the statistics are here added.

British exports of iron and steel, 1882 *to* 1885.

Articles.	Long tons of 2,240 pounds.			
	1882.	1883.	1884.	1885.
Pig iron	1,758,072	1,564,048	1,269,576	960,160
Bar, angle, bolt, and rod iron	313,155	288,271	296,489	264,272
Railroad iron, all kinds	936,949	971,165	728,540	711,415
Wire, and manufactures of, except telegraph wire	86,653	62,620	52,968	55,086
Hoops, sheets, and boiler and armor plates	342,599	347,782	348,298	331,471
Tin plates and sheets	265,039	269,375	288,614	297,728
Cast and wrought iron	328,262	355,842	376,367	349,978
Old iron	132,033	97,475	68,141	84,945
Steel, unwrought	172,329	73,131	56,934	60,466
Manufactures of steel or steel and iron combined	18,461	13,599	11,064	12,880
Total exports	4,353,552	4,043,308	3,496,991	3,128,401
Total values	£31,598,306	£28,590,216	£24,496,065	£21,717,136

Our progress in the manufacture of iron and steel compared with that of other countries.—Nearly all the civilized countries of the world have made great strides in the manufacture and use of iron and steel in the last hundred years, but in the last fifty years, following the general introduction of railroads, this progress has been most marked. In the United States it has been really phenomenal during the twenty-one years under consideration in this paper.

The following table shows the progress made by eight leading countries of the world in the manufacture of pig iron since the introduction of the Bessemer process into the United States twenty-one years ago.

Pig iron is the raw material from which nearly all finished iron and steel is now made, and the statistics of its production in any country furnish a correct measure of the progress of that country in the manufacture of all iron and steel products, each country, however, devoting its attention to some products more than to others. The comparative table which is here given is in long tons of 2,240 pounds for the United States and Great Britain, and in metric tons of 2,204 pounds for all other countries. Miscellaneous castings from the blast furnace in some of the continental countries of Europe are counted as pig iron.

Production of pig iron in the last twenty-one years in the principal iron-producing countries.

Years.	Long tons of 2,240 pounds.		Metric tons of 2,204 pounds.					
	Great Britain.	United States.	Germany.	France.	Belgium.	Austro-Hungary.	Sweden.	Russia.
1865	4, 819, 254	831, 770	....	....	470, 767	....	....	....
1866	4, 523, 897	1, 205, 663	....	1, 260, 348	....	319, 709	....	....
1867	4, 761, 023	1, 305, 023	1, 113, 606	1, 229, 044	423, 069	361, 038	....	....
1868	4, 970, 206	1, 431, 250	1, 264, 347	1, 235, 308	435, 754	425, 071	....	....
1869	5, 445, 757	1, 711, 287	1, 413, 029	1, 380, 965	534, 319	450, 567	285, 065	....
1870	5, 963, 515	1, 665, 179	1, 391, 124	1, 178, 114	565, 234	452, 244	293, 438	3[illegible]4, 032
1871	6, 627, 179	1, 706, 793	1, 563, 682	859, 641	609, 230	476, 627	293, 277	353, 710
1872	6, 741, 929	2, 548, 713	1, 988, 394	1, 217, 838	655, 565	531, 850	334, 788	393, 065
1873	6, 566, 451	2, 560, 963	2, 240, 574	1, 366, 971	607, 373	594, 980	339, 685	378, 387
1874	5, 991, 408	2, 401, 262	1, 906, 262	1, 423, 308	532, 790	545, 742	332, 154	374, 355
1875	6, 365, 462	2, 023, 733	2, 029, 389	1, 416, 228	540, 473	504, 347	343, 551	420, 484
1876	6, 555, 997	1, 868, 961	1, 846, 345	1, 453, 112	490, 508	450, 933	344, 834	....
1877	6, 608, 664	2, 066, 594	1, 932, 725	1, 400, 000	470, 488	409, 000	336, 370	....
1878	6, 381, 051	2, 301, 215	2, 147, 641	1, 417, 072	493, 544	424, 249	333, 496	409, 633
1879	5, 995, 337	2, 741, 853	2, 226, 587	1, 344, 759	448, 371	404, 160	342, 547	429, 865
1880	7, 749, 233	3, 835, 191	2, 729, 037	1, 725, 293	595, 704	465, 518	405, 765	441, 285
1881	8, 377, 364	4, 144, 254	2, 914, 009	1, 899, 861	624, 736	543, 000	435, 428	462, 027
1882	8, 493, 287	4, 623, 323	3, 380, 806	2, 039, 067	727, 000	611, 681	398, 945	498, 400
1883	8, 490, 224	4, 595, 510	3, 469, 719	2, 067, 387	770, 659	710, 037	422, 627	....
1884	7, 528, 966	4, 097, 868	3, 572, 155	1, 855, 247	750, 812	771, 502	430, 534	....
1885	7, 250, 657	4, 044, 526	3, 751, 775	1, 629, 051	714, 677	805, 631	425, 000	....

This table shows that during the last twenty-one years Great Britain increased its production of pig-iron from the first year named in the table to the highest annual product 76 per cent.; the United States, 456 per cent.; Germany, 237 per cent.; France, 64 per cent.; Belgium, 64 per cent.; Austro-Hungary, 152 per cent.; and Sweden, 53 per cent. Next to the United States Germany has made the greatest relative progress in this period in the production of pig-iron. The country which has experienced during the past few years of general depression the most serious check in the growth of its pig-iron industry is Great Britain. In years gone by the large importations of pig-iron and of finished iron and steel from Great Britain into this country have been a very important factor in building up the British iron and steel industries, but these importations have now very greatly diminished. It is exceedingly probable that the gap which now separates our production of pig iron from that of Great Britain will be entirely closed within the next five years if the rates of duties now imposed by the United States on foreign iron and steel are maintained for that length of time. As late as 1871 Great Britain made one-half of all the pig-iron made in the world; since that year her proportion of the world's production has steadily declined. It will be observed that in 1884 and 1885 her production greatly declined; that of the United States also declined in the two years mentioned, but not to so large an extent nor in as large proportion. In the present year Great Britain's production will probably not exceed that of 1885, while that of the United States promises to exceed that of 1885 by one million tons.

The world's production of pig iron.—From the most reliable information that is obtainable, in addition to the statistics which are embodied in the preceding table, giving the production of pig iron by eight leading countries, we submit the following table of the world's production of pig-iron at various periods since the close of the last century.

The world's production of pig-iron.

Years.	Long tons.	Years.	Long tons.	Years.	Long tons.
1800	825,000	1870	11,900,000	1879	13,950,000
1830	1,825,000	1871	12,500,000	1880	17,950,000
1850	4,750,000	1872	13,925,000	1881	19,400,000
1856	7,000,000	1873	14,675,000	1882	20,750,000
1865	9,250,000	1874	13,500,000	1883	21,000,000
1866	9,300,000	1875	13,675,000	1884	19,475,000
1867	9,850,000	1876	13,475,000	1885	19,100,000
1868	10,400,000	1877	13,675,000		
1869	11,575,000	1878	13,925,000		

With this table before us the growth of the world's pig-iron industry within recent years is seen to have been really wonderful. As this industry grew all other branches of the manufacture of iron and steel have also grown. The extraordinary demands by the railroads of the world and the invention of the Bessemer steel process were the chief causes of this remarkable progress, but there were other causes which should not be overlooked. After our civil war there was a great industrial awakening in this country, beginning in 1865, and after the Franco-German war of 1870 there was a similar awakening in France and Germany, but especially in the latter country. This industrial activity, which largely increased the demand for iron and steel, affected the world's iron and steel industries in a marked degree. The increasing use of iron and steel in ship-building, in bridge-building, and for general constructive purposes has also largely increased the demand for both these products. Finally, the American "boom" of 1879 and 1880, following after years of enforced economy in the use of all manufactured articles, gave a fresh and remarkable stimulus to the demand for iron and steel in this country, which the whole world's resources were taxed to supply.

In an address delivered December 10, 1874, at the Continental Hotel, Philadelphia, Hon. Abram S. Hewitt thus referred to the growth of the iron industry in all countries: "In 1856, when the annual production of the world was about 7,000,000 tons, I ventured to predict that the production of iron would reach 14,000,000 tons in 1875. This limit was passed last year, when the product reached 15,000,000 tons. I do not think that I risk my character as a prophet when I indulge the belief that by the close of the present century 25,000,000 tons per annum will be required to supply the wants of man. There are gentlemen in this room who will live to see this prediction verified, for it covers only the life of a single generation." Mr. Hewitt's prediction will probably be verified, but he could scarcely have dreamed when delivering the address from which we have quoted, that long before the close of this century, namely, in 1883, the world's production of pig iron would come so near 25,000,000 tons as it then did. It reached 21,000,000 tons, having more than doubled since 1868.

Conclusion.—It has been the object of this paper to exhibit the astonishing progress of the United States in the manufacture of iron and steel in the last twenty-one years, and to show the prominence of our country as a producer of these essential aids to modern civilization. This has been done. It is not necessary to look closely into the future of our iron and steel industries. That they will continue to grow and prosper as the country grows and prospers may be taken for granted. With an abundance of good ores and good fuel, including under the latter head our large stores of natural gas, we must soon become the first iron and steel producing country in the world, as we have long been the largest consumer of these products. Only Great Britain excels us in the production of pig iron and steel, but we annually consume more of each product than our great rival. We consume to-day one-fourth of all the pig iron and one-third of all the steel that the world produces.

IRON IN THE ROCKY MOUNTAIN DIVISION.

BY F. F. CHISOLM.

Colorado.—With regard to the iron ore deposits of Colorado, there is nothing to be added to the description published on pages 281–285 in the "Mineral Resources" for 1883 and 1884. The low prices of iron products have prevented the consumption of any large quantity of ore. The Colorado Coal and Iron Company is the only producer of iron in the State.

The production of iron ore by the Colorado Coal and Iron Company has been as follows:

Iron ore mined by the Colorado Coal and Iron Company.

Mines.	1882.	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
South Arkansas	14,202	19,645	10,483	2,902
Hot Springs	29,190	25,939	12,406	550
Placer	8,378	1,513		
Silver Cliff	854			
Grape Creek	801			
Total	53,425	47,097	22,889	3,452

Wyoming.—There have been no developments of iron in Wyoming in 1885. The rolling mill at Laramie is operated entirely upon old iron supplied by track renewals of the Union Pacific railway, and its entire product goes to the railway company.

New Mexico.—The only iron ore extracted in New Mexico is the comparatively small quantity used in smelting lead ores. No statistics have been obtained of this product.

Montana.—While iron ore, in considerable quantities and of fair quality, is known to occur in various parts of Montana, no disposition of it has been attempted anywhere except near Mill Switch, on the Utah and Northern, where there is a good seam of hematite. A considerable quantity of this has been shipped to the Hecla lead smelter at Glendale, and some to the Anaconda smelter and to smelters at Butte. A switch will probably be built up to the mine in 1886, and shipments of the iron ore considerably increased. It is a very desirable ore for fluxing purposes.

IRON ON THE PACIFIC COAST.

BY C. G. YALE.

It was generally supposed a year or so since that the Clipper Gap, Oregon, and Puget Sound furnaces would produce more iron than sufficient for the wants of the Pacific coast, as they have the capacity and the material; but they cannot market their products satisfactorily when American iron at $21.50 and Scotch at $22.50 are competitors.

The Clipper Gap furnace, belonging to the California Iron and Steel Company, was idle during most of 1885, the city supplies having been obtained chiefly from the company's accumulated stocks, which only amounted to 1,000 tons at the end of the year. The company sent 1,200 tons of iron to San Francisco in 1885.

The following statistics from J. W. Hamson's annual circular will give an idea of the iron business in San Francisco during 1885 and preceding years. The circular is dated January 1, 1886.

Consumption, price, imports, &c., of pig iron at San Francisco.

Year.	Quality.	Stock December 31.	Consumption.	Importations.	Lowest and highest prices.	Afloat December 31.
		Tons.	*Tons.*	*Tons.*	*Per ton.*	*Tons.*
1881	White	315	1, 659	300	$24. 50 to $30. 00	2, 877
	Soft	7, 960	13, 518	8, 302		
	Total	8, 275	15, 187	8, 602		
1882	White	828	989	1, 502	28. 00 to 35. 00	4, 337
	Soft	7, 280	19, 170	18, 491		
	Total	8, 108	20, 159	19, 993		
1883	White	1, 490	1, 176	1, 838	24. 50 to 27. 50	1, 615
	Soft	14, 548	20, 674	23, 142		
	Total	16, 038	21, 850	24, 980		
1884	White	359	1, 596	465	22. 00 to 26. 00	4, 230
	Soft	16, 505	10, 263	12, 220		
	Total	16, 864	11, 859	12, 685		
1885	White	693	661	995	21. 50 to 23. 50	3, 204
	Soft	12, 796	15, 581	11, 872		
	Total	13, 486	16, 242	12, 867		
Average for the past five years.	White	737	1, 216	1, 020	26. 25	3, 252
	Soft	11, 817	15, 841	14, 805		
	Total	12, 554	17, 057	15, 825		

The above figures show the stock on hand to be 3,375 tons less than last year at this time, yet 935 tons greater than the average stock for the past five years at this time. The stock on hand and *en route*, together with the promised output of the Clipper Gap furnace for the next six months, insures consumers against any scarcity in the near future.

The present stock on hand consists of 13,489 tons, of which 8,150 tons are British, and 5,339 tons Eastern and home manufacture. There are 3,943 tons in first hands, and 9,546 tons among consumers.

The total importation of wrought scrap iron in 1885 at San Francisco was 9,567 tons, of which 5,557 tons came from Great Britain.

California.—The Clipper Gap furnace, at Hotaling, Placer county, California, was not in blast from October, 1884, until February 1, 1886. An immense quantity of charcoal was made in 1885, while the furnace was idle, waiting for prices of iron to advance, and it was decided to utilize this, otherwise the furnace might have remained cold for some time longer. There is a fine body of ore, plenty of timber for charcoal, and the best plant in the western country, but low prices of product have prevented successful work. The *Placer Republican* thus describes the mine and works:

"Ever since the reorganization of the company in January, 1882, a series of interruptions has interfered with the production. A fire destroyed almost everything at the works in the fall of that year. New machinery was put in and they went into blast in May, 1883. The furnace was kept going until November, when it was shut down until May, 1884. During that time a large, improved blowing engine was put in and the last run before the present season continued from May until October, 1884.

"The company owns between 8,000 and 9,000 acres of land, the bulk of which is in Nevada county. Only about two sections are in Placer. Much of this land can be classed among the best fruit land in the foothills. The managers of the company have received numberless applications from those who wish to take the lands for fruit culture, but they are not disposed to part with their possessions at present, even when the timber is off, because they are strong believers in the steady increase of the value of the property for agricultural purposes. There are five batteries of kilns located at convenient places, aggregating thirty kilns, but these are idle and probably will be for some time. When the furnace went into blast (in February, 1886) there were 400,000 bushels of charcoal on hand, and 500 cords of wood had been hauled to the works, or enough wood to make 20,000 bushels more. When the furnace is running at full blast of between thirty and forty tons a day, the daily consumption of charcoal is about 4,000 bushels, but the furnace is not now being charged to anything like its full capacity.

"There are at present 28,000 cords of wood cut in Nevada county, which is altogether too large a stock to have on hand, and a sale of it to the railroad company is being negotiated for fear that it will deteriorate in quality before it will be needed for charcoal. There were also 4,500 tons of ore mined as a beginning, and twenty or twenty-five men at the mine can take out ore as fast as it can be used. Four shafts have been prospected during the past three or four years, but the one known as shaft No. 2. is the main-stay. It is only about half a mile from the furnace and has been worked to a depth of 128 feet. The character of the ore is magnetic, while limonite is found in some of the other shafts.

"The outlook of the business at this date (February 10, 1886) is not particularly encouraging. Iron that sold in San Francisco for $32 to $35 a ton in the spring of 1884 now finds a slow sale in that market at $22, which will not cover more than the cost of production. The market is unusually dull, owing to the unprecedented stand-still in the manufacture of mining machinery. The little iron that is being used is cheap coke iron brought from the East, which can be laid down in San Francisco for $20 a ton. The most of it comes from Philadelphia as ballast at as low figures as $3 to $3.20 a ton, while it costs all of $3 a ton to transport pig iron from Hotaling to San Francisco. Another reason for the dull market is the fact that so little is being done in the railroad shops at Sacramento. When busy, the railroad company is a good buyer of Hotaling iron, using it almost exclusively in the manufacture of car wheels. Until recently between two and three thousand tons of pig iron a year have been sold to the railroad for that purpose. "On the other hand, business men discern what they call signs of a little 'better feeling' in the iron trade."

Oregon.—The Oregon Iron and Steel Company's furnace, at Oswego, near Portland, Oregon, is now out of blast, and there is no prospect of its starting up for some time. The furnace produced 1,950 tons of iron in 1885.

Washington Territory.—The only other smelting furnace on the Pacific coast is near Port Townsend, and belongs to the Puget Sound Iron Company. The furnace continues out of blast, though it is stated that it will before long be started up once more by capitalists who intend to work the mines extensively.

Idaho.—No iron was marketed in Idaho during 1885, though some ore was mined at Wood river for home consumption at the smelting works.

Utah.—The great iron fields of Utah, located in Iron county, in the southern part of the territory, were looked over by capitalists and experts early in the year 1885, with a view to establishing works there. The iron ore, which exists in large quantity, was deemed ample and the quality good, while an abundance of coal was found accessible thirty-five miles distant; but the quality of this fuel was such as to render its use in the reduction of the ores impracticable. Hence nothing was done, and the development of these iron fields awaits the time when the hard coals of Colorado can be transported by rail. The only iron ore mined during the year in Utah was at Ironton, Juab county, the entire product amounting to 9,720 tons, which was shipped to the Salt Lake smelters and used as a flux in the reduction of argentiferous lead ores. It is mined, shipped by rail a distance of 65 miles, and sold at $4.50 per ton at the smelting works, which consumed also 1,000 tons of iron ore from Colorado.

GOLD AND SILVER.

Mint statistics.—The total production of gold and silver during 1885 has been estimated by Dr. James P. Kimball, Director of the Mint, at $83,401,000, an increase of $3,801,000 above the estimate for the preceding year by Mr. Burchard. The production of gold was $31,801,000, an increase of $1,001,000 over the estimate for 1884. The production of silver, calculated at the coining rate in silver dollars, is estimated at $51,600,000 against $48,800,000 in 1884, an increase of $2,800,000. This estimated increase in the production of precious metals during 1885 is rendered more probable by the increase shown in the estimates by other persons, notably that of Mr. J. J. Valentine, vice-president and general manager of Wells, Fargo & Co., to which reference will be made farther on. The production of gold and silver for the past five years, together with its distribution through the various States and Territories, is given below. The estimates previous to 1885 are those of Hon. Horatio C. Burchard, lately Director of the Mint.

Production of gold and silver in the United States during the calendar years* 1881 *to* 1885, *inclusive.

States and Territories.	1881.			1882.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.
Alaska	$15,000	....	$15,000	$150,000	....	$150,000
Arizona	1,060,000	$7,300,000	8,360,000	1,065,000	$7,500,000	8,565,000
California	18,200,000	750,000	18,950,000	16,800,000	845,000	17,645,000
Colorado	3,300,000	17,160,000	20,460,000	3,360,000	16,500,000	19,860,000
Dakota	4,000,000	70,000	4,070,000	3,300,000	175,000	3,475,000
Georgia	125,000	....	125,000	250,000	....	250,000
Idaho	1,700,000	1,300,000	3,000,000	1,500,000	2,000,000	3,500,000
Maine	....	5,000	5,000	....	....	....
Montana	2,330,000	2,630,000	4,960,000	2,550,000	4,370,000	6,920,000
Nevada	2,250,000	7,060,000	9,310,000	2,000,000	6,750,000	8,750,000
New Mexico	185,000	275,000	460,000	150,000	1,800,000	1,950,000
North Carolina	115,000	....	115,000	190,000	25,000	215,000
Oregon	1,100,000	50,000	1,150,000	830,000	35,000	865,000
South Carolina	35,000	....	35,000	25,000	....	25,000
Tennessee	5,000	....	5,000	....	....	....
Utah	145,000	6,400,000	6,545,000	190,000	6,800,000	6,990,000
Virginia	10,000	....	10,000	15,000	....	15,000
Washington	120,000	....	120,000	120,000	....	120,000
Wyoming	5,000	....	5,000	5,000	....	5,000
Total	34,700,000	43,000,000	77,700,000	32,500,000	46,800,000	79,300,000

Production of gold and silver in the United States, &c.—Continued.

	1883.			1884.		
Alaska	$300,000	....	$300,000	$200,000	....	$200,000
Arizona	950,000	$5,200,000	6,150,000	930,000	$4,500,000	5,430,000
California	14,120,000	1,460,000	15,580,000	13,600,000	3,000,000	16,600,000
Colorado	4,100,000	17,370,000	21,470,000	4,250,000	16,000,000	20,250,000
Dakota	3,200,000	150,000	3,350,000	3,300,000	150,000	3,450,000
Georgia	199,000	1,000	200,000	137,000	....	137,000
Idaho	1,400,000	2,100,000	3,500,000	1,250,000	2,720,000	3,970,000
Montana	1,800,000	6,000,000	7,800,000	2,170,000	7,000,000	9,170,000
Nevada	2,520,000	5,430,000	7,950,000	3,500,000	5,600,000	9,100,000
New Mexico	280,000	2,845,000	3,125,000	300,000	3,000,000	3,300,000
North Carolina	167,000	3,000	170,000	157,000	3,500	160,500
Oregon	660,000	20,000	680,000	660,000	20,000	680,000
South Carolina	56,500	500	57,000	57,000	500	57,500
Utah	140,000	5,620,000	5,760,000	120,000	6,800,000	6,920,000
Virginia	6,000	....	6,000	2,000	....	2,000
Washington	80,000	500	80,500	85,000	1,000	86,000
Wyoming	4,000	....	4,000	6,000	....	6,000
Other	17,500	....	17,500	76,000	5,000	81,000
Total	30,000,000	46,200,000	76,200,000	30,800,000	48,800,000	79,600,000

	1885.		
Alaska	$300,000	$2,000	$302,000
Arizona	880,000	3,800,000	4,680,000
California	12,700,000	2,500,000	15,200,000
Colorado	4,200,000	15,800,000	20,000,000
Dakota	3,200,000	100,000	3,300,000
Georgia	136,000	....	136,000
Idaho	1,800,000	3,500,000	5,300,000
Montana	3,300,000	10,060,000	13,360,000
Nevada	3,100,000	6,000,000	9,100,000
New Mexico	800,000	3,000,000	3,800,000
North Carolina	152,000	3,000	155,000
Oregon	800,000	10,000	810,000
South Carolina	43,000	....	43,000
Utah	180,000	6,750,000	6,930,000
Washington	120,000	70,000	190,000
Texas, Alabama, Tennessee, Virginia, Vermont, Michigan, and Wyoming	90,000	5,000	95,000
Total	31,801,000	51,600,000	83,401,000

Rank of the States and Territories in the production of gold and silver in 1883.

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

Rank of the States and Territories in the production of gold and silver in 1884.

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

Rank of the States and Territories in the production of gold and silver in 1885.

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

Mr. Valentine's estimates for 1885.—Mr. J. J. Valentine, vice-president and general manager of Wells, Fargo & Co., furnishes the following statement of the bullion product of the States and Territories west of the Missouri river, including also British Columbia, and the express receipts from the western coast of Mexico. The table includes the value of lead and copper as well as gold and silver.

Bullion product of the States and Territories west of the Missouri river in 1885, including the value of base bullion (lead and copper), and also including the partial products of British Columbia and the west coast of Mexico.

[Estimated by Mr. J. J. Valentine.]

States and Territories.	Gold dust and bullion by express.	Gold dust and bullion by other conveyances.	Silver bullion by express.	Ores and base bullion by freight.	Total.
California	$11, 750, 490	$587, 524	$1, 608, 500	$1, 090, 158	$15, 036, 672
Nevada	1, 253, 355	....	6, 575, 430	1, 384. 336	9, 213, 121
Oregon	396, 937	198, 468	12, 000	....	607, 405
Washington	72, 700	36, 350	....	....	109, 050
Alaska	215, 000	20, 000	....	16, 000	251, 000
Idaho	905, 946	200, 000	867, 410	2, 450, 000	4, 423, 356
Montana	2, 091, 000	....	6, 317, 512	5, 816, 000	14, 224, 512
Utah	33, 362	....	3, 061, 424	5, 831, 948	6, 926, 734
Colorado	2, 653, 000	....	5, 024, 000	13, 695, 000	21, 372, 000
New Mexico	226, 519	60, 000	1, 107, 627	2, 431, 617	3, 825, 763
Arizona	726, 426	120, 000	2, 752, 068	2, 996, 652	6, 595, 146
Dakota	2, 506, 623	100, 000	120, 000	....	2, 726, 623
Mexico (west coast States)	287, 704	....	1, 953, 340	20, 000	2, 261, 044
British Columbia	488, 834	120, 000	....	....	608, 834
Total	23, 607, 896	1, 442, 342	29, 399, 311	35, 731, 711	90, 181, 260

The values of the gold, silver, copper, and lead, segregated, were—

	Per cent.	Value.
Gold	30. 26	$27, 290, 294
Silver	51. 55	46, 489, 939
Copper	8. 69	7, 838, 036
Lead	9. 50	8, 562, 991
Total	....	90, 181, 260

Mr. Valentine has estimated the gold and silver production of the States and Territories west of the Missouri river since 1870, as shown in the following table. The production of British Columbia and the shipments from the west coast of Mexico, and the values of copper and lead have been excluded.

Mr. Valentine's estimates of the production of gold and silver in the States and Territories west of the Missouri river from 1870 to 1885 inclusive.

Years.	Gold.	Silver.	Total.
1870	$33, 750, 000	$17, 320, 000	$51, 070, 000
1871	34, 398, 000	19, 286, 000	53, 684, 000
1872	38, 177, 395	19, 924, 429	58, 101, 824
1873	39, 206, 558	27, 483, 302	66, 689, 860
1874	38, 466, 488	29, 699, 122	68, 165, 610
1875	39, 968, 194	31, 635, 239	71, 603, 433
1876	42, 886, 935	39, 292, 924	82, 179, 859
1877	44, 880, 223	45, 846, 109	90, 726, 332
1878	37, 576, 030	37, 248, 137	74, 824, 167
1879	31, 420, 262	37, 032, 857	68, 453, 119
1880	32, 559, 067	38, 033, 055	70, 592, 122
1881	30, 653, 959	42, 987, 613	73, 641, 572
1882	29, 011, 318	48, 133, 039	77, 144, 357
1883	27, 816, 640	42, 975, 101	70, 791, 741
1884	25, 183, 567	43, 529, 925	68, 713, 492
1885	26, 393, 756	44, 516, 599	70, 910, 355

The apparent discrepancy between the estimates of the Director of the Mint and those of Mr. Valentine are partially explained by the exclusion in the latter estimates of the eastern States, and also by the statement of Mr. Valentine that the facilities afforded for the transportation of bullion, ores, and base metals, by the extension of railroads into mining districts, increase the difficulty of verifying the reports of the products from several important localities; and the general tendency is to exaggeration when the actual values are not obtainable from authentic sources; but the aggregate result may be relied upon with reasonable confidence as approximately correct.

Total output to date.—The estimate of the entire production of gold in the United States since 1804, as given in the last report, has been carried forward to include the year 1885 and amounts to $1,708,715,670, the corresponding total for silver is $722,283,217; total yield of both metals equals $2,430,998,887. The following table shows the estimates for previous years:

Production of gold and silver in the United States to December 31, 1885.

Periods.	Gold.	Silver.	Total.
Output of the southern States from 1804 to the discovery of gold in California in 1848 (based on estimates of Prof. J. D. Whitney)	$13,243,475	....	$13,243,475
Product from 1848 to 1879, inclusive, by fiscal years	1,484,041,532	$422,722,260	1,906,763,792
Fiscal year ending June 30, 1880 (census figures, covering a period one month earlier, assumed)	33,379,663	41,110,957	74,490,620
July 1, 1880, to December 31, 1880 (estimated on the basis of half the product of the fiscal year 1881, as reported by Hon. Horatio C. Burchard, Director of the Mint)	18,250,000	21,050,000	39,300,000
Calendar years 1881 to 1884, inclusive (as reported by Hon. Horatio C. Burchard, Director of the Mint)	128,000,000	184,800,000	312,800,000
Calendar year 1885 (as reported by Dr. James P. Kimball, Director of the Mint)	31,801,000	51,600,000	83,401,000
Total product of the United States to close of 1885	1,708,715,670	722,283,217	2,430,998,887

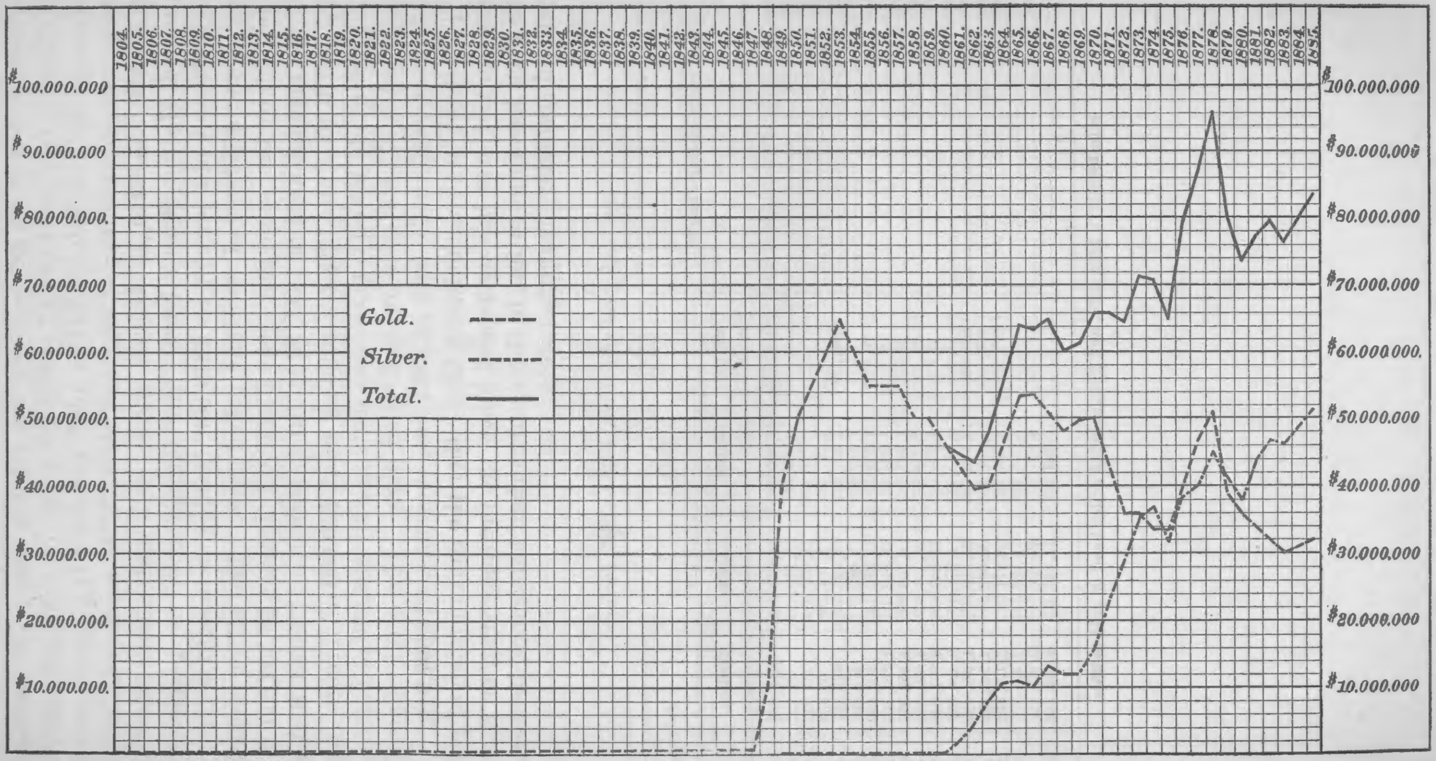

FIG. 2.—PRODUCTION OF GOLD AND SILVER IN THE UNITED STATES TO DECEMBER 31, 1885.

Consumption in the arts.—From the returns from 2,700 consumers of gold and silver, Dr. Kimball states the value of gold consumed in the arts to have been $10,837,944 in 1885 against $14,500,000 reported by about the same number of firms in 1884. Of the amount for 1885 about $2,800,000 consisted of United States coin and about $6,000,000 of stamped United States bars. The foreign coin used amounted to $178,000 and old jewelry to $819,000, leaving only $467,000 of native grains and $559,000 of wire and rolled plate. The silver consumption reported by the same firms was $3,470,000 against $5,500,000 in 1884. Of the amount used in 1885, $124,910 consisted of United States coin, $2,773,975 of United States refinery bars, $40,000 of foreign coin, and $219,000 of old jewelry, plate, &c., leaving only $94,000 of native grains and about $217,000 of wire and rolled plate. The total value of gold and silver used in the arts in 1885 was, therefore, $14,307,944.

This leads to the conclusion that either the consumption of gold and silver in the arts has decreased since the previous year, or that there has been less duplication in the returns than heretofore, between original and secondary manufacturers.

Imports of gold and silver, 1868 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Gold.			Silver.	
	Dust. (*a*)	Bullion.	Coin.	Bullion.	Coin.
1868		$1,909,503	$6,558,602	$151,238	$5,304,835
1869		890,064	13,240,191	54,267	5,622,548
1870		697,904	11,452,414	161,932	14,217,406
1871		1,177,387	5,704,298	69,836	11,591,875
1872	$258,329	1,101,617	7,339,572	405,631	4,647,034
1873	7,771	1,549,899	7,092,011	476,608	12,318,911
1874	20,842	1,349,346	18,089,155	830,639	8,153,087
1875	15,222	1,562,767	12,018,537	1,294,763	5,913,474
1876	28,802	1,167,102	6,596,692	1,057,377	6,885,795
1877	85,858	2,032,997	24,131,925	4,693,605	9,829,666
1878	17,602	1,955,005	11,365,656	6,971,849	9,512,704
1879	17,949	1,275,749	4,373,168	2,424,675	12,203,871
1880	883,690	19,453,755	60,420,951	1,981,425	10,294,489
1881	697,467	30,301,452	69,032,340	2,303,472	8,240,766
1882	647,551	8,758,502	24,971,001	2,121,833	5,973,603
1883		3,334,708	14,399,441	2,475,968	8,279,274
1884		4,997,571	17,833,746	2,910,451	11,684,494
1885		8,849,237	17,842,459	4,530,384	12,020,243

a In 1868–1871, 1883, 1884, and 1885 included under head of gold bullion.

Exports of gold and silver of domestic production, 1851 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Gold and silver coin. (b)	Gold.		Silver.	
		Bullion.	Coin.	Bullion.	Coin.
1851	$18, 069, 580				
1852	37, 437, 837				
1853	23, 548, 535				
1854	38, 062, 570				
1855	19, 842, 423	$34, 114, 995			
1856	15, 458, 333	28, 689, 946			
1857	28, 777, 372	31, 300, 980			
1858	19, 474, 040	22, 933, 206			
1859	24, 172, 442	33, 329, 863			
1860	26, 033, 678	30, 913, 173			
1861	10, 488, 590	13, 311, 280			
1862		13, 267, 730	$17, 776, 912		
1863	44, 608, 529	11, 385, 033			
1864		10, 985, 703	86, 148, 921	$836, 387	$2, 502, 551
1865		21, 145, 055	35, 413, 651	6, 311, 986	1, 747, 432
1866		20, 731, 473	49, 395, 993	10, 832, 849	1, 683, 059
1867		13, 867, 641	22, 362, 035	15, 853, 530	2, 892, 990
1868		23, 841, 155	44, 390, 003	12, 978, 311	2, 536, 506
1869		13, 584, 407	14, 858, 369	13, 573, 427	899, 763
1870		15, 812, 108	12, 768, 501	11, 748, 864	3, 554, 329
1871		9, 089, 959	55, 491, 719	17, 285, 916	2, 535, 765
1872		7, 986, 145	40, 391, 357	22, 729, 657	1, 691, 081
1873		8, 810, 175	35, 661, 863	27, 759, 066	1, 674, 442
1874		3, 878, 543	28, 766, 943	22, 498, 782	4, 555, 418
1875		2, 233, 775	59, 309, 770	17, 197, 914	5, 115, 670
1876		1, 888, 896	27, 542, 861	15, 240, 344	5, 366, 590
1877		1, 084, 536	21, 274, 565	11, 482, 894	9, 292, 743
1878		205, 319	6, 427, 251	15, 035, 045	5, 394, 270
1879		24, 774	4, 120, 311	11, 883, 064	1, 526, 886
1880		87, 066	1, 687, 973	6, 912, 864	659, 990
1881		84, 943	1, 741, 364	11, 852, 995	547, 642
1882		1, 598, 336	29, 805, 280	11, 653, 547	423, 099
1883		4, 118, 455	4, 802, 454	12, 551, 378	150, 894
1884		23, 052, 183	12, 242, 021	14, 241, 050	690, 381
1885		395, 750	2, 345, 809	20, 422, 924	1, 211, 627

b In 1862 and 1864–1885 segregated, appearing n the other columns.

COPPER.

THE COPPER INDUSTRY OF THE UNITED STATES.

BY C. KIRCHHOFF, JR.

The year 1885 has been the severest yet experienced by the copper trade of the world, the lowest prices for long continued periods having been reached during that year. The market in this country has not followed a course strictly parallel to that in Europe, and therefore the low values of the latter have not affected in the same way the different producing regions of the United States. The reason for this is, that the percentage of the product sent abroad varies within wide limits with the different sections. Montana in 1885 exported the bulk of its produce, the Lake Superior district only a part, and Arizona a small fraction. The decline abroad was largely due to the quantities sent from this country, and to the manner in which the copper was marketed.

At home, after the expiration of the sliding-scale contracts, which carried prices to an unprecedentedly low level, the market rallied and remained fairly steady during the year at a level considerably above that of European markets.

The effect of the low prices upon the American mines had nearly exhausted itself towards the close of 1884, and there has been very little change in the ranks of the producers during 1885. Some of them realized in an increased output on the preparations made during preceding years; this has been notably the case in the Lake Superior district, and with the Anaconda mine, Butte, Montana, which has kept its large concentrating and smelting plant running the year round on ore extracted during a former period. Some mines, which were able to meet the low prices current, have nevertheless been idle, preferring not to exhaust reserves of rich ore without reaping an adequate profit. Their number, however, has been small. In the beginning of the year the extravagant claims in behalf of a newly-discovered district in the southwest gave rise to some uneasiness, not unnatural since the recent experience with so suddenly overwhelming a competitor as Montana. The trade has learned to become very sensitive on this subject, but neither the Texas deposits nor those of Lower California will in the near future play any important part in shaping the course of the metal.

How far reductions in cost have compensated for the decline in receipts per pound of product it is difficult to ascertain, so far as the producers generally are concerned. In the Lake Superior district the reports of a number of public companies throw sufficient light on the subject. In the Arizona mines there has been some relief in the way of lower freights on fuel and product, and the same may be stated so far as the Montana producers are concerned. The latter are still handicapped by high labor. The majority of the mines of the Rocky mountains are now in the hands of individual firms or of close corporations so that it is impossible to state what, if any, their profits or losses have been. The dividends paid by public companies during 1885 compare as follows with the profits paid out in previous years:

Dividends of copper mining companies.

Name of mine.	1882.	1883.	1884.	1885.
Calumet and Hecla (Lake Superior)	$2,000,000	$2,000,000	$1,300,000	$1,700,000
Quincy (Lake Superior)	440,000	380,000	280,000	180,000
Osceola (Lake Superior)	200,000	200,000	62,500	....
Atlantic (Lake Superior)	80,000	80,000	40,000	20,000
Central (Lake Superior)	60,000	60,000	40,000	*a* 30,000
Franklin (Lake Superior)	....	80,000	80,000	40,000
Copper Queen (Arizona)	325,000	500,000	200,000	....
San Francisco (California)	....	2,500	....	....
United Verde (Arizona)	....	37,500	60,000	....

a By sale of timber lands.

It should be stated that some of the Lake Superior mining companies declare their dividends in the beginning of the year out of the earnings of the year before, so that the date of the dividend does not in some cases reflect the earning capacity of the mine in that year.

There has been much less difficulty during the current year than in the past in collecting full statistics. Absolute accuracy is not claimed, nor is it attainable, where the producers themselves often do not know to a pound what their output has been. This applies particularly to some of the Montana mines whose product goes abroad for treatment. As in former years, the refining works have sent full, confidential returns showing the source of the copper handled by them, information which affords a valuable guide in other directions, to be discussed further on.

DOMESTIC PRODUCTION.

The growth in the production of copper in the United States, compiled up to 1885, inclusive, from the best data available, is shown in the following table. It proves in a striking manner how preponderating was, until the past few years, the influence of the Lake Superior district; and again of one great mine in it, the Calumet and Hecla, for more than a decade. In order to point out more clearly how preponderating has been the output of the Lake district from 1867 to 1880, a column has been added giving its percentage of the total product from year to year. It should be stated that the yield of copper from pyrites is not here included.

Production of copper in the United States from 1845 *to* 1885, *inclusive.*

Years.	Total production.	Lake Superior.	Calumet and Hecla.	Percentage of Lake Superior of total product.	Years.	Total production.	Lake Superior.	Calumet and Hecla.	Percentage of Lake Superior of total product.
	Longtons.	*Longtons.*	*Longtons.*			*Longtons.*	*Longtons.*	*Longtons.*	
1845...	160	12	....	12.0	1866...	8,900	6,138	....	68.8
1846...	150	26	....	17.0	1867...	10,000	7,824	603	78.2
1847...	300	213	....	71.0	1868...	11,600	9,346	2,276	80.6
1848...	500	461	....	92.5	1869...	12,500	11,886	5,497	95.1
1849...	760	672	....	96.0	1870...	12,600	10,992	6,277	87.2
1850...	650	572	....	88.0	1871...	13,000	11,942	7,242	91.9
1851...	900	779	....	86.6	1872...	12,500	10,961	7,215	95.7
1852...	1,100	792	....	72.0	1873...	15,500	13,433	8,414	87.3
1853...	2,000	1,297	....	64.9	1874...	17,500	15,327	8,984	87.6
1854...	2.250	1,819	....	71.1	1875...	18,000	16,089	9,586	89.4
1855...	3,000	2,593	....	86.4	1876...	19,000	17,085	9,683	88.9
1856...	4,000	3,666	....	91.6	1877...	21,000	17,422	10,075	82.9
1857...	4,800	4,255	....	88.7	1878...	21,500	17,719	11,272	82.4
1858..	5,500	4,088	....	74.3	1879...	23,000	19,129	11,728	83.2
1859...	6,300	3,985	....	63.3	1880...	27,000	22,204	14,140	82.2
1860...	7,200	5,388	....	74.8	1881...	32,000	24,363	14,000	76.1
1861...	7,500	6,713	....	89.1	1882...	40,467	25,439	14,309	62.1
1862...	9,000	6,065	....	67.4	1883...	51,574	26,653	14,788	50.1
1863...	8,500	5,797	....	67.0	1884...	63,555	30,916	17,812	48.4
1864...	8,000	5,576	....	69.7	1885...	74,053	32,206	21,093	43.5
1865...	8,500	6,410	....	75.4					

Territorially distributed the production of the United States in 1885 has been as follows, as compared with previous years. For 1884 some modifications have been made in some of the figures, since official returns have been obtained in a few instances which were refused a year since:

Total copper production in the United States in 1882, 1883, 1884, *and* 1885.

Source.	1882.	1883.	1884.	1885.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Lake Superior	56,982,765	59,702,404	69,353,202	72,148,172
Arizona	17,984,415	23,874,963	26,734,345	22,706,366
Montana	9,058,284	24,664,346	43,093,054	67,797,864
New Mexico	869,498	823,511	59,450	79,839
California	826,695	1,600,862	876,166	469,028
Colorado	1,494,000	1,152,652	2,013,125	1,146,460
Utah	605,880	341,885	265,526	126,199
Wyoming	100,000	962,468	....	....
Nevada	350,000	288,077	100,000	8,871
Idaho	....	....	46,667	40,381
Missouri	294,695	260,306	230,000	....
Maine and New Hampshire	290,000	212,124	249,018	211,602
Vermont	1,265,000	400,000	655,405	
Southern States	400,000	395,175	317,711	40,199
Middle States	....	64,400	2,114	190,641
Lead desilverizers, &c	125,000	782,880	950,870	910,144
Total domestic copper	90,646,232	115,526,053	144,946,653	165,875,766
From imported pyrites and ores	1,000,000	1,625,742	2,858,754	5,086,841
Total, including copper from imported pyrites	91,646,232	117,151,795	147,805,407	170,962,607

The Montana product this year is compiled from official returns from all the largest producers, only small mines being missing. As the bulk of this product goes to the works of the larger producers by purchase of ores and concentrates, only a small error can have been made by estimating the copper contents of the ore and concentrate shipments made to foreign countries.

The following is, in detail, the output of the Lake Superior mines. In the majority of cases it is the official product, based on smelting-works returns; in a few instances it is an official estimate of the ingot product based on the known output of mineral. The Mass is the only larger mine in the case of which the ingot was estimated from the published statement of the output of mineral. The total is accurate, therefore, within a few thousand pounds.

The production of Lake Superior copper mines, 1880 *to* 1885.

Mines.	1880.	1881.	1882.	1883.	1884.	1885.
Calumet and Hecla	31, 675, 239	31, 360, 781	32, 053, 039	33, 125, 045	40, 473, 585	47, 247, 990
Quincy	3, 696, 263	5, 506, 848	5, 665, 796	6, 012, 239	5, 650, 436	5, 848, 530
Osceola	3, 383, 537	4, 179, 976	4, 176, 782	4, 256, 409	4, 247, 630	1, 945, 208
Franklin	2, 336, 466	2, 677, 932	3, 264, 120	3, 488, 708	3, 748, 652	4, 007, 105
Allouez	1, 318, 471	1, 473, 007	1, 683, 557	1, 751, 377	1, 928, 174	2, 170, 476
Atlantic	2, 341, 195	2, 528, 009	2, 631, 708	2, 682, 197	3, 163, 585	3, 582, 633
Pewabic	970, 509	1, 876, 244	1, 482, 666	1, 171, 847	227, 834	....
Central	2, 026, 078	1, 418, 465	1, 353, 597	1, 268, 556	1, 446, 747	2, 157, 408
Grand Portage	67, 860	26, 264	757, 080	735, 598	255, 860	....
Conglomerate	233, 814	386, 091	734, 249	222, 117	1, 198, 691	....
Mass	517, 159	467, 684	737, 440	659, 474	481, 396	365, 000
Copper Falls	6, 615	669, 121	587, 500	804, 000	891, 168	1, 168, 000
Phœnix	436, 010	409, 357	537, 177	512, 291	631, 004	344, 355
Hancock	3, 032	571, 897	540, 575	484, 906	562, 636	203, 037
Huron	70, 285	254, 515	364, 579	720, 213	1, 927, 660	2, 252, 484
Ridge	223, 353	235, 606	102, 936	60, 155	74, 030	63, 390
Saint Clair	13, 195	135, 493	87, 126	125, 225	139, 407	....
Cliff	78, 962	79, 382	66, 053	10, 374	28, 225	....
Wolverine	....	....	25, 623	699, 622	751, 763	328, 610
Nonesuch	55, 584	119, 061	46, 450	....	23, 867	28, 484
Isle Royal	79, 469	47, 308	35, 447	....	16, 074	....
Minong	27, 407	15, 397	21, 380	3, 582	....	....
National	....	....	17, 060	26, 006	87, 368	162, 252
Minesota	26, 033	24, 227	10, 672	6, 226	1, 144	12, 608
Belt	....	....	5, 625	16, 402	130, 851	27, 433
Sheldon and Columbia	26, 931	10, 031	3, 299	....	9, 828	....
Aztec	3, 757	....	3, 129	....	....	....
Adventure	2, 951	7, 500	429	....	4, 333	4, 000
Peninsula	....	....	....	849, 400	1, 225, 981	....
Tamarack	....	....	....	7, 435	....	181, 669
Ogima	5, 885	16, 776	4, 207	3, 000	1, 106	12, 000
Concord	10, 464	28, 849	....	....	....	....
Evergreen Bluff	10, 651	968	....	....	954	1, 500
Flint Steel River	28, 080	4, 140	....	....	....	....
Madison	....	1, 534	....	....	....	....
Northwestern	916	....	....	....	....	....
Ash Bed	....	24, 804	72, 636	....	1, 517	....
Centennial	....	....	83, 554	....	....	....
Sundry companies—tributers	6, 166	1, 642	....	....	21, 696	34, 000
Total	49, 682, 337	54, 548, 909	57, 155, 991	59, 702, 404	69, 353, 202	72, 148, 172

The figures given under "lead desilverizers" in the general table is the closest approximation obtainable by a study of the returns from the lead-desilverizing works, who usually report to this office separately their make of bluestone and of matte. The total stated under "imported pyrites and ores" may include some copper from domestic pyrites, since it is impossible to separate them in some cases. It may be stated, however, that fully 4,000,000 pounds can be traced to a foreign source directly.

THE COPPER DISTRICTS OF THE UNITED STATES.

Lake Superior.—The low prices reached in the first months of the year 1885 forced a suspension of operations at a number of the smaller mines and of concerns who by recent heavy capital outlays had exhausted their resources. Some of these were turned over to the tender mercies of tributers. The higher prices realized during the second part of the year have given encouragement, and a few older producers, practically idle for years, are again taken in hand. So far as the large corporations are concerned, the preparations for increased output made in 1884 and partly in 1885, the strict economy exercised in every department and the moderate decline in fuel, supplies, and other costs have made it possible to effect a saving in the figures at which the metal can be put into eastern markets. The following table gives the cost of production of the principal mines in the years 1875, 1881, 1882, 1883, 1884, and 1885:

Cost of production of lake copper per pound.

Mines.	Cost of production (in cents per pound).						Yield (per cent.).					
	1885.	1884.	1883.	1882.	1881.	1875.	1885.	1884.	1883.	1882.	1881.	1875.
Quincy	7.50	8.63	9.00	9.55	10.03	15.79	2.51	2.70	2.86	3.21	2.62	......
Osceola	10.90	11.24	12.21	12.97	......	......	......	1.17	1.21	......	1.29	......
Atlantic	9.37	10.88	12.56	13.80	13.68	22.12	.74	.75	.68	.69	.72	.78
Central	8.83	15.10	15.40	14.76	14.24	15.81	3.37	2.48	1.90	2.20	1.58	2.65
Allouez	11.29	13.46	15.98	17.38	19.32	......	.84	.85	.86	.85	.95	......
Franklin	10.03	11.62	12.96	13.00	......	......	1.46	1.45	1.38	1.10	......	......
Pewabic	......	......	21.47	17.00	16.36	......	......	......	1.01	1.00	1.38	......
Huron	11.75	14.78	......	......	......	......	1.18	1.45	......	......	......	......

This record is one of which the Lake Superior copper companies may well be proud. It should be noted that the Osceola Company was under heavy outlays for a part of the time, and did not crush more than a part of the year. It is more than likely that its cost, with cheaper transportation of rock from mine to mill, will be considerably lowered during this year.

At the Calumet and Hecla mine the work of replacing the Ball by Leavitt stamps was continued during the year, and the summer of 1886 will witness the completion of the equipment for twelve of the Leavitt stamps, of which two are to be held in reserve, making the capacity of the mill about 2,500 tons per day. If running exclusively on rock from the Calumet and Hecla mines, and not treating any of the lower-grade ore from the Black Hills ground, the mine would have a capacity of about 64,000,000 to 65,000,000 annually. The Quincy Company has done well during the year, having produced 7,091,805 pounds of mineral, of which 6,604,125 pounds were from stamping 108,181 tons of rock, on which the earnings for the year were $235,653.73, allowing the payment of $240,000 dividends on the year's business.

The Osceola Company took an important step during the year 1885 in moving its mill from Portage Lake, a distance of 12 miles from the mine, to Torch Lake, with which the mine is connected by a new railroad, the Hancock and Calumet railroad. This work, which occupied about six months and cost $64,000, with other construction outlays and the cost of continuing mining work reduced the surplus from

$231,530 to $102,282, but placed the mine, with nearly an additional year's reserve of productive ground, in the position of making copper more economically. A part of the mill is leased to the Tamarack Company pending the erection of a plant for that new mine, which is largely controlled by the same parties.

The event of the year in the Lake Superior district was the piercing of the Calumet and Hecla lode, on the 20th of June, by the vertical shaft of the Tamarack, at a depth of 2,270 feet. The sinking of the shaft was begun in February, 1882, and, considering the ground, is remarkable as being the most rapid work of its kind; the average monthly progress being 41.4 feet in 1882, 59.7 feet in 1883, 63.4 feet in 1884, and 64 feet in 1885. The average cost of sinking per foot is reported to have been $61, including all expenses. According to the report of Mining Commissioner Lawton, the price paid for sinking in the spring of 1886 was $28 per foot; for cross-cutting to the lode, $8; for driving on the conglomerate, $12 to $15; and for stoping, $10 to $14 per cubic fathom. Sinking the shaft is progressing steadily, and in February three levels had been opened. Owing to the fact that the first shaft is located near the corner of the property, the first level develops 224 feet of the lode; the second, 65 feet vertically below it 400 feet; and the third, 57 feet below the second, may develop 2,570 feet of the lode. Ground has been broken for the second shaft 731 feet north of the first. The Tamarack enterprise is a new departure in Lake Superior mining, since it is the first to adopt the system of vertical shafts in the place of numerous inclines. Its advantages are great in permitting of rapid hoisting and large capacity, without heavy outlays for plant, by the use of comparatively small high-speed engines, and in reducing the cost of timbering on the lode to a minimum both in shaft and in stopes. While the greater part of the area of the Tamarack property is so located that those portions of it underlaid by the Calumet and Hecla chute can only be reached at considerably greater depth than that thus far attained, the high grade of the rock and the absence of all serious difficulties to very deep mining open for it a very promising future. The mine is now a regular producer, the company having leased a part of the Osceola mill. It made in December, 1885, 125 tons of mineral; in January, 1886, 174 tons; in February, 200 tons; and in March, 220 tons. Mr. Lawton is authority for the statement that while restricted to the Osceola mill it is not probable that a greater monthly average than 350 tons will be reached. Its product will, however, probably figure prominently in the returns for 1886, and will more than compensate for the falling off in the output of the Osceola, since the rock treated is much higher in grade.

In spite of the fact that the amount of mineral per ton of rock at the Franklin mine fell off from 1.78 per cent. in 1884 to 1.75 per cent. in 1885, the yield of ingot copper rose to 3,999,172 pounds, a gain of 250,520 pounds, produced at a lower cost. The saving amounted to 27 cents per ton, the cost of mining and manipulating per ton of rock hoisted declining to $1.95. The mill crushed 137,276 tons of rock, a gain of 8,394 tons over 1884, and the management was able to report in the mine, broken and ready for hoisting, 25,000 tons of rock, not valued as an asset. The Huron mine, under energetic and careful management has come forward rapidly, considering the adverse circumstances, the stamping facilities not being up to the capacity of the mine to furnish rock. Yet the mine shows a gain in output of 331,225 pounds of ingot, while the cost of production has been lowered. The amount of rock hoisted was 139,129 tons, which cost to manipulate it $1.59, a saving of 69 cents over 1884. The stamp mill treated 95,476 tons, the average yield being 1.18 per cent of ingot copper.

The Atlantic mine during the year 1885 has obtained even better results, so far as cost of treatment of rock is concerned, than in former years. With rock yielding only 0.743 per cent. of refined copper, the costs have been as follows per ton of rock treated:

Cost at the Atlantic mine.

	1885.
	Cents.
Mining, selecting, breaking, and all surface expenses, including taxes	78.62
Transportation to mill	4.80
Stamping and separating	30.36
Freight, smelting, marketing, and New York expenses	25.45
Total working expenses	139.23
Total expenditures	143.60
Net profit	22.05

The Central mine had a comparatively prosperous year, owing to the fact that some of the ground stoped proved more productive, while the costs were little increased. The mine is one of the few of the "mass" mines which have survived. Out of its product of 2,714,840 pounds of mineral in 1885, 1,482,535 pounds were stamp copper, while 1,232,305 pounds were barrel and mass copper. The yield of the stamp copper was 3.37 per cent. on 17,812 tons, crushed and washed at an expense of 74.31 cents per ton, running about half time. The mining profit was $56,642.50 for the year, out of which a dividend of $40,000 was declared on the 1st of February, 1886, the balance being added to surplus, which was carried up to $268,281.88. It is proposed to improve the hoisting facilities during the year 1886, they having become inadequate to handle rock from greater depth. The mine has reached a depth of over 2,000 feet vertically, and the engine now building, of a special design, is intended to meet all requirements to a depth of 3,000 feet.

The Peninsula mine was idle during the greater part of the year, but preparations are to be made to resume work. The Minesota property has passed into the same hands which control the Franklin and the

Huron mines, and it is expected that operations will be more vigorously carried on in the near future.

The Ridge mine was idle during the summer, and its product, 79,137 pounds of mineral, yielding almost 80 per cent. of ingot copper, was obtained by tributers. On the Conglomerate property no work has been done by the company. The Belt has done little during the year.

Reviewing the situation generally, it may be stated that if the leading companies utilize their equipment to its full capacity, the yield of the Lake Superior mines will show a slight increase during 1886. Prices at the beginning of the season, after the opening of spring, while fairly profitable to mines in operation, were not such as to encourage the resumption of idle plants.

Arizona.—The output of Arizona has declined during 1885, because prices were too low to allow of the working of a number of smaller mines, which were generally idle during the year. At least one company, which was in a position to meet the market, preferred not to exhaust reserves. Two of the largest mines, controlled by strong parties, have not made any effort to increase product. In the Bisbee district the Copper Queen consolidated with the Atlanta mine, and was running steadily during the year to the extent of the capacity of its reduction plant. The Copper Prince, a property adjoining the Copper Queen, produced some copper and shipped some ore. In the Clifton district the Detroit and Arizona Companies have both worked steadily, producing a slightly increased quantity of copper. The former company is putting up concentrating works. In Globe the Old Dominion Company ceased operations for a part of the time, and ultimately passed into other hands. It is still hampered by its great distance from railroad transportation. Few details are available concerning the financial results of operations at the Arizona mines. It may be stated, however, in a general way, that costs have been reduced by lowering of price of fuel, cheaper supplies, and reductions in railroad freights, so that those concerns which have a fair and steady supply of good ore are able to meet the market and receive good returns on moderate investments. No large deposits have been developed in new mines during the year, and with the leading concerns following a conservative course, and other producers threatened with possible exhaustion of ore bodies, the tendency in 1886 will be toward a reduction rather than a growth in the output compared with 1885, providing prices do not rise above the level of the early months of the year.

Montana.—The principal increase in the production of copper in the United States during 1885 was due to the heavy growth in the output of Montana. The equipment of the leading mines, which was provided in the course of 1884 and added to in some cases in 1885, came into full play during the greater part of the year, and accumulated ore piles in at least one conspicuous instance helped to carry the output very close to its maximum capacity. It has been swelled by the treatment of larger quantities of first-class ores than will probably be available in some of the leading mines for some time to come. Deeper mining has proved, what was generally expected, the opening up of bodies of lower-grade unaltered ores. As yet this is the case only in individual mines, others containing supplies for years to come of richer material. It is this reserve, on the one hand, and the absolute necessity of keeping large plants in constant operation, which will maintain the product at a high figure, and will cause its rapid increase under the stimulus of any marked advances in the price of the metal. Yet the capacity of the Butte district will be more and more measured by the magnitude of its concentrating and reduction plant, starting with a low-grade ore as the basis.

The works of the Anaconda Company, completed towards the close of 1884, ran steadily during 1885, largely on ore accumulated in former years. This accumulation has been worked up, and the product is dependent more closely upon current extraction of ore, which is not so rich, on an average, as that obtained from the upper levels. This has led to the decision to put up a second concentrating plant, a duplicate of the first, which will be completed during the current year.

The Parrott Company, the second largest producer in the district, has increased its facilities. In the spring of 1886 it had a concentrating mill capable of handling 240 tons of ore per day, a number of roasting kilns, twelve large calcining furnaces, six reverberatory matting furnaces, one 80-ton blast furnace, one small cupola, and six Manhès converters.

The Montana Copper Company has followed the conservative course of closing down its works, preferring to develop its mines and leave its reserves intact rather than exhaust them without reaping adequate returns. The company has a 125-ton concentrating mill, roasts in open heaps, has twelve single and two double calcining furnaces, six reverberatory matting furnaces, and a 40-ton blast furnace.

Mr. A. A. Clark's works consist of a 100-ton concentrating plant, two automatic O'Hara calciners, one reverberatory matting furnace to smelt flue dust, &c., one 40-ton blast furnace, and one 80-ton blast furnace. The latter has been recently completed, but is to be remodeled.

The Orford Sulphur and Copper Company, one of the leading refiners of the Atlantic seaboard, is identified with a plant which includes the 40-ton concentrating mill of the Liquidator Mining Company, leased for one year, one large calcining furnace, one 30-ton and a recently built 125-ton blast furnace.

The smelting works of the Bell Company, which have been idle for some time, consist of two calcining furnaces and two blast furnaces.

The Boston and Montana Company, which works chiefly highly argentiferous copper ores, has a 60-ton concentrating mill, four large calciners, and six matting furnaces. The Anaconda Company has also entered into this business, buying custom ores and smelting them in a blast furnace.

The equipment of the Butte mines has therefore enlarged considerably, but it may be questioned whether, taking into account enforced or voluntary idleness of two works, and the lower grade of the ores of others, especially with low prices for copper, a considerable decline in the production can be prevented.

In the other States and Territories the output of copper has been small. One or two new enterprises have fallen far short of the sanguine expectations of their projectors, and with prices for copper ranging between 10 and 11 cents for lake there is little or no hope for new concerns. Practically, therefore, with prices for lake as low as 10 cents, the contest lies between the producers of the three great districts of the country, each of them favored in some respects and handicapped in others.

IMPORTS.

The imports of fine copper contained in ores, and regulus and black copper, and of ingot copper, old copper, plates not rolled, rolled plates, sheathing metal, and manufactures not otherwise specified, and of brass, are given in the following tables:

Fine copper contained in ores, and regulus and black copper imported and entered for consumption in the United States, 1867 to 1885 inclusive.

Fiscal years ending June 30—	Fine copper contained in ores.		Regulus and black copper. (a)		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1867	....	$936, 271	....	....	$936, 271
1868	3, 496, 994	197, 203	....	....	197, 203
1869	24, 960, 604	448, 487	....	....	448, 487
1870	1, 936, 875	134, 736	....	....	134, 736
1871	411, 315	42, 453	499	$60	42, 513
1872	584, 878	69, 017	4, 247	1, 083	70, 100
1873	702, 086	80, 132	1, 444, 239	279, 631	359, 763
1874	606, 266	70, 633	28, 880	5, 397	76, 030
1875	1, 337, 104	161, 903	12, 518	2, 076	163, 979
1876	538, 972	68, 922	8, 584	1, 613	70, 535
1877	76, 637	9, 756	1, 874	260	10, 016
1878	87, 039	11, 785	....	....	11, 785
1879	51, 959	6, 199	....	....	6, 199
1880	1, 165, 283	173, 712	2, 201, 394	337, 163	510, 875
1881	1, 077, 217	124, 477	402, 640	51, 633	176, 110
1882	1, 473, 109	147, 416	224, 052	30, 013	177, 429
1883	1, 115, 386	113, 349	....	....	113, 349
1884	2, 204, 070	219, 957	2, 036	204	220, 161
1885	3, 665, 739	343, 793	285, 322	20, 807	304, 600

a Not enumerated till 1871.

Copper imported and entered for consumption in the United States, 1867 *to* 1885 *inclusive.*

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

a Not enumerated until 1873.

b Includes "Plates not rolled."

Copper imported and entered for consumption in the United States, &c.—Continued.

Fiscal years ending June 30—	Plates rolled; sheets, pipes, &c.		Sheathing metal, in part copper. (*a*)		Manufactures not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Pounds.*			
1867	....	$1,101	220,889	$37,717	$15,986	$424,565
1868	....	1	101,488	18,852	21,492	89,932
1869	....	39	43,669	6,592	43,212	86,800
1870	....	2,039	....	....	485,220	519,608
1871	....	7,487	....	....	668,894	722,673
1872	....	18,895	....	....	1,007,744	1,817,910
1873	....	4,514	....	....	869,281	3,216,429
1874	....	27	282,406	50,174	125,708	448,252
1875	....	617	136,055	23,650	35,572	127,272
1876	....	326	18,014	2,903	29,806	71,949
1877	....	203	110	22	41,762	75,761
1878	....	1,201	647	55	35,473	68,318
1879	....	786	300	20	39,277	58,035
1880	....	4,134	6,044	693	130,329	432,522
1881	....	82	39,520	4,669	284,509	390,318
1882	5,855	1,551	....	....	77,727	141,372
1883	2,842	379	6,791	1,047	40,343	78,601
1884	6,529	2,330	19,637	926	55,274	71,290
1885	470	120	86,619	9,894	61,023	79,027

a Does not include copper sheathing in 1867, 1868, and 1869.

Brass imported and entered for consumption in the United States, 1867 *to* 1885 *inclusive.*

Fiscal years ending June 30—	Bars and pigs.		Old, fit only for remanufacture.		Not otherwise provided for.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Pounds.*			
1867	....	$3,099	....	$26,468	$170,873	$200,440
1868	31,104	2,071	129,913	11,699	181,114	194,883
1869	36,179	2,457	131,640	10,838	198,310	211,605
1870	54,108	3,791	98,825	6,918	49,845	60,554
1871	28,453	2,803	438,085	37,922	13,659	54,384
1872	17,963	1,664	829,964	73,098	23,738	98,500
1873	56,656	7,147	699,478	71,494	114,767	193,408
1874	253	19	682,151	64,848	350,266	415,133
1875	370,273	38,867	124,285	12,786	273,873	325,526
1876	....	....	618,191	54,771	232,870	287,641
1877	....	....	689,633	59,402	207,642	267,044
1878	....	....	713,171	57,551	205,209	262,760
1879	950	49	485,354	32,278	232,030	264,357
1880	....	....	958,590	75,093	339,131	414,224
1881	85,370	11,202	1,615,402	151,541	331,506	494,249
1882	30,769	3,168	2,954,148	263,891	400,477	668,136
1883	6,380	559	1,015,345	84,786	485,321	570,666
1884	1,611	445	508,923	40,766	429,224	470,435
1885	2,305	532	166,317	15,717	400,175	416,424

EXPORTS.

The wide fluctuations in the quantities of copper, copper ore, and manufactured copper exported for a series of years are exhibited in the following tables:

Value of copper, brass, and manufactured copper exported from the United States, 1791 *to* 1863, *inclusive.*

Fiscal years ending September 30 until 1842, and June 30 since.	Value.	Fiscal years ending September 30 until 1842, and June 30 since.	Value.
1791	$493	1833	$208,880
1803	6,233	1834	198,273
1804	8,654	1835	69,791
1805	12,977	1836	72,991
1806	25,340	1837	91,724
1807	12,742	1838	81,363
1808	4,031	1839	81,334
1809	3,095	1840	86,954
1810	17,426	1841	72,932
1811	9,282	1842	97,021
1812	2,644	1843 (nine months)	79,234
1813	....	1844	91,446
1814	....	1845	94,736
1815	366	1846	62,088
1816	16,152	1847	64,980
1817	8,765	1848	61,468
1818	33,379	1849	66,203
1819	12,721	1850	105,060
1820	18,547	1851	91,871
1821	26,694	1852	103,039
1822	36,974	1853	108,205
1823	16,768	1854	91,984
1824	26,981	1855	690,766
1825	30,472	1856	534,846
1826	60,083	1857	607,054
1827	52,341	1858	1,985,223
1828	60,452	1859	1,048,246
1829	129,647	1860	1,664,122
1830	36,601	1861	2,375,029
1831	55,755	1862	1,098,546
1832	105,774	1863	1,026,038

Copper and copper ore of domestic production exported from the United States, 1864 *to* 1885 *inclusive.*

[Cwts. are long hundredweights of 112 pounds.]

Fiscal years ending June 30—	Ore.		Pigs, bars, sheets, and old.		Value of manufactured.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Cwts.		*Pounds.*			
1864	109,581	$181,298	102,831	$43,229	$208,043	$432,570
1865	225,197	553,124	1,572,382	709,106	282,640	1,544,870
1866	215,080	792,450	123,444	33,553	110,208	936,211
1867	87,731	317,791	(*a*)4,637,867	303,048	171,062	791,901
1868	92,612	442,921	1,350,896	327,287	152,201	922,409
1869	121,418	237,424	1,134,360	233,932	121,342	592,698
1870	(*a*) 19,198	537,505	2,214,658	385,815	118,926	1,042,246
1871	(*a*) 54,445	727,213	581,650	133,020	55,198	915,431
1872	35,564	101,752	267,868	64,844	121,139	287,735
1873	45,252	170,365	38,958	10,423	78,288	259,076
1874	13,326	110,450	503,160	123,457	233,301	467,208
1875	(*a*) 51,305	729,578	5,123,470	1,042,536	43,152	1,815,266
1876	15,304	84,471	14,304,160	3,098,395	343,544	3,526,410
1877	21,432	109,451	13,461,553	2,718,213	195,730	3,023,394
1878	32,947	169,020	11,297,876	2,102,455	217,446	2,488,921
1879	23,070	102,152	17,200,739	2,751,153	79,900	2,933,205
1880	21,623	55,763	4,206,258	667,242	126,213	849,218
1881	9,958	51,499	4,865,407	786,860	38,036	876,395
1882	25,936	89,515	3,340,531	565,295	93,646	748,456
1883	112,923	943,771	8,221,363	1,293,947	110,286	2,348,004
1884	386,140	2,930,895	17,044,760	2,527,829	137,135	5,595,859
1885	432,300	4,739,601	44,731,858	5,339,887	107,536	10,187,024

a Evidently errors in quantities.

Value of brass, and manufactures of, exported from the United States, 1867 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1867	$12,864	1877	$327,817
1868	16,841	1878	589,451
1869	40,063	1879	200,871
1870	169,997	1880	183,468
1871	210,816	1881	216,057
1872	229,458	1882	322,439
1873	494,575	1883	287,847
1874	503,531	1884	301,014
1875	1,000,629	1885	538,118
1876	256,974		

The problem of tracing the origin of the copper exported is a complicated one, and only a rough distribution of it can be arrived at. The factors which tend to render accuracy impossible are numerous. Copper produced in one section goes to other works for treatment, is refined in another locality, so that its identity is entirely lost. For instance, some copper matte made in Montana goes with material from other sources to the Argo works of the Boston and Colorado Smelting Company, and after extracting the precious metals a part of it is sent abroad direct, another part is refined in the East and is sold to consumers. The refiners themselves, receiving furnace material from many quarters, ship ingot to European markets, and they probably could not, if they desired it, ascertain whether it was Montana or Arizona produce. Then there appear under exports the quantities of copper extracted from foreign ores and pyrites, either in the form of ingot or of matte. The figures for exports do not, furthermore, exactly tally with the shipments from some localities like Montana, because varying quantities are in transit from the Rocky mountains to the Atlantic and Pacific coasts. While, therefore, strict accuracy is not attainable, an estimate of the sources from which our contribution to foreign markets is made up is not without its great value, because export shipments imply a sacrifice. To the different producing sections it is a matter of moment to obtain some clear conception to what extent its product is placed on the more valuable home market. Past years witnessed a sharp struggle between the Arizona and Lake Superior mines, and in the earlier days of the history of the former region an important percentage out of the whole annual make had to be placed abroad. This seems to have undergone a change worthy of notice.

Out of the entire Arizona product of 22,706,366 pounds fine, not less than 20,300,000 pounds went to American refining works. Out of the balance of 2,400,000 pounds a considerable proportion went direct to consumers in the form of blister copper, they refining it in furnaces, with which a number of them are equipped, or using it direct without refining. This business has grown considerably, so that the quantity of bars, the direct product of Arizona furnaces, exported was probably not more than 1,000,000 pounds. It will be noted, therefore, that only a small percentage of the copper produced in Arizona seeks foreign markets, the bulk of it being consumed at home. This is largely due to the fact that some of the most prominent producing mines are controlled by a concern which does its own refining, and which, as a large manufacturer, consumes the bulk of it.

The scarcity of furnace material from other quarters in the open market has caused our refining works to devote more attention than formerly to the treatment of Montana concentrates and mattes. Our returns from refiners indicate that the total product from that quarter treated by them amounted to no less than 19,000,000 to 20,000,000 pounds. Some of this, converted into electrolytic copper, was undoubtedly exported as such. Other quantities, which cannot be identified as Montana produce, were probably shipped abroad by refiners or second hands, so that ore, concentrates, and matte are not the only forms in which Montana copper went out. Besides it is unnecessary to state that some Manhès' blister produced by the Parrot company was also exported. Taking all these points into consideration, it will be conceded that no small quantity of Montana copper was consumed at home, contrary to the opinion generally prevailing. There was in this movement, which seemed likely to gain rather than to lose strength, a menace to the Lake mines.

The establishment of refining works for handling Montana copper at Bridgeport, and the building of a plant at Belleville, Illinois, near Saint Louis, to employ the processes adopted at the Vivian works, Swansea, point in this direction. This did bring into and will in the near future put upon the market the disturbing element of new brands and new grades of copper, which can only secure recognition by constant concessions. It is claimed that the copper produced from Montana Manhès' blister is as pure as that from Arizona ores, and it is asserted that it approaches Lake copper in quality. These are points which still remain to be proved, but it is undoubtedly suitable for a variety of purposes, like ordinary brass castings, and must displace a corresponding quantity of the better grades. We have no data for estimating the consumption of inferior qualities of the metal. It is undoubtedly large, and it is a problem which once more comes up for solution, to what extent these grades will be allowed to encroach upon markets hitherto controlled by Lake copper. The question is somewhat affected by the relative position of electrolytic copper, some of the Australian brands and Lake metal in the European markets. It is stated with some show of authority that carelessness in treating arsenical material, notably in England, has resulted in a depreciation in quality of electrolytic brands. This has shaken confidence in their quality, and would tend to restore to Lake the advantage of a large extra price, which it had partly lost. This in turn would lessen the anxiety of Lake producers to conquer as great a share of the home market as possible. The sale by the latter of a large block to consumers, at 10 cents, which took place towards the end of May, 1886, showed that they were keenly alive to the dangers of such a competition, and were determined to meet it.

In the form of ingots, bars, and old copper, the exports during the calendar year were 36,221,931 pounds. To this quantity the Lake mines contributed, directly and indirectly, about 24,000,000 to 25,000,000 pounds. Refiners exported 7,145,000 pounds from miscellaneous sources and the balance must be credited to Arizona bars, Montana blister and electrolytic copper, precipitate and Colorado coarse copper. The "ore," which includes concentrates and matte, is estimated to have contained 50,000,000 pounds. The bulk of it is, of course, Montana produce; some of it is, however, matte obtained from smelting the cinder of imported pyrites, used in the manufacture of sulphuric acid. The quantity of copper contained in this "ore" has been arrived at by deducting from the product of the Montana mines the quantities which went to home refiners. It has been claimed, without any further authority than a rough guess, that the quantity thus reached is excessive, and the quantities of "ore" exported in the calendar years 1884 and 1885, with accompanying valuations, have been quoted to give color to this assertion.

Consumption.—So much has been said concerning the growth of the copper consumption in this country, stimulated by low prices, that an effort was made to get at some clear numerical expression which might serve as a guide to the trade. Mr. George W. Cope, of Philadelphia, secretary of the American Iron and Steel Association, a skilled statistician, kindly consented to receive the confidential returns of consumers, and in reply to inquiries the following companies and firms, among whom, it will be noted, are all but two or three of the great manufacturers of brass and copper in the United States, sent the figures covering their consumption of copper bars, ingots, cakes, and slabs:

Coe Brass Manufacturing Company, Torrington, Connecticut.
Waterbury Manufacturing Company, Waterbury, Connecticut.
C. G. Hussey & Co., Pittsburgh, Pennsylvania.
Manhattan Brass Company, New York.
New Haven Copper Company, Seymour, Connecticut.
Bristol Brass and Clock Company, Bristol, Connecticut.
Plume & Atwood Manufacturing Company, Waterbury, Connecticut.
Holmes & Wessel Metal Company, New York.
Bridgeport Brass Company, Bridgeport, Connecticut.
Wallace & Sons, Ansonia, Connecticut.
Waterbury Brass Company, Waterbury, Connecticut.
Shelton Brass Hardware Company, Birmingham, Connecticut.
United Brass Company, Lorain, Ohio.
Haydenville Manufacturing Company, Haydenville, Massachusetts.
Detroit Brass and Copper Company, Detroit, Michigan.
Baltimore Copper Rolling Mill Company, Baltimore, Maryland.
Benedict & Burnham Manufacturing Company, Waterbury, Connecticut.
Ansonia Brass and Copper Company, Ansonia, Connecticut.
Stanier & Laffy, New York.
John A. Roebling's Sons Company, Trenton, New Jersey.
Holmes, Booth & Haydens, Waterbury, Connecticut.
Scovill Manufacturing Company, Waterbury, Connecticut.
Seymour Manufacturing Company, Seymour, Connecticut.
E. Miller & Co., Meriden, Connecticut.
Cheshire Brass Manufacturing Company, Cheshire, Connecticut.
Osborne & Cheeseman Company, Birmingham, Connecticut.
Taunton Copper Manufacturing Company, Taunton, Massachusetts.
De Witt Wire Cloth Company, New York.
Rome Iron Works, Rome, New York.
New Bedford Copper Company, New Bedford, Massachusetts.
James G. Moffatt, New York.
Revere Copper Company, Boston, Massachusetts.

In the aggregate these works consumed 50,011,471 pounds of copper in 1885, against 43,151,960 pounds in 1884, thus indicating a rate of increase of 16 per cent. These figures, it should be distinctly stated, cover only a part of the consumption. They ignore entirely the large quantity annually distributed by dealers, but they do furnish tangible evidence of the growth in the consumption, which is all the more encouraging in times of general business depression, when the consumption of such leading articles as iron and steel remained practically stationary.

One as yet insuperable barrier to any reliable estimates concerning the total copper consumption in this country is the absence of data on stocks. It is possible, therefore, to ascertain only with a fair degree of accuracy how much of the copper product of the country has remained here and how much has gone abroad. Another difficulty is encountered through the fact that the returns of the Bureau of Statistics do not give the copper contents of the "ore," including concentrates and matte exported. This has been overcome largely through special returns from the refiners giving the source of the copper handled by them. From the data obtained the following estimate has been made:

Estimate of copper consumption in the United States in the calendar year 1885.

	Pounds.
Production, 1885, and excess of imports of fine copper in ore	170, 962, 607
Imports of pig and old	574, 514
Total supply	171, 537, 121
Exports, ingots and bars	36, 221, 931
Exports, copper contents of "ore"	50, 050, 000
Re-exports of foreign ore	348, 020
Total exports	86, 619, 951
RECAPITULATION.	
Production and imports	171, 537, 121
Exports	86, 619, 951
Available for home consumption	84, 917, 170

In the report for 1884, published in the "Mineral Resources of the United States," the consumption was estimated at 80,000,000 pounds. In the light of the data received from consumers, it is fair to assume that if the figure for 1884 was correct, that for 1885 must have reached at least 90,000,000 pounds, and that, therefore, there must have been a drain on stocks during the year 1885.

THE COPPER MARKETS.

The following table summarizes the highest and lowest prices obtained for Lake copper monthly in the New York market from 1860 to 1885, both inclusive:

Highest and lowest prices of Lake Superior ingot copper, by months, from 1860 *to* 1885.

[Cents per pound.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860	24	23½	24	23¾	23¾	23	23½	23	23¼	22½	22½	21¾
1861	20	19	19½	19	19¾	19¼	19¾	19	19¾	19¼	19	18
1862	28	27	28	25	25	23	23	21½	21½	20¾	23	20¾
1863	35	31	37	35	37	31	31	30	30½	30	30½	30
1864	41¼	39	42	41¼	42½	41½	44	42½	44	43	49	44
1865	50½	46	46	44	44½	34	35	34	34	30	30½	28½
1866	42	38	38	35½	35½	29½	30	28½	31	29	33	31
1867	29¼	27	27¾	27½	27½	24	24½	23½	24¼	24	24½	24
1868	23½	21½	24	22½	24	23¼	24¼	23¼	24¼	24	24	23⅛
1869	26¼	23¾	27	26	26¾	24	24	23¼	24¼	23¾	23¾	22
1870	22	21⅛	21¼	20⅞	20¾	19	19¾	19¼	19½	19	20⅝	19
1871	22⅞	22	22⅜	21⅞	22	21½	21¾	21¼	21¾	21⅜	21½	21¼
1872	28½	27⅛	28⅜	28¼	30½	28⅜	44	30½	42	36	34¾	33
1873	35	32½	35	34	35	34½	34½	33½	33½	32	31½	29⅛
1874	25	24½	25	24⅛	24¾	24	25	24¾	25	24⅛	24¾	24¼
1875	23½	21½	22¾	21¾	21¾	21½	21¾	21½	23¼	22⅝	23	23
1876	23¼	23	22⅞	22½	22¼	22	22⅝	22	22⅛	21	21	19¼
1877	19½	19	20½	19½	19½	19	19½	19¼	19¼	19	19⅜	19
1878	17⅝	17¼	17⅞	17⅛	17⅛	16⅞	17	16⅞	16¾	16¼	16⅜	16¼
1879	16	15½	15½	15½	15¾	15¾	16	15¾	16¼	16	16¼	16⅛
1880	25	21⅜	24½	24	24	22¾	22½	21	21	18	18½	17⅞
1881	19⅜	19⅛	19⅜	19⅛	19⅜	19	19	18¼	18⅞	18¼	18¼	16⅜
1882	20⅜	20¼	20	19	19¼	18⅞	18⅞	17⅞	18¼	18	18¼	18
1883	18⅛	18	17⅞	17¾	17⅝	17⅛	16	15¾	16	15⅞	15⅞	15
1884	15	14⅞	15	14⅞	15	14⅞	15	14⅛	14¼	14⅛	14¼	14
1885	11½	10⅜	11⅛	10⅘	11⅛	10⅗	11¼	10.10	11½	9⅘	11⅛	11

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860	21¾	21½	21½	21½	22	21¼	22	21½	21½	20¼	20¼	19¾
1861	18	17½	19	17¾	20¼	19	20¼	20	22½	20¼	27	22½
1862	24½	22½	24½	24	27	24¼	32⅞	27	32⅞	30½	31½	30½
1863	32	29	31	29	32¼	31	34½	32¼	38½	34½	38¾	38½
1864	55	49	52½	50	52½	47½	48	47	49	47	50	48½
1865	30¼	28	32	30½	32¾	31½	33	32½	45½	33	45½	39¼
1866	33½	31	31	30	31½	30¾	31	30¾	30¾	26½	29	26½
1867	26	24	26¼	25¾	27¼	26¼	26¾	22¾	23	22¾	23	21½
1868	24½	23⅛	24¼	24	24	23¾	24	23	24	22½	24½	23¾
1869	22¼	21⅞	23⅛	21⅞	23	22	22¾	22	22½	22	22	21½
1870	20½	20⅜	21⅜	20⅛	21½	20¾	21¾	21½	23⅜	21¾	22⅝	22¼
1871	22¼	21⅝	23	22⅜	23⅞	22⅞	23⅞	23¾	24¼	23¼	27	24½
1872	34	33	35	32½	35¼	33	34¾	31¼	32¼	30¾	32½	30½
1873	29	26⅝	27½	27	27	25½	25½	24	24	21	25	23
1874	24¼	20	21	19	21¼	21	22¼	21¼	23¾	22¼	23¼	23¼
1875	23	22⅝	23⅜	23	23⅞	23⅛	23¼	23	23¼	23	23⅜	23⅜
1876	20	19½	19½	18¾	21	18¾	21¼	20½	20½	20	20	19⅝
1877	19¼	19	19	17⅞	18½	17⅞	18	17¾	17¾	17⅝	17¾	17½
1878	16¼	16	16	16	16¼	16	16	15½	15⅞	15½	16	15⅞
1879	16⅛	16	16⅜	16	17	16¼	21½	18	21¾	21	21½	21
1880	18⅞	18½	19⅛	19	18⅞	18¾	18⅞	18¾	18⅞	18¾	19⅛	18⅞
1881	16½	16	16⅝	16⅜	18⅛	16¾	18⅜	18	19	18⅛	20⅜	19¼
1882	18¼	18⅛	18¼	18⅛	18¼	18	18¼	18	18⅛	18	18	17⅞
1883	15⅛	15	15	15	15¼	15⅛	15¼	15⅛	15	14⅞	15	14⅞
1884	14⅛	13⅞	14	13⅞	13⅛	13	13⅛	12⅞	13	12⅛	12⅛	11
1885	11¼	10⅞	11¼	11	11⅛	10.95	11⅛	10⅘	11⅛	10⅘	11½	11.10

1885. The following shows the fluctuations of Lake copper and ordinary Baltimore, or its equivalent, in the open market:

Prices of copper in 1885.

[Cents per pound.]

Months.	Lake copper.		Casting copper.	
	Highest.	Lowest.	Highest.	Lowest.
January	11.50	(a)10.60	10.75	10.25
February	11.12½	(a)10.80	10.75	10.50
March	11.12½	(a)10.40	10.62½	10.12½
April	11.25	(a)10.10	10.75	10.25
May	11.50	(a)9.80	10.89½	10.60
June	11.50	11.00	10.62½	10.20
July	11.25	10.87½	10.35	10.20
August	11.25	11.00	10.35	10.15
September	11.12½	10.95	10.25	10.10
October	11.12½	10.80	10.12	9.90
November	11.12½	10.80	10.00	9.80
December	11.50	11.10	10.50	10.00

a Under Chili bar sliding-scale contracts.

The market opened quiet in January, the transactions in Lake on the open market being few, since the principal consumers were being supplied under the sliding-scale contracts entered into during the preceding year. Under these contracts the prices to consumers are estimated at 10.60 cents for January, 10.80 cents for February, 10.40 cents for March, 10.10 cents for April, and 9.80 cents for May, in accordance with the steady decline in Chili bars abroad. This offered little inducement to consumers to purchase other copper than Lake, and the market remained very quiet until the close of April, when the stock, estimated at 1,000,000 pounds, held by a bankrupt refining company, was closed out. In May consumers again entered into a contract with the leading Lake companies for 10,000,000 pounds at 11½ cents. The market again became dull, and the continuance of the decline abroad to unprecedented figures created a depressed feeling, causing general weakness. Early in September 11 cents was made the basis of Lake contracts with consumers, and, under the pressure of supplies of other Lake, Arizona, and Montana copper, the market receded steadily till the middle of November. The sudden advance at London gave encouragement here, and the spot stocks being small, with a heavy export and a large consumption, the price gradually rallied. The tone became so strong that the Lake companies were enabled to make 11½ cents the basis of the contracts, for 10,000,000 pounds, with consumers, covering the early months of 1886. During the entire year our market has been relatively higher than those abroad, and since the end of the sliding-scale contracts the bulk of the Lake copper has sold at an average considerably above 11 cents.

The prices realized for copper during the year are best indicated by the figures given in a number of the reports of the Lake Superior companies. The following table has been compiled from those documents:

Prices realized for Lake Superior copper in 1883 *and* 1885.

Mines.	1883. Sales.	1883. Average price.	1885. Sales.	1885. Average price.
	Pounds.	*Cts. per lb.*	*Pounds.*	*Cts. per lb.*
Allouez	1, 751, 377	15. 13	(*b*)1, 050, 546	11. 03
Franklin	3, 418, 456	15. 66	3, 291, 806	11. 04
Atlantic	2, 385, 585	15. 08	(*a*)2, 729, 588	11. 08
Pewabic	1, 239, 740	15. 91	....	....
Central	1, 125, 910	15. 08	(*a*)1, 600, 899	11. 02
Huron	647, 787	15. 69	2, 729, 588	10. 92
Osceola	....	....	1, 639, 169	10. 75

a Not including copper on hand sold. *b* First five months.

Since the English quotations have become of such direct importance to American copper miners, the following table, showing a comparison of values in 1885 with former years, is of interest:

Average values in England.

Years.	Chili bars.	Ore, 25 per cent.	Precipitate.
	Long ton.	*Per unit.*	*Per unit.*
1880	£62 10 0	£0 12 9	£0 12 11
1881	61 10 0	12 6	13 8 3/16
1882	66 17 0	13 6¾	13 10 1/16
1883	63 5 10	12 4½	12 10 1/16
1884	54 9 1	10 5½	11 1
1885	44 0 10	8 4	9 0⅛

In detail the average prices monthly during 1885 were as follows:

Monthly averages of values in England in 1885.

Months.	Chili bars, per long ton.			Ore of 25 per cent., per unit.		Precipitate, per unit.	
	£	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
January	48	14	7	9	3	9	11½
February	47	13	6	9	0	9	8⅞
March	46	4	9	8	7	9	5½
April	44	9	2	7	11	9	1¼
May	44	13	6	8	3	9	1⅝
June	44	18	3	8	3	9	2⅛
July	44	4	9	8	3	9	0⅝
August	43	5	11	8	3	8	10½
September	41	17	6	7	11	8	7
October	39	18	6	7	9	8	2⅜
November	41	3	0	8	0	8	5¼
December	41	6	6	8	0	8	5⅝

THE PRINCIPAL FOREIGN PRODUCERS.

As the United States has become one of the heaviest contributors to foreign markets, and the returns received for that share of its produce shipped abroad depend upon the capacity of its competitors to meet prevailing prices, the conditions affecting the mines in all quarters of the globe have become a matter of keen interest. These influences re-act upon our home markets, though they are tempered by a variety of circumstances. The year 1885 with its low prices has exerted an enormous pressure upon the copper mines in all the different countries. The great pyrites companies of the Spanish peninsula have been forced to reduce dividends heavily, in spite of their efforts to decrease costs by increasing output, and although they were earning well on sales of pyrites. The producers in Chili are, according to the latest authoritative advices, finding it difficult to make ends meet, although exchange has favored them. The Australian and Venezuelan mines have lost money, and the Mansfeld company in Germany is seeking relief by agitating for a higher duty. The magnificent profits of the Cape of Good Hope mine have shrunk to low figures. The smaller concerns, scattered in different countries, have either closed down completely, or are lingering on reserves, so that the contest has narrowed down to a struggle between a few large producers. Although consumption has increased somewhat as the result of low values, their combined output is too great to allow of any material rise so long as the general business situation the world over remains as unfavorable as it has been for some time past, and even moderate supplies are shipped abroad from this country.

Messrs. Henry Merton & Co. have compiled the following table of the copper production of the world, and have since its publication kindly completed some of the estimates when later returns were available. Some of the data have been changed and corrected by this office from information directly received from various quarters. The copper is in all cases credited to the source where it originated. Thus the contents of the pyrites shipped from Spain are included in the figures given for that country. The table as it stands reflects the results of the closest scrutiny and may be accepted as the most complete and accurate now available:

The copper production of the world, 1879 *to* 1885 *inclusive.*

Countries.	1885.	1884.	1883.	1882.	1881.	1880.	1879.
EUROPE.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Great Britain	2,773	3,350	2,620	3,464	3,875	3,662	3,462
Spain and Portugal:							
Rio Tinto	23,484	21,564	20,472	17,389	16,666	16,215	13,751
Tharsis	(*a*) 11,500	(*a*) 10,800	9,800	9,000	10,203	9,151	11,324
Mason & Barry	(*a*) 7,000	(*a*) 7,500	8,000	8,000	8,170	6,603	4,692
Sevilla	1,800	2,000	2,026	1,885	1,340	1,705	1,360
Portugueza	1,665	(*a*) 2,300	2,357	1,700	1,410	1,000	770
Poderosa	(*a*) 500	(*a*) 500	1,000	800	800	800	800
Germany:							
Mansfeld	12,460	12,582	12,634	11,536	10,999	9,800	8,400
Other German	(*a*) 2,800	(*a*) 2,200	3,568	3,552	1,743	1,000	600
Austria	(*a*) 670	670	572	474	474	500	255
Hungary	(*a*) 800	800	661	661	800	900	1,019
Sweden	775	662	732	798	995	1,074	800
Norway	2,560	2,706	2,630	2,590	2,640	2,426	2,412
Italy	835	1,325	1,600	1,400	1,480	1,380	1,140
Russia	(*a*) 5,000	5,000	3,500	3,537	3,411	3,154	3,081
Total Europe	74,612	73,959	72,172	66,786	65,006	59,370	53,866

a. Estimated.

The copper production of the world, 1879 *to* 1885 *inclusive*—Continued.

Countries.	1885.	1884.	1883.	1882.	1881.	1880.	1879.
NORTH AMERICA.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
United States	74, 053	63, 555	51, 574	40, 467	32, 000	27, 000	23, 000
Canada	....	236	1, 055	500	500	50	50
Newfoundland:							
Bett's Cove	778	668	1, 053	1, 500	1, 718	1, 500	1, 500
Mexico	375	291	489	401	333	400	400
Total North America	75, 206	64, 750	54, 171	42, 868	34, 551	28, 950	24, 950
SOUTH AMERICA.							
Chili	38, 500	41, 648	41, 099	42, 909	37, 989	42, 916	49, 318
Bolivia:							
Corocoro	(*a*) 1, 500	(*a*) 1, 500	1, 680	3, 259	2, 655	2, 000	2, 000
Peru	229	362	395	440	615	600	600
Venezuela:							
New Quebrada	4, 111	4, 600	4, 018	3, 700	2, 823	1, 800	1, 597
Argentine Republic	233	159	293	800	307	300	300
Total South America	44, 573	48, 269	47, 485	51, 108	44, 389	47, 616	53, 815
AFRICA.							
Algiers	250	260	600	600	600	500	500
Cape of Good Hope:							
Cape Copper Company	5, 450	5, 000	5, 975	5, 716	3, 467	4, 739	4, 328
Total Africa	5, 700	5, 260	6, 575	6, 316	4, 067	5, 239	4, 828
ASIA.							
Japan	(*a*) 10, 000	(*a*) 10, 000	7, 600	4, 800	3, 900	3, 900	3, 900
Total Asia	10, 000	10, 000	7, 600	4, 800	3, 900	3, 900	3, 900
AUSTRALIA.							
Australia	11, 400	14, 100	12, 271	8, 512	10, 000	9, 700	9, 500

a Estimated.

RECAPITULATION.

	1885.	1884.	1883.	1882.	1881.	1880.	1879.
Europe	74, 839	73, 959	72, 172	66, 786	65, 006	59, 370	53, 866
North America	75, 206	64, 750	54, 171	42, 868	34, 551	28, 950	24, 950
South America	44, 573	48, 269	47, 485	51, 108	44, 389	47, 616	53, 815
Africa	5, 700	5, 260	6, 575	6, 316	4, 067	5, 239	4, 828
Asia	10, 000	10, 000	7, 600	4, 800	3, 900	3, 900	3, 900
Australia	11, 400	14, 100	12, 271	8, 512	10, 000	9, 700	9, 500
Total	221, 491	216, 338	200, 274	180, 390	161, 913	154, 775	150, 859

Great Britain.—The following are the official returns of the quantity of ore and precipitate produced by English mines, and their copper contents, or, as the latest report puts it, "metallic copper obtainable by smelting."

Production of copper in Great Britain.

Years.	Ore.	Copper.	Years.	Ore.	Copper.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
1860	362, 696	15, 968	1877	73, 143	4, 486
1865	198, 298	11, 888	1878	56, 094	3, 952
1870	106, 698	7, 175	1879	51, 035	3, 462
1871	97, 129	6, 280	1880	52, 118	3, 662
1872	91, 893	5, 703	1881	52, 556	3, 875
1873	80, 188	5, 240	1882	52, 810	3, 464
1874	78, 521	4, 981	1883	46, 820	2, 620
1875	71, 528	4, 323	1884	42, 149	3, 350
1876	79, 252	4, 694	1885	36, 379	2, 773

According to the official returns of the Board of Trade the British imports and exports of copper have been as follows for a series of years:

British imports and exports of copper.

Years.	Imports of— Bars, cakes, and ingots.	Imports of— Copper in ores and furnace products.	Total imports.	Exports.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
1860	13, 142	13, 715	26, 857	26, 117
1865	23, 137	23, 922	47, 059	41, 398
1870	30, 724	27, 025	57, 749	53, 006
1871	33, 228	23, 671	56, 899	56, 633
1872	49, 000	21, 702	70, 702	53, 195
1873	35, 840	26, 756	62, 596	55, 716
1874	39, 906	27, 894	67, 800	59, 742
1875	41, 931	29, 483	71, 414	51, 870
1876	39, 145	36, 191	75, 336	52, 468
1877	39, 743	53, 582	93, 325	54, 088
1878	39, 360	48, 212	87, 572	55, 001
1879	46, 670	50, 421	97, 091	62, 412
1880	36, 509	56, 225	92, 734	59, 482
1881	32, 170	54, 057	86, 227	61, 689
1882	35, 509	58, 366	93, 875	55, 683
1883	35, 653	63, 493	99, 146	59, 350
1884	39, 767	72, 617	112, 384	64, 692
1885	41, 931	81, 616	123, 547	62, 050

The following figures from the Board of Trade returns for the eight years since 1878 show in detail the form in which the copper is brought into Great Britain and in what form it is exported:

Imports of copper into Great Britain from 1878 to 1885 inclusive.

Character.	1878	1879.	1880.	1881.	1882.	1883.	1884.	1885.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Pure in pyrites	14, 443	12, 040	16, 446	13, 551	15, 672	15, 016	14, 077	16, 333
Pure in precipitate	13, 173	18, 159	18, 205	18, 619	17, 935	23, 645	19, 688	21, 398
Pure in ore	15, 441	13, 173	14, 976	15, 396	15, 489	15, 880	24, 677	15, 683
Pure in regulus	5, 155	7, 049	6, 598	6, 491	9, 270	8, 952	11, 181	28, 202
Bars, cakes, etc	39, 360	46, 670	36, 509	32, 170	35, 509	35, 653	39, 767	41, 931
Total	87, 572	97, 091	92, 734	86, 227	93, 875	99, 146	109, 390	123, 547

Turning first to the imports of pyrites, we find the following table of the imports and their source since 1873 in the volume of the "Mineral Statistics of Great Britain":

Imports of pyrites into Great Britain.

Years.	Norway.	Portugal.	Spain.	Germany.	Other countries.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1873	67, 462	199, 559	246, 692	....	6, 634	520, 347
1874	41, 044	162, 569	294, 117	....	907	498, 637
1875	21, 820	165, 433	344, 019	....	6, 283	537, 555
1876	7, 688	56, 579	419, 068	....	21, 417	504, 752
1877	8, 564	149, 562	498, 977	....	22, 209	679, 312
1878	5, 773	136, 705	419, 561	....	12, 318	474, 357
1879	8, 485	82, 529	374, 505	....	15, 783	481, 302
1880	10, 952	166, 519	463, 199	8, 695	8, 684	658, 049
1881	6, 009	140, 079	379, 216	8, 412	8, 662	542, 378
1882	....	114, 132	497, 807	....	15, 761	627, 700
1883	1, 271	121, 137	473, 343	....	5, 537	601, 288
1884	522	85, 454	471, 556	....	5, 541	563, 073
1885	2, 608	28, 899	619, 523	....	3, 491	654, 521

These figures show clearly how the Spanish mines are rapidly monopolizing the English pyrites trade.

The following table exhibits the quantity of burned pyrites treated at the twenty-two metal-extraction works, together with the quantities of metallic copper and gold and silver extracted by the Claudet process:

Metals extracted from burned cupriferous pyrites.

Years.	Ore.	Copper.	Gold.	Silver.
	Long tons.	*Long tons.*	*Ounces.*	*Ounces.*
1880	415, 567	15, 000	1, 043	246, 981
1881	396, 737	14, 000	1, 490	258, 463
1882	434, 427	15, 300	1, 500	400, 000
1883	439, 156	15, 370	1, 511	348, 210
1884	416, 412	15, 200	1, 900	335, 000
1885	407, 700	14, 880	1, 840	328, 000

The decline in the consumption of sulphuric acid and of soda manufacture has therefore only had a moderate effect, chiefly for the reason that the Solvay ammonia process has thus far made its greatest strides on the Continent.

The following table giving the returns covering the imports of precipitate and regulus, or matte, into Great Britain for the first time enumerates specially the amounts received from this country. The enormously rapid growth deserves special notice. It will be observed also that the imports of Spanish precipitate show a very large increase, eclipsing all former years.

Imports of precipitate and regulus into Great Britain.

Countries.	1880.	1881.	1882.	1883.	1884.	1885.	Containing fine copper (estimated).
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Portugal	5,358	8,144	7,301	8,873	7,161	8,283	25,487
Spain	20,482	21,647	21,398	28,962	27,621	38,267	
Chili	14,659	8,116	10,882	6,384	10,699	5,255	2,365
United States	....	....	....	....	5,805	29,861	18,895
Other countries	4,502	6,309	9,716	13,509	11,124	6,000	2,853
Total	45,001	44,216	49,297	57,728	62,410	87,666	49,600
Pure copper	24,772	25,110	27,205	32,597	34,172	49,600	....

Another great source of supply of the English metallurgical works is ore. The following table gives the Board of Trade returns, the average values being computed by this office.

Imports of copper ore into Great Britain.

Countries.	Quantities.			Average value per ton.		
	1883.	1884.	1885.	1883.	1884.	1885.
	Long tons.	*Long tons.*	*Long tons.*			
Italy	9,403	11,100	7,405	£7.11	£4.79	£5.42
Venezuela	31,844	25,900	38,613	6.73	6.16	4.46
Bolivia	1,029	2,067	4,642	12.98	8.81	8.22
Chili	1,062	245	529	13.17	19.92	17.10
Cape of Good Hope	19,917	22,330	20,875	17.71	15.35	11.80
British North America	10,876	2,067	5,002	6.04	4.35	2.02
United States	....	31,316	5,970	....	18.94	14.27
Other countries	31,748	29,189	18,941	11.65	6.76	6.79
Total ore	105,879	124,214	101,977	10.35	11.09	7.07
Total pure copper	15,880	24,842	15,683	....	....	....
Average percentage	15.00	20.00	14.43	....	....	....

These figures are deeply interesting because they show what a complete revulsion was effected in one year in the character of the shipments from this country, which is for the first time taken from the general heading of "other countries." In one year we sent 31,316 long tons of copper ore, in the next only 5,970 tons, and of the latter the bulk were concentrates. This is particularly instructive because our own export statistics group ore and matte together as "ore." This has led to very erroneous deductions, it being assumed that since the quantities sent show little variation, it follows that the copper contents are nearly alike. It is probable that the ore sent in 1884 did not average higher than 30 per cent., while the grade of the matte exported is probably nearer 60 per cent. The English receipts were of both in 1884 and 1885:

	1884.	1885.
	Long tons.	*Long tons.*
Ore	31,316	5,970
Matte	5,805	29,861
Total	37,121	35,831

This change in the character of our exports is of course largely due to the cessation of ore shipments late in 1884 by the Anaconda mine, and the starting of the smelting plant of that company.

The values per ton computed in the above table show clearly that whenever it was possible the mines of the different countries sorted their ore much more carefully, carrying up its grade. When this was impossible, as in the case of the receipts from British North America, the value per ton declined very heavily.

The chief sources of the receipts of ingot copper and of bars are Australia, furnishing the former, and Chili which sends the latter. A comparatively small quantity is received from the United States, which probably in 1885 included also some Montana blister.

Imports of copper, wrought and unwrought, into Great Britain.

Countries.	1880.	1881.	1882.	1883.	1884.	1885.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chili	24, 258	21, 019	23, 585	22, 799	22, 843	24, 832
Australia	9, 406	9, 150	8, 152	9, 531	9, 329	8, 564
United States	....	....	....	1, 866	3, 408	3, 259
Other countries	2, 845	2, 001	4, 772	1, 457	4, 235	5, 338
Total	36, 509	32, 170	35, 509	35, 653	39, 815	41, 993

Messrs. James Lewis & Son, of Liverpool, estimate as follows the imports of other than Chili copper into Liverpool, London, and Swansea during the years 1882, 1883, 1884, and 1885, which represents the total imports, with the exception of precipitate, into Newcastle and Cardiff, reliable returns of which cannot be obtained, but which is estimated to vary from 10,000 to 12,000 tons fine per annum.

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

Countries.	1882.	1883.	1884.	1885.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Chili	30, 112	27, 504	31, 298	28, 985
United States	745	9, 410	17, 309	24, 037
Spain and Portugal	464	2, 788	2, 359	4, 655
Spain (precipitate)	8, 757	11, 249	10, 009	9, 186
Spain (pyrites)	15, 673	15, 017	14, 077	16, 333
Australia	9, 847	9, 694	9, 685	8, 951
Cape of Good Hope	5, 298	5, 670	6, 042	5, 405
New Quebrada	3, 164	3, 960	3, 675	4, 074
Japan	....	....	1, 064	3, 010
Italy	1, 386	1, 091	1, 310	835
Norway	446	296	289	27
Canada	347	448	266	....
Newfoundland	1, 362	1, 185	224	723
Mexico	372	489	291	374
Peru	821	426	408	229
River Plate	260	319	131	233
Other countries	925	946	284	325
Total, tons fine	79, 979	90, 492	98, 721	107, 382

The exports of copper from Great Britain, in different forms, were as follows:

Exports of copper from Great Britain from 1878 to 1885, inclusive.

Character.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Raw English	17,319	16,370	15,202	18,737	12,776	16,777	17,943	18,736
Sheets	12,769	15,402	16,580	15,960	15,698	16,071	20,669	21,108
Yellow metal, at 60 per cent	8,744	10,042	10,128	9,939	10,892	11,918	11,602	12,551
Brass, at 70 per cent	3,450	2,761	2,677	3,263	3,499	3,381	3,735	3,233
	42,282	44,575	44,587	47,899	42,865	48,147	53,949	55,628
Fine foreign	12,719	17,837	14,895	13,790	12,818	11,203	10,742	6,422
Total	55,001	62,412	59,482	61,689	55,683	59,350	64,691	62,050

Chili.—The following table gives the record of the exports of copper from Chili for a long series of years, no official statements of the production being available:

Exports of copper from Chili.

Years.	Tons.	Years.	Tons.
1855	20,250	1871	41,200
1856	21,938	1872	46,337
1857	25,498	1873	42,165
1858	30,470	1874	48,240
1859	28,250	1875	45,430
1860	36,289	1876	50,740
1861	38,371	1877	45,400
1862	43,109	1878	46,770
1863	32,540	1879	49,390
1864	47,500	1880	42,990
1865	48,327	1881	38,030
1866	44,820	1882	42,960
1867	44,654	1883	41,229
1868	43,669	1884	43,700
1869	54,867	1885	38,500
1870	49,130		

Until the middle of the year 1885 exchange declined almost as heavily as the price of copper in London, and the result was that the producers in Chili did not feel it as did the miners in every other country. From January, 1883, when exchange was 37*d.*, it fell in August, 1885, to 23*d.*, a decline of 38 per cent. In the same period Chili bars in London dropped from £65 10*s.* to £42 5*s.*, or 35½ per cent., so that copper in Valparaiso rose from $17.95 to $18.70 per quintal. Early in March, 1886, the price had reached $15.80, while exchange advanced to 25½*d.* Advices of that date from a leading authority in Chili represent that such prices must rapidly affect adversely the productive capacity of the country.

Spain.—An interesting estimate of the actual output of copper in the Peninsula, including the fine copper both in precipitate and pyrites, has been made by Messrs. H. R. Merton & Co., of London, who place the product as follows:

Copper production of Spain and Portugal.

Mines.	1885.	1884.	1883.	1882.	1881.	1880.	1879.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rio Tinto (Spain)	23,484	21,564	20,472	17,389	16,666	16,215	13,751
Tharsis (Spain)	11,500	11,800	9,800	9,000	10,203	9,151	11,324
Mason & Barry (Port)	7,000	7,500	8,000	8,000	8,170	6,603	4,692
Sevilla (Spain)	1,800	2,000	2,026	1,885	1,340	1,705	1,360
Portugueza (Port)	1,665	2,300	2,357	1,700	1,410	1,000	770
Poderosa (Spain)	500	500	1,000	800	800	800	800
Total	45,949	45,664	43,655	38,774	38,589	35,474	32,697

The Rio Tinto mines continue to excite the greatest interest as among the greatest of the world. Their production for a series of years has been as follows:

Production of the Rio Tinto mines.

Years.	Pyrites for shipment.	For extraction of copper by local treatment.	Total.	Actual consumption of pyrites in England, Germany, etc.	Average copper contents of ore mined.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Per cent.*
1877	251,360	520,391	771,751		
1878	218,818	652,289	871,107		
1879	243,241	663,359	906,600	236,849	
1880	277,590	637,567	915,157	274,201	2.619
1881	249,098	743,949	993,047	256,827	2.750
1882	259,924	688,307	948,231	292,826	2.805
1883	313,291	786,682	1,099,973	288,104	2.956
1884	312,028	1,057,890	1,369,918	314,751	3.234
1885	406,772	944,694	1,351,466	354,501	3.102

The production of copper by local treatment at the Rio Tinto mines was as follows since 1876:

Production of metallic copper at Rio Tinto.

Years.	Long tons.
1876	946
1877	2,495
1878	4,184
1879	7,179
1880	8,559
1881	9,466
1882	9,740
1883	12,295
1884	12,668
1885	14,593

In spite of this increase in the production both of pyrites for shipment, and of copper by extraction, the profits have fallen off heavily, and it should be specially noted that while the make in 1885 had risen to 14,593 tons the sales were 16,246.

The profit on sale of produce, the net profit, and the dividends paid were as follows from 1879 to 1884, inclusive:

Years.	Profit on sale of produce.	Net profit.	Dividends.	Dividends.
				Per cent.
1879	£443, 930	£114, 419	£112, 500	....
1880	611, 340	181, 783	180, 000	....
1881	622, 786	(*a*)405, 456	395, 000	....
1882	698, 985	477, 184	455, 000	14
1883	691, 571	459, 678	455, 000	14
1884	472, 326	191, 775	178, 750	5¼

a Including £80,000 reserved from premiums on new issue of shares.

The year 1885 was one of disappointment so far as the sales of pyrites were concerned, since the actual sales fell nearly 50,000 tons behind the quantity estimated during the year. Nor did the output of copper come quite up to expectations. The aim of the management is to reach 20,000 tons of 21 hundred weights, and one of the principal obstacles to attaining that end, the accumulation of a sufficiently abundant water supply, has been overcome by the completion of the great dam some years since. During 1885 the rainfall was abundant, so that a greater output can be handled during the summer of 1886. Substantially no change has taken place in 1885 in the bonded debt of the company, which at the close of that year stood £2,309,820 of 5 per cent. bonds issued in 1880, and £1,177,500 of 5 per cent. bonds, issued 1884, the amount redeemed in 1885 being £53,720. The annual interest charge is therefore £174,366, which must be met before any dividends can be paid on £3,250,000 of stock. Among its reserves the company counts 64,643 tons of copper in the heaps undergoing treatment at the mines, which stand on the books at £6 11*s.*, on which the only cost is that of precipitation, estimated at £15 per ton. The company has leased refining works at Cwm Avon, in South Wales.

The second great pyrites company of Spain, the Tharsis Sulphur and Copper Company limited, has similarly felt the effect of a forced lowering of the price of pyrites through the encroachments of the Solvay soda process and the decline in the value of copper. It has also been touched by the lower prices of iron ore, the residue from roasting the pyrites in sulphuric acid manufacture, and of silver, which is extracted from the burnt pyrites.

The following table gives an epitome of the business during the past four years:

Operations of the Tharsis Company.

Years.	Ore raised.	Pyrites shipped.	Precipitate shipped.	Net profits.	Dividends.
	Long tons.	*Long tons.*	*Long tons.*		
1882	486, 860	218, 218	5, 534	....	....
1883	490, 033	202, 318	6, 717	334, 492	323, 032
1884	518, 552	206, 939	7, 095	....	....
1885	587, 303	311, 151	(*a*)6, 110	104, 211	117, 466

a Larger quantity in stock at mines; total product of fine copper somewhat greater than 1884.

Like the Rio Tinto company, the Tharsis has large waste heaps, from which during 1885 about 1,000 tons of copper were extracted. Unlike the larger concern it does not, however, carry the copper contents thus in reserve as an asset. Unlike it, also, it treats itself a large proportion of its pyrites, selling the copper, the "blue billy," and the silver. During the past four years the company has been paying off a debenture debt of £400,000. Now it is proposed to reissue a similar amount, mainly to provide for the extension of the Huelva Tharsis railroad from the Tharsis to the Calanas mines which are being prepared for an increased output.

Portugal.—The most important producer is the Mason & Barry Company, limited, which works the San Domingos mine. According to the annual report for the year 1885, the amount of ore broken and extracted was 1,033,524 tons from 1878 to 1880, 352,439 tons in 1881, 405,029 tons in 1882, 382,555 tons in 1883, 344,459 tons in 1884, and 350,387 tons in 1885. In the beginning of 1885 the company decided to treat locally for the extraction of copper the whole quantity of ore broken, and therefore the ore sold for its sulphur value are "smalls," low in copper. The company claims that for their sulphur contents these smalls are superior to the lump ore. The price fixed for it is 3½ *d.* and 4 *d.* per unit, according to locality, if sold in England, under the condition that the burnt ore is returned to the company, who then, at their Wallsend works first wash out the small remaining portion of copper and then turn the residual iron ore into a form suitable for use in the blast furnaces. This, it will be noted, is an entire change of base, since it transfers the operation of copper extraction from the works scattered in England and the Continent to the mines in Portugal. To some extent the Rio Tinto Company is doing the same. Mason & Barry increased their production of copper precipitate from 4,860 tons in 1882 to 5,970 long tons, fine copper, in 1883, and to 6,190 long tons, fine copper, in 1884. This is, of course, exclusive of the copper contents of the pyrites shipped. Mr. John C. Barry, secretary, informs this office that in 1885 the copper product of the San Domingos fell off. He estimates the production in fine copper in precipitate and ore at about 7,000 long tons for 1885.

From 1878 to 1884, both years included, the net profits aggregated £1,463,163, out of which there was paid in dividends £1,243,308 on 185,164 shares allotted, at the rate of 12½ per cent. in the years 1881, 1882, and 1883. In 1884 it was reduced to 8 per cent. In 1885 the net revenue applicable to dividends was only £90,340 as against £173,510, and the profits obtained by shareholders fell to 3¾ per cent. per annum.

The following summary gives the capital of these three great companies early in 1886:

Capital in 1886.

Company.	Shares.	Bonds, &c.	Total.
Rio Tinto	£3, 250, 000	£3, 487, 320	£6, 737, 320
Mason & Barry	1, 851, 640	....	1, 841, 640
Tharsis	1, 174, 660	319, 930	1, 494, 590
Totals	6, 276, 300	3, 807, 250	10, 073, 550

Dividends paid on the net revenue applicable thereto.

Company.	Dividends.			Revenue applicable to dividends.	
	1885.	1884.	1883.	1885.	1884.
	Per cent.	*Per cent.*	*Per cent.*		
Rio Tinto	5¼	8	14	£191, 774	£274, 142
Mason & Barry	3¾	8	12½	90, 340	173, 510
Tharsis	10	20	27½	104, 212	273, 148

This shows a decline in the profits in one year of £298,474, or 43½ per cent.

Germany.—The German copper production has held its own during the past few years. That of 1885 is unofficially estimated at 15,250 long tons, an increase of less than 500 tons.

Production of copper in Prussia and in the Mansfeld district.

Years.	Prussia.	Mansfeld district.
	Metric tons.	*Metric tons.*
1875	7, 212	6, 046
1876	8, 235	6, 287
1877	8, 412	6, 908
1878	9, 096	8, 007
1879	9, 610	8, 526
1880	13, 605	9, 814
1881	14, 626	11, 000
1882	(*a*)16, 653	11, 691
1883	(*a*)18, 194	12, 836
1884	(*a*)16, 825	12, 774
1885	....	12, 635

a German Empire, assuming matte produced to carry 50 per cent. of copper.

The last annual report of the Mansfeld'sche Kupferschieferbauende Gewerkschaft, for 1884, kindly forwarded by that company, is of special interest, because it ranks high in the list of the giants of the copper trade, and is probably without a rival as a carefully managed concern. The year 1884 was one of hardships growing out of a breaking through of water into an important district, and while the disaster was not threatening to the future of that district, it involved a heavy outlay for additional machinery and more pumping, and decreased the output of ore and its grade, because it was necessary in order to give employment to the miners to put them into stopes carrying poorer ore. This led to a decline in the production from 536,085 tons of ore to 522,181 metric tons in 1884. It increased the cost of mining by 2,116,252 marks, the expenditures for dead work by 403,090 marks, and for new construction by 406,690 marks. These increased expenditures were partly balanced by a greater yield of silver, by the sale of stocks of copper, the cost of which had been charged to 1883 accounts, and by reductions in smelting costs. The sales of copper were made at comparatively favorable terms; the average for 1884 being 122 marks per 100 kilograms, equal to £61 per long ton. The result was that the falling off in the receipts amounted to only 671,240 marks. The gross profits for the year amounted to 5,675,734 marks, which was reduced by writing off for value of supplies, cost of flooding, and expenditure for two new shafts to 3,352,420 marks, out of which a dividend of 45 marks on 69,120 shares, equal to 3,110,400 marks, was declared. Referring this profit to copper alone, it represents 26.5 marks per 100 kilograms, or roughly £13 per long ton, the bulk of which would be swept away in 1885 by the decline in prices. The company had obligations outstanding to the amount of 9,759,000 marks at the end of 1884. Its assets, exclusive of value of mines and works, are estimated at 31,867,724 marks, so that it is financially strong enough to weather any storms which may threaten the copper producers of the world.

The cost of mining is placed at 32.73 marks per ton, an increase of 5 marks per ton as compared with the preceding year. Labor is very cheap, the average earnings of the miners on contract in the "upper" district being, in 1884, 3.07 marks, or 74 cents per eight-hour shift, and 2.98 marks, or 71 cents in the "lower" district. When it is considered that the bed is so narrow that the miners cannot sit erect in the workings, and that the ore is carried to the main gangways by boys crawling on their sides dragging a sled strapped to the leg, it will be appreciated how low their wages are. In producing the 505,797 tons in the Mansfeld district, 1,106,700 square meters of the bed were extracted, or nearly 2 meters, equal to 21½ square feet of the bed for every ton of ore. The blast furnaces of the company, some of which are blown with hot blast, smelted 517,633 tons of ore, which yielded 36,996 tons of raw matte. This ore averaged 2.592 per cent. of copper, against 2.611 per cent. in 1883, and 0.0154 per cent. of silver, or 4.49 ounces of silver per ton against 0.0152 per cent. in 1883. The roasting of the matte yielded 18,510 tons of chamber acid.

In 1885 the Mansfeld company produced 12,635 metric tons of copper and 75,075 kilograms of silver, the proceeds being 4,812,302 marks less than in the preceding year, leaving a loss of 653,338 marks. Out of the whole decline in the income 3,210,927 marks were due to lower prices realized for copper.

The following table shows the imports of copper and copper manufactures into Germany:

Imports of copper and copper manufactures into Germany.

Character.	1879.	1880.	1881.	1882.	1884.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Ingot copper and brass	13,378	12,719	11,372	10,579	13,819
Copper rods, sheet, and wire	608	770	437	230	538
Manufactured copper	1,201	1,015	1,119	1,015	997
Total	15,187	14,504	12,928	11,824	15,354

The details of the source from which the copper was obtained throw no light on the matter, since a large share of the imports come in transit via Hamburg, the Netherlands, and Belgium. The following is the table, as given in the official imports statistics:

Imports of copper into Germany.

Country.	1884.	Eleven months, 1885.	Country.	1884.	Eleven months, 1885.
	Metric tons.	*Metric tons.*		*Metric tons.*	*Metric tons.*
Hamburg-Altona	2,075	1,681	Great Britain	6,935	5,708
Austria-Hungary	161	138	United States	417	668
France	358	231	Other countries	398	963
Belgium	1,002	963			
Netherlands	2,473	2,193	Total	13,819	12,545

Germany exports considerable copper, though not as much as she imports. According to the latest returns accessible for the first eleven months of 1885, the exports were:

Exports of copper from Germany for 1884.

Country.	Ingots, and old.	Rods and sheets.	Wire and telegraph cable.
	Metric tons.	*Metric tons.*	*Metric tons.*
Hamburg-Altona	131	217	53
Russia	691	134	48
Austria-Hungary	4,065	67	135
Switzerland	119	118	64
Belgium	1,310	34	28
France	235	....	12
Netherlands	91	279	222
Great Britain	81	62	69
Italy	113	202	56
United States	....	....	23
Other countries	69	170	206
Total	6,905	1,283	916
Eleven months, 1885	4,818	2,896	....

France.—The following is an official statement of the quantity of copper produced in French works from imported ores and furnace material, with the exception of a trifling quantity:

Production of copper in France.

Years.	Metric tons.	Years.	Metric tons.
1870	2,100	1877	2,330
1871	2,720	1878	3,500
1872	2,600	1879	3,350
1873	2,140	1880	3,300
1874	2,000	1881	3,395
1875	2,300	1882	3,627
1876	2,230	1883	3,255

The following figures, compiled by English authorities, show the magnitude of the French copper trade:

The French copper trade.

Years.	Imports, all kinds direct.	Imports of American, etc.	Imports of Chili.
	Long tons.	*Long tons.*	*Long tons.*
1876	16,418	4,220	12,198
1877	13,015	4,030	8,985
1878	13,094	4,016	9,078
1879	10,402	4,675	5,727
1880	11,818	320	11,498
1881	16,436	3,205	13,231
1882	13,573	1,379	12,194
1883	20,894	4,830	16,064
1884	18,683	7,597	11,086
1885	15,592	9,235	6,357

Russia.—While the yield of the copper mines in the Oural mountains has been declining, increased attention is being paid to some extent by foreign capitalists to the copper resources of Trans-Caucasia. A report by M. de Fulgence, French vice-consul at Batoum, to his government, refers to the latter at length. The mines of the Tchorok group are not regarded by him as being of early promise on account of the lack of means of transportation, and the want of fuel. Rich ores characterize the Zanguezour group, between Ordoubât and Nakhitchevan, on the left bank of the Araxe, but as the region is so remote from market, the product is only about 300 metric tons, for local consumption. In the Alaverdy district, favored by its proximity to Tiflis, the Alaverdy, Akhtal, and Chamblouk works have closed down because the mines have been robbed. In the Elizabethpol district, the Siemens brothers, the well-known manufacturers of telegraph cables, are operating the Kedabek and Kalakent works, producing in 1884 from 17,000 tons of ore, 1,100 metric tons of copper, at an estimated cost of 110 francs per ton. The copper must be taken by carts to Chamkor and is delivered by rail to Bakou. The exhaustion of the timber resources has led to efforts to use Russian petroleum as a fuel. The most promising of the Trans-Caucasian copper districts yet undeveloped, is the Kakhetie group in the Alezane valley, near Telav. German capital is going into mining there.

Official statistics published in 1884 place the copper product of Russia at the following figures, for a series of years:

Production of copper in Russia.

Years.	Metric tons.
1876	3,876
1877	3,507
1878	3,522
1879	3,126
1880	3,205
1881	3,467
1882	3,595

Austria.—From official sources the following table of the output of the Austrian mines is compiled:

Production of copper in Austria.

Years.	Metric tons.
1879	259
1880	500
1881	482
1882	482
1883	581
1884	681

Cape of Good Hope.—The Cape Copper Mining Company, limited, has, judging from estimates of receipts in England during 1885, fallen off in production by over 600 tons. In 1884, according to the annual report submitted for that year, the receipts were £264,360, for ore averaging 29.25 per cent., at the rate of 9*s.* 3*d.* per unit. The costs and expenses were £203,672, thus showing a net profit of £60,688, equivalent to about £10 14*s.* per long ton of fine copper. In 1884 sufficient sums were drawn from the profit reserve fund to pay dividends and a bonus aggregating £90,000. The decline in the price of copper during 1885 has been so heavy that the profits realized last year must have been reduced to a very low figure, if indeed they have not entirely disappeared. The principal mine is the Ookiep, from which 17,495 tons were obtained, partly from surface reserves however. The old Specktakel mine was closed down in 1885, and the developments, according to the last annual report, did not, in any of the company's properties, disclose any large new bodies. The reserves in the Ookiep mine at the close of 1884 were estimated at 51,312 tons of ore.

Venezuela.—Mr. William Warren, chief resident engineer of the Quebrada Railway, Land and Copper Company, limited, reports to this office the following as the accurate exports of copper from Venezuela:

Years.	Yellow, ruby, and other ores.	Regulus.	Total units of fine copper.
	Long tons.	*Long tons.*	
1885	42,939	2,586	560,833
1884	30,537	6,259	523,514
1883	30,392	3,234	422,135
1882	28,045	3,072	418,030
1881	22,107	2,880	339,256

The bulk of this material was shipped to England, although some was sent to this country for treatment.

LEAD.

THE LEAD INDUSTRY OF THE UNITED STATES.

By C. Kirchhoff, Jr.

The year 1885 has witnessed one of the revulsions in the lead trade which it has repeatedly experienced in the last fifty years. The approaching exhaustion of a number of the heaviest lead-producing mines in the Rocky mountains had its effect in curtailing supplies, although to some extent this was compensated for by the output of mines furnishing an ore high in lead and low in silver, serving merely as the basis of smelting operations. Under a moderate consumptive demand, the country was gradually relieved of pressing stocks; and, when they were largely cleared away, prices steadily rose during the second half of the year until finally the import limits were exceeded, and moderate quantities of foreign lead were needed to cover the deficiency. The high prices for lead came too late in the year to have a strongly stimulating effect upon the output. The product of a large proportion of the leading districts has for some time been regulated rather by the demands of smelters for lead ores, who, during the greater part of the year, even before the advance, paid more for the metal in the ore than they could possibly realize for it in the markets of the country. Notably in the Leadville district, therefore, conditions independent of the price of lead have stimulated the output during the year, and while it is to be expected that the higher prices established towards the end of the year will act as an incentive to vigorous mining, the effect will not be so great as it would otherwise have been had the returns received for lead in the ores been affected solely by the fluctuations of the metal in the great distributing centers. Though still dependent very largely upon the prosperity of individual mines, which may be counted on one's fingers, a far larger proportion of the make is due to the operations of small mines and of low-grade ores than was the case ten years ago. The industry has broadened, and to that extent has become less susceptible to the vicissitudes of individual mines or of single districts. The unexplored territory has been narrowed down considerably. The chances of the discovery of new districts capable of flooding the markets at short notice have been reduced to a minimum, and it is more possible than ever before to gauge the probable supplies for at least moderately long periods in advance. An interesting example is furnished by the estimate made by Mr. D. Bauman of the prospects of Colorado for the current year. On the other hand, it should not be forgotten that comparatively little has been done in an era of depression in railroad building to make new productive sections available. Of late a little more activity has been displayed in this direction. So far as known, none of the lines in course of construction or in contemplation will open out sections capable of quickly furnishing very large supplies. But they will nevertheless enlarge the productive capacity, or fill gaps caused by the decline in other older sections.

In a general way it may be stated that costs have been little affected by the developments of the year 1885. Wages have practically remained the same. Fuel has been lowered in some instances and freights have occasionally declined, but there has been no change so marked as to justify the assertion that the cost per pound delivered at distributing centers has been much lower.

Attention has been called in former reports to the interdependence of silver and lead mining in the Rocky mountains. It has been repeatedly asserted in the past, and this has been true to a certain extent, that lead was merely a by-product in the extraction of silver. If the ground were taken that without its silver contents the lead could not have been profitably worked, then that view of the case would be correct, and even to-day the output would be insignificant under those conditions. But a change has taken place in this respect. A decade since, smelting works, owned and operated by the leading mining companies themselves, could only treat ores carrying both a high percentage of lead and silver. Now the bulk of the ore is smelted by custom smelters who buy both lead ores low in silver and silver ores low in lead. A scarcity of the former forces prices to a point when practically a premium is paid on the metal. A decline in the price of silver, such as has taken place during 1885 and is still continuing, discourages the output of the second class, since a considerable proportion of that which reaches the open market leaves only a narrow margin to the miner. Until now the buyers of lead ores have recouped themselves by profits realized by working the other class. A fall in silver has therefore the tendency to make work less profitable in those mines yielding both metals, and by narrowing the market of purely silver ores, it acts too in the direction of lessening the call for lead ores carrying little or no silver. It is impossible to give numerical expression to this change, but it is generally accepted as having wrought a complete revolution in the trade. An effort to obtain the figures would involve the study of every ore shipment to the different smelters. It may be stated, however, that returns from desilverizing works whose aggregate product was 105,142 tons of refined lead showed a total yield of 25,834,684 ounces of fine silver and 153,642 ounces of fine gold. In 1884 the reports covered 117,608 tons of lead, 21,505,248 ounces of fine silver, and 146,830 ounces of fine gold.

PRODUCTION.

The following table of the production of lead for a long series of years shows that the output of that metal reached its climax in the year 1883, and that it has since steadily declined. The figures from 1825 to 1853 are those published by Whitney; those of the later years have been collected by Mr. Edward A. Caswell, of New York city. Since 1882 the figures are those collected by this office.

Up to the year 1873 no specific data concerning the relative output of the different producing districts were available. For the succeeding years the quantities of desilverized lead and of non-argentiferous lead and the percentage of the former of the total have been added because they reveal clearly the growing importance of the former industry, which has its seat in the Rocky mountains; while almost the whole of the non-argentiferous lead is produced in Missouri, Kansas, Illinois, and Wisconsin, only a small quantity being made in Virginia. In this table, and throughout this paper, the tons are short tons of 2,000 pounds.

Production of lead in the United States.

Years.	Total production.	Desilverized lead.	Non-argentiferous lead.	Percentage of desilverized lead.
	Short tons.	*Short tons.*	*Short tons.*	*Per cent.*
1825	1,500			
1830	8,000			
1831	7,500			
1832	10,000			
1833	11,000			
1834	12,000			
1835	13,000			
1836	15,000			
1837	13,500			
1838	15,000			
1839	17,500			
1840	17,000			
1841	20,500			
1842	24,000			
1843	25,000			
1844	26,000			
1845	30,000			
1846	28,000			
1847	28,000			
1848	25,000			
1849	23,500			
1850	22,000			
1851	18,500			
1852	15,700			
1853	16,800			
1854	16,500			
1855	15,800			
1856	16,000			
1857	15,800			
1858	15,300			
1859	16,400			
1860	15,600			
1861	14,100			
1862	14,200			
1863	14,800			
1864	15,300			
1865	14,700			
1866	16,100			
1867	15,200			
1868	16,400			
1869	17,500			
1870	17,830			
1871	20,000			
1872	25,880			
1873	42,540	20,159	22,381	47.7
1874	52,080			
1875	59,640	34,909	24,699	58.5
1876	64,070	37,649	26,421	58.8
1877	81,900	50,748	31,152	62.0
1878	91,060	64,290	26,770	70.6
1879	92,780	64,650	28,130	69.7
1880	97,825	70,135	27,690	71.7
1881	117,085	86,315	30,770	73.7
1882	132,890	103,875	29,015	78.3
1883	143,957	122,157	21,800	84.8
1884	139,897	119,965	19,932	86.4
1885	129,412	107,437	21,975	83.0
Total	2,002,546			

The figures for the output of desilverized lead are the aggregates of the returns made by every desilverizing works in the country. This system of depending upon the refiners for the record of output has been accepted by this office because it gives the certainty that the figures of small smelters working intermittently at many points in the Rocky mountains are included. It affords the closest approximation, furthermore, to the amounts actually available for consumption since the aggregate of the smelters' returns would be too great. Thus alone the silver contents of base bullion would call for an allowance of nearly 700 tons, and the waste due to refining and the removal of antimony, arsenic, copper, and other impurities, would require a further deduction of at least 4 per cent. Thus, to produce 107,437 tons of refined lead, the smelters' returns would have to show roughly 112,500 tons. The presentation of that figure would be very misleading. On the other hand, the output of the refiners may not correctly express the real make of lead in the country. The desilverizing works may have entered the year carrying a greater or smaller stock of base bullion than they did at its close, and the same may be true of the smelters, who in addition thereto may have worked partly on stocks of ore. The result may be that the output of refined lead may considerably over or under state the actual extraction of lead from the mines of the country. This is known to have been true in the year 1885. Notably, some of the Leadville smelters carried over 1884 output forwarded to market in 1885, so that the actual product of the country was even somewhat less than the return shows. It is estimated that therefore it was not more than 127,000 to 128,000 tons, indicating even a heavier decline than the face of the returns shows.

During the year 1885 the interchange of ores from one Territory or State to another has grown so much through the concentration of smelting operations in a few leading sections, and through the growth of the smelting operations at refining works, that an attempt to trace the lead to its source had to be abandoned. The ore passes through so many hands in many cases that its identity can be traced only by a laborious investigation which would involve too great a demand upon the time of those interested. This is much to be regretted because it makes it all the more difficult to trace the changes in the relative importance of different sections as producers. Some general data bearing upon this subject will, however, be found elsewhere. It may be stated, however, that Colorado and Utah bear between them by far the greatest proportion of the decline. The last estimate is repeated for the sake of affording some idea of the magnitude of lead mining in different States and Territories.

Source of the lead produced in the United States in 1883, 1884, *and* 1885, *by States and Territories.*

States and Territories.	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*
Utah	29,000	28,000	23,000
Nevada	6,000	4,000	3,500
Colorado	70,557	63,165	55,000
Montana	5,000	7,000	(?)
Idaho	6,000	7,500	(?)
New Mexico	2,400	6,000	5,000
Arizona	1,500	2,700	3,000
California	1,700	1,600	1,000
Missouri, Kansas, Illinois, and Wisconsin	21,600	19,676	21,650
Virginia	200	256	250
Total	143,957	139,897	112,400

LEAD-PRODUCING REGIONS OF THE UNITED STATES.

Utah.—For a series of years, the production of the Territory has been estimated as follows:

Production of lead in Utah.

Years.	Short tons.	Years.	Short tons.
1871	5,000	1879	14,000
1872	8,000	1880	15,000
1873	15,000	1881	24,000
1874	20,000	1882	30,000
1875	19,000	1883	29,000
1876	25,000	1884	28,000
1877	27,000	1885	23,000
1878	21,000		

According to the statement of Messrs. Wells, Fargo & Co., the product of Utah was as follows:

Wells, Fargo & Co.'s statement of the product of Utah for 1885.

Base bullion.	Unrefined lead.	Fine silver.	Fine gold.
	Pounds.	*Ounces.*	*Ounces.*
Germania Lead works	7,975,400	629,754	1,404
Hanauer	9,352,644	666,685	2,158
Horn Silver Mining Company (three months)	4,905,932	123,062	....
Mingo Furnace Company	11,744,000	403,081	1,586
Net product base bullion	33,977,976	1,822,582	5,148
Lead, silver, and gold in ores shipped	20,340,800	1,366,994	2,141
Total	54,318,776	3,189,576	7,289

The Germania lead works, and the Hanauer and Mingo works are custom smelters, drawing supplies largely from Idaho, and to some extent from Montana. Since no data are available concerning the proportion of their output of 15,536 tons, which originated outside of Utah, it is impossible to give the net amount really coming from that Territory. It is probably in the neighborhood of 23,000 tons.

The tonnage of the different districts has been estimated as follows:

District.	Tons.
Cottonwood	1,800
Bingham	22,500
Toolee	10,000
Tintic	34,000
Beaver	15,000
Park City	20,000

The principal event of the year 1885 was the closing down on April 1 of the Horn silver mine, whose product therefore declined from about 15,000 tons in former years to only about 2,500 tons. During the year, however, the Horn silver mine is estimated to have marketed, besides their product, an old stock amounting to about 2,500 tons. So heavy a falling off in the product of one mine, with slight prospects of an early return to productiveness, was largely responsible for the reduced output of lead in the United States in 1885. The advance in the price of lead has, however, given an impetus to mining in all of the silver-lead ore producing districts of Utah. Many small mines on which work had been suspended for years were reopened during the second half of 1885, and thus kept up fairly well the aggregate of the lead product of the Territory.

In Little Cottonwood the Joab Lawrence mined 1,200 tons of ore, and the Big Cottonwood and the Maxfield produced considerable quantities towards the close of the year. Bingham has profited by the advance in lead more than any other district, since the chief value of its low grade ores lies in that metal. The Brooklyn is the principal producer, having shipped about 9,000 tons, followed by the Lead mine and the Yosemite. Among the mines of Toolee county which show increased activity, are the Honorine and the Calumet at Stockton; the Hidden Treasure, in Dry Cañon; and the Stanton and Miners' Delight at Ophir. As indicating the effect of higher lead prices, it may be stated that the ore shipments over the Utah and Nevada railroad rose from 2,646 short tons in the first half of 1885 to 6,874 tons in the second half. During the latter part of 1885, the Waterman smelter was made ready for work. In the Tintic country the Eureka Hill has shipped 11,300 tons, and the Bullion, Beck, and Champion 11,840 tons, both running low in lead, however.

One of the most striking instances of shipments to smelters on the part of what were formerly classed as silver mines is furnished by the Ontario mine. In addition to crushing large quantities in its own stamp mills, this company sold 8,752 tons of ore to smelters containing 1,361 tons of lead, 809,621 ounces of silver, and 700 ounces of gold.

The Crescent, at Park City, which has large bodies of low-grade ores, produced in eleven months of its fiscal year (ending September 30) 11,581 tons of ore netting $199,413, the ore averaging 30 per cent. of lead.

The Sampson, near the Crescent, has sent to market about 1,300 tons of 25 per cent. ore.

Nevada.—Since 1877 the production of lead in the State has been as follows:

Production of lead in Nevada since 1877.

Years.	Short tons.	Years.	Short tons.
1877	19,724	1882	8,590
1878	31,063	1883	6,000
1879	22,805	1884	4,000
1880	16,659	1885	3,500
1881	12,826		

The only district of importance, furnishing almost the entire product, is the Eureka, in which the Eureka Consolidated and the Richmond companies are the principal producers. The following data, taken from the last annual reports of these companies, will furnish some idea of the conditions affecting the district generally:

The Richmond desilverizing works turned out in 1885, 1,657 tons of refined lead, 418,000 ounces of silver, and 13,085 ounces of gold. According to the annual report, for the fiscal year ending February 28, 1886, the company smelted 7,559 tons of Richmond ore and 7,493 tons of purchased ores, which yielded 2,045 short tons of lead, 444,368 ounces of silver, and 13,163 ounces of gold. At the commencement of the fiscal year the company was carrying 11,644 tons, and sold 7,538 short tons, leaving an estimated stock of about 6,000 tons.

A small quantity of lead has been produced by the Eureka and at the smelter of the Wells company in Elko county. It has been proposed to enlarge the smelting facilities of the latter during the current year. The total product of the State has therefore remained very moderate, nor do the developments to date hold out any promise of increased supplies from that source.

Colorado.—This State has remained the heaviest contributor to the supply of lead of this country.

Production of lead in Colorado.

Years.	Short tons.	Years.	Short tons.
1873	56	1880	35,674
1874	312	1881	40,547
1875	818	1882	55,000
1876	667	1883	70,557
1877	897	1884	63,165
1878	6,369	1885 (smelter's base bullion product)	66,251
1879	23,674		

The total given for 1885 is the output of all the smelters in Colorado. How large a proportion of the lead thus credited to that State is in reality from other quarters may be conceived when it is stated that out of the whole published figures, covering the operations of the

Omaha and Grant Smelting and Refining Company, of 13,827 short tons not less than 8,423 short tons were from States and Territories other than Colorado. It is probable that the actual lead product of the State did not exceed, if it did reach, 55,000 short tons.

The following figures relate to Leadville:

Leadville bullion product.

Years.	Lead.	Silver.	Gold.	Ore.	Value of ore shipments.
	Tons.	*Ounces.*	*Ounces.*	*Tons.*	
1877	175	376,827	3,750	3,300	$400,000
1878	2,324	450,476	897	15,840	2,360,503
1879	17,650	6,004,416	1,100	18,549	2,851,850
1880	33,551	8,999,399	1,687	12,410	1,460,363
1881	38,101	7,162,909	12,192	15,630	1,016,044
1882	39,864	8,376,802	12,615	22,416	1,872,604
1883	36,870	5,057,990	22,330	(?)	6,420,692
1884	35,296	5,720,904	22,626	(?)	(?)
1885	19,128	5,099,271	8,262	137,869	(?)

The railroad shipments of bullion from Leadville during 1885 were 21,328 tons, thus showing that heavy stocks held in the beginning of the year were cleared away in the course of 1885. The railroad shipments of ore were 137,869 tons. The *Herald-Democrat* estimates the contents of 132,000 tons shipped, at 16,972 tons of lead, 3,184,514 ounces of silver, and 24,440 ounces of gold. This would make Leadville's contribution 36,100 short tons, a falling off as compared with 1884.

Through the active competition of the smelters both at Leadville and in the "valley," Leadville has become, comparatively speaking, one of the most favorable ore markets, to the miner, in the world. This will be clearly apparent from the following quotations which have been the basis of transactions, during the year 1885. They represent the prices paid at Leadville, delivered at the sampling works. Classifying the ores we have:

(1) *Carbonate lead ores.*—The principal producers of this class of ore are the Iron Mining Company, the Silver Cord, Adams Mining Company, the Little Ella, the Carbonate Hill mines, among which are prominent: the Crescent, the Morning Star, the Evening Star, etc., and finally, a number of mines at Red Cliff, a tributary camp.

The highest bid for this class of ore has been: New York quotation for silver, less 5 per cent., $20 per ounce for gold, and 40 cents per unit, or each per cent., for lead, if under 40 per cent. of lead, and 45 cents per unit, if over 40 per cent. of lead, regardless of the actual New York price for lead. The bid provided that there be no smelting charge whatever.

The following is the general price list for lead ore during 1885:

Silver: New York quotation, less 5 per cent.

Gold: $19 per ounce, if over 0.1 ounce per ton.

Lead: 45 cents per unit, when the New York quotation of lead is 4.25 cents; 40 cents per unit, when the New York quotation of lead is under 4.25 cents.

Working charges, per ton of 2,000 pounds, dry weight.

Kind of ore.	Charges.
On 30 per cent. lead ore	$3.00
On 25 per cent. lead ore	4.00
On 20 per cent. lead ore	5.00
On 15 per cent. lead ore	6.00
On 10 per cent. lead ore	7.00
Under 10 per cent. lead ore	8.00

(2) *Dry oxidized silver ores.*—The leading producers of this class of ore are the Matchless, the Forest City, the Denver City, the Robert E. Lee, the Silver, and the May Queen mines.

Silver: New York quotation, less 5 per cent.

Working charges: $12 per ton of 2,000 pounds.

(3) *Argentiferous iron ore.*—The leading mines which market this class of ore are the Morning Star, the Henriett, the Denver City, the Dunkin, the Robert E. Lee, and the Matchless. The following is the basis on which this ore is sold. The contents of the ore, in percentages, of metallic iron and of metallic manganese is added, and from this is deducted the contents, in per cent. of silica. The figure thus arrived at is called the "base excess," and the tariff standard is based on the assumption that this "base excess" is 40 per cent. The prices paid during 1885 were:

(*a*) For low grade iron ore, carrying 12 ounces of silver or less per ton:

Silver: 50 cents per ounce.

Working charge: none.

Iron: 10 cents added for each per cent. iron or manganese over 40 per cent. "base excess"; 10 cents deducted for each per cent. iron or manganese under 40 per cent. "base excess."

(*b*) For first-grade iron ore, carrying over 12 ounces of silver per ton:

Silver: New York quotation, less 5 per cent.

Working charge: $6 per ton.

Iron: 10 cents added for each per cent. iron or manganese over 40 per cent. "base excess," and 10 cents deducted for each per cent. iron or manganese under 40 per cent. "base excess."

(4) *Sulphurets carrying galena.*—The principal producers are the "Colonel Sellers" and the "Minnie" and the "A. Y." mines. The lowest price paid until March, 1885, was as follows:

Silver: 90 per cent. of New York quotations.

Lead: 25 cents per unit when the New York quotation is 4 cents for lead. Five cents per unit is added or deducted for each 5 cents per 100 pounds advance or decline in the New York quotation for lead.

Zinc: 12 per cent. is the standard. For each unit of zinc above the standard 50 cents is deducted.

Working charge: $21.50 per ton of 2,000 pounds.

The latest and highest prices paid in 1885 for this class of ore were the following:

Silver: 93 per cent. of New York quotations.

Lead: 35 cents per unit, when the ore contains 30 per cent. of lead, 40 cents per unit when the ore contains over 30 per cent of lead.

Zinc: Standard, 20 per cent. For each unit above 20 per cent. 50 cents is deducted.

Working charges.

Kind of ore.	Charges.
	Per ton.
On 20 per cent. lead ore	$19.00
On 20 to 25 per cent. lead ore	18.00
On 25 to 30 per cent. lead ore	17.00
On over 30 per cent, lead ore	16.00

(5) *Sulphurets with no galena and little zinc.*—These ores, high in iron pyrites, which are produced by the Mike and Star mine, are sold on the following basis:

Silver: 95 per cent. of New York quotation.

Copper: $1 per unit.

Working charges: $13 per ton, free on board cars.

(6) *Sulphurets with no galena and* 10 *to* 15 *per cent. of zinc.*—This class of ore is produced chiefly by the Forepaugh mine, and is paid for at the following rates:

Silver: 95 per cent. of New York quotation.

Working charges: $15 per ton, free on board cars.

When it is considered that coke, containing 20 per cent. of ash, costs at Leadville $13 per ton, and that the cost of smelting, placing it at a low figure, is $8 per ton run of ore, it will be understood by an examination of the above figures that more is paid for the lead in the ores than can be recovered for it.

During the current year smelting charges have been more favorable thus far to the furnace men, without rising so much as to discourage mining.

Mr. D. Bauman, of Buena Vista, under date of January 26, has furnished an estimate of the probable output of lead ores in Colorado, based upon a careful study of the conditions existing at that time. Such an estimate is of course subject to many contingencies affecting individual producers, entire groups of mines or the whole industry. The total may be swelled by the striking of exceptionally high grade bodies of great magnitude, or by temptingly high prices. It may be diminished by accidents, labor troubles in allied industries or a decline in values. As it is however, it constitutes a thorough and clear review of the actual status of the industry of more immediate interest than a historical sketch of the happenings of the past year.

In Leadville the first group of mines to be considered is that of Main Fryer hill. The record of the Chrysolite, Little Chief, and Little Pittsburgh shows that whatever vitality they may possess as producers of dry and milling iron ores, their output will not be greater than 3,000 tons of lead ore, averaging 12 per cent. Adding 50 tons of 20 per cent. ore from a few smaller mines, a total of 370 tons of lead is reached. The product of the Matchless, New Pittsburgh, and Hibernia, on East Fryer hill, yielding ore of higher grade, is estimated at 750 tons of metallic lead contents. The mines on Yankee hill, of which the leading ones are the Moyamensing, May Queen, Forest City, Denver City, Lee Basin, Alleghany, Scooper, and Chieftain, carry but little lead in the siliceous and ferruginous ores they turn out. It is estimated that 300 tons of lead will cover the product.

The three sections of Leadville thus far mentioned are those lowest in lead, though their importance is great in other respects as producers of iron and dry chloride and iron sulphide ores. Those acquainted with that section look forward to the discovery of lead sulphide ores both on East Fryer and Yankee hills, but it is not believed that even if this possibility is verified that it will have any appreciable effect upon the current year's markets.

Carbonate hill is looked forward to as one of Leadville's chief sources of lead ore supply, and it is likely that fully nine-tenths of it will come from the Maid of Erin, Henriett, Brookland-Clontarf or Adams mines, the Wolf Tone-Agassiz, and Morning Star. It is believed that these mines combined will produce not less than 9,000 tons of metallic lead, provided the Maid of Erin and Henriett ship 10,000 tons of ore, which it is believed that they will do, though it is not likely that they will exceed it much. The Wolf Tone-Agassiz are counted upon to contribute a like amount to the market. A number of other mines, among them the Catalpa, Carbonate, Leadville, Glass-Pendery, Crescent, Ætna, Modest Girl, and a few others, may yield 200 tons of metallic lead. Thus far the preparations for treating the sulphides of Carbonate hill are not extensive, and until now the development of that class of ore in a large body has been limited to the Wolf Tone.

On Iron hill the mines of the Iron-Silver Company, including its California Gulch properties, may be credited with an output of 24,000 tons, including concentrates, the whole averaging about 16 per cent., or 3,840 tons of metallic lead. The Silver Cord mines, which shipped last year nearly 10,000 tons, of which a large percentage was high-grade ores, now show more sulphides, which are too low to be marketed without previous concentration, which has not been provided for as yet. They will not, therefore, in 1886 occupy the same prominent position as contributors to the lead supply. On the other hand, another lead mine, called the Benton, has been opened in the rear of Iron Hill, in what is known as Adlaide Park. It is an extension of the regular deposits of the Park mine, which a few years since made considerable shipments. During the greater part of 1885 the Benton mine sent to market from 500 to 600 tons per month of ore carrying 36 per cent. of lead. It may be credited with 4,000 tons of ore or 1,000 tons of lead in 1886, the policy of the management at present being rather to push development work than to extract ore. The Argentine, Terrible, Humboldt, Newton, and Silver Cord may be estimated at 1,000 tons of metallic lead. The Louisville, Colorado No. 2, and North Ruby may produce 7,500 tons of 30 per cent. ore. It is possible that the grade may be lower, but in that case it is likely that the tonnage will be heavier, so that the product of metal may be put at 2,250 tons. The Smuggler, Iron Hill Consolidated, and the A. Y. and Minnie mines may be relied upon for 6,000 tons of carbonates, equivalent to 1,200 tons of lead. The great sulphide deposits of the Colonel Sellers, A. Y., Minnie, Accident, Sierra Nevada, and Moyer, which form one enormous ore chute, believed to be continuous through the William Moyer placer, the eastern part of the Silver Cord, and the Ruby, is an uncertain element in the question. It depends upon the success of the concentrating works built already and the activity with which building of new works will progress during the year. The sales of ore of the Colonel Sellers mine and the output of its concentrating plant may be estimated at 18,000 tons, equivalent to 4,250 tons, and the yield of the A. Y. and Minnie mines may be placed at 3,000 tons of sulphides or 1,000 tons of metallic lead.

On Rock hill the Sullivan, Only Chance, and Emmet mines will produce not less than 7,000 tons of lead ore, aggregating 2,500 tons of lead. The La Plata, Crown Point, Pinnacle, Montgomery, Gilt Edge, Sequin, Pease, Willis, and Moyer properties are believed to be good for 10,000 tons of lead ore, carrying 2,500 tons of lead. The Lillian, Brian Boru, G. M., Favorite, and other mines of Printer Boy hill will in all likelihood yield about 5,000 tons of ore or 1,000 tons of lead. The Upper Iowa Gulch mines and Ball Mountain will probably not exceed 500 tons of lead ore or 200 tons of metal, and will do well if they produce that.

On Little Ellen hill the New Year property is known to contain large ore bodies, but it will hardly come into the market this year, since the incline being driven towards them will probably not reach it until the close of the year. All the other mines of this section, with the exception of the Little Ellen mine proper, have been poorly worked and are partly unsafe. So far as lead ore is concerned they are pockety. The Little Ellen and the majority of the other mines are worked by lessees. It is not likely that all of them together will ship more than 6,000 tons of ore or 1,200 tons of lead, unless the New Year mine begins active extraction earlier than expected.

Mount Sheridan, Sugar Loaf, Mount Kevin, and Frying Pan mines, in the vicinity of Leadville, may produce 300 tons of metallic lead.

The Red Cliff district, in Eagle county, is tributary to Leadville. The Iron Mask and Black Iron are the principal producers, and with the Little Chief, Ollie, Belden, Eagle Bird, and others, will turn out at least 11,000 tons of ore or about 3,500 tons of metallic lead.

At Aspen, in Pitkin county, a number of the principal mines have been consolidated as the Aspen Mining and Smelting Company, the aim of which will be to increase the smelting capacity and cheapen the transportation facilities with the coal mines controlled by it. It is believed that the delays incident to the carrying out of such comprehensive plans will keep the output within 3,500 tons of metallic lead.

In Chaffee county the Monarch district has been the greatest producer, next to Leadville. The Madonna mines, owned by the Colorado Smelting Company, shipped, in 1885, 32,000 tons gross or 29,000 tons net, yielding about 10,000 tons of lead.

The White Pine district, in Gunnison county, is a lead carbonate camp, with the Eureka Nest Egg as the most prominent mine operated by the American Mining and Smelting Company, which ships the product to the Royal George smelter at Cañon City, owned by the same company. The majority of the other mines are mere prospects, and the ore of several of them carries an undesirable percentage of zinc carbonate. For the grade of its silver ores the district is too far distant from railroad communication, and heavy snowfalls further embarrass shipping. Therefore it is assumed that the shipments will not exceed 20 tons per 250 shipping days, or 1,400 tons of metallic lead for the year.

Until the spring of 1885 Custer county produced very little lead ore, the only mine of any consequence being the Bull Domingo, the ore from which requires concentration. Operations were begun during the course of 1885 to open a known lower ore body, but the plant was destroyed by fire. The only important lead mine is the Terrible, at Ilse, at the head of Oak creek, which, with its concentrating plant, has gone into the hands of the Omaha and Grant Smelting Company. The ore is quarried in a width of about 90 feet, the lead occurring as cerussite disseminated in a porphyry gangue. The mill produces daily two carloads of 60 per cent. concentrates. Allowing only 250 working days, the output would be 5,000 tons of ore, equivalent to 3,000 tons of metal. A few smaller concentrators at Silver Cliff and the Bull Domingo may probably add 200 tons of metallic lead to the output of Custer county for the current year.

Clear Creek, Boulder, Gilpin, Summit, and Park counties have gradually increased their output during the past five years from 1,000 to 1,500 tons of lead, the greatest part of which is the product of concentration. Some of it, from Park and Summit counties, goes to Leadville.

Those irregularly producing districts are to be considered next, whose product cannot reach the great smelting centers at Denver and in the Arkansas valley. Depending as they do, therefore, upon local markets, their output has been pushed. During the last two years attempts have been made at several points in southern and western Colorado to create permanent home markets by the building of smelting works. The majority of these efforts have ended in failure, the points showing greatest vitality being Durango, Rico, and Gunnison.

City. The districts tributary to these markets may send there and to competitive points a tonnage equal to 6,000 tons of lead.

Recapitulating these figures, we have the probable lead output of Colorado as follows:

Probable output of lead in Colorado in 1886.

Locality.	Metallic lead in ore.
Leadville:	*Short tons.*
Main Fryer hill	370
East Fryer hill	750
Yankee hill	300
Carbonate hill	9,200
Iron hill:	
Iron Silver Consolidated	3,840
Adlaide, Terrible, Argentine, Humboldt, Newton	1,000
Benton	1,600
Louisville, Colorado No. 2, Ruby	2,250
Smuggler, Iron Hill, Consolidated, Blind Tom, Queen of the West, A. Y. carbonates	1,200
Colonel Sellers sulphide	4,250
Minnie, A. Y. sulphide	1,000
Rock hill:	
Sullivan, Only Chance, Emmet	1,500
La Plata, Crown Point Pinnacle, and others	2,500
Printer Boy hill:	
Lillian and others	1,000
Upper Iowa gulch	400
Printer Boy hill—Continued.	*Short tons.*
Little Ellen hill	1,200
Mt. Sheridan, Sugar Loaf, St. Kevin	300
Total, Leadville	32,660
Red Cliff, Eagle county	3,500
Aspen	3,500
Klamath district, Chaffee county	11,000
White Pine, Gunnison county	1,400
Custer county, Terrible, &c	3,200
Clear Creek, Boulder, Gilpin, Summit, and Park counties	1,500
Gunnison, Rico, and Durango smelters and districts	6,000
Total	62,760
Deduct 15 per cent. for loss in transit of ore, moisture, and loss in smelting	8,214
Total	54,546

The above estimate was submitted for revision to Mr. Bauman in July. He reports that the estimate for Fryer Hill calls for no modification, and that the aggregate for Carbonate Hill will remain the same, although the Adams and Morning Star mines have turned out more than the figure given them. On the other hand, there has been a corresponding falling below the expectations of the Henriett and Maid of Erin, due to troubles with water. It should be noted also that the Castleview is coming in as a fair producer. Mr. Bauman thinks it possible that Carbonate Hill may exceed the estimate of 2,000 tons if the present rate of output is continued. For the first half of the year it has not been attained, however. On Iron hill about 1,000 tons should be deducted from the figure credited to the Benton deposit, but, on the other hand, the Louisville and Colorado No. 2 will make up the deficiency. In the Monarch district, Chaffee county, the Madonna will fall behind somewhat on account of trouble with surface water. The amount lost will, however, be covered by the Silent Friend. The shipments from Red Cliff are larger than given, but the percentage of lead in the ore accepted as the average is too high, so that there will be no material change.

Montana.—The Helena Mining and Reduction Company, at Wickes, has continued its prosperous career, having produced during 1885, 3,464 tons of lead, 601,362 ounces of silver, 18,440 dwts. of gold, and 10,433 pounds of copper, which is about the same as the product of 1884. The company paid dividends aggregating $138,500. In southern Montana the Glendale was the leading producer, though the dividends, $195,000, were not so heavy as those of 1884. At Toston a smelter has been in operation part of the time and has since turned out larger quantities. Some lead was produced also in the Barker district and in Beaver Head county. Better transportation facilities will, it is expected, make the Ten-Mile district, known to carry heavy lead ores, a more prominent section.

Idaho.—The year 1885 has witnessed considerable development in the lead and silver mines of Idaho, though in the aggregate its product has not come up to the expectations of an earlier period. It is difficult to arrive at any accurate estimate of the lead product, because a large, in fact the heaviest, proportion is shipped in the form of ores and concentrates. In the Wood River district the Queen of the Hills has been the leading producer, having shipped in 14 months, of which 2½ were lost by a strike, 3,636 tons of ore, estimated to average about 70 per cent. of lead, the freight and smelting charges being reported at $37 per ton. Towards the end of the year the capacity of the concentrating plant has been doubled to 100 tons per day. The Idahoan has also been productive and prosperous, while the output of the Minnie Moore has fallen off through the faulting of the deposit. The Mayflower has been run by tributers, its concentrating works being idle, and the Eureka has done nothing. At Ketchum the smelting works of the Philadelphia Company have been turning out some bullion. The Buzzo mine has done little, the Parker has been prospecting, and the Elkhorn has contributed little to the market. In the Little Wood River district some work was accomplished by the Eagle Bird. From the Galena, Little Smokey, and Sawtooth districts small quantities of high-grade ores have been shipped, and in some cases transportation facilities have been improved, so that there is some outlook for a larger and steadier supply. At Bay Horse the smelter has been idle, while A. J. Cook & Co.'s reduction works at Clayton have turned out about 500 tons of base bullion. At Nicholia, smelting operations have been carried on for a part of the year.

The higher prices for lead are likely to stimulate its production considerably during the current year, and a heavier output from Idaho is confidently expected.

New Mexico.—In New Mexico the Billing works at Socorro turned out by far the heaviest proportion of the lead produced in this Territory. According to published returns the make was 4,651 tons of base bullion, carrying 909,652 ounces of silver and 3,926 ounces of gold. Besides this a small quantity of lead in the aggregate has been added to the output by scattered concerns smelting intermittently. The total make of lead from New Mexican ores did not probably reach 5,000 tons.

Arizona.—The only two works which produced lead in Arizona were the Benson works, Cochise county, which, according to published returns, made 2,435 tons of base bullion, and the smelter of the Tombstone Mining and Milling company, which added 728 tons, making a net product of about 3,000 tons. Considerable quantities of ore carrying some lead are shipped to distant smelters. Nogales is the only addition to the reduction plants, and it gets a good deal of ore from Mexico, which comes in free, being argentiferous.

Missouri.—Under the stimulus of good prices, the product of the non-argentiferous mines of Missouri, Kansas, and Illinois has gained, and it is likely to grow further still, during the current year. The product of the St. Joe, Desloge, and Mine La Motte companies, the leading ones in Missouri, aggregated alone in 1885, 13,863 short tons. The works of the Desloge company were destroyed by fire, and the property has since been acquired by the St. Joe Lead Company.

IMPORTS.

Since the shortage in the supply of domestic lead, the imports have again assumed significance. The following tables give in detail the quantities of ore and dross, pigs and bars, sheets, pipe, and shot, and other manufactures not specified, imported since 1867:

Lead imported and entered for consumption in the United States, 1867 *to* 1885 *inclusive.*

Fiscal years ending June 30—	Ore and dross.		Pigs and bars.		Sheets, pipe, and shot.		Shot.		Not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*			
1867	611	$25	65, 322, 923	$2, 812, 668	185, 825	$9, 560	....	....	$6, 222	$2, 828, 475
1868	6, 945	239	63, 254, 677	2, 668, 915	142, 137	7, 229	....	....	6. 604	2, 682, 987
1869	....	....	87, 865, 471	3, 653, 481	307, 424	15, 531	....	....	18, 885	3, 687, 897
1870	5, 973	176	85, 895, 724	3, 530, 837	141, 681	6, 879	....	....	10, 444	3, 548, 336
1871	316	10	91, 496, 715	3, 721, 096	86, 712	4, 209	....	....	8, 730	3, 734, 045
1872	32, 331	1, 425	73, 086, 657	2, 929, 623	12, 518	859	....	....	20, 191	2, 952, 098
1873	....	....	72, 423, 641	3, 233, 011	105	12	420	$50	21, 503	3, 254, 576
1874	....	....	46, 205, 154	2, 231, 817	....	....	30, 219	1, 349	36, 484	2, 269, 650
1875	13, 206	320	32, 770, 712	1, 559, 017	....	....	58	4	25, 774	1, 585, 115
1876	....	....	14, 329, 366	682, 132	....	....	20, 007	1, 204	27, 106	710, 442
1877	1, 000	20	14, 583, 845	671, 482	....	....	16, 502	1, 242	1, 041	673, 785
1878	....	....	6, 717, 052	294, 233	....	....	15, 829	963	113	295, 309
1879	....	....	1, 216, 500	42, 983	....	....	3, 748	209	930	44, 122
1880	....	....	6, 723, 706	246, 015	....	....	1, 120	54	371	246, 440
1881	5, 981	97	4, 322, 068	189, 129	....	....	900	65	1, 443	160, 734
1882	21, 698	500	6, 079, 304	202, 603	....	....	1, 469	99	2, 449	205, 651
1883	600	17	4, 037, 867	130, 108	....	....	1, 510	79	8, 030	138, 234
1884	419	13	3, 072, 738	85, 395	15, 040	630	....	....	1, 992	88, 030
1885	4, 218	57	5, 862, 474	143, 103	971, 951	22, 217	....	....	1, 372	166, 749

Old and scrap lead imported and entered for consumption in the United States, 1867 *to* 1885 *inclusive.*

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

Lead ashes imported and entered for consumption in the United States, 1869 *to* 1881 *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1869	$1,461	1875	$503
1870	8,892	1876	4,241
1871	8,852	1877	33,297
1872	1,315	1878	4,886
1873	254	1879	69
1874	1,583	1881 (*a*)	67

a Not separately classified since 1881.

EXPORTS.

Except during the period of 1842 to 1846, both fiscal years included, and in the years 1878 and 1879, when considerable quantities of lead were sent to China, the export movement of lead has always been insignificant as compared with the home production.

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

Fiscal years ending September 30 until 1842, and June 30 since.	Manufactures of—			Bars, shot, etc.		Total value.
	Lead.		Pewter and lead.			
	Quantity.	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
1790	13,440	$810	....	....	....	$810
1803 (barrels)	900	....	....	....	....	....
1804	19,804	....	....	....	....	....
1805	8,000	....	....	....	....	....
1808	40,583	....	....	....	....	....
1809	126,537	....	....	....	....	....
1810	172,323	....	....	....	....	....
1811	65,497	....	....	....	....	....
1812	74,875	....	....	....	....	....
1813	276,940	....	....	....	....	....
1814	43,600	....	....	....	....	....
1815	40,245	....	....	....	....	....
1816	35,844	....	....	....	....	....
1817	111,034	9,993	....	....	....	9,993
1818	281,168	22,493	....	....	....	22,493
1819	94,362	7,549	....	....	....	7,549
1820	25,699	1,799	....	....	....	1,799
1821	56,192	3,512	....	....	....	3,512
1822	66,316	4,244	....	....	....	4,244
1823	51,549	3,098	....	....	....	3,098
1824	18,604	1,356	....	....	....	1,356
1825	189,930	12,697	....	....	....	12,697
1826	47,337	3,347	....	....	....	3,347
1827	50,160	3,761	....	....	....	3,761
1828	76,882	4,184	....	....	....	4,184
1829	179,952	8,417	....	....	....	8,417
1830	128,417	4,831	....	....	....	4,831
1831	152,578	7,068	....	....	....	7,068
1832	72,439	4,483	....	....	....	4,483
1833	119,407	5,685	....	....	....	5,685
1834	13,480	805	....	....	....	805
1835	50,418	2,741	....	....	....	2,741
1836	34,600	2,218	....	....	....	2,218
1837	297,488	17,015	....	....	....	17,015
1838	375,231	21,747	....	....	....	21,747
1839	81,377	6,003	....	....	....	6,003
1840	882,620	39,687	....	....	....	39,687
1841	2,177,164	96,748	....	....	....	96,748
1842	14,552,357	523,428	....	....	....	523,428
1843 (nine months)	15,366,918	492,765	....	....	....	492,765
1844	18,420,407	595,238	....	....	....	595,238
1845	10,188,024	342,646	....	....	....	342,646
1846	16,823,766	614,518	....	....	....	614,518
1847	3,326,028	124,981	....	....	....	124,981
1848	1,994,704	84,278	....	....	....	84,278
1849	680,249	30,198	....	....	....	30,198

Lead and manufactures of lead exported, etc.—Continued.

Fiscal years ending September 30 until 1842, and June 30 since.	Manufactures of—			Bars, shot, etc.		Total value.
	Lead.		Pewter and lead.			
	Quantity.	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
1850	261,123	$12,797				$12,797
1851			$16,426	229,448	$11,744	28,200
1852			18,469	747,930	32,725	51,194
1853			14,064	100,778	5,540	19,604
1854			16,478	404,247	26,874	43,352
1855			5,233	165,533	14,298	19,531
1856			5,628	310,029	27,512	33,140
1857			4,818	870,544	58,624	63,442
1858			27,327	900.607	48,119	75,446
1859			28,782	313,988	28,575	57,357
1860			56,081	903,468	50,446	106,527
1861			30,534	109,023	6,241	36,775
1862			28.832	79,231	7,334	36,166
1863			30,609	237,239	22,634	53,243
1864			30,411	223,752	18,718	49,129
1865			29,271	852,895	132,666	161,937
1866			44,483	25,278	2,323	46,806
1867			27,559	99,158	5,300	32,859
1868			37,111	438,040	34,218	71,329
1869			17,249			17,249
1870		28,315				28,315
1871		79,880				79,880
1872		48,132				48,132
1873		13,392				13,392
1874		302,044				302,044
1875		429,309				429,309
1876		102,726				102,726
1877		49,835				49,835
1878		314,904				314,904
1879		280,771				280,771
1880		49,899				49,899
1881		39,710				39,710
1882		178,779				178,779
1883		43,108				43,108
1884		135,156				135,156
1885		123,466				123,466

REVIEW OF THE LEAD MARKET.

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

Highest and lowest prices of lead at New York City, monthly, from 1870 *to* 1885 *inclusive.*

[Cents per pound.]

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

a Gold. *b* Currency.

Highest and lowest prices of lead at New York City, &c.—Continued.

[Cents per pound.]

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

An average of the sales reported in the trade papers during the years 1883, 1884, and 1885, from week to week in the three principal markets, New York, Chicago, and Saint Louis, will yield a fair approximation to the figures at which lead has sold. The sales at Saint Louis and Chicago are of course converted into their equivalent laid down in New York.

Average market price of lead at New York City.

Periods.	Cents per pound.
First half, 1883	4.51
Second half, 1883	4.07
Average, 1883	4.28
First half, 1884	3.824
Second half, 1884	3.632
Average, 1884	3.766
First half, 1885	3.785
Second half, 1885	4.278
Average, 1885	4.045

These figures, of course, are the average, irrespective of different brands and qualities, and, as they do not include jobbing sales, represent very closely the average result of wholesale transactions. The differences between market prices of the different qualities of lead have become much smaller than they were formerly, and are rarely larger than 5 cents per hundred pounds, or $1 per ton.

Foreign markets.—Since the foreign markets have again acquired importance through importations of lead on a larger scale, the fluctuations for a series of years are of interest. The average price of English lead in London from 1860 to 1885 has been as follows:

Average price of English lead in London from 1860 *to* 1885.

Years.	Price per ton.	Years.	Price per ton.
	£ s. d.		£ s. d.
1860	22 6 3	1873	23 6 0
1861	21 0 4	1874	22 2 0
1862	20 16 3	1875	22 9 4
1863	20 16 0	1876	21 13 0
1864	21 12 0	1877	20 11 3
1865	20 2 0	1878	16 14 0
1866	20 10 0	1879	14 16 6
1867	19 11 0	1880	16 7 6
1868	19 6 6	1881	14 19 3
1869	19 11 6	1882	14 7 3
1870	18 13 0	1883	12 18 0
1871	18 4 0	1884	11 16 0
1872	20 0 0	1885	11 11 0

In detail the fluctuations in the London and Paris markets during the year 1885 have been as follows:

Fluctuations in the price of lead in the London and Paris markets in 1885.

Months.	English lead (London), per long ton.	Spanish lead (London), per long ton.	French lead (Paris), per 100 kilos.
	£ s. d.	£ s. d.	*Francs.*
January	11 0 1	10 15 0	27.50
February	10 17 6	10 10 2	27.56
March	10 15 7	10 8 5	27.56
April	10 19 0	10 10 4	27.56
May	11 5 6	10 17 6	28.25
June	11 10 3	11 2 2	28.87
July	12 13 0	12 6 0	32.20
August	12 5 0	11 14 4	30.81
September	11 11 10	11 3 9	29.62
October	11 10 6	11 4 6	29.30
November	11 19 8	11 14 4	30.00
December	12 12 6	12 3 5	31.06
Average	11 11 8½	11 4 2	29.19

1885.—During 1885 the price of lead fluctuated as follows from month to month:

Price of lead in 1885.

[Cents per pound.]

Months.	Highest.	Lowest.
January	3.70	3.55
February	3.70	3.60
March	3.70	3.62½
April	3.70	3.62½
May	3.75	3.60
June	3.85	3.62½
July	4.15	3.87½
August	4.25	4.12
September	4.25	4.00
October	4.25	4.00
November	4.60	4.00
December	4.67½	4.50

The year 1885 was one of considerable uncertainty, and a number of fluctuations were experienced. In the beginning of the year efforts to advance the price fell flat owing to the slackness of the demand, and February proved a very dull month in the eastern markets. The outlook for the spring trade in the latter, in March, was not bright, and consumers there took comparatively little, while in the West corroders were heavy buyers. April was dull, and May only slightly better, but in June a heavier demand, backed by speculation, put up values, which, however, were again unsettled because round blocks of Richmond lead became available. August thus was made a dull month, and it was only in September, when the fall demand set in, that there was more activity. The sale of Richmond lead, however, again affected prices in October. In November speculation again took hold, on the strength of diminished supplies, a gradual exhaustion of stocks, and a generally more cheerful business outlook, carrying lead up to 4.60 cents for large lines. A number of small blocks of foreign lead were bought in for consumption, irrespective of the small quantities usually imported by cartridge makers and canners to be re-exported under the drawback clauses. With the close of the year the market became duller, January delivery being freely offered from the West at 4.60 cents.

The production of lead in the world has been estimated as follows:

The world's production of lead.

Countries.	1876.	1881.	1882.	1883.	1884.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Spain	101, 522	105, 809	115, 368	126, 889	116, 293
Germany	77, 500	90, 216	92, 591	(*b*)98, 846	102, 584
England	59, 606	49, 364	51, 133	39, 817	40, 716
France	(*a*)8, 500	(*a*)8, 500	8, 076	7, 827	(*a*)7, 500
Italy	(*a*)6, 000	(*a*)13, 000	(*a*)14, 000	14, 320	(*a*)14, 000
Greece	(*a*)8, 000	11, 892	6, 645	9, 612	(*a*)8, 000
Belgium	7, 275	7, 651	8, 805	8, 391	(*a*)8, 000
Austria	4, 291	8, 783	11, 113	(*b*)11, 134	(*b*)11, 391
Hungary	(*a*)2, 000	(*a*)1, 850	1, 843	(*a*)1, 800	(*a*)1, 800
Russia	1, 169	987	573	(*a*)500	(*a*)500
Sweden	(*a*)400	(*a*)400	494	(*a*)500	(*a*)400
United States	58, 118	106, 208	120, 544	139, 836	126, 907
Mexico	(*a*)1, 000	(*a*)1, 000	(*d*)1, 000	(*a*)1, 000	(*a*)1, 000
Turkey	(*a*)250	(*a*)250	(*a*)500	*a*750	(*a*)600
Australia	(*a*)500	(*a*)500	(*a*)1, 000	5, 054	(*a*)5, 000
South America	....	(*a*)1, 500	(*a*)1, 500	(*a*)2, 000	(*a*)2, 000
Total	336, 131	407, 910	435, 185	468, 276	446, 691

a Estimated. *b* Including litharge, estimated at 80 per cent. lead.

Spain.—Through the kindness of Señor Don Ramon Oriol, editor of the *Revista Minera y Metalurgica*, the official volumes of the mineral statistics have been received covering the years 1881, 1882, and 1883, the latter being the last issued. According to these documents the production of lead ore in the principal provinces for the three years was as follows:

Production of lead ore in Spain in the years 1881, 1882, *and* 1883.

Provinces.	1881.	1882.	1883.
	Metric tons.	*Metric tons.*	*Metric tons.*
Murcia	189, 452	189, 360	156, 548
Jaen	113, 186	104, 856	89, 391
Almeria	20, 719	22, 329	16, 888
Badajos	13, 406	18, 541	12, 270
Huelva	2, 815	2, 795	2, 218
Ciudad Real	1, 716	1, 402	1, 465
Total, including less important provinces unenumerated	342, 938	341, 818	280, 061

The official statistics enumerate separately the quantities of argentiferous lead ore, the principal producing provinces being as follows:

Production of argentiferous lead ore in Spain in the years 1881, 1882, *and* 1883.

Provinces.	1881.	1882.	1883.
	Metric tons.	*Metric tons.*	*Metric tons.*
Almeria	17, 731	16, 306	21, 506
Guipuzcoa	2, 285	1, 889	1, 850
Ciudad Real	2, 086	2, 330	543
Badajos	2, 281	1, 292	....
Total, including provinces not specified	24, 655	22, 425	24, 548

These ores, of both classes, are worked partly in the same province, and are largely, too, sent to smelting works in other provinces, Murcia doing the bulk of this business. The following table, grouping the lead product by provinces, does not therefore represent the source of the metal, but merely shows the relative importance of the different provinces as smelting centers.

Production of lead by provinces.

Provinces.	1881.	1882.	1883.
	Metric tons.	*Metric tons.*	*Metric tons.*
Murcia	42, 798	36, 426	32, 688
Almeria	19, 067	14, 776	20, 999
Cordova	10, 812	17, 391	25, 730
Guipuzcoa	8, 308	8, 680	8, 050
Jaen	4, 940	4, 977	5, 447
Malaga	3, 731	3, 340	2, 550
Ciudad Real	35	1, 786	2, 480
Badajos	932	963	1, 368
Gerona	49	....	....
Total	90, 672	88, 339	99, 312

These figures differ strikingly from the data furnished by the export returns, the latter being given in the official documents as follows:

Export of refined lead from Spain.

Countries.	1881.	1882.	1883.
	Metric tons.	*Metric tons.*	*Metric tons.*
France	18, 084	23, 266	25, 139
England	41, 212	49, 539	50, 702
Portugal	120	342	....
Germany	371	229	249
Sweden	103	....	....
Russia	32	....	....
Cuba	27	12	34
United States	453	....	226
Ecuador	2	2	8
Holland	....	202	....
Gibraltar	....	3	....
Porto Rico	....	4	9
Italy	....	....	519
Brazil and New Granada	....	....	14
Total	60, 404	73, 599	76, 894

In addition to this the following quantities of "argentiferous lead," or base bullion, as it is termed in this country, were exported:

Export of lead (base bullion) from Spain.

Countries.	1881.	1882.	1883.
	Metric tons.	*Metric tons.*	*Metric tons.*
France	19,873	21,142	20,478
England	29,449	20,394	31,420
Belgium	364	31	....
Portugal	87	....	....
Total base bullion	49,773	41,567	51,898
Total refined lead	60,404	73,599	76,894
Total lead export	110,177	115,166	128,792

In addition to these figures the export returns give small quantities of manufactures of lead and considerable amounts of "galena," as follows, small quantities not enumerated going to other countries besides those named:

Export of lead ore from Spain.

Countries.	1881.	1882.	1883.
	Metric tons.	*Metric tons.*	*Metric tons.*
France	1,504	2,512	3,439
England	1,886	2,214	2,459
Belgium	5,793	7,725	8,464
Total	9,183	12,451	14,362

Deducting 5 per cent. for waste on the base bullion, allowing for the lead contents of the ore at the rate of 60 per cent., and adding, finally, the exports of manufactured lead, we reach the following approximate estimate of the lead exports from Spain:

Lead exports from Spain.

Years.	Metric tons.
1881	113,477
1882	120,849
1883	135,691
1884	116,293
1885	109,014

This makes no allowance for domestic consumption. The discrepancy between these figures and the production reported by the mining department is so enormous that the system of collecting the statistics of production must be so exceptionally defective as to be absolutely worthless. The official documents offer no explanation whatever for it. Spanish metallurgical works do not handle any foreign ores or base bullion, nor can it be claimed that the excess of shipments over output returned to the department was from accumulated stocks, because the same large differences appear year after year. A graphic chart attached to the report for 1883, published last year, exhibits a third set of figures at variance with those published in former reports. This office has, therefore, continued to accept as the only fairly reliable guide for the production of Spain the export figures published, and until explanations are forthcoming must warn those in the lead trade to regard the reports of the Spanish mining department with suspicion.

Germany.—The production of Germany, the second in importance in Europe, has been as follows for a series of years:

Production of lead in Germany.

Years.	Quantity.	Years.	Quantity.
	Metric tons.		*Metric tons.*
1852 to 1855	15,000 to 20,000	1876	77,500
1856 to 1859	20,000 to 25,000	1877	79,970
1860	28,000	1878	83,336
1861 and 1862	30,000 to 35,000	1879	85,566
1863 and 1864	35,000 to 40,000	1880	88,867
1865 and 1866	40,000 to 45,000	1881	90,216
1867	49,000	1882	95,860
1868 to 1872	50,000 to 60,000	1883	94,811
1873	64,000	1884	98,814
1874	72,030	1885	92,485
1875	69,900		

The production of the different districts in Germany is shown by the following table, the make of silver being added, since it largely influences the profits of the different works. In the case of Freiberg and the Hartz it probably includes some silver extracted from rich imported Mexican and South American ores:

Production of lead and silver in Germany.

Districts.	Lead.			Silver.		
	1883.	1884.	1885.	1883.	1884.	1885.
Prussia:	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Kilos.*	*Kilos.*	*Kilos.*
Stolberg Company	13,753	15,983	15,956	23,989	26,770	33,127
Rhenish-Nassau Company	6,457	6,177	6,170	5,953	6,062	8,027
Mechernich Company	25,582	26,200	23,481	4,369	5,257	5,248
Commern Company	1,640			525		
A. Poensgen & Sons	3,540	3,300	3,910	1,757	1,967	2,824
Rothenbach Works	44	36	56	886	793	903
Walther Cronek Works	5,154	5,403	5,428	3,397	3,071	3,268
Friedrichs Works	9,561	11,351	12,804	5,755	6,671	6,697
Hanover:						
Upper Hartz	9,749	9,541	8,991	37,259	42,828	39,321
Lower Hartz	599	1,268	3,108	5,252	4,867	6,934
Nassau:						
Ems	5,227	5,641	4,608	7,418	6,585	6,460
Braubach	3,187	3,732	3,901	9,915	7,612	10,034
Saxony:						
Freiberg	5,274	5,469	4,072	58,946	60,309	79,952
Total	89,767	94,101	92,485	165,421	172,792	202,795

In addition to the pig lead produced there were marketed in 1883, 5,044 tons of litharge and in 1884, 4,713 tons. Besides there were obtained in several zinc works of Upper Silesia, in 1883, 556 tons of lead as a by-product, not counted. The corresponding figure for 1884 is not known. The silver product given does not, it may be incidentally mentioned, include the output of the Mansfeld copper works, which, having been 50,985 kilograms in 1882, 58,946 kilograms in 1883, and 60,309 kilograms in 1884, swells the total silver product of Germany to 213,982 kilograms for 1882, 233,884 kilograms for 1883, and 246,925 kilograms for 1884.

The greatest lead mine of the world, and in many respects one of the most remarkable ones, is that of the Mechernich Mining Company. Working a very low-grade sandstone containing small accretions of galena, distributed through it with fair uniformity, the mining operations are carried out on a grand scale, followed by concentration of great magnitude, which in 1885 turned out 33,759 tons of lead ore and 1,078 tons of potters' ore, yielding 23,480 tons of lead and 5,248 kilograms of silver. On a capital of 9,600,000 marks, the company realized a gross profit of 1,650,157.54 marks; or, after writing off 378,854.16 marks, a net profit of 1,271,303.38 marks, out of which a dividend of 12 per cent. per annum was declared. Putting in the mining property at 4,011,806.30 marks, the company showed assets of 12,276,704.47 marks, and carried a reserve fund of 960,000 marks.

Great Britain.—The tendency toward a decline in the output of the British mines has been checked during 1884. Owing to the closing down of mines and the voluntary liquidation of mining companies, however, a decline again took place in 1885. The following figures are gathered from the official statistics:

Lead statistics of Great Britain.

Years.	Production of lead ore.	Lead from British ores.	Silver.	Lead imported and obtained from foreign ores.	British and foreign lead exported.	Available for home consumption.
	Long tons.	*Long tons.*	*Ounces.*	*Long tons.*	*Long tons.*	*Long tons.*
1874	76, 801	58, 777	509, 277	74, 351	41, 321	91, 807
1875	77, 746	57, 435	487, 358	89, 705	38, 624	108, 516
1876	79, 096	58, 667	483, 422	91, 010	42, 685	106, 992
1877	80, 850	61, 403	497, 375	105, 472	47, 885	118, 990
1878	77, 350	58, 023	397, 471	112, 977	36. 478	134, 519
1879	66, 878	41, 635	333, 674	117, 014	40, 530	128, 119
1880	72, 245	56, 949	295, 518	107, 211	38, 344	125, 816
1881	64, 702	48, 587	308, 398	106, 593	48, 453	106, 727
1882	65, 001	50, 328	372, 446	100, 331	40, 018	110, 641
1883	50, 980	39, 190	344, 053	118, 521	42, 848	114, 863
1884	54, 485	40, 075	....	132, 829	37, 631	135, 273
1885	51, 302	37, 687	....	129, 402	42, 169	124, 920

During the early part of 1885 there was much distress among English lead miners, but the better prices ruling during the second half of the year aided them considerably. The principal sources of the lead and lead ore imported into England are the following, the total imports of pig and sheet lead having been 108,063 long tons, and of lead ore 26,738 long tons:

Principal imports of lead and lead ore into Great Britain in 1885.

Countries.	Lead ore.	Countries.	Lead.
	Long tons.		*Long tons.*
Italy	6,690	Germany	9,218
Greece	2,320	Holland	5,822
Turkey	1,375	France	1,585
Algeria	9,854	Spain	76,556
Australasia	2,804	Greece	8,147
		United States	4,989

The principal exports of British lead, aggregating 23,545 long tons, were as follows:

Principal exports of British lead in 1885.

Countries.	Long tons.
Russia	1,439
France	812
East Indies	2,536
China	3,781
Hong-Kong	8,213
Australasia	2,578
British North America	1,437
United States	436

The principal exports of British pipe and sheet lead were as follows:

Principal exports of British manufactures of lead in 1885.

Countries.	Long tons.
Russia	1,813
Germany	976
Portugal	417
East Indies	2,380
Australasia	3,120
British North America	700
Brazil	636

The total, including a number of shipments of smaller amounts to other countries, was 14,981 long tons, to which must be added 2,902 tons of lead and sheet lead of foreign origin.

Italy.—The leading mines in Italy are those of G. Henfrey & Co. at Pertusola, on the Gulf of Spezia, near Sargana, the del Bottino works having been closed in 1883 and the Cogoleto works, near Genoa, having been altered for another purpose in the same year. Producing, as they do now, about 15,000 tons of lead and 30,000 kilograms of silver, they have taken a leading rank among the great metallurgical establishments of Europe. The ore supply is derived almost exclusively from Sardinia, the principal mines being those of Montevecchio, Monteponi, Monte Santo, Nebida, and Malacalzetta. Thus an important source of supply of English and Belgian works is diverted to Italy. The following figures will illustrate the growth of the business done:

Production of the Pertusola works.

Years.	Argentiferous lead ore worked.	Lead produced.	Silver produced.
	Metric tons.	*Metric tons.*	*Kilograms.*
1867	3,867	2,257	1,028
1868	7,044	4,642	2,457
1869	7,310	4,416	1,667
1870	6,695	3,851	1,515
1871	6,994	4,250	1,815
1872	7,709	4,583	1,943
1873	8,469	5,036	2,273
1874	7,679	4,401	2,413
1875	8,625	6,018	2,461
1876	8,844	4,784	2,828
1877	10,995	6,179	3,864
1878	13,652	8,088	6,848
1879	12,711	8,354	6,886
1880	15,806	10,425	10,434
1881	16,795	11,496	11,518
1882	19,664	12,836	12,885
1883	19,221	13,120	12,937

Since 1884 the supply which formerly went to Cogoleto, chiefly high-grade silver ore, has also gone to Pertusola, and the output has risen to 15,000 tons and 30,000 kilograms of silver. The small Sardinian smelting works at Nebida and Masua turn out annually about 1,200 tons of base bullion, which is desilverized at Pertusola, together with some Spanish base bullion.

Greece.—The latest statistics available for the production of lead in Greece are those of M. Argyropoulo, of Athens. The bulk of it is the yield from smelting the "ekvolades," or ancient slag piles, to which must be added the lead contents of the Nikias plumbiferous iron ores used as a flux in smelting them. This flux carries from 4 to 6 per cent of lead. In 1883 the Greek Laurium Company produced 7,693 metric tons of base bullion, carrying 1,600 grams of silver to the metric ton, which is shipped to English desilverizers, while the French Laurium Company turned out 1,919 metric tons, averaging 2,000 grams of silver to the ton, which goes to Marseilles. Besides this the Escombrera Bleyberg Company received 3,880 tons of an ore carrying 30 per cent. of zinc and 10 per cent. of lead with 250 grams of silver.

Russia.—The latest official statistics place the product of Russia as follows for a series of years:

Production of lead in Russia.

Years.	Metric tons.
1876	1,169
1877	1,205
1878	1,398
1879	1,358
1880	1,147
1881	987
1882	573

Austria.—In Austria one of the principal lead producers is the Bleiberg Bergwerks Union, which in 1885 turned out 3,812 tons of lead, as compared with 3,975 tons in 1884, on which a profit of 86,802 florins was made, enabling the payment of a dividend of 4½ per cent. The famous mines at Przibram turned out the following quantities for a series of years:

Product of the Przibram mines.

Years.	Soft lead.	Antimonial lead.	Litharge.	Silver.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Kilograms.*
1881	1,032	259	2,945	30,646
1882	417	269	3,829	30,926
1883	215	318	3,943	32,511
1884	771	382	3,559	34,707

Taking litharge at 80 per cent., the 1884 figures represent an output of 4,000 tons.

France.—From a study of the French official statistics for the year 1883, the latest available, it appears that taking the yield of the ore extracted from mines in France and Algeria at averaging 70 per cent., the home product is about 3,127 metric tons. In that year there were produced in French smelting works from imported and domestic ores a total of 7,770 metric tons. Besides this, French desilverizers treated 20,956 tons of Spanish and 1,851 tons of Greek base bullion, producing 22,268 tons of refined lead. In that year the consumption of lead in France was officially estimated at 71,000 tons.

ZINC.

THE ZINC INDUSTRY OF THE UNITED STATES.

By C. Kirchhoff, Jr.

The conditions affecting the zinc industry during the year 1885 have not materially changed in comparison with former years. The home producers recovered full control of the market, and the formation of a great syndicate abroad proved fully that the low prices then prevailing had become intolerably unremunerative to European makers. It held out the promise that there would be no danger of an influx of foreign spelter, always provided that the restriction of output in Europe was sufficient to keep it within the bounds of current consumption there. American makers have learned to look with alarm at such syndicates, since in the past the latter have believed it good policy to strengthen the European market by sacrificing a small surplus in this country. No indications of such a movement took place in 1885, and it must be admitted that the foreign syndicate was formed too late in the year to allow the necessity for it to develop.

Spelter is consumed in three forms principally. It is used to a moderate extent in this country as sheet zinc, the figures for the production of which are not available since the manufacture is confined to two works; it is used furthermore for galvanizing, a branch depending upon the prosperity of a few branches of the iron trade, and it is used in brass manufacture. The prosperity of the zinc trade may therefore be said to be bound up with activity in building, with a growing demand for sheet iron, barb wire, and a few other specialties in iron manufacture, and with an expansion in the consumption of brass in its many forms. The year 1885 did not witness any revival in building, or in the iron trade, and it may be questioned whether the consumption of spelter in those directions was up to the average. The low price of copper, however, stimulated the introduction of all its forms into new uses, and, as is shown elsewhere in the discussion of the year's history of that metal, a marked increase took place in the quantities manufactured. This has continued, and is the most promising feature connected with the zinc manufacture of the country. It is a fact which has probably averted greater depression, and which must in the future prove the most potent cause towards bringing about a revival. In the spring of 1886 the barb-wire trade proved a keen disappointment, a fact which of course was reflected in the demand for spelter; but, on the other hand, the unprecedented consumption of iron and steel thus far in 1886 holds out the hope that it will carry with it fuller employment to the spelter works. No effort could be made in 1885 to arrive at data which would show how the consumption of spelter is apportioned among the different industries named, to which should be added, too, the desilverizing of base lead bullion, in which a part of the zinc used for the extraction of the silver is lost during the distillation of the rich zinc crusts, and during the refining of the desilverized lead.

Complete returns have been received from all the spelter-producing works of the United States, with the exception of one small concern in Tennessee, whose output is estimated to have been 300 short tons.

PRODUCTION.

The records of the production of spelter and zinc in previous years are incomplete, the following figures being the only ones available which are worthy of consideration:

Production of spelter in the United States.

Years.	Short tons.
1873	7,343
1875	15,833
1880 (census year ending May 31)	23,239
1882	33,765
1883	36,872
1884	38,544
1885	40,688

Grouped by States, the product has been as follows:

Production of spelter in the United States, 1881 to 1885, inclusive, by States.

States.	1881.	1882.	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Illinois	16,250	18,201	16,792	17,594	19,427
Kansas	5,000	7,366	9,010	7,859	8,502
Missouri	2,750	2,500	5,730	5,230	4,677
Eastern and southern States	....	5,698	5,340	7,861	8,082
Total	....	33,765	36,872	38,544	40,688

During 1885, the capacity of the zinc works of the United States has not been materially enlarged, and the figures given in former reports from this office may be accepted as correct, with the change that the works of the Missouri Zinc Company, formerly at Carondelet, have been dismantled and should be stricken from the list. The Joplin works in Missouri were idle during eleven months of the year, and the Rich Hill plant, also, did not run up to capacity.

IMPORTS AND EXPORTS.

Zinc imported and entered for consumption in the United States, 1867 *to* 1885 *inclusive.*

Fiscal years ending June 30—	Blocks or pigs.		Sheets.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
1867	5, 752, 611	$256, 366	5, 142, 417	$311, 767	$1, 835	$569, 968
1868	9, 327, 968	417, 273	3, 557, 448	203, 883	1, 623	622, 779
1869	13, 211, 575	590, 332	8, 306, 723	478, 646	2, 083	1, 071, 061
1870	9, 221, 121	415, 497	9, 542, 687	509, 860	21, 696	947, 053
1871	11, 159, 040	508, 355	7, 646, 821	409, 243	26, 366	943, 964
1872	11, 802, 247	522, 524	10, 704, 944	593, 885	58, 668	1, 175, 077
1873	6, 339, 897	331, 399	11, 122, 143	715, 706	56, 813	1, 103, 918
1874	3, 593, 570	203, 479	6, 016, 835	424, 504	48, 304	676, 287
1875	2, 034, 252	101, 766	7, 320, 713	444, 539	26, 330	572, 635
1876	947, 322	56, 082	4, 611, 360	298, 308	18, 427	372, 817
1877	1, 266, 894	63, 250	1, 341, 333	81, 815	2, 496	147, 561
1878	1, 270, 184	57, 753	1, 255, 620	69, 381	4, 892	132, 026
1879	1, 419, 791	53, 294	1, 111, 225	53, 050	3, 374	109, 718
1880	8, 092, 620	371, 920	4, 069, 310	210, 230	3, 571	585, 721
1881	2, 859, 216	125, 457	2, 727, 324	129, 158	7, 603	262, 218
1882	18, 408, 391	736, 964	4, 413, 042	207, 032	4, 940	948, 936
1883	17, 067, 211	655, 503	3, 309, 239	141, 823	5, 606	802, 932
1884	5, 869, 738	208, 852	952, 253	36, 120	4, 795	249, 767
1885	3, 515, 840	113, 268	1, 839, 860	164, 781	2, 054	180, 103

Exports of zinc and zinc-ore of domestic production, 1864 *to* 1885 *inclusive.*

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

PRICES OF ZINC.

The following table summarizes the prices of spelter since 1875:

Prices of common western spelter in New York City, 1875 *to* 1885 *inclusive.*

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

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1875	6.75	6.37	6.67	6.25	6.50	6.20	(7.00)	6.50	(7.25)	7.15	(7.25)	7.15
1876	(7.60)	7.40	(7.75)	7.50	(7.75)	7.62	(8.00)	7.60	(8.00)	7.75	(8.00)	7.25
1877	6.50	6.25	6.62	6.50	6.50	6.37	6.37	6.25	6.25	6.00	6.12	5.87
1878	5.75	5.50	5.62	5.25	5.62	5.25	5.25	5.00	5.00	4.62	4.62	4.25
1879	4.50	4.25	4.62	4.40	4.62	4.37	4.75	4.25	4.50	4.25	4.37	4.12
1880	6.50	5.87	6.75	6.37	6.75	6.50	6.50	6.12	6.00	5.62	5.50	5.12
1881	5.25	4.87	5.25	5.12	5.00	4.87	5.12	4.75	5.00	4.87	5.00	4.75
1882	6.00	5.75	5.75	5.62	5.62	5.37	5.50	5.25	5.62	5.25	5.37	5.25
1883	4.62	4.50	4.62	4.50	4.75	4.62	4.75	4.60	4.75	4.50	4.62	4.37
1884	4.37	4.20	4.40	4.25	4.60	4.40	4.65	4.50	4.60	4.45	4.60	4.45
1885	4.50	4.12	4.30	4.25	4.30	4.12	4.30	4.12	4.25	4.10	4.10	4.00

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1875	(7.35)	7.25	(7.25)	7.10	(7.25)	7.10	(7.40)	7.15	(7.40)	7.15	(7.40)	7.15
1876	7.25	7.12	7.25	7.00	7.12	6.80	6.75	6.62	6.62	6.37	6.50	6.37
1877	5.87	5.62	5.90	5.80	5.87	5.75	5.90	5.70	5.87	5.62	5.75	5.50
1878	4.75	4.50	4.87	4.50	4.87	4.75	4.82	4.50	4.75	4.50	4.37	4.25
1879	4.75	4.37	5.62	4.80	6.00	5.62	6.37	6.00	6.25	5.87	6.25	6.00
1880	5.00	4.87	5.25	4.87	5.12	4.75	5.00	4.87	4.90	4.65	4.75	4.65
1881	5.00	4.75	5.12	5.00	5.25	5.00	5.37	5.25	5.87	5.50	6.00	5.87
1882	5.37	5.12	5.50	5.12	5.37	5.12	5.37	5.12	5.12	4.87	4.87	4.50
1883	4.50	4.30	4.40	4.30	4.50	4.40	4.45	4.35	4.40	4.37	4.37	4.35
1884	4.55	4.45	4.62	4.52	4.62	4.50	4.55	4.40	4.40	4.30	4.25	4.00
1885	4.40	4.10	4.60	4.40	4.62	4.50	4.62	4.50	4.60	4.45	4.60	4.45

1885.—During 1885 the price of spelter fluctuated as follows:

Price of spelter in 1885.

[Cents per pound.]

Months.	Highest.	Lowest.	Months.	Highest.	Lowest.
January	4.50	4.12	July	4.40	4.10
February	4.30	4.25	August	4.60	4.40
March	4.30	4.12	September	4.62½	4.50
April	4.30	4.12	October	4.62½	4.50
May	4.25	4.10	November	4.60	4.45
June	4.10	4.00	December	4.60	4.45

During the year 1885 the spelter market was generally quiet, with a declining tendency during the first half of the year, recovering in July to higher figures which were fairly well maintained during the balance of the year, a slight weakness developing towards its close. The event of the year was the formation in Europe of a spelter combination in which all of the Silesian, Belgian, Rhenish, French, and English works finally joined, representing an annual output of 250,000 tons. The principal point in connection with the pool is the agreement to restrict the output to the quantities made during 1884, beginning with 1886 and continuing till the middle of 1889. The only exception is Silesia, which is allowed to make 5 per cent. more than was produced in 1884. All the works may increase at a rate to be fixed in the future when the price of zinc goes beyond a given figure. It is understood that the penalty for exceeding the allotment is £13 per ton of excess.

THE PRINCIPAL FOREIGN PRODUCERS.

Total production.—Although the bulk of the spelter now imported into the United States is re-exported under drawback clauses, the foreign markets have an influence which must not be underrated upon the course of the metal in this country. Mr. Archibald Means, of Peru, Illinois, in an argument before the Committee on Ways and Means of the House of Representatives, has given some figures relating to wages and value of ores in the United States, comparing them with the data relating to Silesia, compiled from official sources in the report from this office for 1883 and 1884. Mr. Means gives as follows the wages paid in 1885 by the Illinois Zinc Company:

Wages paid by Illinois Zinc Company in 1885.

Class of labor.	Average hours.	Wages per day.	Class of labor.	Average hours.	Wages per day.
Labor on the furnaces:			Labor in sheet-zinc mill:		
62 men	12	$1.90	9 rollers	8	$3.00
40 men	12	1.45	18 rollers	8	1.80
76 men	8	1.45	24 men	10	1.35
22 men	10	1.20	10 men	10	1.60
4 men	10	2.25	26 boys	10	.85
9 boys	10	.85			

The comparison of the cost of ores stands as follows:

Cost of ore in Silesia and in Missouri and Kansas.

Years.	Average value per ton.	
	Silesia.	Missouri and Kansas.
1879	$3.32	$13.20
1880	3.44	17.20
1881	2.27	14.50
1882	2.53	17.20
1883	1.90	20.00

It should be noted in this connection, however, that the Silesian ores are generally leaner than those of our western mines.

The production of spelter in the world in 1881, 1882, 1883, and 1884 was as follows, compiled from the best sources available:

The world's production of spelter.

Countries.	1881.	1882.	1883.	1884.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*
Germany	105, 272	115, 346	116, 688	125, 182
Belgium	69, 800	72, 947	75, 366	77, 487
France	(*a*)18, 500	18, 525	15, 915	(*a*)16, 500
England (*b*)	24, 810	25, 090	28, 104	29, 727
Spain	4, 910	4, 973	4, 233	(*a*)4, 200
Austria	4, 119	4, 791	4, 539	4, 536
Hungary	(*a*)600	605	(*a*)600	(*a*)600
Russia	4, 552	4, 472	3, 789	4, 227
United States	27, 450	30, 628	33, 459	34, 975
Total	260, 013	278, 277	282, 693	297, 434

a Estimated. *b* Estimated by Henry Merton & Co., London.

Messrs. Henry Merton & Co., of London, grouping the figures somewhat differently, make the world's production as follows:

Merton's estimate of the world's production.

Countries.	1885.	1884.	1883.	1882.	1881.	1880.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rhine district and Belgium	129, 754	130, 522	123, 891	119, 193	110, 989	98, 830
Silesia	79, 623	76, 116	70, 405	68, 811	66, 497	64, 459
Great Britain	23, 099	29, 259	28, 661	25, 581	24, 419	(*a*)22, 000
France and Spain	14, 847	15, 341	14, 671	18, 075	(*a*)18, 358	15, 000
Poland	5, 019	4, 164	3, 733	4, 400	(*a*)4, 000	(*a*)4, 000
Austria	2, 928	2, 365	2, 867	3, 199	(*a*)2, 520	(*a*)2, 520
Total, Europe	255, 270	257, 767	244, 228	239, 259	226, 783	206, 809
Total, United States	36, 339	34, 414	32, 921	30, 148	(*a*)27, 000	20, 749
Grand total	291, 609	292, 181	277, 149	269, 407	253, 783	227, 558

(*a*) Estimated.

The differences between the two tables arise from the fact that Messrs. Merton & Co. include in the product of Belgium that part of the make of the Vieille Montagne Company, which is turned out at the works located in France.

Germany.—The production of spelter in Germany is shown by the following table, giving the output of the three great districts, Silesia, the Rhenish provinces, and Westphalia:

Production of spelter in Germany.

Years.	Silesia.	Rhenish provinces.	Westphalia.	Total.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*
1878	59, 710	19, 887	15, 631	95, 228
1879	63, 413	18, 942	14, 066	96, 421
1880	65, 798	19, 606	14, 362	99, 766
1881	67, 474	21, 034	16, 764	105, 272
1882	69, 992	24, 654	20, 700	115, 346
1883	71, 468	24, 471	20, 749	116, 688
1884	77, 247	48, 029		125, 276
1885 (approximate)	79, 623	(*a*)37, 321		(*a*)118, 001

a Exclusive of scattering works.

The total production of ore in Prussia in 1882, 1883, and 1884 was as follows:

Production of zinc ore in Prussia.

Years.	Calamine.	Blende.	Total.
	Metric tons.	*Metric tons.*	*Metric tons.*
1882	480,615	212,754	693,369
1883	457,979	218,817	676,796
1884	387,624	243,611	631,235

In detail the product of the different districts was in 1884:

Production of zinc ore by districts in 1884.

Districts.	Calamine.	Blende.	Total.
	Metric tons.	*Metric tons.*	*Metric tons.*
Silesia	371,973	143,384	515,357
Hanover	....	5,480	5,480
Westphalia	12,688	26,472	39,160
Hesse-Nassau	....	13,634	13,634
Rhine provinces	2,963	54,641	57,604
Total	387,624	243,611	631,235

The supply of calamine is falling off and the works are becoming more and more dependent upon blende.

As indicating the better returns on capital, the result of the operaion of the leading zinc company in Silesia may be quoted. The Schlesiche Actien-Gesellschaft für Bergbau- und Zinkhüttenbetrieb, which made a profit of 1,716,742 marks in 1883, yielded 2,783,666 marks in 1885, on a product of 22,080 metric tons of spelter, and 4,612 tons of sulphuric acid produced from 91,399 tons of calamine, 39,469 tons of blende, and 2,565 tons of zinc products. They use the spelter made in the manufacture of sheet zinc, of which the company turned out 27,748 tons in 1885.

The Actien-Gesellschaft für Bergbau, Blei- und Hütten-fabrikation zu Stolberg und in Westfalien made a profit in 1885 of 775,887 marks, against 678,024 marks in 1884, and only 452,440 marks in 1883, enabling the payment of six per cent. on preferred and one per cent. on common shares. The product of the concern has remained about the same; in 1885 it was 14,673 tons of spelter, 15,956 tons of lead and 33,127 kilo. grams of silver. The Rheinisch-Nassauische Bergwerk und Hütten Actien-Gesellschaft made a profit of 241,914 marks, or 3 per cent., on the sale of 6,656 tons of argentiferous lead ore and 17,395 tons of zinc ore.

Of these two companies, the former may be accepted as a representative of the Silesian district and the latter of the Rhine provinces. The Stolberg Company, however, as will be noted, produces lead and silver, and for that reason its financial results are not so directly a proof of the condition of its spelter industry.

The product of the works of the Rhine provinces is often grouped with those of Belgium, with which they naturally form one group. Messrs. Merton & Co. give the output of the different works as follows:

Production of the Rhine district and Belgium.

Name of company.	1885.	1884.	1883.	1882.	1881.	1880.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Vieille Montagne	50, 687	52, 532	49, 265	48, 140	49, 600	44, 690
Stolberg Company	14, 452	14, 283	14, 496	14, 921	12, 601	11, 643
Austro-Belge	9, 610	9, 270	8, 986	5, 695	8, 455	8, 406
Rhein-Nassau Company	7, 676	7, 827	7, 623	6, 458	5, 760	5, 669
L. de Laminne	7, 039	6, 596	6, 257	6, 163	5, 814	5, 490
Nouvelle Montagne	5, 079	5, 030	5, 392	5, 800	5, 400	5, 158
Märk, Westf., Bergw., Ver.	4, 429	5, 270	5, 095	5, 784	6, 300	4, 876
G. Dumont & Frères	7, 072	5, 800	5, 800	5, 500	5, 500	4, 200
Gladbach Company	5, 046	5, 000	4, 800	4, 916	4, 861	4, 613
Escombrera Bleyberg	5, 835	5, 579	5, 136	4, 577	2, 998	1, 200
Eschger Ghesquière & Co	3, 792	3, 970	4, 600	4, 170	3, 700	2, 885
Grillo	5, 158	5, 400	4, 078	2, 569	....	....
Société Prayon	3, 879	3, 965	2, 363	(*a*)1, 500	....	....
Total	129, 754	130, 522	123, 891	119, 193	110, 989	98, 830

Messrs. Merton & Co., have compiled the following table to show the make of the different works in Silesia.

Production of Silesia.

Name of company.	1885.	1884.	1883.	1882.	1881.	1880.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Schlesische Actien-Gesellschaft	21, 750	21, 609	20, 495	20, 494	18, 300	17, 158
G. von Giesche's Erben	16, 782	16, 716	15, 418	14, 941	14, 986	13, 351
Herzog von Ujest	14, 937	10, 949	10, 233	9, 956	8, 853	6, 994
Graf H. Henckel von Donnersmarck	9, 680	10, 040	10, 238	9, 129	8, 593	9, 135
Graefin Schaffgotsch	6, 091	6, 204	6, 348	6, 327	6, 600	6, 305
Graf G. Henckel von Donnersmarck	1, 682	1, 502	1, 415	1, 463	1, 392	1, 349
H. Roth	1, 733	1, 036	913	938	846	760
W. Martulik	....	418	479	353	537	590
Wünsch	1, 808	1, 330	1, 083	1, 122	1, 006	1, 175
Von Tiele-Winckler	....	2, 625	1, 100	1, 035	1, 721	2, 011
Vereinigte Königs & Laurahütte	1, 305	1, 180	1, 018	1, 011	1, 026	1, 094
Graf Ballestrem	658	842	730	874	588	680
Saeftel	876	780	480	645	625	690
G. v. Kramsta'sche Erben	....	....	....	....	550	1, 361
A. Wolff	....	430	430	458	474	1, 028
Oberschlesische Bk. für H. & J.	....	....	....	....	280	393
Fiscus	106	145	25	65	90	80
Weidemann	....	....	....	....	30	305
Schmieder (Lazy)	2, 165	310	....	....	....	....
Total	79, 623	76, 116	70, 405	68, 811	66, 497	64, 459

(*a*) Estimated.

The imports of spelter and sheet zinc into Germany in 1884, and in the first eleven months of 1885, were as follows:

Imports of spelter into Germany.

Source.	1884.	Eleven months, 1885.
	Metric tons.	*Metric tons.*
Hamburg-Altona	475	355
Austria-Hungary	987	729
France	215	8
Belgium	1, 186	1, 090
Great Britain	1, 526	654
Other countries	131	670
Total	4, 520	3, 506

The exports of spelter and sheet zinc from Germany are, of course, very heavy. The following table gives the latest data available:

Exports of spelter and sheet zinc from Germany.

Destination.	Spelter.		Sheet zinc.	
	1884.	Eleven months, 1885.	1884.	Eleven months, 1885.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*
Hamburg-Altona	23,067	15,600	5,122	3,442
Denmark	....	50	610	704
Norway	....	72	363	436
Sweden	....	330	509	518
Russia	3,109	2,390	....	98
Austria-Hungary	12,713	12,869	771	1,050
Switzerland	....	136	609	450
France	1,251	1,713	....	64
Belgium	1,238	1,521	170	63
Netherlands	7,023	5,840	1,212	916
Great Britain	6,574	19,531	5,356	5,723
Italy	....	215	482	589
United States	891	1,065	579	271
Other countries	1,126	248	500	181
Total	56,992	61,590	16,283	14,506

It will be observed that apparently there has been a large increase in the exports of spelter to Great Britain, while the shipments via Hamburg have fallen off. It is impossible to ascertain, in the absence of the export statistics of Hamburg, whether or not this is due simply to possible changes in the shipping ports, or the transfer of a large part of the business from Silesian to Rhenish works.

Belgium.—M. Em. Harzé, in his official report, gives the following data concerning the production of the Belgian mines and the output of the Belgian zinc works:

Production of the Belgian mines and zinc works.

Years.	Blende.	Calamine.	Spelter.	Sheet zinc.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*
1870	15,783	41,316	45,754	....
1871	19,970	41,159	45,623	....
1872	20,623	34,914	41,838	....
1873	13,952	28,630	42,314	....
1874	17,087	26,212	46,388	20,958
1875	18,750	23,754	49,960	23,476
1876	21,739	15,974	47,981	22,388
1877	26,310	18,677	55,923	23,380
1878	27,134	18,159	61,227	23,178
1879	23,229	19,460	57,157	25,710
1880	23,080	15,735	59,880	22,410
1881	8,169	15,384	69,800	25,394
1882	2,171	18,272	72,947	27,278
1883	3,711	16,924	75,366	27,457
1884	27,606		77,487	....

Taken over a series of years the supplies from home mines, it will be noticed, have declined heavily in the face of a constant increase of the production of metal. In 1884 the working of a deposit previously flooded added to the output. M. Harzé gives the following details in his report for 1882, 1883, and 1884:

Statistics of Belgian zinc works.

Details.	1882.	1883.	1884.
Works in operation	11	11	11
Number of furnaces running	319	327	314
Number of furnaces idle	48	60	66
Average number of retorts running	22, 299	22, 521	23, 313
Number of workmen	2, 864	3, 507	3, 649
Average daily wages, francs	3. 41	3. 38	3. 25
Ore consumed:			
Belgian, metric tons	12, 989	19, 250	24, 171
Foreign, metric tons	161, 632	171, 538	169, 587
Spelter produced, metric tons	92, 947	75, 366	77, 487

The Vieille Montagne Company, the leading concern in Belgium, used, during its fiscal year 1885, 61,000 tons of ore, of which the bulk was foreign, chiefly Swedish produce. They turned out 51,540 metric tons of spelter, of which 38,675 tons were used for making sheet zinc. In addition thereto they made 6,970 tons of zinc white. The total profit for the year was 2,273,140 francs.

Great Britain.—The official statistics of the Mining Record Office do not cover the output of the metallurgical works of the country, and it is only recently that, through the efforts of Messrs. Henry Merton & Co., of London, exact data of the make have become available. The following is the statement of the product of the different works:

Production of Great Britain.

	1885.	1884.	1883.	1882.	1881.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Vivian & Sons	8, 048	7, 590	7, 220	6, 644	6, 522
English Crown Spelter Company, Limited	3, 500	4, 570	5, 200	4, 792	5, 062
Dillwyn & Company	2, 967	4, 894	4, 660	4, 800	4, 400
Swansea Vale Spelter Company	2, 185	2, 219	2, 266	2, 180	2, 213
Villiers Spelter Company	1, 985	2, 000	2, 000	2, 000	1, 655
Pascoe, Grenfell & Sons	1, 082	1, 272	1, 555	1, 815	1, 500
Nenthead & Tynedale Company	1, 380	1, 384	1, 556	1, 500	1, 350
Kenrick & Sons				600	1, 220
D. Swan & Company		780	1, 004	550	398
Anchor Spelter Company		350	(*a*)700	(*a*)700	99
John Lysaght, Limited	1, 952	2, 700	1, 500		
Staffordshire Knot		1, 500	(*a*)1, 000		
Total	23, 099	29, 259	28, 661	25, 581	24, 419

(*a*) Estimated.

The following table summarizes the official statistics of the production of zinc ore from the mines of Great Britain:

Production of zinc ore in Great Britain.

Years.	Zinc ore (blende).	Zinc in ore.	Years.	Zinc ore (b e).	Zinc in ore.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
1870	13,563	3,936	1878	25,438	6,309
1871	17,736	4,966	1879	22,200	5,554
1872	18,543	5,191	1880	27,548	7,162
1873	15,969	4,471	1881	35,527	14,947
1874	16,830	4,470	1882	32,539	16,130
1875	23,978	6,713	1883	29,728	13,603
1876	23,613	6,641	1884	....	9,918
1877	24,406	6,833			

Being by far the largest consumer, Great Britain imports heavy quantities of spelter from the continent. The following are the official figures:

Imports of zinc into Great Britain.

Years.	Crude zinc.	Zinc manufactures.	Years.	Crude zinc.	Zinc manufactures.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
1860	24,416	....	1879	34,180	15,474
1865	32,191	....	1880	33,409	16,648
1870	31,103	....	1881	46,198	19,302
1875	37,870	....	1882	42,201	18,185
1876	29,466	14,719	1883	40,792	20,370
1877	35,094	16,102	1884	47,647	20,138
1878	32,750	16,207	1885	60,229	19,668

According to the Board of Trade returns the total imports of zinc ore in 1885 were 21,453 long tons, as against 45,835 tons in 1883. The principal sources of the supply were: Greece, 13,173 tons; Italy, 3,841 tons; Spain, 1,554 tons, and France, 1,085 tons.

The total imports of spelter were 60,129 long tons, of which Germany shipped 31,434 tons, Holland, in transit from Germany and Belgium, 13,790 tons, Belgium direct, 12,598 tons, and France, 1,787 tons.

The imports of manufactures of zinc aggregated 19,664 long tons, of which Germany is credited with 7,189 tons, Holland with 8,369 tons, and Belgium with 3,919 tons.

The total exports of spelter from Great Britain footed up to 7,688 long tons of British spelter and 4,473 long tons of foreign zinc, a total of 12,161 long tons. Of this quantity the East Indies received 5,279 tons of British and 1,794 tons of foreign spelter; Holland, 1,089 tons of the former and 62 tons of the latter, and France, 86 tons of the former and 779 tons of the latter.

France.—The largest works are those of the Société Royale Asturienne at Auby-lez-Douai (Nord), which produced in 1884, 11,210 metric tons, against 10,597 metric tons in 1883, chiefly from Spanish ores. The same company has works in Spain.

Greece.—Greece is one of the sources of supply of ore for continental and English zinc works. According to the figures of M. Argyropoulo, of Athens, the latest available, there were exported from Greece in 1883 2,601 tons of crude calamine from the Antiparos mine, carrying 35 per cent. of metal, and 37,520 tons of calcined 60 per cent. calamine from the mines of the French Laurium Company, the bulk of which is taken by the Vieille Montagne Company.

Russia.—According to official statistics issued in 1884, the production of spelter in Russia has been as follows for a series of years:

Production of spelter in Russia.

Years.	Metric tons.
1876	4,626
1877	4,635
1878	3,646
1879	4,321
1880	4,390
1881	4,552
1882	4,472
1883 (*a*)	3,789
1884 (*a*)	4,227

a Estimated.

The figures for 1883 and 1884 are unofficial estimates. According to official returns, gathered for the first time in 1882, the output of ore was 97,000 metric tons.

QUICKSILVER.

Present condition of the industry.—The depression ruling in the quicksilver market in 1884 continued with little change during 1885. There was somewhat less variation in price, and a slight average advance caused a steadier feeling, which, however, being due to increased exports from England to China, was only felt indirectly in the American market.

At one time there were thirty working mines in California; now there are only ten. It is not known that any of these earned a dividend last year, but it is quite certain that none was paid. There was a slight increase in the total production and a noteworthy increase in exports, leaving the market bare of accumulated stock during the greater part of the year. The most encouraging outlook for the coming year is the opening of a number of small gold and silver mines, which will increase the local consumption of quicksilver.

Domestic sources.—All the quicksilver produced in the United States comes from mines in California. More than two-thirds of the total supply is from the New Almaden mine; the others are small and sustained with difficulty, particularly since the opposition to Chinese labor, used in all except the New Almaden. The earnings from this mine for the last fifteen years, under the management of Mr. J. B. Randol, are given below:

Statement of earnings and expenses of the Quicksilver Mining Company, New Almaden, California, from January 1, 1871, *to December* 31, 1885.

EARNINGS.		
Quicksilver produced, 299,822 flasks, average value $35.1204		$10,529,851.70
Miscellaneous		599,521.20
		11,129,372.90
EXPENSES.		
Pay rolls	$4,747,932.67	
Miscellaneous and taxes	678,687.38	
Materials consumed in operations of mine and furnaces	1,513,017.21	
		6,939,637.26
Profit balance		4,189,735.64

This profit balance is accounted for as follows:

There have been expended for improvements and repairs $885,354.25, as below. (Since 1872 all repairs have been included in current expenses.)

Furnaces and condensers	$299,499.96	
Hoisting works, machinery, pumps, and shafts	442,681.37	
Houses, sheds, and shops	74,162.31	
Flumes, water works, ore-cleaning floors, roads, and other surface improvements	69,010.61	
		$885,354.25

Add real estate purchased	14, 500. 00	
Add legal expenses and patents	38, 469. 62	
Add "black" debt of 1870	9, 342. 68	
		62, 312. 30
Profits expended in California		947, 666. 55
Accounted for by increase in personal property accounts in California and consignments abroad		147, 523. 72
Total profits accounted for in California		1, 095, 190. 27
Profits remitted to New York office		3, 094, 545. 37
Total profits accounted for		4, 189, 735. 64
Funded debt and dividends paid in New York, as per annexed statement		2, 434, 442. 80
Interest on funded debt, taxes, legal expenses, etc		660, 102. 57
Profits sent to New York, as above		3, 094, 545. 37

The company now has neither funded nor floating debt.

Principal of funded debt and dividends paid in New York.

First mortgage gold bonds (paid June 1, 1873, interest 7 per cent.)	$500, 000. 00	
Second mortgage gold bonds (paid July 1, 1879, interest 7 per cent.)	1, 000, 000. 00	
		$1, 500, 000. 00
DIVIDENDS.		
$9.25 on 42,913 preferred shares, $2.25 on 57,087 common shares, August 4, 1881	525, 391. 00	
$6 on preferred stock, 40 cents on common stock, May 3, 1882	280, 312. 80	
$3 on preferred stock, February 26, 1884	128, 739. 00	
		934, 442. 80
		2, 434, 442. 80

Production.—During 1885, 32,073 flasks, of 76½ pounds net each, were produced, an increase of 160 flasks over the production of 1884, but less than the output of any other year in the last decade. The following table, compiled by Mr. J. B. Randol, gives the entire production of quicksilver in the United States:

***Production of quicksilver in the United States to the close of* 1885, *all from California except* 50 *flasks produced in Oregon in* 1882.**

Years.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Pope Valley.	Napa Consolidated.(a)	St. John.	Altoona.	Oceanic.	Oakland.	California.	Great Eastern.	Sunderland.	Cloverdale.	Abbott.	Manhattan.	Various mines.(b)	Total yearly production of California mines.
	Flasks.	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Fl'ks.*	*Flasks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Flasks.*	*Flasks.*	*Flasks.*
1850	7,723	Production from 1858 to 1866, 17,455 flasks—no yearly details obtainable—included in production of various mines.	...	...	Yearly production previous to 1875 not obtainable (estimated at 20,000 flasks), included in production of various mines.	...	...	...	...	Some was produced prior to 1875, but no record kept (estimated production previous to 1875, 1,000 flasks), included in production of various mines.	...	...	...	...	...	...	...	Yearly production previous to 1876 not obtainable (estimated at 3,594 flasks), included in production of various mines.	...	7,723
1851	27,779		...	...		...	...	...	...		...	...	...	...	...	...	...		...	27,779
1852	15,901		...	...		...	...	...	...		...	...	...	...	...	...	...		4,099	20,000
1853	22,284		...	...		...	...	...	...		...	...	...	...	...	...	...		...	22,284
1854	30,004		...	...		...	...	...	...		...	...	...	...	...	...	...		...	30,004
1855	29,142		...	...		...	...	...	...		...	...	...	...	...	...	...		3,858	33,000
1856	27,138		...	...		...	...	...	...		...	...	...	...	...	...	...		2,862	30,000
1857	28,204		...	...		...	...	...	...		...	...	...	...	...	...	...		...	28,204
1858	25,761		...	...		...	...	...	...		...	...	...	...	...	...	...		5,239	31,000
1859	1,294		...	...		...	...	...	...		...	...	...	...	...	...	...		11,706	13,000
1860	7,061		...	...		...	...	...	...		...	...	...	...	...	...	...		2,939	10,000
1861	34,429		...	...		...	...	...	...		...	...	...	...	...	...	...		571	35,000
1862	39,671		444	...		...	...	...	...		...	...	...	...	...	...	...		1,885	42,000
1863	32,803		852	...		...	...	...	...		...	...	...	...	...	...	...		6,876	40,531
1864	42,489		1,914	...		...	800	...	...		...	...	...	...	...	...	...		2,286	47,489
1865	47,194		3,545	...		...	...	...	...		...	...	...	...	...	...	...		2,261	53,000
1866	35,150	6,525	2,254	...		...	...	...	...		...	...	...	...	...	...	...		2,621	46,550
1867	24,461	11,493	7,862	...		...	...	...	...		...	...	...	...	...	...	...		3,184	47,000
1868	25,628	12,180	8,686	...		...	1,122	...	...		...	...	...	...	...	...	...		112	47,728
1869	16,898	10,315	5,018	...		...	1,580	...	...		...	...	...	...	...	...	...		...	33,811
1870	14,423	9,888	4,546	...		...	1,220	...	...		...	...	...	...	...	...	...		...	30,077
1871	18,568	8,180	2,128	...		...	1,970	...	...		...	...	...	...	...	...	...		840	31,686
1872	18,574	8,171	3,046	...		...	1,830	...	...		...	...	...	...	...	...	...		...	31,621
1873	11,042	7,735	3,294	...		340	1,955	...	...		...	...	...	...	...	...	...		3,276	27,642
1874	9,084	6,911	6,678	573		1,122	1,645	...	1,743		...	...	...	...	...	...	...		...	27,756
1875	13,648	8,432	7,513	5,372	3,342	3,384	1,940	...	1,927	533	...	...	...	412	...	...	...		3,747	50,250
1876	20,549	7,272	9,183	8,367	7,381	4,322	300	573	1,683	1,979	2,358	2,150	965	387	1,570	1,028	1,436	976	2,595	75,074
1877	23,996	6,316	9,399	10,993	6,241	5,856	1,060	2,229	1,463	1,317	2,575	1,395	1,516	505	735	1,291	836	439	1,234	79,896
1878	15,852	5,138	6,686	9,465	9,072	4,963	1,075	3,049	...	1,534	1,679	1,615	1,640	1,366	472	116	...	...	158	63,880
1879	20,514	4,425	4,516	9,249	15,540	6,333	1,325	3,605	1,290	1,919	779	1,505	1,110	1,455	...	18	...	...	101	73,684
1880	23,465	3,209	2,139	10,706	6,670	6,442	275	4,416	492	245	...	166	422	1,279	...	...	...	...	...	59,926
1881	26,060	2,775	2,194	11,152	5,228	6,241	...	5,552	...	...	...	...	...	1,065	...	208	...	...	376	60,851
1882	28,070	1,953	2,171	5,014	1,138	5,179	...	6,842	...	...	...	...	...	2,124	...	...	...	...	241	52,732
1883	29,000	1,606	1,894	2,612	84	3,869	...	5,890	...	...	...	...	...	1,669	...	...	...	...	101	46,725
1884	20,000	1,025	881	890	1,179	3,292	...	4,307	...	...	...	...	...	332	...	...	...	...	7	31,913
1885	21,400	1,144	385	1,296	35	3,469	...	3,506	...	...	...	...	...	446	...	...	...	...	392	32,073
Total	835,259	124,693	97,228	75,689	55,910	54,812	18,097	39,969	8,598	7,527	7,391	6,831	5,653	11,040	2,777	2,661	2,272	1,415	63,567	1,421,389

a Including Ætna. *b* The column of "various mines" includes the product of the Buckeye, Mt. Jackson, Bacon, Bella Union, American, Porter, Wall Street, Rattlesnake, Kentuck, and other mines. This column includes, in 1882, 50 flasks produced in Oregon.

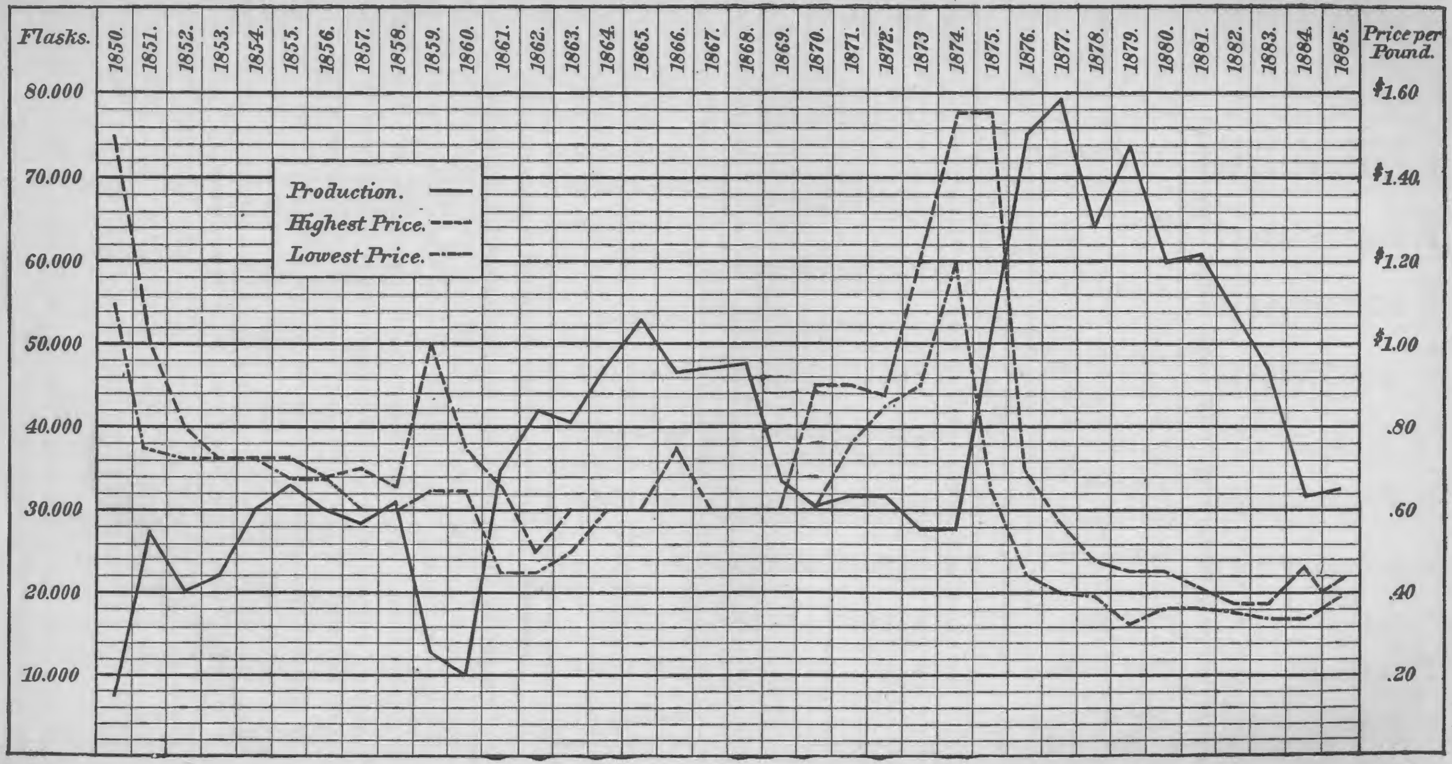

Fig. 6.—Production and price of quicksilver in the United States to December 31, 1885.

Production of quicksilver in California in 1883, by months.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Napa. (a)	Great Eastern.	Various.	Total.
	Flasks.	*Flasks.*	*Flasks.*	*Flasks.*	*Fl'ks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Fl'ks.*	*Flasks.*
January	2,497	112	367	280	77	390	590	262	7	4,582
February	2,150	133	181	310	7	364	295	156	4	3,600
March	2,230	142	202	335	.....	305	485	162	14	3,875
April	1,756	76	243	310	.....	294	530	142	3	3,354
May	2,344	144	135	350	.....	293	325	164	13	3,768
June	2,214	137	165	91	.....	400	360	184	10	3,561
July	2,618	85	141	130	.....	446	452	150	2	4,024
August	3,000	139	94	112	.....	315	695	76	.....	4,431
September	3,010	164	45	265	.....	297	750	81	30	4,642
October	2,672	272	109	206	.....	215	521	134	.....	4,129
November	2,212	115	78	160	.....	208	613	102	.....	3,488
December	2,297	87	134	63	.....	342	274	56	18	3,271
Total	29,000	1,606	1,894	2,612	84	3,869	5,890	1,669	101	46,725

a Production of Ætna and Napa mines in 1883 under heading of Napa mine.

Production of quicksilver in California in 1884, by months.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna.	Napa Con.	Great Eastern.	Various.	Total.
	Flasks.	*Flasks.*	*Fl'ks.*	*Fl'ks.*	*Flasks.*	*Flasks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Flasks.*
January	1,440	103	127	263	....	373	329	135	28	7	2,805
February	1,458	59	104	....	....	241	276	174	9	....	2,321
March	1,606	36	123	68	....	223	249	152	2	....	2,459
April	1,785	75	50	76	....	232	422	69	....	....	2,709
May	1,672	125	53	200	....	169	245	6	....	....	2,470
June	1,859	44	118	....	200	258	215	....	....	....	2,694
July	1,543	29	71	52	200	258	374	101	....	....	2,628
August	1,804	63	47	20	306	334	228	110	....	....	2,912
September	1,448	67	52	35	58	354	136	169	58	....	2,377
October	1,625	115	68	25	160	328	153	90	104	....	2,668
November	1,900	157	32	53	150	230	132	240	91	....	2,985
December	1,860	152	36	98	105	292	172	130	40	....	2,885
Total	20,000	1,025	881	890	1,179	3,292	2,931	1,376	332	7	31,913

Production of quicksilver in California in 1885, by months.

Months.	New Almaden.	Ætna.	Napa Con.	Great Western.	Guadalupe.	New Idria.	Sulphur Bank.	Redington.	Great Eastern.	Various.	Total.
	Flasks.	*Flasks.*	*Flasks.*	*Flasks.*	*Fl'ks.*	*Flasks.*	*Flasks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Flasks.*
January	1,700	189	131	172	......	190	24	40	37	......	2,483
February	1,506	96	180	245	35	70	85	24	75	......	2,316
March	1,500	88	145	314	......	80	83	......	33	19	2,262
April	2,003	142	145	340	......	80	69	......	37	......	2,816
May	2,000	62	190	269	......	75	194	......	......	3	2,793
June	1,750	112	250	330	......	62	91	50	63	5	2,713
July	1,750	45	191	321	......	75	209	43	50	10	2,694
August	2,104	118	175	324	......	80	150	49	......	47	3,047
September	1,936	201	180	347	......	95	85	57	......	77	2,978
October	1,598	52	185	236	......	85	123	42	65	82	2,468
November	1,576	54	190	292	......	122	61	43	43	87	2,468
December	1,977	150	235	279	......	130	122	37	43	62	3,035
Total	21,400	1,309	2,197	3,469	35	1,144	1,296	385	446	392	32,073

Prices.—The extreme range between the highest and lowest prices of quicksilver was not so great as in 1884. The highest price was $33 per flask, at the opening of the year; this was due to the effort of producers to maintain the sudden rise which took place late in 1884; the sales were small, however, until the price was reduced to $29. The rise to $32 at the close of the year was the effect of foreign advances. In London the price was maintained at £6 15*s.* for the first three months of 1885, but only with the result of checking the demand so that the price sank to £6 at the end of March, and gradually declined to £5 10*s.* in May. In August the shipment of about 10,000 flasks to China was followed by an advance to £6 2*s.* 6*d.* Minor fluctuation between this price and £5 17*s.* 6*d.* continued towards the close of the year, when the unsettled political situation in Spain was the most probable cause of a rise to £6 5*s.* It is not probable that this price will be maintained in 1886. At the average price of quicksilver, $30.53 per flask, the value of the total product in 1885 was $979,188, an increase of $42,861 over 1884.

The following table shows the fluctuations in prices for each month during the past three years:

Monthly quotations of quicksilver at San Francisco in 1883, 1884, *and* 1885, *per flask.*

Months.	1883.		1884.		1885.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
January	$26.75	$26.00	$26.25	$26.00	$33.00	$32.50
February	27.25	26.00	29.00	26.00	32.50	32.50
March	28.00	26.75	29.00	28.00	32.50	31.00
April	27.00	26.75	29.00	28.00	31.00	30.00
May	27.00	26.75	29.00	29.00	29.00	28.50
June	28.50	26.75	29.00	29.00	30.00	29.00
July	28.50	27.50	29.00	28.75	30.00	29.75
August	27.50	26.25	30.00	28.75	29.75	29.50
September	26.75	26.25	31.00	30.00	30.50	29.50
October	26.50	26.50	30.50	29.00	30.50	30.00
November	26.50	26.00	34.00	29.00	30.00	29.75
December	26.25	26.00	35.00	32.00	32.00	30.00
Extreme range	28.50	26.00	35.00	26.00	33.00	28.50
Average	$26.83		$29.34		$30.53	

The following table shows the extreme range in price per flask of quicksilver in California and in England:

Highest and lowest prices of quicksilver during the past thirty-six ycars.

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

Foreign sources.—The most important mines in the world are those in Spain, particularly at Almaden, of which the following is a descriptio taken from the "Iron & Mining Statistics of Spain" for 1883:

The results obtained at the mining establishment of Almaden, Spain, during the year 1883, were as follows:

Five hundred and fifty-six excavations were made in ore and eighty-six in barren ground, the quantities excavated being represented by 5,965.038 and 687.551 cubic meters respectively. The work in ore cost 296,056.86 pesetas (19.3 cents) for labor and 12,774.94 pesetas for the supply and replacement of tools, having taken 73,925 days' labor, which averaged 4 pesetas. Each place produced on an average 10.728 cubic meters, requiring 133 days' labor, and giving a labor cost of 49.63 pesetas per cubic meter and 0.081 cubic meter excavated per day's labor.

The excavations in barren ground cost 26,872.76 pesetas for labor, and 1,642.28 pesetas for the supply and replacement of tools, yielding on an average 7.995 cubic meters each, with 115 days' labor at the rate of 2.73 pesetas, giving as a result 39.08 pesetas per cubic meter and 0.07 cubic meter excavated for every day's labor.

Of the reserves there were excavated at the Pozo mine 529.537 cubic meters and at the Castillo mine 642.569, making a total of 1,172.106 cubic meters.

In the quarries which are worked to obtain material to be used for masonry of all kinds, 6,568.031 cubic meters were excavated in 16 places, showing 3,033½ days' labor, at a cost of 16,277.87 pesetas. There have been excavated besides in one place or cut (tajo) 949.975 cubic meters of clearing, as work preparatory to taking out stone for the masonry, which has cost 1,662.46 pesetas and occupied 304 days' labor.

In the work of underground strengthening of the mine, 620.178 cubic meters of arch and 2,923.711 of solid wall were constructed, costing for labor 5,402.26 and 21,358.07 pesetas, respectively, or say 8.71 pesetas per cubic meter of arch and 7.30 for the wall, and for materials and underground transportation 26.10 and 9.58 pesetas. On the surface the work cost 7,646.33 pesetas for labor and 953.76 for material. The total expense of every kind for masonry work at the establishment amounted to 90,214.38 pesetas.

The total expense of every kind for timbering and carpenter work in the mine amounted to 122,671.82 pesetas, of which 94,488.82 was for labor for timbering.

The hoisting engine at San Teodoro hoisted 21,014 casks of water, equal to the same number of cubic meters, and at the San Miguel 4,579 casks, or 3,754.78 cubic meters, the cost of this work being 1,929.27 pesetas. Extracted from the mine during the year 1883: 159,771.42 metric quintals of ore, 17,243.18 of barren rock, and 6,879.93 of tools for repairs. Sent down into the mine: 6,965.55 metric quintals of tools, 20,353.32 of mortar, 9,646.31 of brick, 885.98 of powder and fuse, and 31,882.99 of stone. The expenses of hoisting and sending down amounted to 24,066.52 pesetas, or 0.09 pesetas per metric quintal.

The expenses at the workshops for work not done by contract was 24,106.61 pesetas, of which 4,523.15 was for blacksmithing, 3,445.52 for carpenter work, 16,002.94 for repairs, and 135 for forges and bellows.

The various sums which have been spent under the name of "expenses for prospecting" have amounted during the year to 110,908.51 pesetas. The unfortunate accidents which occurred at the works of the establishment resulted in 1 death, 4 serious and 102 slight wounds. During the season the 10 pairs of Aludel furnaces and the pair of Idria chamber furnaces (hornos de camara de Idria), which are in the "Circo de Buitrones" were in operation for the reduction of ores, the former having treated 134,136.57 metric quintals of ore, yielding 13,492.177 of quicksilver, and the latter 21,619.95 metric quintals, producing 1,822.407 of quicksilver, the Bustamente furnaces having consumed 4,939 quintals of brushwood, 3,870.08 metrical quintals of wood and 6,447.82 of mineral coal, and the Idria furnaces 3,359 loads of brush The two reverberatory furnaces of rectangular form have also been in operation this year, built for the reduction of fragments in the place occupied by those called San Firmiro and San Franciscan, and they treated 9,768.51 metric quintals of ore, yielding 460.441 of quicksilver, and consumed 1,467.87 of wood and 968.87 of mineral coal.

In the Canal furnaces 2,343.75 metric quintals of ore were treated, producing 147.653 of quicksilver, and consuming 72.56 quintals of wood and 156.56 of mineral coal. The reduction operations during the year, the ore work and product obtained, are specified in the following tables:

Table of ores received and worked in the "Circo de Buitrones."

	Useless, thrown on dump.	Superior.	Medium.	Poor rock.	Fragments (vaciscos).	Total.
	Met. quint.	*Met. quint.*	*Met. quint.*	*Met. quint.*	*Met. quint.*	*Met. quint.*
Ores on hand at end of last year	....	10, 952. 96	67, 119. 06	8, 278. 73	118, 089. 89	204, 440. 64
Ores taken out this year	3, 777. 15	32, 565. 78	74, 432. 00	18, 124. 46	30, 341. 48	155, 463. 72
Total	....	43, 518. 74	141, 551. 06	26, 403. 19	148, 431. 37	359, 904. 36
Ores worked this year	....	35, 137. 21	78, 512. 30	25, 382. 00	28, 837. 28	167, 868. 79
Ores on hand for following year	....	8, 381. 53	63, 038. 76	1, 021. 19	119, 594. 09	192, 035. 57

Table of ore worked and quicksilver obtained.

	Number of calcinations.	Net quintals of ore worked.	Net quintals of quicksilver obtained.	Yield, per cent.
S. Pedro y S. Pablo	147	14, 017. 75	1, 334. 568	9. 520
Atocha y Almudena	147	14, 028. 75	1, 353. 986	9. 651
S. Antonio y Sto Domingo	148	14, 129. 43	1, 371. 034	9. 703
Larrañaga y Prado	144	13, 920. 08	1, 329. 405	9. 550
S. Carlos y S. Sebastian	144	12, 327. 57	1, 351. 427	10. 963
Sta. Cruz y Stos. Reyes	143	12, 280. 39	1, 319. 705	10. 746
Cavanillas y Caravantes	143	12, 268. 59	1, 350. 061	11. 004
Monasterio y Buceta	143	12, 310. 79	1, 355. 555	11. 011
S. Carlos y S. Luis	68	21, 619. 95	1, 822. 407	8. 429
S. Miguel y S. Benito	148	14, 116. 63	1, 386. 902	9. 825
S. Fermin y S. Francisco	....	9, 768. 52	460. 441	4. 713
S. Eugenio y S. Julian	146	14, 736. 59	1, 339. 444	9. 089
Horno de Canales	....	2, 343. 75	147. 653	6. 300
Total	1, 521	167, 868. 79	15, 922. 678	9. 458

Other countries.—During the year 1885 a company was formed in London for developing the deposits near Kilkivan, Queensland. Shafts and tunnels have been made on a number of veins, and a considerable amount of ore exposed; further, a few tons of quicksilver have been extracted and sold to the miners in Queensland. No statement has been made of the percentage yield, and the future of an enterprise working in opposition to such established works as the Almaden is doubtful. The discovery of a new and very pure deposit of cinnabar at Schuppiastena, near Belgrade, is reported. Being in a mining region it is possible that the deposit may be used. Small amounts of quicksilver are annually produced in Hungary as is seen in the following table, taken from the "Mineral Resources of Hungary."

Production of quicksilver in Hungary.

Years.	Metric tons.
1864	33
1865	40
1866	65
1867	61
1868	45
1869	35
1870	25
1871	18
1872	15
1873	14
1874	13
1875	18
1876	22
1877	26
1878	25
1879	24
1880	18
1881	18
1882	16
1883	12

Imports.—In spite of the production of nearly half of the world's supply in this country, some quicksilver is imported; this amounted in 1885 to 257,659 pounds, valued at $90,416, nearly twice the importation of the previous year, but far less than in 1883. The importations of mercurial preparations was formerly noteworthy, as given in the following tables:

Quicksilver imported and entered for consumption in the United States, 1867 *to* 1884 *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	....	$15,248	1877	38,250	$19,558
1868	152	68	1878	294,207	135,178
1869	....	11	1879	519,125	217,770
1870	239,223	107,646	1880	116,700	48,463
1871	304,965	137,332	1881	138,517	57,733
1872	370,353	189,943	1882	597,898	233,057
1873	99,898	74,146	1883	1,552,738	593,367
1874	51,202	52,093	1884	136,615	44,035
1875	6,870	20,957	1885	257,659	90,416
1876	78,902	50,164			

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

Fiscal years ending June 30—	Blue-mass.		Calomel.		Mercurial preparations not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
1867	....	....	....	$4,242	....	$2,242
1868	....	....	....	4,440	....	4,440
1869	....	....	....	4,516	....	4,516
1870	....	....	....	6,306	....	6,306
1871	....	....	....	8,147	....	3,147
1872	1,009	$667	8,241	6,590	$629	7,886
1873	919	660	5,520	5,240	699	6,599
1874	259	192	6,138	6,676	4,334	11,202
1875	125	109	2,424	2,817	52	2,978
1876	489	365	5,433	5,820	92	6,277
1877	455	327	4,649	4,305	90	4,722
1878	397	252	4,133	3,576	363	4,191
1879	485	266	5,875	4,635	6,453	11,354
1880	533	262	4,780	3,330	30	3,622
1881	395	236	8,177	5,640	116	5,992
1882	207	124	5,215	3,411	58	3,593
1883	188	79	8,732	5,503	190	5,772

a Not specified in 1884 and 1885.

Exports.—It will be seen by the following tables that the production of California is distributed widely. Under the head of exports by sea is included all the quicksilver to New York. Some of this is then exported to England and elsewhere, while another portion is consumed in the manufacture of vermilion and in the applications of quicksilver in the arts. There was a marked increase in these shipments to New York during 1884, which was continued in 1885. The total exports from San Francisco increased from 21,901 flasks in 1884 to 25,730 in 1885. This increased exportation is not due to the slight increase in production, and it caused a drain on the accumulated stock, which was reduced to less than 1,000 flasks. The yearly exports since 1854 are shown in the following tables:

Quicksilver of domestic production exported from the United States.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1854		$94, 335	1870	1, 200, 385	$511, 918
1855		806, 119	1871	994, 005	732, 845
1856		831, 724	1872	862, 694	691, 637
1857		665, 480	1873	714, 783	626, 021
1858		129, 184	1874	501, 389	580, 521
1859			1875	986, 469	1, 075, 796
1860		258, 682	1876	2, 711, 584	1, 740, 293
1861		631, 450	1877	3, 894, 311	1, 767, 266
1862		1, 237, 643	1878	2, 552, 388	1, 230, 008
1863		1, 237, 116	1879	3, 624, 827	1, 418, 331
1864	1, 736, 596	976, 868	1880	3, 574, 412	1, 360, 176
1865		1, 629, 063	1881	2, 955, 948	1, 124, 955
1866	2, 948, 699	1, 508, 039	1882	2, 485, 551	959, 128
1867	1, 736, 924	750, 673	1883	2, 762, 554	1, 020, 827
1868	2, 995, 789	1, 220, 809	1884	1, 242, 080	427, 219
1869	2, 152, 499	869, 803	1885	516, 867	206, 630

Movement of quicksilver from San Francisco by sea and rail.

Years.	Flasks.	Years.	Flasks.
1850	6, 467	1868	44, 506
1851	10, 791	1869	24, 415
1852	21, 458	1870	14, 240
1853	18, 800	1871	16, 339
1854	20, 963	1872	16, 780
1855	27, 165	1873	11, 164
1856	23, 740	1874	11, 750
1857	27, 262	1875	37, 829
1858	24, 412	1876	49, 046
1859	3, 399	1877	52, 695
1860	9, 488	1878	41, 877
1861	35, 995	1879	62, 845
1862	23, 747	1880	46, 294
1863	26, 014	1881	45, 790
1864	36, 927	1882	40, 417
1865	42, 469	1883	37, 867
1866	30, 287	1884	21, 901
1867	28, 853	1885	25, 730

The shipments shown in this and in the following table do not include supplies sent to local and Nevada precious-metal mines.

Movement of quicksilver from San Francisco in 1883, 1884, *and* 1885 *in detail.*

To—	1883.	1884.	1885.	Increase.	Decrease.
By sea:	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*
China	16,330	200	233	33	
Japan	1,253	588	302		286
Mexico	10,764	5,404	5,884	480	
South America	970	155	100		55
Australia	600	110			110
New Zealand	160	20	100	80	
Central America	59	52	9		43
New York	3,100	8,350	9,055	705	
Various	11	22	47	25	
Total by sea	33,247	14,901	15,730	829	
By rail:					
Central Pacific, Southern Pacific, and Northern Pacific railroads	4,620	(*a*)7,000	(*a*)10,000	3,000	
Grand total	37,867	21,901	25,730	3,829	

a Including about 3,500 flasks to Mexico by Southern Pacific railroad.

Movement of quicksilver in London.—The following tables give a summary of the imports and exports of quicksilver for the past three years, and an estimate of the accumulated stock at the end of each year:

London imports and exports of quicksilver.

Years.	Imports.	Exports.	Estimated stock on hand December 31.
	Flasks.	*Flasks.*	*Flasks.*
1883	54,519	46,997	
1884	56,969	52,492	74,000
1885	55,154	48,822	65,500

The detailed statement of imports for each month of 1885 are given below:

Monthly imports of quicksilver into England in 1885.

Months.	Flasks.
January	4,350
February	4,603
March	8,434
April	329
May	9,545
June	21,328
July	427
August	1,607
September	300
October	2,057
November	474
December	1,700
Total	55,154

Uses.—In addition to the use of quicksilver in the amalgamation process of gold and silver mining, about 530,000 pounds are consumed yearly in the production of quicksilver vermilion, of which an account by Mr. Marcus Benjamin is given below.

Vermilion.—The production of this pigment from quicksilver is controlled by a syndicate, consisting of four firms as follows: C. T. Raynolds & Co., D. F. Tiemann & Co., Sondheim, Alsberg & Co., and A. B. Ansbacher & Co., all of New York City. The process of manufacture, which is an exceedingly difficult one, requiring much skill and delicacy of manipulation, is kept secret by the combination. In a general way it is said to consist in bringing quicksilver, sulphur, and an aqueous solution of caustic potash together in a revolving drum. The mixture is gently heated until a temperature of 115° F. is reached; this heat is then kept constant and the reddening action proceeds. The methods of manufacture differ somewhat with each maker. From 85 to 90 pounds of quicksilver are necessary in order to produce 100 pounds vermilion. The quicksilver used is bought on the open market and that which is cheapest at the time is purchased, so that the exact amount of American or foreign quicksilver used in the production of vermilion cannot be estimated.

The output of American vermilion made from quicksilver during 1885 by this syndicate is estimated at 600,000 pounds. The ruling price during this time was 52 cents in bulk, 53 cents in bags, and 57 cents in smaller quantities. A small amount of quicksilver vermilion, perhaps 10,000 pounds, is annually imported into the United States, but its high price, 65 to 70 cents per pound, prevents any great demand for it.

Prices of vermilion.

Vermilion.	Cents per pound.
American quicksilver, in bulk	52 to ....
American quicksilver, in bags	53 to 60
Chinese	65 to 80
Imported English	65 to 70
Trieste	70 to 72½
American	10½ to 11
Artificial	10 to 25

Foreign vermilion is not regarded as having any influence upon the demand for American, which was active during 1885. The production of the latter, however, has been very seriously affected by the introduction of numerous varieties of imitation vermilion. These products have already been described on page 502 of the "Mineral Resources of the United States, 1883 and 1884," and need no further mention beyond the statement that the production of orange mineral (see page 524) has been largely augmented during the past year by its use with certain anilines in making these low grades of artificial vermilion.

NICKEL.

Production.—As in previous years, the production of metallic nickel in the United States was limited during 1885 to the American Nickel works in Camden, New Jersey, where ore in the form of nickeliferous pyrrhotite from the Gap mine, Lancaster county, Pennsylvania is smelted. The works were in operation throughout the year and produced 245,504 pounds of "grain" nickel, valued at $169,397. Besides the amount of metallic nickel given above, matte containing nickel and cobalt was made at Mine la Motte, Missouri, containing in all 14,400 pounds of nickel, all of which was exported to England and Germany. Nickel ore, to the extent of 90 short tons, was also exported from Nevada; it was estimated to contain in all about 18,000 pounds of nickel. The total production of nickel ore and matte was equivalent therefore to 277,904 pounds of metallic nickel, valued at about $190,000. The production of metallic nickel, and also the amounts of matte and ore, is summarized in the following tables:

Annual production of metallic nickel in the United States from 1876 *to* 1885 *inclusive.*

Years.	Pure grain nickel.	Nickel contained in copper-nickel alloy.	Total.	Average price per pound.	Value.
	Pounds.	*Pounds.*	*Pounds.*		
1876	....	....	201, 367	$2. 60	$523, 554
1877	....	....	188, 211	1. 60	301, 138
1878	....	....	150, 890	1. 10	165, 979
1879	....	....	145, 120	1. 12	162, 534
1880	....	....	233, 893	1. 10	257, 282
1881	....	....	265, 668	1. 10	292, 235
1882	277, 034	4, 582	281, 616	1. 10	309, 777
1883	6, 500	52, 300	58, 800	. 90	52, 920
1884	....	64, 550	64, 550	. 75	48, 412
1885	....	....	245, 504	. 69	(*a*)169, 398

(*a*) Not including value of nickel in ore and matte.

Total production of nickel in 1885.

	Pounds.
Metallic nickel	245, 504
Nickel in ore and matte	32, 400

Price.—The average price of American nickel in 1885 was 69 cents per pound. The price paid by the Mint for German nickel was 5.7

cents per Troy ounce. The range in price of nickel for the last ten years is given in the table of production. The price is still declining in consequence of the forced sales of the product of the New Caledonia mines.

Imports and exports.—The following tables show the amounts of nickel and nickel alloys imported, and the values of manufactured nickel, nickel coin, and nickel ore exported from the United States:

Nickel imported and entered for consumption in the United States, 1868 *to* 1885 *inclusive.*

Fiscal years ending June 30—	Nickel.		Oxide and alloy of nickel with copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1868	....	$118, 058	....	....	$118, 058
1869	....	134, 327	....	....	134, 327
1870	....	99, 111	....	....	99, 111
1871	17, 701	48, 133	4, 438	$3, 911	52, 044
1872	26, 140	27, 144	....	....	27, 144
1873	2, 842	4, 717	....	....	4, 717
1874	3, 172	5, 883	....	....	5, 883
1875	1, 255	3, 157	12	36	3, 193
1876		....	156	10	10
1877	5, 978	9, 522	716	824	10, 346
1878	7, 486	8, 837	8, 518	7, 847	16, 684
1879	10, 496	7, 829	8, 314	5, 570	13, 399
1880	38, 276	25, 758	61, 869	40, 311	66, 069
1881	17, 933	14, 503	135, 744	107, 627	122, 130
1882	22, 906	17, 924	177, 822	125, 736	143, 660
1883	19, 015	13, 098	161, 159	119, 386	132, 484
1884	....	....	194, 711	129, 733	129, 733
1885	....	....	105, 603	64, 166	64, 166

Value of exports of nickel and nickel ore of domestic production from the United States.

Fiscal years ending June 30—	Manufactured nickel.	Nickel coin.	Nickel ore.
1864	....	....	$25, 494
1865	....	....	36, 710
1869	....	....	11, 350
1872	....	....	43, 500
1873	$19, 780	....	19, 891
1874	16, 062	....	75, 696
1875	26, 000	....	72, 020
1876	168, 050	....	35, 100
1877	8, 200	....	....
1878	....	....	2, 452
1880	4, 120	....	....
1881	6, 600	$32, 880	....
1882	12, 474	7, 200	....
1883	9, 911	....	12, 182
1884	....	....	(a)22, 249
1885	1, 223	....	10, 500

a Classed as "nickel and cobalt ore."

New occurrences of nickel.—Mr. C. G. Yale states that besides the localities mentioned in the last volume of this report, the various ores of nickel occur at the following places in California: The sulphide has been observed on the Central Pacific railroad in Placer county. A nickel ore also occurs with chrome iron at Panoches, Gabilan mountains, at Cañada, San Benito, and elsewhere in the Coast range mountains. At none of these places does the ore occur in quantity. From the deposits discovered several years since in Cottonwood cañon, Churchill county, Nevada, some ore averaging 8 per cent. nickel was extracted last year, and shipped to Europe. Although these deposits are not so extensive as at first reported, much more ore might have been extracted had the business proved profitable, which it did not, owing to the low grade of the ore and the cost ($18 per ton) of hauling to the railroad. The work of prospecting is still continued at this place, in the hope of finding the deposits more concentrated and the ore of a better grade. The mines are reported to have been sold to English capitalists having the intention of erecting extensive reduction works. With the nickel deposits in Oregon, described in the first volume of these reports, nothing has been done, though there is little doubt of their value and extent. That they will be worked on a large scale as soon as the railroad is completed, which is to pass within a few miles of them, is altogether probable. Mr. F. F. Chisolm reports that the vein in the Gem mine, in Custer county, Colorado, has been lost, and no ore can now be found in the mine. This is the only mine in Colorado where any attempt has been made to ship nickel ores. The occurrence of the mineral in other places is so slight as to preclude the possibility of regular shipments.

Foreign sources of nickel.—The chief foreign sources of nickel, with which the United States must as yet be regarded as a minor competitor, have been given in former reports. With the exception of an effort of very questionable value in the direction of increasing the home production of Germany, by developing the Hessian mines near Gladenbach, there has been little change in European mines during the year. The market has been controlled altogether, however, by the mines of New Caledonia. An admirable treatise upon the present condition of these mines is taken from the *Iron Age* as follows:

The production of nickel in New Caledonia—Only a few years since, industrial circles were aroused by the discovery in New Caledonia of highly important deposits of nickel. A company was formed in France to work them, acquiring the patents of Garnier, and building works for treating the ore and refining the metal at Septemes, near Marseilles, where the vessels from Noumea discharged. Later these works were abandoned for a plant at Birmingham. The capital was increased, an alliance formed with a great metallurgical establishment at Glasgow to work other metals besides, like chromium, cobalt, antimony, etc. The abundance and the richness of the New Caledonia deposits, and the strong financial backing of the enterprise, seemed to assure for it a bright future. It was expected that nickel, produced at a low price, would displace copper in many directions, and that the production would keep pace with the steadily growing consumption at gradually declining prices. Such, according to M. Charles du Peloux, in the *Génie Civil*, was the outlook in 1882. Now, four years since, the works at Nouméa are closed down, and work at the mines is reduced to what is absolutely necessary. M. du Peloux explains this outcome in a very interesting review of the conditions affecting the New Caledonian mines.

The ore, known as "garnierite," is a hydrosilicate of nickel and magnesia, and is found at a great number of points in Caledonia—in fact, it may be stated that, with the exception of the northeast end, traces of nickel may be found in all parts of the island, which is made up of more or less decomposed eruptive rocks, among which serpentine plays the most important part. The nickel ore is always found in the beds of serpentine. Still, though apparently so abundant, the ore is found in quantity and accessible in workable deposits only at a very few points in the districts along the northeast coast of the island. After examination, these rich regions are reduced to three principal districts, named Canala-Méré-Kuana, Thio-Port Bouquet, and Bourindi. They are, properly speaking, detached districts without any connection geographically, but are simply the points of maximum grade above the entire belt. The Canala-Honailou group was the first worked, and, while it had many rich veins, the grade was too low, the workings too much scattered, and transportation too difficult to make it profitable. It has been abandoned. The Thio group, which was then taken in hand, is the only one now being worked. It is the best known and is considerably nearer Noumea. Although it has been well developed in all directions during the past six years it is far from being exhausted. It consists of an important central group, and two others at quite a distance from it. The third district, the Bourindi, is probably justly considered the richest on the island, both for quantity and grade of ore. It is nearest Noumea, and has not been touched as yet. It is kept as a reserve.

The veins, so far as strike and dip are concerned, are fairly regular, striking north-northeast and south-southwest and dipping almost vertically. But the contents vary widely and suddenly in grade. The veins are not very persistent, and it is asserted, after experience which must be considered final, that they do not descend deeper than 300 to 500 feet, even that depth being very rare. The ore is mined by the usual methods, and is sorted by hand at the mine and sacked. M. du Peloux describes in detail how frequently the ore is handled, evidently disapproving of it; he enumerates that the ore of the Thio district, which is best equipped with means of transportation, is handled twelve times. This is partly due to the fact that the sacks are taken to the river bank, the bar at the mouth of which they can only cross at flood tide, and that the beach is so shallow that the ore must again be lightered to the sea-going vessels in the offing, which carry it to the smelting works at Noumea. Thus the irregularity of the ore distribution and the high cost of transportation greatly increase the expense of mining. To this must be added the scarcity of suitable labor in New Caledonia. Among the force available are, first, those transported criminals who are liberated with residence restricted to the colony.

They are lazy and difficult to handle. They receive from 6 to 9 francs for eight hours' work. Then there are the natives of the New Hebrides islands engaged under supervision of the government for a period of three to five years. Although apparently cheap labor, they cost 3 francs a day, are unfit to work in the mines, and are unable to adapt themselves to the climate, from 25 to 30 per cent. always being in the hospital, where the majority die. Their immigration has been finally prohibited by the French Government. The Australians are fair miners and good workmen, but they demand at least 12.50 francs a day. Latterly Chinese laborers have been brought in, and give better promise, although they require constant watching. Added to the high cost of labor, as compared with European standards, there is often trouble through want of water.

The ore is taken in lots of 200 to 250 tons to Noumea, where it is worked in two blast furnaces, one of which is used for nickel ores alone, and the other for mixed ores of nickel and cobalt. The charcoal and coke come from Australia, and, in spite of the proximity of the two colonies, are very dear. Charcoal costing 12.50 francs at Sydney is worth 40 francs at Noumea, while coke sells at 70 to 80 francs. The object in smelting the ore is to produce a matte carrying from 60 to 70 per cent. of metal. It is granulated and shipped to England.

The production of nickel is far greater than the consumption, and this is the principal reason which has led to the temporary suspension of the working. The sale of the metal was considered too easy a matter. Production was pushed too fast, and thus the company was finally brought face to face with an enormous stock. In April, 1884, the product of the Thio mines had reached 1,000 tons a month and orders came to increase it even then. With the usual grade, this represented an annual production of 850 tons of metal. During the years 1882, 1883, and 1884 the Caledonia company have thrown on the market about 2,400 tons of pure nickel. It may be estimated that in those three years the European and American mines marketed a total of 600 tons, carrying the aggregate for three years to 3,000 tons, or 1,000 tons per annum. Now the consumption is probably not greater than 700 to 800 tons, if it reaches that figure. At present prices, ranging between 6 and 7 francs, the profits are small. M. du Peloux, however, believes that the cost may be reduced so that the company can sell at 4 to 5 francs and yet have a good profit, and that in spite of the temporary stoppage the future is full of promise.

Use.—Contrary to normal industrial development, the production of nickel has increased considerably beyond the demands for the metal. Stocks have accumulated repeatedly, resulting in cessation of production in various parts of the world until this stock could be cleared off. The expectation that the use of malleable alloys of nickel would increase the consumption markedly has not yet been fulfilled. The production of such alloys lingers in the experimental stage. Switzerland coined 20-centime pieces in pure nickel last year succesfully, and it is proposed to coin 5, 10, and 20 centime pieces in France. The use of nickel in American coinage is given in the following table. The nickel so used in 1885 was all of German manufacture and was applied only to 3 and 5 cent pieces.

Nickel coinage of the United States.

Calendar years.	One-cent nickel coins.		Three-cent nickel coins.		Five-cent nickel coins.		Pure nickel consumed.
	Pieces.	Value.	Pieces.	Value.	Pieces.	Value.	
							Troy ounces.
1857	17,432,410	$174,324.10					313,931.92
1858	24,600,000	246,000.00					448,731.22
1859	36,400,000	364,000.00					637,687.87
1860	20,566,000	205,660.00					391,199.20
1861	10,100,000	101,000.00					181,076.48
1862	28,375,000	283,750.00					505,320.42
1863	49,840,000	498,400.00					895,878.04
1864	13,170,000	131,700.00					237,049.00
1865			11,382,000	$341,460.00			165,955.08
1866			4,801,000	144,030.00	14,742,500	$737,125.00	674,553.54
1867			3,915,000	117,450.00	30,909,500	1,545,475.00	1,307,978.08
1868			3,252,000	97,560.00	28,817,000	1,440,850.00	1,213,242.65
1869			1,604,000	48,120.00	16,395,000	819,750.00	688,017.22
1870			1,335,000	40,050.00	4,806,000	240,300.00	215,171.62
1871			604,000	18,120.00	561,000	28,050.00	32,591.00
1872			862,000	25,860.00	6,036,000	301,800.00	215,303.32
1873			1,173,000	35,190.00	4,550,000	227,500.00	110,057.07
1874			790,000	23,700.00	3,538,000	176,900.00	76,772.51
1875			228,000	6,840.00	2,097,000	104,850.00	21,135.36
1876			162,000	4,860.00	2,530,000	126,500.00	2,688.42
1877							
1878			2,350	70.50	2,350	117.50	132.90
1879			41,200	1,236.00	29,100	1,455.00	1,821.78
1880			24,955	748.65	19,955	997.75	1,197.32
1881			1,080,575	32,417.25	72,375	3,618.75	10,505.16
1882			25,300	759.00	11,476,600	573,830.00	344,553.71
1883			10,609	318.27	22,969,421	1,148,471.05	703,426.73
1884			5,642	169.26	11,273,942	563,697.10	399,141.37
1885			4,790	143.70	1,476,490	73,824.50	58,615.82
Total	200,483,410	2,004,834.10	31,303,421	929,102.63	162,302,233	8,115,111.65	9,848,734.81

MANGANESE.

By Jos. D. Weeks.[a]

The general subject of the occurrence, uses, and character of manganese ores, as well as the localities in the United States in which they are found, were discussed at length in Dr. Day's report on manganese in the last volume of "Mineral Resources." To that report those interested are referred for more definite information than is here given.

In the present report the ores containing manganese which are described are divided into two classes, manganese ores and manganiferous iron ores. Some difficulty was experienced in deciding upon the percentage of manganese that should constitute the dividing line between these two grades. The percentage which is the standard of shipments in English chemical works was adopted, that is, 70 per cent. of binoxide, which equals 44.252 parts of the metal per 100. It is to be understood, however, that ores containing less than this percentage of metallic manganese are used in the manufacture of high manganese spiegel and ferromanganese, while some ores with manganese in excess of this may be used for low spiegels. It is also to be noted that all ores that are utilized for their manganese, without reference to the percentage contained, are reported in the tables of production. To these should be added the high manganese ores of Montana, utilized for their silver contents and the fluxing properties of the manganese.

A word as to the ores of manganese. Those utilized in this country are, with scarcely an exception, oxides. Four oxides are noted:

Protoxide (MnO), known also as the monoxide or manganous oxide. Multiplying the amount of the protoxide or MnO in an ore by .7746 will give the contents of metallic manganese in the ore.

Sesquioxide (Mn_2O_3), *braunite, brown oxide*, known also as manganic oxide. This oxide occurs in nature as braunite and in the state of hydrate as *manganite* (Mn_2O_3, H_2O). This, in the form of braunite, is one of the most important ores of manganese occurring in this country. Multiplying the amount of sesquioxide (Mn_2O_3) in an ore by .6392 will give the amount of metallic manganese in the ore.

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[a] I desire to make especial acknowledgment for assistance rendered and information given in the preparation of this report to Mr. John Fulton, Johnstown, Pennsylvania; Mr. A. M. Evans, Batesville, Arkansas; Mr. A. P. Silva, Cartersville, Georgia; Mr. Albert Markham, Markhamsville, New Brunswick; and Mr. E. Gilpin, jr., of Halfax, Nova Scotia.—J. D. W.

Peroxide (MnO_2) *pyrolusite, black oxide.*—This is, with braunite, the most common ore of manganese in the United States. Psilomelane contains the peroxide. Multiplying the amount of peroxide (MnO_2) in an ore by .63218 will give the amount of metallic manganese in the ore.

Hausmannite is a brown manganese oxide containing theoretically 72.1 per cent. of metallic manganese.

Localities in the United States.—The localities in this country in which manganese is found will be given in detail when discussing its occurrence in the different States. It only need be said here that it has a distribution almost coextensive with the deposits of the brown hematite ores of the country. In almost all of these ores manganese occurs as a constituent. At times the manganese displaces so much of the iron as to make the ore a manganiferous iron ore, while, at other times, in close association with the iron ores, veins or pockets of manganese ores will be found. This statement is especially true of the hematite ore beds of the great Appalachian chain of mountains from the northern to the southern extremity. It is particularly noticeable in Virginia.

Though manganese is found in many sections, there are but three, possibly four, localities that yielded any amount of ore in 1885, the Crimora mines, in Virginia; Cartersville, Georgia; and Batesville, Arkansas. To these the Mount Athos or Leet's mine, Virginia, should be added. The Crimora mine is much the more important, yielding two-thirds of all the manganese mined in the country in 1885.

In addition to these there were two localities in Virginia that produced some manganiferous iron ore in 1885, the Houston mines and those of the Shenandoah Iron company.

Origin of manganese ore.—There is no more interesting question, geologically, than the origin of manganese. This report will not attempt to solve the question, but all information that could be gathered as to the occurrence of the several deposits thus far discovered has been brought together in the hope that it would aid in its solution. It is evident that its origin is similar to that of hematite ores, that it has been deposited from solution, and that lime has been one of the agents in its deposition. Possibly this accounts for the fact that the manganese deposits seem to contain less phosphorus than the rocks from which they have leached.

It is also remarkable that so far as known the valuable deposits of manganese have been in pockets, usually embedded in a tenacious clay which requires washing to remove.

Production and value in the United States.—The production of manganese and manganiferous iron ores in the United States in 1885 was 26,495 long tons, of which 23,258 tons were manganese ores, or those averaging more than 44.252 per cent. of metallic manganese, and 3,237 tons manganiferous iron ore, or ores carrying less than this 44¼ per cent. of manganese, but still high enough to be utilized for this metal. The amount of metallic manganese in these manganiferous iron ores was from 31 per cent. to 45 per cent., averaging 39 per cent.

The distribution of this production was as follows:

Production of manganese ore in the United States in 1885.

Locality.	Production.
	Long tons.
Virginia:	
Augusta county:	
Crimora	18,212
Campbell county:	
Mount Athos (Leet's)	500
Bishop mine	13
Rockbridge county:	
Guy's Run	20
Total, Virginia	18,745
Georgia:	
Cartersville	2,580
Arkansas:	
Batesville	1,483
California	200
Nevada	200
Other localities, small amounts	50
Total manganese ore	23,258
Add manganiferous iron ores, Virginia	3,237
Total	26,495

To the above should be added the argentiferous manganese ores of Montana utilized for their silver, amounting to 4,263 tons in 1885.

Virginia produced 18,745 tons, or 80.6 per cent. of the 23,258 tons of manganese ores produced in the country in 1885, and all of the manganiferous iron ore. The Crimora mine produced all but 533 tons of the manganese ores produced in Virginia.

The value of this ore was as follows:

Value of manganese ore and manganiferous iron ore produced in the United States in 1885, free on board at mines.

Locality.	Production.	Value.	
		Per ton.	Total.
	Long tons.		
Virginia:			
Crimora	18,212	$9.00	$163,908
Mount Athos	500	9.50	4,750
Bishop mine	13	9.50	124
Guy's Run	20	8.00	160
Total, Virginia	18,745	9.01+	168,942
Georgia:			
Cartersville	2,580	5.19	13,390
Arkansas:			
Batesville	1,483	4.00	5,932
California	200	5.00	1,000
Nevada	200	3.00	600
Other localities	50	8.34	417
Total for United States	23,258	8.18	190,281
Manganiferous iron ore, Virginia	3,237	5.35	17,318
Total manganese and manganiferous iron ore	26,495	7.83+	207,599

It is almost impossible to arrive at the production of manganese for the years prior to 1885. In the last volume of "Mineral Resources" it is estimated that 8,000 tons were mined in 1883 and 10,000 tons in 1884, and that of these amounts Virginia furnished fully three-fourths, Arkansas a fifth, and the balance was contributed by Georgia and North Carolina. I have been able to learn of the following amounts mined in each of the years from 1880. With the exception of 1885, the table is not given as including all the ore mined, but as the best approximation to the actual facts:

Production of manganese ores (over 44½ per cent. of metallic manganese) in the United States, 1880–'85.

States.	1880.	1881.	1882.	1883.	1884.	1885.
Virginia	3, 661	3, 295	2, 982	5, 355	8, 980	18, 745
Arkansas	....	100	175	400	800	1, 483
Georgia	1, 800	1, 200	1, 000	....	....	2, 580
Other States	300	300	375	400	400	450
Total	5, 761	4, 895	4, 532	6, 155	10, 180	23, 258

The Virginia production is very nearly correct; as to Arkansas there is considerable doubt. There is a strange reluctance on the part of those who could give a statement of the amounts mined to impart the information. This it may be said is the only case of refusal. Georgia's figures are those of shipments.

The value given for the manganese mined in 1885 is that of ore on cars or carts at the mine, and not the price at points of consumption nor of distribution other than the mine itself. It is understood that this was not the basis adopted in the previous report, as the price for 1883 is put at $11 to $16, and for 1884 at $12 for 75 per cent. manganese dioxide. The greater part of the Crimora ore, which was the bulk of the ore mined, sold for much less than this at the mine; an average of $8.50 in 1884 and of $9 in 1883 would be approximately correct.

Production of spiegel iron and ferro-manganese.—Spiegel iron and ferro-manganese were produced in 1885 in two States, New Jersey and Pennsylvania, and at five works; those of the New Jersey Zinc Company and the Passaic Zinc Company, of New Jersey, and the Lehigh Zinc and Iron Company, the Cambria Iron Company, and the Edgar Thomson Steel Works, in Pennsylvania. The three first named use zinc residuum, the last two manganese ores.

The total production of spiegel iron and ferro-manganese in the country in 1885 was 30,955 long tons. In 1884 the production was 30,262 tons. Of the total made in 1885 the Edgar Thomson furnace A, at Pittsburgh, produced 7,218 long tons of ferro-manganese and 4,722 tons of spiegel iron.

In making a 20 per cent. spiegel iron, the ore must contain 38 per cent. iron and 15 per cent. manganese. Ores containing less than this proportion of iron and manganese must be mixed with others richer in both elements; these rich ores are scarcer in Europe, whilst ores containing 2 per cent. to 10 per cent. of manganese are abundant in Spain and Algeria. These ores are comparatively cheap, and can be used with economy with rich manganese ores of Virginia, Georgia, and Arkansas in making spiegel iron.

VIRGINIA.

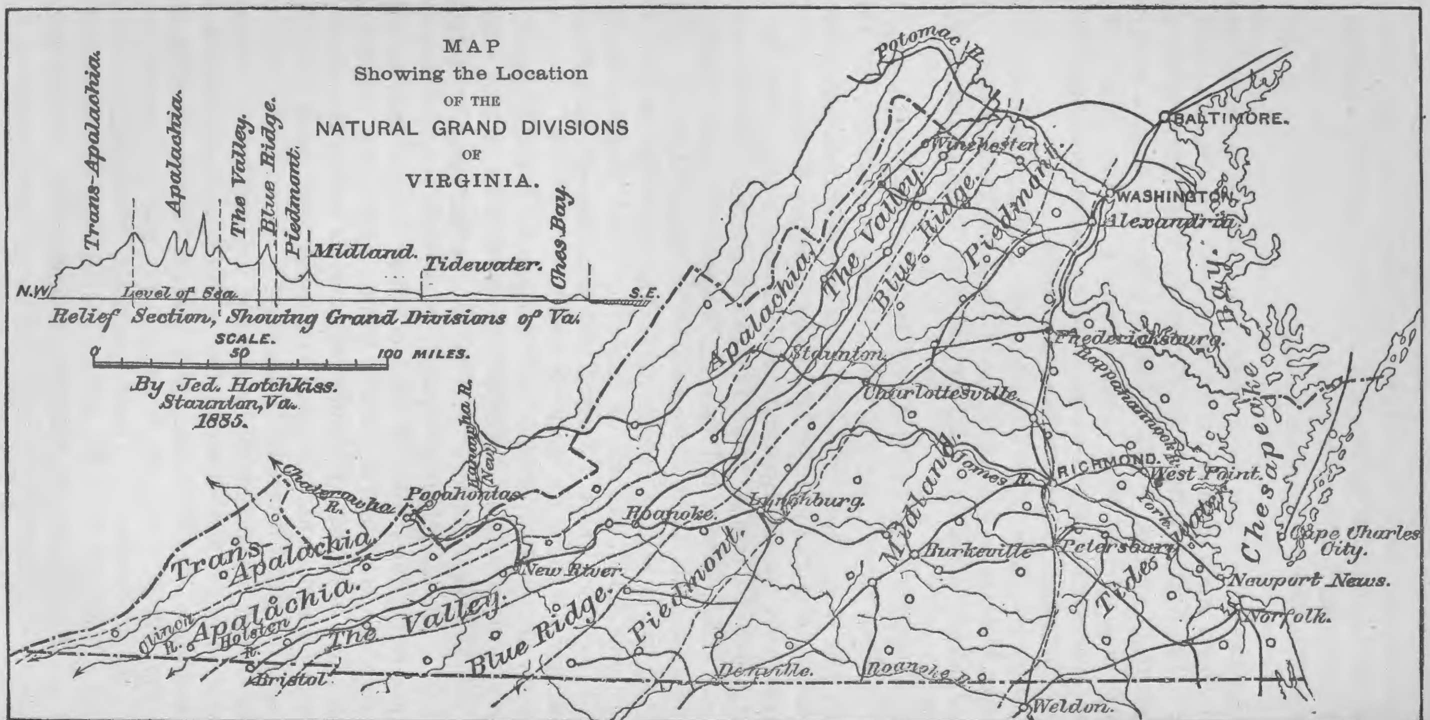
So far as explorations have been made, manganese ores have been found over a much greater extent of territory in Virginia than in any other of the United States. It is uncertain what future developments may prove to be true of other States, especially of Arkansas, but at present Virginia has more known deposits of this mineral, they are spread over a greater extent of territory, more localities have been worked, and more manganese has been raised.

As to the localities in this State in which manganese ore is found, Maj. Jed. Hotchkiss, mining editor of the *Industrial South*, in the first issue (January 6, 1886) of that journal after its consolidation with *The Virginias*, says:

"In the brief time and with the small means at my disposal to collect minerals from Virginia for the New Orleans World's Fair of 1884–85, without any special seeking, I had there on exhibition, manganese ores from thirty different localities in sixteen counties of the State. From Midland: from one in Spottsylvania; two in Louisa; one in Appomattox; four in Campbell; and two in Pittsylvania. From Piedmont: from one in Albemarle, and two in Nelson. From the Valley: from one in Shenandoah, two in Augusta, one in Rockbridge, four in Botetourt, and one in Wythe. From Apalachia: from one in Bath, four in Craig, two in Bland, and one in Tazewell. I can recall as many more Virginia localities where I know of the existence of manganese ores, and hundreds of them can easily be found.

"Observation and experience have taught me that deposits of manganese almost invariably accompany those of iron, so that where the latter are abundant, more or less of the former may be confidently looked for. At least eight groups of the geological formations in Virginia are ferriferous; each of these contains more or less manganese. These iron ores are found in belts or bands, generally extending across the State in a northeast and southwest direction with the strike of the outcrops of the rocks as a rule, and with the general trend of the length of the natural grand divisions of the State."

In discussing the manganese deposits of Virginia it will be more convenient to arrange them in accordance with the natural divisions of the State mentioned in the extract just quoted. These divisions are (1) Tide-water; (2) Midland; (3) Piedmont; (4) The Blue Ridge; (5) The Valley; (6) Apalachia; (7) Trans-Apalachia. The boundaries of these divisions will appear from the accompanying map, for which I am indebted to Hon. Randolph Harrison, commissioner of agriculture of Virginia.


MAP
Showing the Location
OF THE
NATURAL GRAND DIVISIONS
OF
VIRGINIA.
Trans-Apalachia.
Apalachia.
The Valley.
Blue Ridge.
Piedmont.
Midland.
Tidewater.
Ches. Bay.
N.W.
S.E.
Level of Sea.
Relief Section, Showing Grand Divisions of Va.
SCALE.
0
50
100 MILES.
By Jed. Hotchkiss.
Staunton, Va.
1885.
Potomac R.
BALTIMORE.
Winchester
WASHINGTON.
Alexandria.
Fredericksburg.
Staunton.
Charlottesville.
RICHMOND.
West Point.
Lynchburg.
Roanoke.
Pocahontas.
Kanawha R. (New)
New River.
Burkeville.
Petersburg.
Newport News.
Norfolk.
Cape Charles City.
Danville.
Roanoke R.
Weldon.
Bristol.
Holston R.
Clinch R.
Chesapeake Bay.
James R.
York R.
Rappahannock R.

Many of the deposits opened in this State exhibit in a marked degree the uncertainties and risks of manganese mining heretofore pointed out, as well as the misleading character of "indications." Deposits that have promised remarkable results, as well as large returns to their owners, have proven in many cases to be pockets of small extent, producing at most before exhaustion but a few hundred tons of ore, and baffling all attempts to discover additional ore in their vicinity. In other deposits the ore will prove high in phosphorus or low in manganese, or so irregular in its content of mineral as to make selection difficult or uncertain, and to forbid giving the guarantee of richness, and for some uses of the purity, which purchasers require. For obvious reasons, therefore, it has not been possible in every case to ascertain the exact facts as to the character or the present condition of the deposits discussed. The statements made must be regarded as giving the best information available. They are also made "on authority," and are in but very few cases the results of the personal examination of the agents of the Geological Survey.

TIDEWATER, VIRGINIA.

Some manganese has been found in pockets of small extent in the Tidewater sections of Virginia. One deposit near City Point yielded before it was exhausted some hundreds of tons of ore, and it is reported that others have been worked. No deposits of such extent as that at Crimora can be expected in this region, though it is probable that small pockets will be found in connection with the beds of iron ore that outcrop in the bluffs along the banks of the rivers. The age of these deposits is much later than that of those found resting on the Potsdam in the Valley, the iron ore with which it is associated being found in the Tertiary, chiefly in the Miocene.

MIDLAND, VIRGINIA.

In the Midland district of Virginia deposits of manganese become more abundant, this division, with the valley, furnishing practically all the manganese mined in the State in 1885. This region has also, in this and previous years, produced considerable quantities of ore for export, The ore that has been mined is found chiefly in Campbell, Nelson, and Pittsylvania counties, though there are deposits in Spottsylvania, Louisa, Appomattox, and perhaps other counties. The deposits are found in the extreme western part of the section, well up to the base of the mountains that form the dividing line between this and Piedmont; indeed it is possible that some of these deposits should be classed in Piedmont, but as they are all situated on the same belt as Campbell county they are classed in Midland.

Finding its source in the heart of the Alleghenies, the James river runs parallel to their base in a southeasterly direction for some distance, breaking through their most easterly spur at the magnificent pass of

Balcony Falls, and still pursuing its generally southeasterly direction until it strikes Mount Athos, some 6 miles below Lynchburg, where it turns abruptly to the northeast, being deflected by the massive quartzites which carry the mountain. It runs in this general direction for some 50 miles to Scottsville, where it resumes its southeasterly direction to Richmond.

It is in the belt of country lying along the left bank of the James and in its extension to the southwest from Mount Athos, that the manganese ores of this section are chiefly found. Along this entire distance the iron-ore bearing rocks have been traced, in connection with which the manganese is found. The northwestern boundary of these rocks is the Buffalo Ridge and its extensions. The southeasterly boundary has not been determined; sufficient has been learned, however, to indicate that the rocks have a width of several miles, and that they extend through the State in a southwesterly direction.

Describing this region, Dr. J. P. Kimball, the present Director of the Mint, says:

"The iron ores of the James river belt are in the form of bedded veins occupying regular horizons which are remarkably well defined. They are interposed between strata of different characteristics, which are practically parallel throughout the belt. They are therefore distinctly traced and recognized. These include quartzites, sandstones, damourite, and other talcose schists, chloritic schists, and talcose (micaceous) limestone, forming a series of strata over 1,500 feet in thickness (1,500 to 3,000 feet), but by frequent plication they have been folded sharply upon themselves so as to constitute a belt several miles across (from 6 to 8) at the surface."

Campbell county.—The manganese deposit most extensively worked in this region at the present time is near Mount Athos, in Campbell county. Next to the Crimora mine this Mount Athos mine yielded the largest amount of high-grade manganese of any mine in the country. It is situated just across the line from Appomattox county, near Mount Athos station on the Norfolk and Western railroad, just where the James river turns to the north. It is one of the few deposits on the right bank of the James. This mine is sometimes known as the Leets mine, and has been worked recently by Mr. Logan.

During the past six years the production of this mine was as follows:

Production of the Leets mine, Virginia, for six years, 1880 *to* 1885.

Years.	Long tons.	Years.	Long tons.
1880	104	1883	40
1881	50	1884	76
1882	130	1885	500

The manganese is found in pockets associated with iron ore, and also as button ore in a dark-colored micaceous schist, 8 feet thick, holding some 40 per cent. of nodules, varying in size from a bean to that of an oyster. Analyses of this ore are as below:

Analyses of Mount Athos, Virginia, manganese ores.

	No. 1.	No. 2.	No. 3.
	Per cent.	*Per cent.*	*Per cent.*
Metallic manganese	43.58	45.87	44.18
Metallic iron	5.24	5.34	6.64
Phosphorus	.316	.257	.274
Silica	7.15	7.77	7.73

Some of the ore is much better than these analyses, showing 48 to 50 per cent. metallic manganese. Most of the ore is shipped to England for chemical purposes.

At Bishop's mine, Lynch's station, on the Virginia Midland railroad, 13 tons of manganese were mined and shipped to England in 1885 by the same party that worked the Mount Athos mine. This deposit seems to be a continuation of the Mount Athos, and is of the same general character and quality of ore.

A small pocket yielding some 30 tons was opened at Leesville, near Lynch's station, in 1883.

Pittsylvania county.—Southwest of the Mount Athos deposit on the Staunton river, in Pittsylvania county, is a deposit of manganiferous iron ore, yielding the following analyses.

Analyses of manganiferous iron ore from Pittsylvania county, Virginia.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Metallic manganese	24.78	27.86
Metallic iron	29.86	28.14
Phosphorus	.362	.347
Silica	7.02	4.32

The deposit is but a quarter of a mile distant from the Virginia Midland railroad.

Appomattox county.—To the north of Campbell county lies Appomattox. Deposits of good manganese are reported to exist in this county, but no details have been secured.

Amherst county.—Westward of Appomattox county and north of Campbell is Amherst county. At Stapleton Mills, in this county, a manganiferous iron ore with 54.669 per cent. manganous oxide (34.56 metallic manganese), 22.57 metallic iron, and as little as .08 per cent. of phosphorus is found, though it has been mined only to a limited extent, if at all. At Walker's Ford station, in Amherst county, another deposit is reported.

Nelson county.—In Nelson county several deposits of manganese have been worked quite extensively in past years, though no ore is now mined. These deposits are found in the ore belt of the James river already described, the belt running nearly parallel to the river, and about 2 miles from the left or northwestern bank. The manganese shows generally in small quantities on the surface, the deposit widening as it goes down. The manganese is found in pockets and usually in clay.

From what is known as the Cabell mine, two miles from Warminster depot, on the Richmond and Alleghany railroad, some 5,000 tons of manganese were taken in 1868 and 1869, and shipped to Newcastle-on-Tyne. The mine has not been worked since 1871. An analysis of the ore showed 82.25 per cent. of maganese peroxide.

Two other analyses gave the following :

Analyses of maganese ores from Cabell mine, Virginia.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Metallic manganese	44.30	43.02
Metallic iron	3.67	4.24
Phosphorus	.243	.182
Silica	17.45	18.51

About half a mile southwest of the Cabell mine is a deposit known as the Bugley mine, which was worked about the same time and yielded about 2,000 tons of ore.

At Midway Mills is a deposit on the land of Mr. G. F. Simpson, which was worked in 1882, and yielded some 1,200 tons of first-class ore. The mine was worked by shaft to the depth of 165 feet, when it was drowned out. The ore above the water line is said to have shown some 70 per cent. oxide, but below the line it was much richer, 80 to 85 per cent. The entire product was marketed in Liverpool.

At the Davis mine, in Nelson county, an ore giving from a picked specimen the following analysis was at one time mined, though operations are now suspended:

Analysis of manganese ore from Nelson county, Virginia.

	Per cent.
Manganese binoxide	90.42
Iron sesquioxide	2.24
Alumina	1.13
Lime	1.22
Magnesia	2.28
Silica	1.12
Phosphoric acid	.43
Water	1.25
Metallic manganese	57.16
Metallic iron	1.56
Phosphorus	.188

Some 1,000 tons have been taken from this mine, though none in the last year.

No details have been obtained concerning the Piedmont and Blue Ridge districts.

THE VALLEY OF VIRGINIA.

The chief sources of the manganese produced in this State and in the country are the mines of the Valley of Virginia, or, as it is sometimes called, the Shenandoah Valley. In this valley are located the Crimora mines, that have produced as much ore as the entire country besides, those of the Blue Ridge Ore Company and the Shenandoah Iron Company. The manganiferous belt lies along the western base of the Blue Ridge on the eastern side of the valley. It is asserted that this belt extends 300 miles in the State, and that workable beds of manganese ore have been found in every one of the twelve valley counties that abut on the western foot of the Blue Ridge.

It is along this belt that the remarkable body of iron ore accompanying the Potsdam, or No. 1 formation of Rogers, is found, and with this iron the manganese ores are associated. Indeed, it is in the clays formed by the decomposition of the ferriferous shales of the Potsdam that the ore is usually found imbedded. An exception to this is noted by Prof. Wm. M. Fontaine in his "Notes on the Mineral Resources at Certain Localities in the Western Part of the Blue Ridge," as occurring on the lands of Joshua Robertson, some 5 miles from Waynesborough. The ore at this point, which is psilomelane, occurs in the Primordial formation in a fissure in a cracked and crushed band of the upper gray shales and flags, and has impregnated the walls, which are kaolin flags. Some 100 tons were taken from this locality in 1857 by a Mr. Sibert. Professor Fontaine is of the opinon that the origin of this manganese is similar to that of the iron ore occupying a similar geological position, viz: deposition in disturbed beds from solution in water.

Page county.—Passing southwardly down the valley, along the line of the Shenandoah Valley railroad, the first deposit that produced any considerable quantity of the ores of manganese in 1885 is found in Page county, near Milnes station, on the lands of the Shenandoah Iron Company. From these mines there were shipped in 1884, 208 tons of manganiferous ores, and 2,155 tons in 1885. The average of analyses of the deliveries was about as follows:

Analysis of manganiferous ores from Page county, Virginia.

	Per cent.
Metallic manganese	28.
Metallic iron	17.
Phosphorus	.15

This ore was mined in a wash or drift deposit associated with brown hematite. The deposit is quite irregular and uncertain. This range of ore lies along the eastern foot of the Blue Ridge, and evidently contributed to the Crimora basin, which is in this range.

From a deposit on what is known as the Garrison tract, the top of which is a fine ore, but which becomes coarser and harder as it goes down, Mr. A. S. McCreath took samples which gave the following analyses:

Analyses of manganese ores from the Garrison tract.

	Fine ore.	Lump ore.
	Per cent.	*Per cent.*
Metallic manganese	52.691	53.656
Metallic iron	2.325	1.537
Phosphorus	.324	.327
Silica	27.95	1.955

A manganiferous iron ore is found in the Kimball bank, lying 3 miles east from Milnes station. This bank consists of two openings, the Atwood and Bolan, the Atwood carrying the larger proportion of manganese. A sample of these ores mixed (two-thirds Atwood and one-third Bolan) showed the following analyses:

Analysis of manganese ore from Kimball bank.

	Per cent.
Metallic iron	40.875
Metallic manganese	7.349
Phosphorus	.084
Siliceous matter	15.440

Another analysis of the ore by Bowron gives—

	Per cent.
Sesquioxide of iron	70
Manganese oxide	13.31
Silica	4.73
Alumina	.86
Water	11.02
Phosphorus	Mere trace.

The Crimora mines.—The most important mine in this region, and indeed, in the United States, is that of the Virginia Manganese Company, now operated under lease by the American Manganese Company, limited. The ore from this mine was at one time known as the Waynesboro' ore, from its point of shipment on the Chesapeake and Ohio railroad. This mine is in Augusta county, 2½ miles east from Crimora station on the Shenandoah Valley railroad, with which it is connected by a branch-road, and 8 miles northeast from Waynesboro'. A post-office called Mushet has recently been established at the mine. The distance to tidewater at Baltimore is 217 miles, 194 to Newport News, and 209 to Norfolk. To Pittsburgh the distance is 354 miles. The history of this mine and a most complete analysis of the ore is given in the report for 1883–'84. The production brought down to the close of 1885 is as below.

Production of the Crimora mine, Virginia.

	Quantity.
	Long tons.
Prior to 1869	5,684
May, 1869, to February, 1876	280
February, 1876, to December, 1878	2,326
December, 1878, to December, 1879	1,602
1880	2,963
1881	2,495
1882	1,652
1883	5,185
1884	8,804
1885	18,212

The ore deposit, which is most peculiar in its location and accumulation, occurs in an elliptical basin about 500 feet broad on its transverse axis, and 800 to 900 feet long. This basin is cut out of the Potsdam sandstone, which is at this place hard rock. Opposite to the basin and at a right angle to its longer axis is a deep ravine, Turk's Gap, sharply cut into the flanks of the mountain, through which a stream flows. Nearly opposite to this ravine is a ridge that served as a bulwark to the action of the forces at work in this section. Evidently this basin is the work of old time eroding agencies acting just as water now acts below a river dam excavating a deep curved section. The formation and location of this basin, as well as the deposit it contains, is exceedingly interesting and peculiar.

The basin is filled with wash and manganese ore lumps. The general body mixture, the mud, sand, and clay, with the lumps of manganese ore, were carried to place by agencies more recent than those which excavated the basin, just as the iron ore pits in the limestone valleys of Pennsylvania were filled in.

There are two, possibly three, special layers of clay, which are rich in lumps and masses of ore, the lower about 30 feet in thickness, the upper about 25 feet thick. A layer of clay, 20 feet thick, almost barren of manganese ore, separates these two ore-bearing layers. The mining operations are at present confined to these beds.

The ore is found in lumps and masses from the size of a small pebble to lumps weighing a quarter of a ton or more. These lumps are found scattered through the basin as above indicated. The basin at the shaft is 117 feet deep. Some "sheets" of ore formed by the union of masses that lie in a pretty uniform direction are also found. The larger masses when found are blasted in the mine. The smaller pieces, to which the clay adheres quite tenaciously, are washed outside the mine and selections made for the home and foreign markets. A bore hole 285 feet deep has been put down into the sandstone under the mine to secure water for washing. The question of washing the whole contents of the basin on the principle of the hydraulic mining of the gold regions of California has been mooted, and it is quite probable that a large portion of the deposit can thus be treated with profit. At present the dirt covering the mines is being stripped down to the ore deposit and mining at these points will be by open cut.

The older workings on this property were by open pits, and most of the manganese obtained was probably float. The present workings are by shaft, and the ore is found in its original position. The rooms and ways leading from the shaft require heavy timbering, as the clay which forms the ore matrix when acted upon by moist air softens and makes this a very muddy mine in all its parts. There is also some liability to flooding, arising from heavy rains, and the peculiar conformation of the country about the mine.

The quantity of manganese ore in this basin is difficult to estimate, owing to the somewhat irregular distribution of the ore lumps through the mass.

An analysis of the best quality of the ore by Mr. A. S. McCreath shows:

Analysis of manganese ore from Crimora, Virginia.

	Per cent.
Metallic manganese	57.291
Metallic iron	.373
Phosphorus	.075

A second quality would show a reduced percentage of metallic manganese, but on the whole the quality is moderately uniform throughout. The ore is a psilomelane. Occasionally some pyrolusite is found, forming thin veins or nests in the lumps of psilomelane.

The manganese ore probably comes from the decomposition of the lower members of the Auroral limestone (II) of the Shenandoah Valley, possibly from the ferriferous shales, the position of which is somewhat in doubt, it being a question whether they should be regarded as the highest member of the Potsdam or the lowest of the Auroral. The masses are evidently concretionary in their origin, and derived from the manganese diffused through the shales, probably in the form of a carbonate. These masses are not only inclosed in clay which folds around them, but they often inclose clay. The clays in the horizon of the ferriferous shales are colored brown from the diffused manganese, while the clays of the deposit in which the manganese is most abundant are red, showing that the gathering of the manganese into masses has left the iron predominant. Lime was probably the agent in the deposition of the manganese. The process of the concretion of the manganese is still going on at localities in this valley, and partially formed crust and nodules are found.

Other mines in Augusta county.—Quite recently an organization known as the Old Dominion Manganese Company has been formed, with a capital of $50,000, for the purpose of seeking manganese on the lands adjoining those of the Crimora mines. These consist of three tracts containing 543 acres, 348 of which are held in fee, and 195 on a perpetual lease at 50 cents a ton royalty. The company is putting down a shaft on the Patrick tract just across the line and some 100 yards from the shaft of the American Manganese Company, limited. The course of the tunneling of the latter from the bottom of its shaft and the results obtained, lead the Old Dominion Company to the belief that the Crimora deposit will be found to extend to its land. Some 80 or 90 tons of "float" manganese ore of a good quality were mined in open pits on the Patrick tract during the time when the Crimora mines were worked by Mr. Donald, and during the present year surface specimens have been found on the same tract.

Seven miles south of Waynesboro, and 2 miles southeast of Lyndhurst station on the Shenandoah Valley railroad, the Virginia Manganese Mining Company is opening up some old mines and making preparations to ship their product. The deposit lies in Augusta county, 14 miles southwest from the Crimora mines, well up to the western base of the Blue Ridge on a little stream known as Bear creek, 2½ miles above its junction with South river. This creek flows in the clay formed by the decomposition of the ferriferous shales in the Potsdam.

This deposit was opened in 1859 by Mr. Sibert, who opened a number of mines in this valley about this time. He sunk a shaft striking the ore deposit at the depth of 45 feet. From the bottom of the shaft a drift was driven some 20 feet. Upwards of 250 tons of ore were taken from the shaft and drift and shipped to London. Analyses of the ore recently taken from this shaft are as follows (J. Blodgett Britton, chemist):

Analyses of manganese ore from Heiserman's farm, Augusta county, Virginia.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Peroxide of manganese	93.06	86.77
Peroxide of iron	Trace.	2.98
Silica	.18	3.98
Alumina	.91	2.81
Baryta	2.81	.31
Water (total)	2.75	2 93
Lime	....	Trace.
Not determined and loss	.29	.22
Total	100.00	100.00
Available peroxide	92.54	86.62

The old shaft was destroyed and filled up by a flood, a very common occurrence apparently in this section. The new shaft is located above the flood level. It is expected that it will be down to the ore early in 1886.[b]

Adjoining the lands of the Virginia Mining Company just referred to on land formerly owned by a Mr. Wagner, now the property of the American Manganese Company, limited, a most interesting deposit of manganese occurs. Professor Fontaine states that on this tract he observed manganese in process of formation into lumps. He says: "On Mr. Wagner's place, in the bed of the creek, there is an interesting exposure of the clay, showing the manganese in process of formation by concretionary action. Here, as usual, the ore is mainly psilomelane, or hard manganese, but in this place the masses have some pyrolusite and manganite, the softer varieties of manganese oxide in the cavities of the material or forming seams of harder ore. Lumps and crusts of the manganese may be seen imbedded in the clay, and they are plainly now in process of formation. The manganese seems to be freely diffused through the dark brown umber and to be gradually concentrated out of the clay in lumps and crusts. In some cases crusts of manganese may be seen inclosing the clay, and the nodules often show inclosed clay."

Another of the manganese ore deposits opened before the war by Mr. Sibert is known locally as the Kennedy tract, lying 3 miles from Stuart's Draft station on the Shenandoah Valley railroad. It takes its name from the old Kennedy furnace built early in the present century, and adjoins the lands of the more recent Mount Torrey furnace. Mr. Sibert is reported to have mined some 100 tons of the ore in 1859. In 1872 a Mr. Armstead dug some pits searching for iron ore, and is reported to have discovered at a depth of 20 feet a bed of psilomelane. Ore taken from this opening shows from 30.52 to 43.30 per cent. of manganese.

A complete analysis is as follows:

Analysis of manganese ore from Kennedy tract.

	Per cent.
Metallic manganese	43.30
Metallic iron	3.88
Sulphur	.083
Phosphorus	.052
Barium	6.93

The ores occur both as manganese ores and as manganiferous iron ores. At one point it is in bands and films one-fourth of an inch in

[b] Since the above was written, under date of March 15, 1886, Mr. M. P. O'Hern, the president of the company, writes me: "I have completed my shaft down to 65 feet, and have struck a solid body of manganese of the finest quality, all crystallized. The deposit is very extensive; is estimated to be over 20 feet deep. * * * The test of this ore is fully equal to my expectation, assaying from86.77 to 93 per cent. free from iron and other deleterious matters."

thickness, the ore being nodular in form and inclosed in clay from the ferriferous shales.

At Blue bank, at the "Fauber mines," at Newton's mine bank, at the Kelly bank, and several banks on the Big Mary creek, all in the neighborhood of the old Cotopaxi and Vesuvius furnaces, which have been abandoned for some years, manganese and manganiferous iron ores have been found and mined to some extent. These deposits are all near the line of the Shenandoah Valley railroad, and near the line separating Augusta and Rockbridge counties. The Blue bank was opened to supply the Cotopaxi furnace, but it had too much manganese in it to be used as an iron ore, and the working was abandoned. The Fauber mines were opened by Mr. Sibert, who took from them some 75 tons of manganese, it is said. The deposit is psilomelane in nodular masses and lumps in clay. Newton's mine bank is in a steep ridge near the headwaters of the south James river. Sometimes the ore from this mine is a quite pure oxide of manganese, and again only a manganiferous iron ore. The deposit is quite large, a section showing one of the two veins to be 36 feet wide, composed of alternate deposits of hematites, mixed iron, and manganese, and manganiferous iron ore. An analysis of a sample of the ore, one hundred and forty-three pieces, taken from along the face of the open cut, made by Mr. McCreath, shows:

Analysis of manganese ore from Newton's mine bank.

	Per cent.
Metallic iron	41.125
Metallic manganese	8.221
Phosphorus	.265
Silicious matter	14.830

The Kelly bank is part of the property of the old Vesuvius furnace, and is situated in Rockbridge county. Both iron ores and manganiferous ores are found, the latter lying nearer the Potsdam than the former. Much of the ore consists of iron and manganese mixed, the manganese forming layers and films in the iron. On Big Mary creek manganese has been found at several openings, and surface indications of other deposits are abundant. Here the same conditions exist as at the Kelly bank, some of the manganese being quite pure and some mixed with iron. The richest manganese shows some 47 per cent. of the metal to 6 per cent. of iron.

Botetourt county.—A mine in the Valley of Virginia, the Crimora, not only yielded the largest amount of manganese ore produced by one mine in 1885, but another mine in the same valley, the Houston, has produced the largest amount of manganiferous iron ore. Some of this ore much exceeds the 44.252 per cent. of manganese that we have taken as the dividing line between manganese ore and manganiferous iron ores, and should therefore be classed as manganese ores; but as the average of shipments is less than this standard, it is classed as manganiferous iron ore, though included in the total of ore produced.

This deposit is near Houston station, on the Shenandoah Valley railroad, on the property of Mr. Ed. S. Hutter and the heirs of Langhorne; the mines are at present worked by the Blue Ridge Ore Company, of which Mr. Ed. S. Hutter is superintendent. The ore comes from what is known as No. 4 opening, which lies 1¼ miles from the station. The bank is developed by open cut and tunnel, the cut being 75 feet long, 30 feet wide, and 50 feet deep. The ore is highly manganiferous and at points is quite pure. It occurs in pockets next to iron ore, and examination indicates that the deposit is a large one. About two-thirds of the ore is lump, the rest is quite fine. Preparations are now being made to sink a shaft and put up hoisting machinery. A selection of one hundred and fifteen pieces to represent the iron ore, and sixty-eight pieces to represent the manganese, gave Mr. McCreath, upon analysis, the following results:

Analysis.

	Iron ore.	Manganese ore.
	Per cent.	*Per cent.*
Metallic manganese	7.277	44.312
Metallic iron	47.150	12.325
Phosphorus	.061	.101
Siliceous matter	8.030	5.470

Analysis of a sample of selected ore.

	Per cent.
Metallic manganese	59.870
Metallic iron	.500
Phosphorus	.049
Silica	2.300

There have been 4,810 long tons of ore taken from this mine, divided as follows:

Product of ore.

	Long tons.
1883	2,900
1884	828
1885	1,082

The production of 1883 was shipped to the Cambria Iron Company, Johnstown, Pennsylvania; that for 1884 and 1885 to the Edgar Thomson Steel Works, Pittsburgh.

Average analysis of the monthly shipments for 1884 *and* 1885.

	Per cent.
Metallic manganese	39.00
Metallic iron	12.00

The highest monthly average was 45 per cent. metallic manganese; lowest, 31 per cent; phosphorus, about 0.07 per cent.

The manganese deposits at this mine lie well up on the west slope of the Blue Ridge range. No. 4, referred to, is situated on the northwest slope, and just at the foot of a branch ridge separated by a narrow valley, not over 50 feet wide, from another ridge, which lies to the west, and parallel with the ridge in which No. 4 is found. This No. 4 opening is about 1,250 feet above tidewater at Richmond; 400 feet above the drainage level of the surrounding country. The deposits of manganese appear from end to end of the tract, which is worked for two-thirds of a mile in length. The ore line runs northeast to southwest, 35 north of east. The manganese occurs in pockets, usually in a tough yellow clay, sometimes next to a fine red sand; occasionally nest or pockets of the purest manganese are found, yielding 100 to 150 tons of ore in lumps the size of an egg and smaller, and so clean as to require no washing. A drift has been run into the deposit, intersecting it some 100 feet below the slope on the ridge, and some 45 feet below the lowest ground in the valley. It appears to increase in size, and improve in quality the deeper it is mined.

At No. 4 opening, the principal pocket of manganese lies just above and against the Potsdam sandstone, which is here massive and hard. Much of this sandstone when blasted and shattered, contains very beautiful specimens of pure manganese adhering most tenaciously to the stone. In mining, however, but little rock has been uncovered as yet, though some 75,000 tons of iron ore and 4,000 tons of manganese have been taken out. The slates or shales are found to the northwest of the ore line and at the base of the foot hills of the Blue Ridge, half a mile from the clays that carry the ore deposits. Adjacent to these, the limestone stretches away to the northwest.

During the year 1886, it is the intention to sink a shaft 100 feet below the lowest drift. This, with other improvements, will permit of a much larger output in 1886 than heretofore.

Southward from the Houston mines, in the same range, Mr. J. T. Chapman has a deposit of manganese, which gave the following:

Analysis of manganese ore from the Chapman deposit, Botetourt county, Virginia.

	Per cent.
Metallic manganese	45.80
Metallic iron	3.06
Phosphorus	.164

Other Valley deposits.—Along the base of the mountains that form the continuation of those at whose base the Valley deposits already described are found, numerous openings show the presence of manganese and manganiferous iron ores. This is especially true of the country lying along the line of the Cripple creek extension of the Norfolk and Western railroad. These ores are found on Iron mountain on the east, on Lick and Draper mountains in the center, and on Big Walker's mountain on the west side of the Valley.

Four miles east from Radford furnace in Pulaski county, on the east face of a ridge on Mack's mountain, is a deposit of rich dark brown hematite, with associated manganese. Some large lumps of quite pure ore have been found. One hundred and thirty-two pieces as samples were taken from the outcrop by Mr. McCreath, which yielded as follows:

Analysis of manganese ore from Pulaski county, Virginia.

	Per cent.
Metallic iron	39.975
Metallic manganese	14.785
Phosphorus	1.074
Siliceous matter	5.840

The Walton furnace of the Lobdell Car-wheel Company, situated in Wythe county, has used as part of its burden an ore from what is known as the Glade manganiferous ore bank, 4 miles southwest from Max Meadows, which is chiefly a brown hematite, but at times highly charged with manganese. An analysis of a large number of samples gave the following result:

Analysis of manganese ore from the Walton furnace, Wythe county, Virginia.

	Per cent.
Metallic manganese	4.971
Metallic iron	50.450
Phosphorus	.444
Siliceous matter	5.440

At Noble furnace, in the same county (Wythe), is a bank of ore with the same characteristics, mixed hematites and manganese. An analysis of specimens of this ore gave the following result:

Analysis of manganese ore from Noble furnace, Wythe county, Virginia.

	Per cent.
Metallic manganese	3.155
Metallic iron	49.050
Phosphorus	.179
Siliceous matter	10.770

In Smythe county, at what is known as the Razor bank, on the south fork of the Holston river, in Rye valley, the ore shows at times considerable manganese. Mr. McCreath's analysis of a sample of one hundred and thirty-three pieces gave:

Analysis of manganese ore from the Razor bank, Smythe county, Virginia.

	Per cent.
Metallic manganese	10.181
Metallic iron	40.100
Phosphorus	.536
Siliceous matter	10.520

Some 6 miles from Seven Mile Ford station, on the Norfolk and Western railroad, on what is locally known as Chestnut ridge, several openings have been made, showing a rich grade of manganese ore, from which some ore has been taken for trial.

Near Marion, Smythe county, on the east flank of Glade mountain, is a large deposit of manganese, associated with a good brown hematite, which is found in large masses in this region. The deposit has been traced for 8 miles along the outcrop. Large bowlders of the manganese are found, some weighing over half a ton.

The following analysis shows the character of the ore:

Analysis of manganese ore from near Marion, Smythe county, Virginia.

	Per cent.
Metallic manganese	9.91
Metallic iron	45.32
Phosphorus	.086
Silica	1.76

Oriskany ores.—Some of the manganese ores in Pulaski and Wythe counties are found in the Oriskany rocks, the lower member of the Devonian, as the Potsdam, in connection with which so much manganese is found in this valley, is the lower member of the Silurian. The Oriskany ores in this section are usually of a much higher grade than the ores of the Potsdam in the same region. The ores are at times brown hematites of a high grade, at others manganese, and at still others, nothing but a ferruginous sandstone.

APALACHIAN VIRGINIA.

In that portion of Virginia known as Apalachia, which includes the broken mountainous country between the Valley and West Virginia, quite a number of deposits of manganese ore, some quite high in manganese and of a good quality, are known to exist. Most of these are so situated with reference to transportation routes, however, that they are not available at present.

The manganese ores in this portion of Virginia are, as a rule, of a later geological age than those of the Valley. The Valley ores are usually found in connection with the Potsdam No. I. of Rogers' survey. Those of Apalachia are found in the Hudson River No. III., the Clinton No. V., and especially in the Oriskany No. VII. In all cases the manganese is associated with iron ores, usually brown hematites, sometimes as a manganiferous portion of an iron ore, at others as a manganese ore.

Little or no ore was mined in Apalachia in 1885, but preparations are being made to open up several of the known deposits during 1886. Possibly some manganese has already been shipped from the Powell's Fort and the Goshen Bridge mines.

Frederick county.—In the southwest corner of Frederick county is a deposit of manganese known as the Paddy Mills manganese mine, which has produced some manganese in past years. The mine is a conical shaped hill, covering about a square mile, and rising to a height of some 150 feet above the drainage level of the surrounding country. The ore is found in connection with the limestone, and imbedded in the strata. The deposit is somewhat unreliable, being cut off by the limestone. The ore is chiefly soft pyrolusite; part of it, however, is hard, running about 50 per cent. metallic manganese, 4 per cent. iron, and from .09 per cent. to 0.1 per cent. of phosphorus. There have been removed from this mine some 2,000 tons of ore, mostly before the war, and by very imperfect methods of mining. No shaft has gone below 50 feet, so that it is not known how large the deposit is. Should it extend downwards, considerable ore might be found. The ore requires washing, for which there is plenty of water.

Shenandoah county.—At Van Buren furnace, in Shenandoah county, in connection with the iron ores, a valuable and extensive deposit of manganese is found. This was at one time worked extensively, very large amounts being shipped before the war, but no mining has been done for twelve years, owing to the lack of transportation facilities, there being no railroad station nearer than Woodstock, 9 miles distant. The ore occurs in pockets, but they seem to be continuous, and can be traced on the surface for more than 3 miles. The washed ore analyzes upwards of 70 per cent. oxide. In a description of the Van Buren furnace property, on which this deposit is located, Maj. Jed. Hotchkiss makes the following statement regarding manganese:

"Manganese has been mined in considerable quantities from the mine located at the western end of Cupola mountain, where, as is very often the case in Virginia, it accompanies the outcrop of No. VII. (Oriskany), the backbone of that mountain. It outcrops also in the broken hills that prolong Cupola to the southwest; it also shows in places along the iron-ore outcrops of Tea, Little North, and the eastern slopes of Paddy mountains, where, no doubt, large pockets of this valuable mineral will be found in the stratified iron ore beds, locally taking the place of the iron ore, as is often the case in the Clinton beds in Virginia.

There is no doubt but that this mineral will be mined here in large quantities when the price paid for it will warrant mining and hauling it to the railway, or whenever a railway reaches this place."

A company has been organized and a charter secured to build a railroad to this property and beyond. The pig iron made at the furnace on this property, which is an excellent car-wheel iron, shows from 0.36 per cent. to 1.735 per cent. of manganese.

Considerable attention has recently been directed to what is known as the Powell's Fort manganese mines, located at Powell's Fort, in Shenandoah county, on the Northeast Massanutton mountain. This mine has been worked at times for many years. The property is owned by the Manganese and Iron Company of Baltimore, and contains 531 acres immediately between Three Top mountain to the north and Green mountain to the south. This system runs northeast and southwest, conformably with the universal belt of the Apalachian chain. The following statement is furnished by the company:

"There are two parallel veins, over one mile in length; only one of which, however, is developed. The mines have been operated at intervals for several years in a crude manner and on a very small scale. During this time considerably over 1,000 tons of ore were shipped. One of the most celebrated manganese experts in the United States carefully examined this property and advised its purchase by the company, as it was the only well-defined vein he had ever seen—the walls perfectly regular, the hanging conglomerate, the foot-wall sandstone. The vein varied in width from 4 to 7 feet, traceable from one boundary of the property to the other by its bold outcrop, which has been opened at several places, showing well everywhere. At present there are two shafts, respectively, 85 and 75 feet deep, with level over 40 feet long through solid ore. The engine shaft will be sunk to the depth of 200 feet.

The ore is remarkably clean; almost entirely free from foreign matter. It is highly crystallized, very soft, a genuine pyrolusite of high grade, and is nearer chemically pure than any yet found, as will be seen by reference to the accompanying analyses.

It has not only been used in the manufacture of Bessemer steel, but in the arts, and for electrical purposes it is highly satisfactory. A small lot sent to Glasgow was highly commended.

The company has only been in possession six months, during which time new buildings, boilers, engine, hoisting apparatus, pumps, etc., have been placed upon the property, and the mines thoroughly equipped for the economical and expeditious raising and handling of large quantities of the ore.

A line for a railroad, nine miles in length, has been surveyed by the Midland Railroad Company, and will, most likely, be constructed immediately."

Analysis of manganese ore from Powell's Fort, Shenandoah County, Virginia (Manganese and Iron Company).

[By J. Blodgett Britton, of Philadelphia.]

	Per cent.
Oxide of manganese (*a*)	94.30
Moisture	.28
Insoluble siliceous matter	1.78
Alumina	1.10
Baryta	1.30
Sesquioxide of iron, lime, and manganese	.50
Undetermined matter	.74
Total	100.00

a Nearly all binoxide. By the analysis it should be taken as a fully 90 per cent. binoxide.

[By J. Blodgett Britton.]

	Per cent.
Silica in the form of quartz	3.78
Peroxide of iron	.43
Metallic manganese	60.66
Oxygen with manganese, undetermined matter and loss	34.09
Alumina	.25
Moisture	.37
Baryta	.42
Total	(*b*)100.00

b By the analysis it should be taken as a fully 90 per cent. binoxide.

Analysis of a small sample made at the laboratory of the Albany and Rensselaer Iron and Steel Company, Troy, New York, May 16, 1885.

[The sample was from the mine of the Manganese and Iron Company's property.]

	Per cent.
Iron	0.844
Phosphorus	.190
Manganese	59.302
Silica	1.500

Rockbridge county.—On what is known as the Guy's Run estate, in Rockbridge county, six miles southward from Goshen Bridge station, on the Chesapeake and Ohio railroad, quite an extensive deposit of manganese has been discovered. Up to the present time but a few tons have been mined, but extensive working is contemplated for the present year.

In its general topography this estate is quite mountainous. The ores are found in the valleys, and can be transported by well-graded roads to Goshen Bridge for $2 a ton. Four openings have been made, the ore being found in each. One of these is but three miles from the Chesapeake and Ohio railroad. The manganese lies in close proximity to Rogers's No. VII. (Oriskany) brown hematite ores, imbedded in potters' clay, which separates it from the iron ore. It is in pockets more or less persistent along the line of the ore horizon of No. VII.

Analysis of samples of solid ore from Guy's Run estate, Rockbridge County, Virginia.

	Per cent.
Mn_3O_4	89.67
Fe_2O_3	4.30
Sulphuric acid	1.25
Silicic acid	.79
Metallic manganese	64.59
Metallic iron	3.01
Phosphorus	.55

There is the best of evidence that there is a large body of ore on this property.

Other counties.—In the counties of Apalachia southward of those already named many outcrops and other indications of manganese are found. Most of these are now too far from railways to be profitably worked.

At Panther Gap some ore has been mined, though no statement as to amount or the character of the deposit was obtained.

In Craig county, on Gap mountain, several manganese deposits have been opened, but the distance from railroads precludes shipments, the nearest station being some 20 miles away. These deposits are stated to extend a distance of 17 miles.

Analyses are as follows:

Analyses of manganese ores from Craig county, Virginia.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Metallic manganese	45.00	52.42	49.48	53.06	50.50
Metallic iron	....	....	6.83	1.82	4.81
Phosphorus	.085	.303	.063	.058	.026
Sulphur	....	....	.010	....	....
Silica	4.70	.46	2.53	1.67	.58

Nos. 1 and 2 by T. T. Morrell, chemist of the Cambria Iron Company; No. 3 by S. P. Sharpless, Boston; Nos. 4 and 5 by Vulcan Steel Works, Saint Louis.

In Giles county, in the Oriskany measures, the iron ores often give way to manganese. Boyd, in his "Resources of Southwest Virginia," says: "In one point on these rocks (Oriskany) on Flat Top mountain, near the line between Giles and Bland counties, the ore was found in great purity, containing valuable quantities of manganese disseminated heavily through sandstone." Analysis of this ore shows 59.215 per cent. metallic manganese. Manganese is also found in the Buckeye and Spruce River mountains, and at the ore beds of the Sinking Creek furnace, as well as at other localities in the county.

In Pulaski county, manganese ores of a high grade are found among the Oriskany iron ores of Walker's mountain.

The same is true of the extension of these mountains into Wythe county. The manganese ores found in the Oriskany rocks of Big Walker's mountain, in Wythe county, are at times quite pure.

In Bland county the Oriskany measures in several of the parallel mountain ranges that traverse the country from northeast to southwest. show deposits of manganese ores of considerable extent, and at times quite pure.

In Tazewell county surface indications are quite frequent, but the developments are not as yet sufficient to give an idea as to the extent of the deposits. Some of the specimens indicate rich and valuable ores.

In Smythe county there are frequent indications of manganese. At one, on the property of Mr. William Alexander, near Holstein Mill, the ore is in bowlders varying in weight from 2 pounds to 300. Some 20 tons have been taken out at a depth not exceeding 6 feet. An analysis showed 62.57 per cent. black oxide of manganese.

GEORGIA.

Second in point of production of manganese in 1885 was the Cartersville or Etowah district of Georgia, though Batesville, Arkansas, fell but little behind, and promises to surpass it greatly in 1886.

The Cartersville district.—The Cartersville, or, as it is often called, the Etowah district, is located in the northwestern part of Georgia, in the immediate neighborhood of Cartersville, in Bartow county, the manganese deposits possibly extending into Cherokee county. Cartersville is a station on the Western and Atlantic railroad, 91 miles from Chatta nooga and 421 miles from Cincinnati. Tidewater can be reached by rail at Brunswick, 378 miles distant, or at Savannah, 354 miles. The distance to Baltimore is 810 miles. This district was at one time of some importance as an iron-producing section, and at the Diamond furnaces on Stamp creek, near Cartersville, ferro-manganese was first made in the United States, in 1875, by Mr. Willard P. Ward. It is also claimed that this was the first blast furnace ferro-manganese manufacture that was an economic success in any country, the methods of its production at the blast furnaces in Europe prior to this date being extremely wasteful of the manganese in the ore. Mr. Ward produced ferro-manganese containing as high as 67 per cent. of manganese. It is probable that the most successful blast furnace practice in the manufacture of ferro-manganese is still at the furnaces of this country, the Edgar Thomson furnace "A" at Pittsburgh making 7,218 long tons of ferro-manganese and 4,722 tons of spiegel iron in 1885.

In its topography the Cartersville district is broken or knobby, the elevations, however, rarely exceeding 200 feet above the drainage level of the country. The district is quite well watered by the Etowah river and its tributaries, but the manganese deposits opened are so situated as to make it difficult to secure water for washing. The belt of country in which the manganese is found is some 12 miles long by 3 wide. The explorations so far made, however, do not justify any definite conclusions as to the extent of the deposits. It is, of course, understood that all of this belt is not underlaid with ore. At places the ore is missing; at others it is but a few hundred yards wide.

The ore occurs in pockets imbedded in a drift deposit, usually covering hill tops and outcropping, but at times at a depth of from 3 to 30, and even 100 feet below the surface. These deposits are at times bedded with some regularity, and at others scattered without the least regularity. There are frequently "leads" running from one deposit to another. The drift in which the ore is imbedded varies greatly, being sometimes ocher, at others a blue dirt, soft and without grit, and at still others it is said to be found in sand rock. These deposits have as their base the Silurian rocks, usually the Potsdam, and lie near the metamorphic rocks of the State. They are associated with limonite deposits of a similar character, the limonite usually occurring to the west of the manganese.

The ore occurs as massive, crystallized, and needle ore, and is found in grains from the size of a mustard seed to that of a pea and even a walnut, and also in much larger masses. Until quite recently no attempt was made to recover these smaller grains. Last July Mr. A. P. Silva began mining with a view to saving all the ore, and has secured 1,500 tons from a pit which by the old method would have yielded, say, 300 tons. The ore has not averaged as good a quality as by the old method, nor has it brought as high a price, but it has been much more profitable on the whole, and other miners are now following this method. In these pockets the ore varies greatly, not only in the percentage of ore found in the débris, but in its richness. In the same mines some ore will run as high as 60 per cent. metallic manganese, even higher, and often pieces as low as 38 per cent.

The usual method of mining is by stripping and tunneling. The mining consists in first stripping down the outcrop until there is sufficient height of face to drive tunnels through the deposits. Side tunnels are run from the main tunnels. Little timbering is done.

Production from the Cartersville region.—From a gentleman well acquainted with this region, who has had access to the books of the railroad company, the following estimate as to the production of this region since 1866 is given:

Production of manganese in the Cartersville region, Georgia.

Years.	Long tons.	Years.	Long tons.
1866	550	1876	2,400
1867		1877	2,400
1868		1878	2,400
1869		1879	2,400
1870	5,000	1880	1,800
1871		1881	1,200
1872		1882	1,000
1873		1883	....
1874	2,400	1884	....
1875	2,400	1885	2,580

During 1885 the price received from this ore varied from $3.50 to $5.50 at the mines, or from $4.50 to $7.50 on cars. The bulk of the ore was sold at $5 on the cars. The value of the ore was $13,390, or an average of $5.19 per ton.

Most of the ore mined in the earlier years was taken out by the Pyrolusite Mining Company. The last and most productive mine worked by them was the Chumner Hill, located on lot No. 144, Twenty-second district. They also operated the Dobbins mine. Some ore was also taken by this company from the Bishop mine, and the Moccasin ore bank.

The Dobbins mine.—The oldest mine now operated in this region, and the one that has produced the most ore, is what is known as the Dobbins mine, now owned by the Bartow Manganese Mining and Manufacturing Company, but operated under lease since the last of November by E. H. Woodward, of New York. Mining began here in 1867, and has been carried on, not continually, however, but for periods of varying length, since that time. Some 5,500 tons have been extracted, the output for 1885 being 500 tons. The ore, as will be seen from the analysis given in the last report, is quite good. It occurs in a pocket, the lead of ore being several hundred yards wide, running due northeast and southwest. The mining operations have been confined to less than an acre of surface. The mine is 4 miles from the railroad station, the cost of hauling to station being $1 per ton.

An analysis of one of the several carloads of ore shipped from this mine to Carnegie Bros. & Co., limited, gave the following results:

Analysis of manganese ore from Dobbins mine, Cartersville, Georgia.

	Per cent.
Metallic manganese	52.726
Metallic iron	4.490
Silica	4.300
Phosphorus	.1882

Partial analysis of manganese ore from Dobbins mine.

	Per cent.
Metallic manganese	48.832
Metallic iron	5.40
Silica	5.05

Some ore in this mine yields as high as 87 per cent. of peroxide.

Most of the past year has been spent in opening this mine and placing in position the machinery necessary to mine and clean the ore, in view of a largely increased output during 1886.

The Etowah mines.—The largest producer of manganese in this State, and possibly, with the exception of the American Manganese Company, limited, the largest in the United States, was Mr. A. P. Silva, who mined on lot 391 of the land of the Etowah Mining and Manufacturing Company. Mr. Silva began mining in June, and had shipped at the close of the year some 1,500 tons. As has been stated, the methods of mining and recovering the ore used by Mr. Silva enabled him to secure a greater production from a given amount of the manganese drift deposit than had before been obtained.

Analyses made by Prof. H. C. White, State chemist, of the ore from the mines opened on the Etowah property are as follows, lot No. 391 being the opening worked by Mr. Silva:

Analyses of manganese ore from Etowah, Georgia.

	From lot No. 303.	From lot No. 391.
	Per cent.	*Per cent.*
Manganese dioxide	87.960	87.600
Oxides of iron and alumina	2.520	9.135
Sulphur	.008	.010
Phosphorus	.120	.065
Silica	8.350	2.175
Water and organic matter	1.042	1.015
Total	100.000	100.000
Metallic manganese	54.975	54.750

Other mines.—Manganese ore was produced on at least three other properties in the region during the past year.

The Dade Coal Company worked a mine on their property in Bartow county for a short time in the fall of 1885, producing some 100 tons of ore, which was purchased by the agent of an English company and shipped to England. The quality is stated to have been "very good." No analysis has been obtained.

Mr. George W. Satterfield, whose mines are located some 2 miles from Cartersville, mined and shipped to Pittsburgh for blast-furnace use, and to New York, the latter for trans-shipment to England for chemical purposes, some 200 tons of manganese ore. These mines exhibit the general characteristics described above. The ore is stated to occur as "blue, crystallized, and needle" ores.

Mr. James F. Carroll commenced mining in the last quarter of 1885 on the lands of Mr. Larkin Satterfield, adjoining those last mentioned, mining and shipping to Pittsburgh some 180 tons of ore.

An analysis of ore from this property is as follows:

Analysis of manganese ore (run of mine) from the mines of Larkin Satterfield, Cartersville, Georgia.

	Per cent.
Metallic manganese	44.72
Metallic iron	5.19
Silica	17.03
Phosphorus	.151
Water	9.20

Manganiferous iron ores.—Certain of the iron ores of Georgia as of other States are intimately associated with manganese ores. Similar agencies appear to have been at work in their origin and disposition. It will be found, therefore, that these ores not only take the place of each other in some localities, but that in the manganese regions ores that are classed as manganese carry some amounts of iron, while the iron ores carry at times considerable manganese. Indeed, much of the brown ore throughout Georgia has more or less manganese, some of it so much as to be wholly useless for the manufacture of the grade of pig iron produced in the furnaces of that State. But little of this manganiferous iron ore is used.

ARKANSAS.

The search for manganese deposits, with the testing of localities that promise profitable returns, is being prosecuted at the present time with more energy in Arkansas than in any other State. Though the output of manganese ore was greater in Virginia and Georgia in 1885 than in Arkansas, and while it is probable that no single mine will, for some time at least, reach the production of the Crimora mine in Virginia, the developments already made in Arkansas indicate a very greatly increased production for 1886. Though there must be still further and extensive investigations to determine with any degree of accuracy the law of the outspread and continuity of the deposits that are known to exist in this State, enough is already known to indicate that the deposits underlie a great extent of contiguous territory, and that the pockets are as a rule quite large. It is also reported that true veins of considerable extent and rich in manganese have been found and traced in the State.

There are two distinct and widely separated localities that promise to furnish manganese in large quantities. One is in the southwestern part of the State, in which true veins of manganese have been found and traced, but from which up to the present time no ore for commercial use has been mined. In the other locality, known as the Batesville, in the northeastern part of the State, mining operations have been carried on for four or five years, and a total of some 5,000 to 6,000 tons produced and shipped. In this locality at the present time several companies with large capital and experience are searching for manganese and preparing to develop on an extensive scale, pits or mines already known to contain the mineral in quantity.

Production.—Owing to the irregular and spasmodic way in which mining operations have been conducted in the past, it is not possible to give other than an approximate statement of the production of manganese in this State. Parties who might give the information decline to do so. The estimate of 5,000 tons is probably an overestimate.

Production of manganese ores in Arkansas, 1880 *to* 1885 *inclusive.*

Years.	Total amount mined.	Value of ore at mines.
	Long tons.	
1880		
1881		
1882	5,000	$20,000
1883		
1884		
1885	1,483	5,932

The Batesville district.—What has come to be known as the "Batesville manganese district" is located in the counties of Independence and Izard in the northern part of Arkansas. Batesville, from which the district takes its name, is a town of some 2,000 inhabitants, situated on the White river, and is the county seat of Independence county. This river, which is navigable after flowing in a direction slightly south of east for some 20 miles from Batesville, makes an abrupt turn and flows almost due south, entering the Mississippi 175 miles below Batesville, 600 miles above New Orleans, 400 miles from Cairo, and 600 miles from Saint Louis. A branch railroad runs from Newport on the main line of the Iron Mountain division of the Missouri Pacific railroad to Batesville. By this road and its branches the distance to Saint Louis is 291 miles; to Cairo, 191 miles. A branch road is projected to connect this Batesville branch with the Kansas City, Fort Scott and Gulf railroad, making the distance by rail to Memphis some 100 miles. The distance from Saint Louis to Pittsburgh by rail is 621 miles; to Chicago, 282 miles.

The manganese deposits are not in Batesville, but so far as ascertained at present, extend from a point just over the line of Izard county a short distance above the mouth of Lafferty's creek, which enters the White river some 20 miles above Batesville, to Casson's mines, three miles north of this town. It has been generally supposed that all of the deposits were north of the White river. It is reported, however, that there are some south of the river.

In the middle section or belt of Independence county the ores are found. The manganese belt is somewhat elliptical in shape, and has a length from east to west of about 16 miles, with an average breadth of about 3 miles. In this distance, however, the ore is by no means continuous, there being frequent interruptions and many places from which the ore is absent. It is probable that 7 or 8 square miles would cover the ascertained extent of the deposits, though explorations in progress may enlarge this. In its topography the ore district is an irregularly located group of rounded hills, 100 to 500 feet above the general drainage level of the country. Two creeks run through the belt, Polk bayou on the east, and as above stated, Lafferty's creek on the west. The ore belt is by no means well watered, however, and did this ore demand thorough washing there would be considerable difficulty in securing sufficient water for thepurpose. Geologically the country exhibits a monoclinic structure, dipping gently to the southeast from Lafferty's creek towards Batesville. The main portion of the hills above water level are sub-Carboniferous limestone, covered with wash and crowned with broken chert or flint. Underneath the limestone is sandstone.

The ores occur in two horizons, and under two distinct conditions:

I. The drift ores of the northwestern portion of the region.

II. The regular stratified bed of the eastern portion of the belt.

The drift manganese ore is found under the tops of the hills in pieces from the size of a pea up to bowlders 2 and 3 and even 4 tons in weight. The diluvian deposit carrying the ore is from 5 to 25 feet in thickness, averaging say 9 feet, and rests upon a floor of limestone, a brown clay of varying thickness being interposed. This ore drift yields from 12 to 30 per cent. of ore. Above the manganese drift is an earthy wash, interspersed with fragments of chert from 3 to 30 feet thick. At the Southern mine, from which over 5,000 tons have been taken, the stripping is 2 to 25 feet thick, and the drift in which the manganese is found 20 feet thick. The pit at this mine covers a little more than half an acre. At other pits opened the stripping is 10 feet and the ore drift 5 to 11 feet.

The explorations have not as yet been sufficient to indicate the extent of these deposits, nor has enough been learned to justify any general conclusions as to the formation.

The source of the manganese ore lumps is believed to be the "cavernous limestone" found to the northwest of the ore belt, which originally occupied greatly elevated positions. Some of the formation near the mouth of Lafferty's creek, which has escaped the denuding agencies, still carries veins of manganese ore 8 to 14 feet thick.

The ore, which is the black oxide, varies in quality from 40 to 60 units of metallic manganese, is of a bright luster, submetallic in color, subcrystalline, brittle and with a fracture like that of cast iron. The following is the average of thorough analyses of seven shipments. Other analyses of this ore will be found in the volume of Mineral Resources for 1883–84.

Average composition of Batesville (Arkansas) manganese ore.

	Average of seven analyses.
	Per cent.
Metallic manganese	50.43
Metallic iron	3.66
Phosphorus	.164
Water	2.28

A recent analysis shows the following constituents:

Analysis.

	Per cent.
Manganese	58.76
Iron	3.75
Phosphorus	.14

Analyses from three separate pits show the following:

Analyses of Batesville (Arkansas) manganese ores.

	Pit 1.	Pit 2.	Pit 3.
	Per cent.	*Per cent.*	*Per cent.*
Metallic manganese	56.92	54.33	56.88
Phosphorus	.098	.228	.182
Insoluble matter	2.10	1.34	.72

A drift ore gave the following:

Analysis of Batesville (Arkansas) drift manganese ore.

	Per cent.
Metallic manganese	55.95
Phosphorus	.168
Insoluble matter	1.27

The ore has not been washed heretofore. With care in removing the dirt it has been believed that this was not necessary, though dry screening might be advisable. Later advices are to the effect that washing may be undertaken.

The mining cost depends chiefly on the amount of stripping and the percentage of ore in what is termed the "manganese ore drift." From 2 to 5 tons of earth must be removed for every ton of ore, and the drift yields from 12 to 30 per cent. of ore. Two dollars and fifty cents will probably fully cover the mining cost. As the branch railroad at present only extends to Batesville, the ore has to be hauled from the pits to the terminus. This adds to the cost $2 to $2.50. Surveys are in progress for an extension of the railroad through the ore deposits.

The second body of ore is found between the buff-colored sandstone of Batesville and the sub-Carboniferous limestone which forms the floor of the deposits above noted; that is, the first named deposit rests upon the limestone, the second underlies it, or, perhaps better, is in the horizon of transition between the limestone and the sandstone underlying it.

This is a most peculiar deposit. The ore occurs in buttons or concretions embedded in a red matrix of lean siliceous iron ore, the matrix adhering so closely to the "buttons" as to preclude, so far, all attempts to separate it from the rich manganese in the "buttons." The matrix splits up into rusty slabs 2 to 4 or 5 inches thick. This ore has but little commercial value. An average analysis of this deposit is as follows:

Average analysis of Batesville (Arkansas) "button" manganese ore.

	Per cent.
Metallic manganese	16.46
Metallic iron	8.70
Phosphorus	.60
Insoluble matter	43.65

Southwestern Arkansas.—But little has been learned as to the deposits of manganese ores in this section. They are reported as covering a large extent of territory northwestward from Nashville, and showing both true veins and pockets. The distance of the deposits from railroads have so far interfered with their development. The only analyses obtainable of ores from this region were made with a view to chemical manufacture, and are as follows:

Analyses of southwestern Arkansas manganese ores.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Protoxide of manganese	84.995	82.448
Oxygen	10.482	10.002
Silica	2.845	5.329
Baryta	.512	.282
Lime	Trace.	1.178
Magnesia	....	Trace.
Water	1.820	.611

NEW JERSEY.

In the Triassic rock near Clinton, Hunterdon county, there has been an opening made, at first for iron ore, but it proved to contain ores with a large percentage of oxides of manganese, partly pyrolusite and partly braunite. The sample analyzed contained 47 per cent. metallic manganese, 7 per cent. peroxide of iron, and about 25 per cent. insoluble matter. The ore was tried in blast furnaces, and hopes were entertained of making it valuable in the manufacture of spiegel iron, but these have not been realized.

Though, strictly speaking, there are no manganese ores mined in New Jersey, the zinc ores of Sussex county, which are mined for the zinc, contain considerable manganese. The residuum from working them for the zinc would, of course, contain more manganese per ton than the ore itself, and this is smelted in blast furnaces for spiegel iron.

This zinc residuum is worked by the New Jersey Iron and Zinc Company at Newark and the Passaic Zinc Company in Hudson county. When first made this spiegel iron was known as "franklinite iron," after one of the ores used in its manufacture.

From an interesting article in the *Engineering and Mining Journal*, by Mr. George S. Stone, the engineer of the New Jersey Zinc Company, the following statement concerning these ores is condensed:

The zinc ores which carry manganese, and which are used in the production of zinc at the New Jersey Zinc Company's works, are essentially a mixture of willemite, franklinite, zincite, and calcite, from Sterling and Franklin, Sussex county, New Jersey. The ore from the Sterling Hill mine is principally franklinite and calcite, with a very variable proportion of zincite and but very little silicate. The ore from the front vein of the Taylor mine at Franklin also contains a good deal of calcite with franklinite, willemite, and rhodonite; it is low in zinc. The ore from the back vein, or "Buckwheat Field opening," is the best ore. It contains a large proportion of willemite and zincite, with but little calcite. The following analyses show the composition of the ores:

Analyses of zinc ores containing manganese, from New Jersey.

Constituents.	Selected Buckwheat.			Lean Buckwheat.		Sterling.			Front vein.
	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 1.	No. 2.	No. 3.	
SiO_2	10.21	9.91	11.08	10.28	10.33	4.86	4.43	5.15	9.78
Fe_2O_3	31.41	31.63	27.54	30.46	30.36	30.33	30.13	27.62	27.20
MnO	15.84	16.46	17.63	15.66	15.95	12.30	12.21	13.09	17.81
ZnO	32.83	34.07	35.88	27.15	26.34	29.42	27.12	23.38	22.94
CaO	5.09	4.08	2.01	8.45	7.15	12.65	12.63	14.37	11.46
MgO	....	.21	.77	.91	1.09	....	1.69	1.98	.74
Al_2O_3	.21	.80	.24	.09	1.16	.67	....	.64	.67
Fe	21.98	22.14	19.28	21.32	21.25	21.23	21.09	19.33	19.04
Mn	12.27	12.75	13.66	12.12	12.35	9.53	9.46	11.13	13.79
Zn	26.34	27.34	28.78	21.79	21.14	23.61	21.76	18.76	18.41

The New Jersey Zinc Company is using all but the Front vein ore at present. The Lehigh Zinc and Iron Company, at Bethlehem, Pennsylvania, uses an ore that is between the Buckwheat and the Front vein in composition, and the Passaic Company uses partly Buckwheat and partly ore like the Sterling from a mine of its own.

The ores are mixed in various proportions, limestone being added when necessary, and treated in the oxide furnaces, where the greater part of the zinc is volatilized, to be collected and sold as oxide. The ore is mixed in the oxide furnaces with a large proportion of anthracite culm and dust from coal yards, very high in ash, as the following analysis shows:

Analysis.

	Per cent.
Moisture	4.08
Volatile combustible matter	6.03
Fixed carbon	66.64
Ash	23.25

The ash from the culm is, of course, left in the residuum, making it leaner and adding a most objectionable amount of silica and alumina.

The clinker, as it comes from the oxide furnaces, is partly in flat cakes, about 2 inches thick and from 4 to 10 inches in diameter, and partly in small fragments, from dust to 2 inches in diameter. It is screened before going to the blast furnaces, the very fine portion being rejected. The coarse clinker very frequently varies between certain limits, as shown by the following analyses:

Analyses of clinker from zinc oxide furnaces.

Constituents.	1.	2.	3.	4.	5.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
SiO_2	19.97	25.02	23.47	18.14	21.29
Fe_2O_3	33.21	31.06	33.84	36.16	31.06
Al_2O_3	2.25	6.36	8.24	6.94	5.98
MnO	17.83	16.22	15.66	18.90	21.03
CaO	11.96	10.73	11.04	11.81	7.60
MgO	2.30	2.67	1.84	1.98	4.01
ZnO	10.74	6.98	4.98	4.06	7.84
P	.037	....	....	....	....
Fe	23.25	21.74	23.69	25.30	21.74
Mn	13.82	12.56	12.13	14.64	16.29

The last two (4 and 5) are exceptional. The clinker is lean and rather siliceous; it carries, however, nearly enough lime, magnesia, and alumina to flux the silica. The alumina is far from being a desirable ingredient. The zinc oxide varies from 3 to 11 per cent., usually about 6 per cent., and is an unmitigated nuisance. It is all driven off when the furnaces work regularly. Part of it condenses on the throat in a hard, dense ring, which has to be frequently chiseled off at an expenditure of much time and hard labor; part of the remainder collects in the gas flues, condensers, ovens, and boiler settings as a loose powder, and a large part is carried off by the escaping gases and lost.

The new furnace "A" of the New Jersey Zinc Company is the result of a number of most careful experiments, as to dimensions, thickness of walls, etc. It makes more iron, carries a heavier burden, and is less troubled by unavoidable stops than any of previous construction. It is 31 feet high to the stock line, 6 feet 6 inches diameter at the throat, 8 feet at the bosh, and 5 feet 3 inches at the tuyeres. The bell is 3 feet 4 inches in diameter. There are five 3-inch and one 2½-inch tuyeres. The walls are 21 inches thick up to the tuyeres, 16 inches on the bosh, 24 inches for the first 10 feet above the mantel, diminishing to 16 inches at the throat. The increased thickness of the walls, by preventing loss of heat by radiation, is one of the principal reasons of the better working of this furnace. From 1 foot below the hearth to 14 inches below the tuyeres, and at the tuyeres and cinder notch, the furnace has cast-iron water jackets. From 14 inches above the tuyeres to the mantel there is a wrought-iron bosh jacket with sprinkling pipes. The coal unit is 900 pounds. The present charge is 900 coal, 1,275 clinker, 300 limestone—the largest charge that has ever been worked by a furnace using this material. The furnace did not get fairly in working order for the first three months of the blast. For the first six months of the blast the average make was 8 tons 415 pounds of iron with 20.36 per cent. of manganese, requiring 0.029 ton of boiler coal and 2.614 tons of broken coal to the ton of iron; 19.54 per cent. of the iron was 17 to 19 per cent. spiegel, 79.93 per cent. was 20 per cent. spiegel, the remainder, 0.53 per cent., was of lower grades. For the second three months the furnace made 9 tons 1,416 pounds a day with 20.20 per cent. manganese; more than three-fourths of the iron was 20 per cent. spiegel, the remainder 17 to 19 per cent. spiegel. It took 0.019 ton of boiler coal and 2.368 tons of broken coal to the ton of iron. For the past month the make has been over 10 tons 1,500 pounds a day, requiring less than 2.2 tons of coal to the ton of iron.

The residuum used at the furnace of the Passaic Zinc Company averaged as follows:

Analysis.

	Per cent.
Silica	18.56
Oxide of iron	(a) 36.21
Oxide of manganese	(b) 15.69
Oxide of zinc	4.70
Alumina	4.07
Lime	16.70
Magnesia	1.92
Carbon (unburnt coal)	1.85

a = 25.35 metallic iron. *b* = 12.37 metallic manganese.

The coal and limestone (from High Bridge, New Jersey) were the same as used by the New Jersey Zinc and Iron Company.

The furnace at the Passaic works, built in 1883, is 34 feet 9 inches high, 10 feet diameter at the bosh, and 5 feet 8 inches at the tuyeres. The top was at first closed by a swinging lid, which was not satisfactory, as it allowed much of the gas to escape, and could only be used when the wind was in the right direction. It was finally replaced by a bell and hopper. The furnace has columns 13 feet 6 inches high, and is water-jacketed up to the mantel. The first two blasts were unsuccessful; both were prematurely ended by bad gas explosions, which wrecked the condensers. Before blowing in again the furnace was relined and several alterations and improvements were made in other parts of the plant. The last blast began in the latter part of 1884. It has been very satisfactory.

For the year 1885 the following quantities of materials were used to the ton of iron: Boiler coal, 0.57 ton; furnace coal, 2.29 tons; residuum, 2.89 tons; limestone, 0.63 ton; and scrap, 25 pounds. The average pressure of the blast was 5½ pounds, the temperature 381° Fahr. The average make per day was 11 tons 1,792 pounds, containing 22.76 per cent. of manganese. All but 41 tons (0.95 per cent.) of the iron made contained over 20 per cent. of manganese.

Though the furnace of the Lehigh Zinc and Iron Company is in Pennsylvania it will be better to give Mr. Stone's statement as to its residuum and workings here. This company built its furnace in 1881. The residuum used is lower than that of the New Jersey Zinc Company, as the following average analysis will show:

Average analysis.

	Per cent.
Silica	25.16
Oxide of iron	(a)28.99
Oxide of manganese	(b) 9.45
Oxide of zinc	(c) 4.55
Lime	12.80
Magnesia	4.55
Alumina	6.57
Phosphorus	.036

a = 20.29 metallic iron.
b = 7.32 metallic manganese.
c = 3.65 metallic zinc.

The silica frequently runs as high as 32 per cent.

The furnace is 32 feet 9 inches high, 5 feet 4 inches diameter at the throat, 8 feet at the bosh, and 4 feet at the tuyeres, with closed top and closed front. It has four tuyeres 3 inches in diameter. The usual pressure of the blast is 4½ pounds, and the temperature 700° Fahr. Average length of blast, sixteen months. The furnace is stopped twice a week, for one hour each time, for cleaning. The gas passes through six condensers, with five pipes to each. These condensers catch 405 pounds of oxide per ton of iron made, an unusually large proportion considering the comparatively small amount of zinc in the residuum used. The following quantities of materials are used per ton of iron made: Boiler coal, 1.08 tons; furnace coal, 2.79 tons; coke, 0.72 ton; residuum, 3.59 tons; limestone, 1.65 tons. The usual charge is, fuel (one-fourth coke), 700 pounds; residuum, 700 pounds; limestone, 320 pounds. The spiegel contains about 14 per cent. of manganese. About 5 tons are made per day. The cinder contains, on the average, 33.33 per cent. of silica and 5.38 per cent. of protoxide of manganese, equal to 3.89 per cent. of metallic manganese—"the lowest amount," says Mr. Stone, "I have ever known in cinder from any furnace using residuum." The Lehigh company has leaner and more siliceous clinker than either of the other companies working the same ores.

The following table shows the comparative working of the different furnaces of these three companies when making spiegel iron:

Comparative working of the different furnaces.

	Number of tuyeres.	Iron made per day.	Furnace.	Furnace per ton iron per day.	Average manganese in spiegel.	Oxide collected per ton of iron made.	Boiler coal per 100 iron made.	Furnace coal per 100 iron made.	Residuum per 100 iron made.	Limestone per 100 iron made.	Charge per day per 100 cubic feet in furnace.	Approximate weight of cinder per 100 iron.
		Tons.	*Cu.ft.*	*Cu.ft.*	*Per cent.*	*Lbs.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Old "A" furnace, top and front open	3	$7\frac{922}{2240}$	393	53	17.45	367	19	292	305	74	12.65	250
Old "B" furnace, top and front open.....	3	$7\frac{165}{2240}$	695	98	17.55	296	3	292	330	74	7.08	270
"C" furnace, top and front open	5	$7\frac{338}{2240}$	527	73	19.39	448	2	301	317	81	9.48	270
"C" furnace top closed. front open..	3	$6\frac{549}{2240}$	602	96	17.11	132	39	332	356	90	8.07	300
New "B" furnace, top and front closed	6	$8\frac{827}{2240}$	1,139	135	20.74	231	3	264	303	76	4.76	250
New "A" furnace, top and front closed	6	$9\frac{1418}{2240}$	1,232	128	20.20	176	2	(*a*)237	317	77	5.00	250
Lehigh furnace, top and front closed	4	5	925	185	14.00	405	108	(*a*)351	359	165	4.74	300
Passaic furnace, top and front closed....	5	$11\frac{1722}{2240}$	1,466	124	22.76	259	57	229	289	63	4.67	190

a One-fourth coke.

The figures for the first five furnaces are averages for the entire blast; for furnace "A," for the second three months of the blast (it is doing much better at present). It is not stated how long a period the figures for the Lehigh furnace cover. For the Passaic they are the average for the year 1885, which leaves out the first and last parts of the blast, and consequently makes a more favorable showing than if the entire blast were included.

In making comparisons, it must be remembered that the former New Jersey furnaces cut out so rapidly at first that, by the end of a month, their volume was nearly doubled. The New Jersey Zinc Company's furnaces, with the exception of C, closed top, had residuum of nearly equal quality. The Lehigh furnace has considerably leaner and the Passaic rather richer and much less siliceous residuum.

NEW ENGLAND STATES.

Manganese has been found in a number of localities in the New England States, chiefly as wad, however, and of little commercial value. In Maine considerable bog manganese was mined at one time in Knox, Oxford, and Hancock counties. In Blue Hill, Hancock county, what is termed a silicate of manganese has been mined at several dates since 1863. The manganese occurs in a vein about 15 feet in width on the summit of Blue Hill. The hill is a mass of contorted gneiss rock, the manganese running through it east, northeast by west, southwest. In

1877 and 1878 some 120 tons were taken out of this mine for use as flux at the furnace of the Katahdin iron works, since which time the deposit has not been worked. The following are analyses of the ore:

Analyses of manganese ore from Blue Hill, Maine.

	No. 1.	No. 2.	No. 3.
	Per cent.	*Per cent.*	*Per cent.*
Protoxide of iron	14.01	24.91	12
Protoxide of manganese	35.13	29.72	15
Alumina	7.45	3.04	....
Lime	3.49	5.02	....
Silica	35.84	35.70	39
Phosphoric acid	1.02	....	....

No. 1 was made by Prof. R. H. Rickard, No. 2 by the Scranton Steel Company, No. 3 by the Cambria Iron Company.

In New Hampshire some pyrolusite is found in connection with silicate of manganese in Cheshire county.

In Vermont quite a number of deposits of various ores of manganese, such as braunite, psilomelane, and pyrolusite, are noted. Rutland county gives several localities.

In the western part of Massachusetts, in connection with the limonite ores of that section, pyrolusite is frequently found, though rarely, if ever, in sufficient quantities to justify mining it for manganese. These limonites carry at times as much as 4 per cent. protoxide. In Conway, Franklin county, "large beds," with quartz gangue, are reported.

In Connecticut manganese in connection with the iron ores of Salisbury district is of quite frequent occurrence, though no manganese is produced separately. Attempts have been made to find the manganese ore in sufficient quantities to pay for separating it from the iron ore, but without success.

In Rhode Island only bog manganese is reported.

PENNSYLVANIA.

Manganese ore is of quite frequent occurrence in Pennsylvania, although but few deposits have yet been discovered that have been worked. Perhaps the largest mines worked in the State were two at Ironton, in Lehigh county, in connection with iron ore. In the iron mines of the Ironton Company, the Balliet Brothers, and the Balliet Heirs, which form one excavation, manganese ore has been twice met with in local beds in considerable quantities. One deposit overlaid a portion of the brown hematite, and the other was just above the limestone under the brown hematite and separated from it by a red clay. Several hundred tons were taken from these beds. The following analyses are by Mr. A. S. McCreath (1) and Mr. Henry Pemberton, jr. (2):

Analyses of manganese ores from Lehigh county, Pennsylvania.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Metallic manganese	52.631	56.58
Metallic iron	2.562	....
Phosphorus	.063	Trace.
Sulphur	Trace.	....

Another sample from the Ironton Company's mine gave:

Analysis of manganese ore from the Ironton Company's mine.

	Per cent.
Metallic manganese	17.648
Metallic iron	26.400
Phosphorus	.095
Sulphur	.010
Insoluble residue	21.860

In this district the brown hematites often contain some manganese, 0.5 per cent. to 3 per cent. not being uncommon.

In addition to its occurrence in these Lehigh mines, it has been noticed in many of the mines of Northampton and Berks; in Blair, Centre, and Huntingdon, and at various localities on Broad mountain. In the No. XI. red shale of the Ground Hog valley in Broad Top, there is a lead of manganese ore, 2 to 3 feet thick, carrying 50 per cent. metallic manganese and 0.4 per cent. phosphorus.

At an iron ore bank in York county, near Myer's Mills, leased by the Ashland Iron Company, of Maryland, is a manganiferous iron ore (limonite) that gives the following analysis (McCreath):

	Per cent.
Metallic manganese	15.934
Metallic iron	32.400
Phosphorus	.651
Sulphur	.027

As stated above, few of these deposits are of sufficient extent to justify mining for manganese. Others are too high in phosphorus for steel purposes, or too low in manganese to justify shipping abroad for chemical manufacture.

In this State there are three blast furnaces making ferro-manganese and spiegel iron regularly, that of the Lehigh Zinc and Iron Company, at Bethlehem, using zinc residuum, and the Conemaugh furnace of the Cambria Iron Company, and furnace "A" of the Edgar Thomson Steel Works at Pittsburgh, both using manganese and manganiferous iron ores.

MARYLAND.

As noted in the report for last year, manganese was at one time mined in Maryland. A deposit of black oxide was worked at Brookeville, Montgomery county, and another on the Maryland side of the Potomac, across from Harper's Ferry. None is at present mined in the State.

NORTH CAROLINA.

Though manganese ores have been found in quite a number of localities in this State, no ore was mined, so far as has been learned, in 1885. Some of these deposits appear to hold the same relation to the iron ores and to the several mountain ranges as certain of the manganese ores of Virginia.

In the Buckhorn iron mine, located in Chatham county, on the borders of Harnett county, sheets of laminated black oxide 1 to 2 inches thick occur, and the lower part of the bed of iron ore is quite manganiferous. An analysis of this lower part gives:

Analysis of manganese ore from Chatham county, North Carolina.

	Per cent.
Oxide of manganese	22.80
Metallic iron	18.41
Phosphorus	,02
Silica	30.50
Alumina	19.20

At an iron ore bank on Whetstone mountain a manganiferous limonite, with 5 to 6 per cent. manganese, is found.

In Madison and Cherokee counties there "are favorable prospects for large quantities of the ore." Indeed, many of the brown iron ores in this State are accompanied by manganese ores, and at times these are true manganiferous iron ores. The furnaces using these brown ores not infrequently produce a low spiegel by reason of the high percentage of manganese present.

The quantity of manganese ores, or those with over 44 per cent. to 45 per cent. of manganese, does not appear to be large; when ore as rich as this is found it is in very small seams or pockets.

TENNESSEE.

So far as has been learned the only manganese mined in this State in 1885 amounted to a few hundred pounds in Hickman county for use in coloring earthenware. There are, however, quite a number of localities in which both manganese ore and manganiferous iron ores have been found, but up to this time the manganese deposits examined are small in extent, and of but little commercial importance. A brown hematite or limonite iron ore with a large percentage of manganese was at one time mined in Greene county, and used as a mixture with other iron ores in a blast furnace, but no recent attempts to use these ores in the manufacture of iron have been discovered.

The Hickman deposit above referred to is near Whitfield. It has been worked to a small extent since 1837. The ore outcrops in a number of places along the banks of a little stream. It is probably found in connection with iron ore, though information on this point is not definite. This country is quite rich in iron ores, but lack of railroad facilities has interfered with their development.

ALABAMA.

In the neighborhood of Woodstock, Bibb county, Alabama, a manganiferous brown hematite ore is mined for furnace use. It occurs in a thin vein or crust, varying in thickness from 1 to 3 feet, resting upon the main body of hematite ore, which is some 25 feet thick. The manganese portion analyzes as follows:

Analysis of a manganiferous brown hematite iron ore from Bibb county, Alabama.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Metallic iron	38.50	41.76
Metallic manganese	11.44	13.68
Silica	11.45	24.65
Phosphorus	.27	.55
Combined water	11.62	10.66

In mining the iron ore no attempt is made to separate the manganiferous portion, but both grades are charged into the furnace together. The proportion of manganese in the charge is small, but sufficient to give the cinder the greenish tinge indicative of its presence.

This deposit is some 2 miles east of the limits of the great Black Warrior coal basin. Its northern terminus is some 20 miles southwest of Birmingham, on the line of the Alabama Great Southern railway.

In a paper read before the American Institute of Mining Engineers on the geology of Alabama, by E. J. Schmitz, of New York, the following analyses of manganese ores from this State are given:

Analyses of manganese ores from Alabama.

No.	Variety.	Formation.	County.	Analyst.	Peroxide of manganese.	Specific gravity.
1	Pyrolusite	Metamorphic	Chilton	Endemann	71.220	....
2	Psilomelane	Silurian	Talladega	Mallet	62.430	3.712
3	Psilomelane	Metamorphic	Randolph	Mallet	63.250	3.988

MICHIGAN.

Several years since a deposit of manganese near Copper Harbor was worked to some extent, and several hundred tons of mineral shipped to Pittsburgh. Only some 100 tons, however, proved to be manganese ore. This was used in the furnaces of the Cambria Iron Company at Johnstown. Analyses of this ore available for its manganese are as follows:

Analyses of manganese ores from near Copper Harbor, Michigan.

	No. 1.	No. 2.	No. 3.	No. 4.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Metallic manganese	49.14	46.33	46.26	37.17
Metallic iron	1.22	5.68	1.00	2.30
Phosphorus	.019	.022	.011	.028
Silica	12.90	12.79	....	17.56
Copper	2.21	1.60	,98	1.05

At the McComber mine, at Negaunee, pockets of manganiferous iron ores are occasionally met with, some of which are 25 feet across and of a good quality. An analysis of an average sample of this ore is as follows (Charles E. Wright):

Analysis of McComber, Michigan, manganese ores.

	Per cent.
Oxide of iron	71.430
Oxide of manganese	17.250
Alumina	2.200
Phosphoric acid	.073
Sulphuric acid	.073
Silica	2.050
Water combined	5.320
Undetermined	1.604
	100.000
Metallic iron	49.80
Metallic manganese	10.90
Phosphorus	.034
Sulphur	.021

In 1877 advantage was taken of the fact that the Munising furnace was about blowing out for repairs to make a test of this ore for the manufacture of spiegel, some 50 tons being charged. An analysis of the pig gave 10.6 per cent. of manganese and 0.120 per cent. of phosphorus.

MISSOURI.

Considerable quantities both of manganese ores and manganiferous iron ores have been mined in Missouri for use in the Saint Louis furnaces in the manufacture of spiegel iron. These ores have been derived chiefly, if not entirely, from what Professor Pumpelly has termed the "porphyritic" region of Pilot Knob and vicinity, and are usually found associated more or less intimately with iron ore. In 1881 some 2,000 tons of this ore were taken from one mine in this section, but since that year none has been mined on a commercial scale.

On what has been termed the "Cuthbertson Buford Hill" in this Pilot Knob region several deposits occur, from which the ore already referred to was chiefly derived. On the Cuthbertson tract masses of float manganese ore, varying greatly in size, are found, and in the hill occurs a bedded deposit of irregular tabular masses of manganese ore bedded in red ocherous clay. The manganese exists in the ore as red sesquioxide, with a probable admixture of binoxide. This ore is a true manganese ore, as will be seen from the following analysis:

Analysis of Cuthbertson (Missouri) manganese ore.

[Chauvenet and Blair, chemists.]

	Per cent.
Manganese as protoxide	68.20
Peroxide of iron	3.30
Insoluble siliceous matter	.44
Metallic manganese	52.47

The ore of the Buford bank adjoining the Cuthbertson tract is a manganiferous iron ore, but it occurs in a bedded deposit similar to Cuthbertson's manganese ore. An analysis of this by Mr. Chauvenet gave the following results:

Analysis of manganese ore from Buford bank.

	Per cent.
Manganese as protoxide	15.84
Peroxide of iron	68.30
Insoluble matter	8.54
Sulphur	.017
Phosphoric acid	.102
Or—	
Metallic manganese	12.32
Metallic iron	47.81
Phosphorus	.044

A small amount of manganiferous iron ore was taken from Buford mountain some years since for use at the Vulcan Steel works at Saint Louis. The ore averaged about 15 per cent. manganese. The deposit was some distance from the railroad and it was not deemed advisable to prosecute mining.

Near Cuthbertson, on Mr. Marble's land, Professor Pumpelly found a manganese deposit forming an inner stratified layer 3 to 5 inches thick, in a decomposed porphyry, showing 51.06 per cent. of manganese as protoxide.

Mr. P. N. Moore, an assistant of the Geological Survey of Missouri, reports the existence in Reynolds county, as one of the members of a series of bedded porphyry rocks, an ore of the black oxide of manganese, occurring in narrow comby strings in the porphyry. A very compact hard specimen of this, so hard that it struck fire with steel, gave Mr. Chauvenet the following analysis:

Analysis of manganese ore from Reynolds county, Missouri.

	Per cent.
Manganese as protoxide	37.04
Manganese as peroxide	5.48
Insoluble silica	45.55

The 2,000 tons referred to above as being mined in this State in 1881 were from the property of the Arcadia Mining Company, near Arcadia, Missouri. The analysis was as follows:

Analysis of Arcadia, Missouri, manganese.

[Farrell, chemist.]

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Metallic manganese	64.98	58.02
Metallic iron	2.82	3.35
Phosphorus	.04	.03
Silica	2.82	3.35

This ore was used in the furnaces of the Missouri Furnace Company at Saint Louis in such quantities as to give three-fourths per cent. of manganese in the iron. The analyses above given were of exceptionally rich specimens of the ore.

ROCKY MOUNTAIN REGION.

The occurrence of manganese throughout the mining regions of Colorado is quite common, but as a rule the ores found are in small quantity and unavailable for use. In the Leadville district an ore known locally as the "Leadville iron flux" is used to a considerable extent. This ore is practically a manganiferous iron ore containing silver. It contains usually a trace of lead and from 7 to 12 ounces of silver per ton, and the following amounts of silica, iron, and manganese:

Analysis.

	Per cent.
Silica	8 to 15
Iron	35 to 50
Manganese	8 to 15

Sometimes the manganese in these ores runs as high as 20 per cent., and even higher, though in large quantities, say from 50 to 200 ton lots of the "iron flux," the averages are as above given. Towards the close of 1885 the Omaha and Grant Smelting and Refining Company was using from 60 to 80 tons per twenty-four hours of this ore. As is the case with the argentiferous manganese ores of Montana, these are not utilized for their manganese, but for their silver and for the fluxing qualities imparted to them by the iron and manganese. Dr. Malvern W. Iles, to whom I am indebted for this information, states that aside from this manganiferous iron flux, found so abundantly at Leadville, he has noticed manganese in many places in Colorado, but does not know of any large deposits of any of the well known manganese minerals which are mined solely for their manganese.

In Montana the ore from several veins in the Butte mining district is composed almost entirely of manganese compounds. In "Mineral Resources of the United States, 1883 and 1884," on page 379, the manner of occurrence of the manganese here is stated. The ores containing the oxides of manganese are in great demand at Butte by the smelters for use as flux. Analyses are given in the same volume, on pages 379 and 380, of several samples from Butte. No manganese ores are mined for the manganese, but are utilized solely for their silver and fluxing qualities. Some 4,263 tons of these ores, worth $10 a ton on an average, were treated at Butte in 1885. They were estimated to carry 67.75 per cent. MnO_2, but the method of assay was crude. The ore is assayed for insoluble residue and the remainder credited to MnO_2.

Little or nothing is known of the occurrence of manganese ores in New Mexico, Wyoming, Idaho, or Dakota.

PACIFIC STATES.

There are a number of known deposits of manganese ores in the Pacific States, especially in California and Nevada. The relation of most of them to transportation is such that at present few have any commercial value. There is no doubt, however, that at some time these States will be large producers and exporters of this mineral.

In Nevada some 200 tons of manganese ore were taken in 1885 from a mine some 3 miles from Golconda station, Humboldt county, on the Central Pacific railroad. None of this was shipped, owing to the difficulty in finding a market. Mr. J. R. Jennings, the proprietor of the mine, writes that he "can put in San Francisco a 75 per cent. manganese ore at $11 per ton." This would preclude shipments. The ore is both black and yellow. Analyses of the black oxide show 60 to 85 per cent. oxides of manganese. The deposit is described as a regularly defined ledge, of which the outcrop can be traced for some 300 feet. The ledge is from 3 to 10 feet thick.

In California there are several known deposits of manganese, some of which are not far from tidewater at San Francisco. In the two previous volumes of "Mineral Resources of the United States," a number of these localities are mentioned. So far as has been learned the only deposit producing any ore in 1885 was at Livermore, Alameda county. Some 200 tons a year are mined in this locality, and shipped to San Francisco and other places in California, chiefly for use in working sulphuret gold ore. The ore is in pockets, which are said to be quite large. It is quite rich, yielding more than 55 per cent. of manganese. These mines are located on a railroad only 50 miles from San Francisco.

CANADIAN MANGANESE.

New Brunswick.—Manganese ores, some of them of the highest grade, are found in a number of localities in this Province. A recent list of localities of minerals in New Brunswick, published by Mr. F. W. Stockton, in the *Canadian Gazette*, mentions its occurrence in King's, Albert, Westmoreland, Gloucester, and St. John counties.

More than fifty years ago manganese was shipped from Quacco, in St. John county, to the United States and England. The ore was taken out of the Bay of Fundy, below high-water mark, but a storm with heavy sea and high tide filled the pit with gravel, and it was abandoned. Thirty years later manganese was again mined along the shore by several parties in a desultory way, and again within the last five years operations have been carried on, but always resulting in loss to the persons most interested. The ore found here is not of high quality.

About thirty-five years ago manganese of excellent quality was mined at Hopewell, in Albert county, but owing to various causes the mines were closed after being in operation a few years. Since that time the mines have been opened several times by different individuals or companies, but have not been profitable to any one.

The most important manganese mine in Canada is situated at Markhamville, in King's county. The works have been in active operation for upwards of twenty-three years, and about 30,000 tons of manganese have been shipped to Europe and the United States. Notwithstanding the great depression during the last three or four years in business of all kinds, particularly in mining, these mines have been successfully worked. The company has a very complete plant, using steam mills and high explosives, pumps and hoisting engines in the mines, also improved and novel appliances for washing and dressing the ores. A rotatory saw-mill and other machines for preparing timber for underground work, and for building purposes, crusher and mills for preparing the various ores for use of consumers have been supplied.

One of the most important features of these mines is their production of almost all kinds of manganese ores, viz., pyrolusite of the very best quality and highly crystallized manganite and braunite; the two latter, being free from phosphorus and high in metallic manganese, are particularly adapted for steel manufacturers. These ores have a well known standing in the English market. The output since 1880 has been nearly 2,000 tons annually, four-fifths of which has gone to Europe, principally to England, and one-fifth to the United States, the latter almost all high-class ores for glass making. The mines are owned and worked by Boston capitalists, under the management of Mr. Alfred Markham, to whom I am indebted for many of the facts concerning New Brunswick manganese.

An analysis of one grade of their furnace ore (No. 3) is as follows:

Analysis of manganese ore from New Brunswick.

	Per cent.
Peroxide of iron	3.75
Peroxide of manganese	52.74
Carbonate of lime	13.40
Silica	9.50
Sulphur	.02

This is used as a flux at the Katahdin furnace in Maine.

The other mine in this province producing manganese in 1885 was that of Mr. F. W. Stockton, some 6½ miles from Sussex station. This is a new mine, producing a high-grade ore. Some 100 tons were mined in 1885.

Nova Scotia.—Through the kindness of Mr. Edwin Gilpin, jr., chief inspector of mines of the Province of Nova Scotia, I am enabled to give the following facts regarding manganese in this Province:

The least valuable but certainly the most common of the Nova Scotia manganese ores is wad. This ore is found as a superficial deposit in connection with every geological formation known in the Province. Among the localities yielding it may be mentioned Jeddore, Ship Harbour, Saint Margaret's Bay, Shelburne, La Have, Chester, Parrsborough, Springhill, Pictou, and Antigonish. These ores exhibit the varying composition which characterizes their class, and have in some cases been used to a limited extent as paints.

At the Londonderry Iron mines, Colchester county, in the great vein of brown hematite, associated with ocher, ankerite, sideroplesite, and calcite, in strata of Lower Silurian age, secondary changes have at some points enriched the iron ore with manganese peroxide up to 14 per cent. of its total constituents. Some incrusting fibers are manganite, and part of the manganese is present in the form of wad, of which Mr. H. Louis gives the following analysis:

Analysis of manganese ores from Nova Scotia.

	Per cent.
Manganese peroxide	67.10
Manganese protoxide	10.67
Water	9.37
Copper protoxide	.88
Iron protoxide	4.09
Alumina	.67
Nickel and cobalt oxide	.65
Lime	2.49
Magnesia	Trace.
Silica	4.08
Total	100.00

The occurrence of this ore in the pre-Carboniferous rocks is interesting, as showing its originally wide distribution, and as possibly indicating the sources of part of the more recent ores of economic value.

Pyrolusite is the only ore of manganese which has hitherto been mined to any extent in Nova Scotia, and it is known to occur in pre-Carboniferous strata at several points. Between Halifax and Windsor, near Mount Uniacke, pyrolusite is found in small pockets and veins penetrating granite, and in quartzites of the auriferous Lower Cambrian of the Nova Scotia Atlantic coast. It occurs in veinlets in the granite of Musquodoboit, and as small irregular seams in the granite of Ship Harbour. In the hills south of Wolfville, in King's county, the same ore is found in quartzites and slates, presumably of Upper Silurian age. In the Trias of the same county the ore is met in a bedded form near Cornwallis and Wolfville, and in the Triassic trap it is said to occur lining cavities, in association with zeolites, etc.

These ores are found, however, most abundantly in the Lower Carboniferous marine limestone formation. This horizon forms one of the widest spread and most strongly marked of the divisions of the Carboniferous age. It is met in King's county, in Hants, Cumberland, Colchester, Pictou, and Antigonish, and in the four counties of the island of Cape Breton.

In the northern part of Hants county, the Carboniferous marine limestones and the underlying lower coal-measures are found in a series of east and west folds, shifted and broken by transverse subordinate flexures. The presence of manganese in the upper of these divisions is first observable at the mouth of the Shubenacadie river, where a dark-colored limestone underlies the gypsum, and is associated, a short distance east of the river, with red shales, carrying veins of red hematite, with manganese oxides and calcspar. The westward continuation of this horizon is noticeable again at Tenny Cape, where a series of these measures, extending to Walton and Cheverie, a distance of about 15 miles, contains several beds of limestone, which apparently underlie the gypsum, and may be called manganiferous. These measures carrying manganese reappear again south of Windsor, and at Douglass, 15 miles south of Tenny Cape, near the line of their junction with the pre-Carboniferous rocks. In this range cf measures the manganese of Tenny Cape appears to be principally connected with a compact red and gray limestone, which, from the analysis already given, may be called a dolomite. At the western end of the district it occurs as veins in conglomerates and sandstones, and also in limestones in places decidedly magnesian.

The Tenny Cape manganese ores were discovered about the year 1862, and have been worked intermittently since that date. The limestone band to which they seem to be principally confined is about 300 feet thick. The ore occurs in irregular nests, and in seams eroded on the bedding planes and cross fractures. It thus occurs that large masses almost entirely isolated have been met; also seams with occasional pockets, sometimes connected, but in no case, so far as ascertained, following any regular order of position or extent. The largest mass yet found was estimated to contain 180 tons of ore. Apparently the ore has been deposited at irregular intervals of time, with the associated minerals, in the openings worn by the action of water on the limestones. Specimens may be obtained showing pyrolusite cementing waterworn pieces of limestone and surrounding nodules of the bed rock which have resisted erosion. The ore is chiefly a fibrous pyrolusite, with splendent luster, based on a compact or granular ore consisting of pyrolusite, psilomelane, and manganite, the latter mineral, however, not being present in large quantity. The quality of these ores, even after the slight hand dressing they receive at the mines, is very high, and in some years they bring $125 a ton at the mine. They are prized by glass makers for their freedom from impurities, especially of iron. This high grade of the pyrolusite from the Tenny Cape district will appear when, from numerous assays, it has been found to yield from 88 to 95 per cent. of available oxide. The following analyses show the general character of these ores:

Analysis of manganese ores from Tenny Cape district.

	Douglas.	Cheverie.
	Per cent.	*Per cent.*
Moisture	1.660	2.05
Water of composition	3.630	....
Iron peroxide	.603	2.55
Oxygen	7.035	....
Baryta	.724	1.12
Insoluble matter	1.728	2.80
Phosphoric acid	....	1.029
Manganese oxides	84.620	....
Peroxide of manganese	....	90.15
Lime	....	Trace.
Totals	100.000	99.699

At Walton and Cheverie manganite is more common than at Tenny Cape. Its mode of occurrence is similar, and its general character is shown by the following analyses:

Analyses.

	Tenny Cape.	Cheverie.
	Per cent.	*Per cent.*
Manganese oxides	85.54	86.81
Iron peroxide	1.18 }	2.05
Baryta	.89 }	
Insoluble matter	3.27	1.14
Phosphoric acid	.34	....
Water	8.54	10.00
Available oxygen	51.54	47.73

The Tenny Cape manganite is compact, with partly fibrous structure, and submetallic luster. It is not much in demand at present, but it is stated that considerable quantities could be obtained at several points.

Lower Carboniferous limestones at Minudie, in Cumberland county, have yielded small quantities of a soft fine-grained pyrolusite, giving on analysis 97.04 per cent. of manganese binoxide. Ores similar to those of Tenny Cape are found at Onslow, and on the Salmon river, near Truro, Colchester county. Prospecting work has shown red shales and sandstones, and beds of dark-bluish limestone, covered by beds of gravel and clay holding nodules of compact subcrystalline pyrolusite. The ore also occurs in veins, up to 4 inches in thickness, in the sandstones, and in irregular nests and layers in the limestone. Calcspar, barite, and selenite are found in the veins, which are filled with fibrous ore. The exact horizon of the beds holding these ores is not readily ascertainable, and it may be higher in the marine limestone formation than at Tenny Cape. The ore is of very good quality, some of it running as high as 90 per cent. of available oxide. In Pictou county, near Glengarry station, nodules of fibrous pyrolusite, containing 84 per cent. of peroxide, are found with crystals of dogtooth spar, in a dark-blue limestone, similar to that at Springville, already referred to, and exposed close to the junction of the marine limestone with pre-Carboniferous rocks.

Bowlders of a mixture of psilomelane with manganite occur lying on the limestone at Springville, and on the associated red shales. At several points in this vicinity the limonite ores, found along the line of junction of the Upper and Lower Silurian with the Lower Carboniferous marine limestone, are heavily charged with manganese. The ore is dull brownish-black in color, with a black streak, and softer than the normal limonite. The percentage of manganese present in the iron ore varies. The general character of this ore, however, will appear from the following analysis by Mr. Edward Gilpin:

Analysis of manganese ores from Springfield, Nova Scotia.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Water of composition	.... }	12.530
Moisture	1.450 }	
Insoluble residue	2.731	25.130
Alumina	2.880	Trace.
Iron sesquioxide	10.848	48.223
Manganese sesquioxide	62.950	....
Manganese peroxide	....	14.410
Magnesia	1.630	....
Lime	7.280	.015
Baryta	.670	....
Carbonic acid	....	....
Sulphur	....	.480
Phosphorus	....	.020
Totals	90.439	100.808

In Antigonish county similar ferriferous manganese ores have been found in drift at several places.

Cape Breton.—In Cape Breton, deposits of manganese of economic value occur only in the western part of the county of the same name. The manganese ores at the Mosely Iron mines, Loch Lomond, the most important deposit in the island, were discovered three years ago, in a recess where the felsites were succeeded by shales and grits, and finally by limestones, the latter apparently extending from point to point of the ancient bay. The ores at the western mine are found in irregular bedded layers in a soft arenaceous reddish-colored shale, which is in some places calcareous and coated with films of manganese oxide. The layers vary in thickness up to 18 inches, and are frequently connected by cross stringers of ore. The shales when weathered present the ore in small nodules, and the disintegration of the former by water probably indicates the source of the beds of gravel manganese ore found lying on them. The ore at the eastern mine occurs as a bed immediately underlying a layer of black manganiferous limestone, with red and greenish shales and coarse grit. The thickness of the ore and limestone varies from 2 to 8 inches, the average thickness of the two being about 8 inches. The ore also occurs in this vicinity as lenticular and irregular nests in conglomerate, &c., and sometimes forms the cementing material. This latter mode of occurrence is similar to that shown by the red hematites (sometimes highly manganiferous) found at various points in the Lower Carboniferous conglomerates of the island near their junction with the older strata. The analysis of the overlying limestone has already been given. The ore from this locality is generally a pyrolusite, soft, fine grained, and sometimes subcrystalline. It is at some openings mixed with manganite, and the latter ore is abundant at several places in the grits. The minerals associated with the ore are calcspar, barite, films of selenite, and limestone. Analyses by Mr. Hoffman, of the Canadian Geological Survey, show that the ores run as high as 88.9 per cent. of binoxide, and contain an admixture of ferric oxide as low as two-tenths of 1 per cent.

On the Magdalen Islands manganese ores are found, according to Mr. Richardson (Geological Survey Report 1879–'80), associated with sand, clay, gypsum, and doleritic rocks of Lower Carboniferous age. From Mr. Hoffman's report (see above) the ore is a purely crystalline manganite, yielding, on analysis, 45.61 per cent. of binoxide. Samples have, however, been seen of pure pyrolusite from these islands. There do not seem to be any limestones connected with these ores, as surveyed by Mr. Richardson, and the locality appears to form an exception to the rule which, so far as my information goes, governs the presence of manganese ores in the Carboniferous of Nova Scotia, viz., the presence of limestone. Possibly in the case of these Magdalen Island ores they may have been derived directly from the dolerite.

Production.—The production of manganese ore in Nova Scotia since 1872 has been as follows:

Production of manganese ore in Nova Scotia from 1872 to 1885, inclusive.

Years.	Mines.	Production.	Value.
		Long tons.	
1861 to 1871		1,500	$10,500
1872		40	1,400
1873		131	
1874			
1875		7	
1876		16	
1877		97	5,335
1878	Tenny Cape No. 1	79	4,345
	Tenny Cape No. 2	48	2,160
		127	6,505
1879	Tenny Cape No. 1	90	4,950
	Tenny Cape No. 2	55	2,220
		145	7,170
1880	Windsor	62	2,831
	Walton	81	3,600
	Cheverie	70	7,000
	Others	70	1,400
		283	14,831
1881	Tenny Cape	125	
	Walton	7	
	Cheverie	17	
	Pembroke	6	
	Windsor	6	
	Loch Lomond, Cape Breton	70	
		231	
1882	Tenny Cape	120	
	Walton	6	
	Cheverie	21	
	Onslow	6	
	Loch Lomond, Cape Breton	56	
		209	
1883	Tenny Cape	125	} 12,462
	Walton	5	
	Cheverie	4	
	Loch Lomond, Cape Breton	16	
		150	12,462
1884	Tenny Cape	126	11,970
	Windsor	5	550
	Cheverie	2	180
	Walton	89	8,430
	Onslow	30	2,700
	Loch Lomond, Cape Breton	50	
		302	23,830
1885		354	

CHROMIUM.

By David T. Day.

Present condition of the industry.—The development of chromium interests during the past year has been limited to adding a few new mines to many already worked in California. The depression from foreign competition is felt keenly, so that the extension of mines has been markedly checked, and those now in existence have not been worked to the full extent.

The most noteworthy mine among those opened since the last report is that at Livermore, Alameda county, California. Here, on the top of Cedar mountain, Mr. A. Mendenhall discovered chrome iron ore about three years ago. Much prospecting has been done, and five tunnels opened; of these, two have proved rich in chrome iron ore. Although the ore occurs in isolated pockets, which may be exhausted at any date, these mines continue profitable, and have increased in richness, contrary to the general rule. The two main tunnels are worked by Mr. E. N. Knight, of San Francisco, in the interest of Philadelphia manufacturers. Nearly 400 tons of ore were mined at Livermore in 1885. It is brought down Cedar mountain in wagons, and, in spite of this expensive method of transportation, is delivered in Livermore at a cost of $6 per ton, of which $2 is paid to owners of the mine, $1 for mining, and $3 for hauling. The chief interest in this chrome deposit lies in the fact that it is within easy access of a large city, and if the mines hold out it may compete largely with other deposits less favorably located. Mr. H. H. Pitcher states that the ore yields 47 to 51 per cent. chromic acid.

From the deposits in Placer county 750 tons were shipped to the East, some of it coming by rail overland, more going via the Isthmus. About 600 tons were extracted from the San Luis Obispo mines during 1885. More than half of this was taken from the Pick and Shovel mine, and the balance from numerous small deposits in the vicinity. These deposits, which are located on the Sierra Santa Lucia, are much mixed with soil and gravel, and being scattered over a considerable area, afford only a precarious living for some scores of men. The Pick and Shovel mine has been opened by a number of tunnels, one of which is 600 feet in length. Besides these tunnels numerous drifts and chambers have been excavated in search of ore which occurs, as usual, irregularly in pockets containing from a few hundred pounds to many tons. The containing rock is serpentine, much broken up, and easily excavated. No ore is saved which assays less than 40 to 45 per cent. chromic acid. The cost of extracting the ore and delivering it at its final destination is as follows: Cost of ore at the mouth of the mine, $6.50 per ton; hauling by teams to the railroad depot in San Luis Obispo, $2 per ton; loading on cars, 20 cents per ton; freight to San Francisco, $4.50 per ton; add cost of further transportation to Philadelphia, insurance, commissions, weighing, and shrinkage, and the cost in Philadelphia is $26 per long ton. As these deposits appear to be extensive it is probable that they will be mined for a long time even at the present rates, for there is a considerable population in that section of California content to work for moderate wages while partly engaged also in farming.

The mines of Del Norte county furnished 850 tons of chrome ore during 1885. These mines are owned and worked by the Tysons, of Baltimore, who have equipped them very thoroughly, several miles of railroad being included in the plant.

At Soldiers' Delight, Maryland, chrome ore was mined to the extent of 100 tons.

Production.—The amount of chrome ore used in the United States during 1885 was larger than that of the previous year, on account of increased capacity in the Philadelphia works. This might have caused increased production of ore in California but for importations from Russia and Turkey. The ore produced amounted to 2,700 tons, of which 750 tons came from Placer county; 600 from San Luis Obispo; 400 from Livermore, Alameda county; 850 from Del Norte county; and 100 tons from Baltimore county, Maryland. A summary of the production for the past four years is given below.

Production of chrome ore.

Years.	Tons of 2,240 pounds.	Value in California.
1882	2,500	$50,000
1883	3,000	60,000
1884	2,000	35,000
1885	2,700	40,000

Price.—The price of chrome ore varies according to the cost of transportation to a manufacturing center, so that no spot value can be given for it. In San Francisco it is worth about $15 per long ton, but this price is at the mercy of far-distant consumers. It is subject to all the fluctuations in the value of imported ores from Russia and Turkey. The price of ore delivered in Philadelphia or Baltimore was $26 during 1885. The price of potassium bichromate fell from 10½ cents per pound, in 1884, to 9⅞ cents in 1885.

Utilization.—Chrome iron ore is used for making chrome steel, sodium bichromate, and potassium bichromate. The amount of ore used for chrome steel is still about 50 tons a year. The manufacture of sodium bichromate increases in proportion as prejudice is removed. It has been imported from Germany; but in 1885, 500 tons made in Baltimore stopped the importation. It is probable that in future years potassium bichromate will be made from sodium bichromate, which involves less costly materials in its manufacture. The manufacture of potassium bichromate was increased in Philadelphia to about 900 tons, making the total production for the country about 2,000 short tons. Several patents for manufacturing ammonium bichromate have been taken out lately, and it has been made at the Baltimore works. The production since 1882 may be compared in the following table:

Production of potassium and sodium bichromate.

Years.	Potassium bichromate.	Sodium bichromate.
	Short tons.	*Short tons.*
1882	1,000	
1883	1,000	
1884	1,250	
1885	2,000	500

Imports.—The imports were larger than usual. They were principally from Russia and Asia Minor. The amounts are given below:

Chromate and bichromate of potash and chromic acid imported and entered for consumption in the United States, 1867 to 1885, inclusive.

Fiscal years ending June 30—	Chromate and bichromate of potash.		Chromic acid.		Chrome ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Long tons.* (*a*)		
1867	875,205	$88,787					$88,787
1868	777,855	68,634					68,634
1869	877,432	78,288		$3			78,291
1870	1,235,946	127,333		8			127,341
1871	2,170,473	223,529		5			223,534
1872	1,174,274	220,111	514	49			220,160
1873	1,121,357	178,472	922	276			178,748
1874	1,387,051	218,517	44	13			218,530
1875	1,417,812	183,424	45	22			183,446
1876	1,665,011	175,795	120	45			175,840
1877	2,471,669	264,392	13	10			264,402
1878	1,929,670	211,136	32	35			211,171
1879	2,624,403	221,151					221,151
1880	3,505,740	350,279	5	3			350,282
1881	4,404,237	402,088	124	89			402,177
1882	2,449,875	261,006	52	42			261,048
1883	1,990,140	208,681	290	338			209,019
1884	2,593,115	210,677		120			210,797
1885	1,448,539	92,556		39	(*b*)2,000	$55,000	147,595

a Not specified. *b* Commercial estimate.

Exports.—No exports of ore were reported during 1885. Formerly ore was exported in considerable quantity to England and Scotland, according to the following table:

Value of chrome ores exported from the United States, 1864 *to* 1883, *inclusive.*

Fiscal years ending June 30—	Value.
1864	$39,585
1865	19,078
1873	2,080
1874	4,288
1880	7,540
1882	1,548
1883	2,905
1884	(*a*)
1885	(*a*)

a None reported.

COBALT.

By David T. Day.

During 1885 the yield of cobalt increased by the development of the industry of the West. The mines of the Cottonwood district in Nevada, referred to in the last report, have been opened and worked upon an industrial scale. These mines are located in Churchill county, Nevada, in the Table Mountain range, about 45 miles southeast from Lovelock station on the Central Pacific railroad. The region is described by its discoverer, Mr. George Lovelock, as volcanic; the cobalt lies in chimneys and deposits in a mineral belt or ledge of varying width with walls of granite and porphyry. The ledge matter is an aluminous rock impregnated with iron oxides and iron pyrites; the latter also contains traces of cobalt and nickel. The ore deposits vary in size, some being very extensive, but no ores have been found outside the ledge. There are many cobalt and nickel minerals, but the bulk of the ore is black cobalt or "cobaltite," a compound of cobalt, arsenic, and sulphur, which should contain 35.5 per cent. cobalt, but always contains less since part is replaced by varying proportions of nickel, iron, and manganese, and occasionally by antimony. The average character of the ore is represented in the following analysis:

Analysis of cob ltite from Lovelock mines, Nevada.

	Per cent.
Cobalt	17.30
Nickel	13.62
Iron	8.65
Manganese	Trace.
Arsenic	39.37
Sulphur	16.72
Silica	4.02
Loss	.32
Total	100.00

Erythrite, or "cobalt bloom," and smaltite also frequently occur in the ore. There is also a peculiar substance, very soft and black, having the appearance of lampblack, which seems to be what is commonly known as "earthy ore of cobalt;" its composition is given by the following analysis:

Analysis of earthy cobalt from Lovelock mines, Nevada.

	Per cent.
Cobalt	29.03
Nickel	19.13
Manganese	22.82
Iron	6.23
Oxygen	18.20
Silica	4.32
Sulphur	Trace.
Arsenic	Trace.
Loss	.27
Total	100.00

Sometimes the oxygen is partly replaced by sulphur and arsenic, and cobalt and nickel by iron or manganese. A peculiar feature of this ore is that immediately upon exposure to the atmosphere it becomes heated from absorption of oxygen. The cobalt bloom is also quite rich in cobalt.

Analysis of cobalt bloom from Lovelock mines, Nevada.

	Per cent.
Cobalt	23.26
Nickel	4.38
Iron	1.28
Arsenic and oxygen	54.45
Silica	2.90
Water	13.02
Loss	.71
Total	100.00

Since the first opening of the mines in 1883, about 200 tons of ore have been shipped for reduction to England, of which 90 tons were shipped during 1885. The product of 1886 will probably exceed that of any previous year. The general average of the 200 tons shipped to England was said to have been 12 per cent. nickel and 14 per cent. cobalt. The method of working the ore has been to render it as free from gangue as possible, shipping the high-grade ore to England and retaining the low-grade ore at the mines for future treatment. At present there are no facilities for treating the ores at the mines. The erection of a furnace is contemplated, to reduce it to an arsenical speiss. Upon the erection of reduction works for the low-grade ores, the product will be greatly increased.

Great improvement in the production of cobalt has resulted at Mine La Motte, Missouri, from the process of working the ores into a speiss by the addition of arsenic, an improvement introduced by Mr. James W. Neill, E. M. This process was described in the report of 1883 and and 1884. It was then in the experimental stage, but has since proved signally successful, both financially and otherwise, and is now the standard method. The speiss now carries 16 per cent. nickel and cobalt, of which 8 per cent. is cobalt. Formerly the mattes contained only half as much cobalt as nickel. The production of nickel and cobalt has increased at this place.

At the Lancaster Gap nickel mine, in Lancaster county, Pennsylvania, cobalt is found as a very small percentage of the ore, but is regularly saved when working out the nickel at Mr. Joseph Wharton's works in Camden, New Jersey, resulting in a considerable production of cobalt oxide; in fact cobalt oxide is not produced elsewhere in the United States. The product of Mine La Motte, Missouri, and that of Nevada is shipped to England or Germany either in the form of speiss or of crude ore.

Arseniate of cobalt has been found in the Kelsey mine at Compton, Los Angeles county, California. Prof. William P. Blake obtained a specimen described by him as consisting of minute mammillary incrustations, showing, when broken, radial aggregations of silky, fibrous crystals. It is of a rosy-red color, also peach-blossom red. It occurs also in massive earthy aggregations, of small fibrous crystals of a rose-pink color. It is associated with an ore of silver and cobalt in dark-colored earthy masses. How much of this mineral exists at the above locality has not been ascertained, no work directed to that end having been done, though the samples obtained are said to have been of good quality.

Production.—Cobalt ores are changed into cobalt oxide before use, but this is only done in this country with the ore from the Lancaster Gap mine, at the American Nickel Works, Camden, New Jersey, where 8,423 pounds of cobalt oxide were made in 1885. Besides this, 90 long tons of ore, containing 14 per cent. cobalt, were exported from Nevada; this would yield 40,000 pounds of cobalt oxide. Further, 90 short tons of cobalt and nickel speiss were also exported. This speiss contained 8 per cent. cobalt, or enough to yield 20,300 pounds of cobalt oxide. Thus the actual production of cobalt in various forms was equivalent to 68,723 pounds of cobalt oxide. This serves to show the increase over previous years when the production was practically limited to the Pennsylvania mine.

Production of cobalt oxide in the United States.

Years.	Pounds.	Years.	Pounds.
1869	811	1878	4,508
1870	3,854	1879	4,376
1871	5,086	1880	7,251
1872	5,749	1881	8,280
1873	5,128	1882	11,653
1874	4,145	1883	1,096
1875	3,441	1884	2,000
1876	5,162	1885	8,423
1877	7,328		

While the above table represents practically all the cobalt oxide produced in former years, it no longer represents the total cobalt of all present mines. The entire production for 1885 and its value is given below:

Total production of cobalt ores and oxide during 1885.

	Pounds.	Value.
Cobalt oxide	8,423	$19,373
Cobalt ore from Nevada	201,600	31,500
Cobalt speiss from Mine La Motte	180,000	14,500
Total value	....	65,373

Value.—During 1885 the price of cobalt oxide fell from $2.55 per pound, in January, to $2.25 at the close of the year, averaging $2.30. The ore produced in Nevada should be worth, according to its analysis, about $35 per ton, delivered in San Francisco, although this price includes the value of the nickel also contained in the ore. The speiss is worth from $1 to $1.25 for every pound of cobalt in it. This makes the whole sum realized by cobalt mining $65,373. From this it is easily seen that the influence of the Nevada ores is being felt to a considerable extent.

Imports.—The cobalt oxide made at the American Nickel Works in Camden, New Jersey, is limited and does not supply the demand. It is therefore imported regularly from England and Germany, the imported material finding a ready sale from the habit of many consumers, of using only foreign oxide. However well this prejudice may have been founded on the superior quality of imported oxide in former days, it is stated on good authority that cobalt oxide of American make is, as a general rule, better than the greater portion of that imported; and the only foreign variety which can claim greater excellence is that manufactured by the Royal Saxon Works, and which is said to be practically pure. This has but a limited sale and would only be used in fine decorative work on porcelain, such as that produced at the Royal Dresden and Sevres works. The importations since 1868 are given below. It should be stated that an unknown proportion of that imported as "cobalt ore" contains arsenic and is used for fly papers, and hence has no significance as regards its cobalt.

Cobalt oxide and ore imported and entered for consumption in the United States, 1868 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Oxide.(*a*)		Ore.(*b*)		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1868	....	$7,208	....	....	$7,208
1869	....	2,330	....	....	2,330
1870	....	5,019	....	....	5,019
1871	....	2,766	....	....	2,766
1872	....	1,920	....	$72	1,992
1873	1,480	4,714	9,769	920	5,634
1874	1,404	5,500	3,798	612	6,112
1875	678	2,604	5,355	659	3,263
1876	4,440	11,180	6,9[illegible]8	962	12,142
1877	19,752	11,056	18,377	2,390	13,446
1878	2,860	8,693	20	1	8,694
1879	7,531	15,208	....	....	15,208
1880	9,819	18,457	2,424	108	18,565
1881	21,844	13,837	....	....	13,837
1882	17,758	12,764	3,102	367	13,131
1883	13,067	22,323	....	....	22,323
1884	25,963	43,611	....	....	43,611
1885	16,162	28,138	....	....	28,138

a Not enumerated until 1868. *b* Not enumerated until 1872.

The following table is interesting for comparing the American product with that of another country where the cobalt interests are large:

Production of cobalt and nickel in Hungary from 1864 *to* 1883, *inclusive.*

Years.	Metric tons.	Years.	Metric tons.
1864	620	1874	250
1865	570	1875	240
1866	430	1876	50
1867	650	1877	400
1868	530	1878	160
1869	570	1879	350
1870	440	1880	160
1871	450	1881	140
1872	380	1882	180
1873	390	1883	150

Utilization.—In addition to the ordinary use of cobalt oxide as a pigment, the use of metallic cobalt in certain alloys is increasing. It has been shown that an alloy, in which iron is the principal metal, can be made malleable and at the same time sufficiently fusible for casting by the addition of cobalt or nickel, or both. Another useful alloy consists of equal parts of cobalt and copper. It is valuable because easily worked, and yet of very great tensile strength.

TUNGSTEN.

BY DAVID T. DAY.

Several inquiries were made at the Lane and Booth mines at Munroe, Connecticut, for ores of tungsten to be used in hardening steel and for producing certain tungstates for use as pigments. No tungsten ores were mined, but at the close of the year the Booth mine was about to be put in operation again, solely for obtaining the tungsten ores.

Examples were given in the report for 1882 of the conflicting statements concerning the value of tungsten for hardening steel. The key to this question was furnished during the past year by L. Schneider, who showed in a paper in *Dingler's Polytechnisches Journal*, vol. 256, page 509, that when tungsten is added to iron containing considerable carbon (2 to 3 per cent.) it yields, on cooling, microscopic crystals containing about 60 per cent. tungsten. These are very hard and probably give the hardness to tungsten steel. If, however, they are not formed, and the tungsten remains distributed through the mass in an amorphous state, the steel is not hardened. But the crystals are only formed when the steel contains much carbon; hence it is not always possible to produce hard tungsten steel, and it will usually be brittle. Since the hard crystals are only mixed mechanically through the steel, it will require a considerable percentage of tungsten to produce much hardening. It has been shown also that iron alloyed with tungsten withstands the rusting action of the air better than ordinary iron or steel.

PLATINUM AND IRIDIUM.

It is claimed by Mr. J. H. Fisk, of Portland, Oregon, that 100 ounces of crude platinum sand were produced near Randolph at the mouth of the Coynill river, in Coos county, Oregon, in connection with gold washings. In addition to this, enough crude platinum was saved by gold miners in California to make the total production of platinum sand for the year 250 troy ounces, valued at $187.50. This is in addition to the platinum in iridosmine, for which there is a regular demand to the extent of 300 ounces annually. It is probable that much platinum which is now wasted every year would be saved if a refinery for the metal was established in this country.

New localities.—Platinum and iridium occur together in many of the gold mines of the Pacific coast. In addition to the localities mentioned in the last report platinum has been found in notable proportions in slate at a point known as McKenzie's Bridge, on the McKenzie river, Lane county, Oregon. It is also found in limited amount in all the black sand mines along the coast north as far as Gray's Harbor, in Wyoming Territory, and in the gold mines on the Colville Indian reservation. Mr. Fisk states that he has just received a package of platinum dust from Granite creek, British Columbia. No new occurrences of iridosmine have been noted during the year. It should be stated, however, that the crude platinum from Oregon contains iridosmine, according to the following analysis by Mr. J. H. Fisk:

Analysis of crude platinum from Oregon.

	Per cent.
Platinum	52.00
Gold	.35
Iridosmine	37.50
Iron	5.00
Copper	2.40
Sand	2.50
Total	99.75

Foreign sources.—The principal supply of platinum still comes from the Russian mines in the Ural mountains; this is refined chiefly in England. The production of these mines is well described in an article in the *Russkie Wedomosti*, of which the following is condensed from the *Chemiker Zeitung:*

The difficulties in manufacturing platinum which have existed till lately have now been almost entirely overcome. Although the platinum utensils exhibited at the last Paris exposition came from foreign, particularly English, workshops, yet the increase in the use of the metal was very evident. In the Moscow exhibition the production of platinum was represented by only two Russian firms. P. P. Demidow, prince of San Donato, exhibited native platinum and platinum plate. In 1875 the firm of Kolbe & Lindfors was established in St. Petersburg to manufacture platinum utensils of all kinds, but their ware was not equal to the English. The firm, with fifteen to twenty workmen, produced platinum ware to the amount of 300,000 rubles, which was used principally in Russia. For the last sixty years the production of platinum has been limited to districts of Goroblogodat and Nishni-Tagilsk. Grains of platinum are found in other districts, but the mining of them has been given up entirely. The following is a table of production from 1827 to 1881, inclusive:

Production of platinum ores in Russia.

Years.	Pounds avoirdupois.	Years.	Pounds avoirdupois.
Previous to 1827	600	1870	3,864
1827 to 1842, inclusive	54,000	1871	4,096
1843	7,560	1872	3,044
1844 to 1861, inclusive	24,480	1873	3,146
1862	5,113	1874	3,986
1863	1,082	1875	3,080
1864	872	1876	3,146
1865	4,997	1877	3,440
1866		1878	4,128
1867		1879	4,520
1868	3,570	1880	5,876
1869		1881	5,956

It is seen that the production in the last few years has increased markedly on account of greater inquiry for the wares, and the price has risen also. The 5,956 pounds produced in 1881, came largely from Nishni-Tagilsk (2,456 pounds). Kresto Wosdwishensk produced 886 pounds; Werchotursk 1,508 pounds and 1,048 pounds mixed with gold; and Bogoslaw 752 pounds. It is expected the production will soon extend to other districts. Until 1877 the production was almost entirely by private parties. In 1861 the government only mined 128 pounds. The proportion in subsequent years is not given.

Imports.—The platinum ware sold in this country is principally made from "flat stock," that is, platinum in the form of sheets or thick wire imported from England. Manufactured utensils are occasionally imported from France. The following imports, therefore, represent the total consumption of platinum in this country, for the slight domestic product is exported to England to be refined.

Platinum imported and entered for consumption in the United States, 1867 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Manufactured.	Unmanufactured.		Vases or retorts, etc.
		Quantity.	Value.	
		Pounds.		
1867	$456	....	....	....
1868	290	....	$95,208	$20,274
1869	184	....	80,014	22,004
1870	648	....	99,984	16,294
1871	48	....	108,244	22,470
1872	310	....	91,472	21,816
1873	43	....	90,771	9
1874	143	....	123,293	59,698
1875	173	....	141,188	18,082
1876	6	....	141,207	7,421
1877	11	....	81,925	18,611
1878	241	....	120,121	50,133
1879	73	....	166,178	34,209
1880	964	....	217,144	41,827
1881	290	....	273,343	21,292
1882	1,731	3,125.60	285,731	48,452
1883	4	3,104.15	298,799	92,967
1884	None.	2,846.00	289,898	83,112
1885	3	2,612.34	285,239	17,473

Exports.—There is a demand from England for "scrap" platinum to which the United States contributes by exporting some worn-out utensils to be repaired and reimported. A portion of these exports also go to France. The following table gives the exports from 1880 to 1885, inclusive:

Value of platinum exports.

Fiscal years ending June 30—	Unmanufactured.	Manufactured.	Old platinum.
1880	....	....	$600
1881	....	....	4,222
1882	....	$19,244	....
1883	$6,250	21,600	....
1884	....	18,587	1,130
1885	....	....	7,000

In addition to a small domestic production of iridosmine, the following amounts of iridium were imported at a value of $20 per troy ounce for the American Iridium Company for uses which were described in detail in the last report:

Iridium imported and entered for consumption in the United States, 1873 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Value.
1873	$429
1874	275
1875	500
1876	180
1877	311
1879	425
1881	1,730
1882	7,307
1883	495
1884	(*a*)
1885	5,852

a None reported.

TIN.

American tin.—At the close of 1884 there was a prospect that the production of American tin might become an established industry in the year to follow. The purchase of the Etta mine in the Black Hills of Dakota by eastern capitalists, and plans for a concentrating plant, contributed largely to this opinion and led to much prospecting throughout the region from which tin has been reported. But the entire year passed by in this preparatory work without the production of tin, except experimentally. A large mill, capable of handling 100 tons of ore daily, was constructed at the Etta mine, and at the close of the year the outlook justified the very sanguine reports of the local press, but in March of 1886 the actual tests of the ore began by means of the mill. According to the most reliable statements the mill consumed in all about 400 tons of ore, containing perhaps 7 tons of tin. Much of the ore milled was scarcely more than waste rock, which did not yield one-half per cent. of tin. It is very probable that this is not a fair test of the mine, which needs further opening, and it was for this purpose that the mill stopped operations in May, 1886.

The prospecting has been very active, both in the Harney Peak region and near Custer City, resulting in the addition of a large number of new claims, all of which await the tests of concentration on a large scale. This prospecting has been limited to the neighborhood of well-known claims, so that the general field has not been extended nor any accurate information obtained beyond the scope of the last report.

In the Nigger Hill district, Wyoming, many new claims have been worked over by engineers, and some have proved promising as far as they have been developed. The Molitor-Trebor group of claims has shown the following percentage yield of tin:

Assays of tin ore from Wyoming.

	Per cent.
Swansea, Nos. 3 and 4	2
Grand Deposit	1
Connection	$1\frac{8}{10}$
Congress	$\frac{1}{8}$
Valley View	$3\frac{1}{4}$
Chicago	$\frac{1}{4}$
Montana	$\frac{1}{8}$
November	$\frac{3}{4}$
Yankee	$1\frac{3}{10}$
Yankee, sample No. 2	$\frac{1}{4}$
Uncle Sam	$5\frac{38}{100}$
Uncle Sam, sample No. 2	$5\frac{7}{10}$
Grey Eagle	$2\frac{4}{10}$

These claims are located on three veins, one of which has been traced 5,600 feet. This has been developed by an open cut 35 feet long, crossing the vein at right angles, and by a shaft about 10 feet deep. The assay of specimens from this claim shows 5 per cent. of tin; the claim is promising. The development of the other claims has been very slight. The Montana Tin Mining company is actively pushing a claim 12 miles east of Dillon in that State.

Mr. Hotchkiss has recently visited and personally examined the tin-bearing region near the head of Irish creek, Rockbridge county, Virginia, and submitted the following report of his observations and conclusions to the president of the Lexington Tin company.

"The tin field is located in a small area, in the eastern part of Rockbridge county, Virginia. The region is very accessible from nearly all directions.

"The Irish Creek area within which tin ore has been found is about 3 miles wide from northwest to southeast, and about 4 miles long from northeast to southwest, and therefore embraces some 12 square miles of territory. It is near three lines of railways. To the Shenandoah Valley railroad the air-line distance is but 3 miles, and the distance by the valley of Irish creek, following that stream, is about 10 miles. To the Valley branch of the Baltimore and Ohio railroad the air-line distance is 6½ miles; and to the Richmond and Allegheny railway 11 miles.

"The tin ore of this region is found in the form of crystals, threads, or strings, and in masses of varying size, disseminated in fissure veins traversing, in all directions, the granitic and other Archæan rocks that here constitute the crest and the immediate westerly slopes of the Blue Ridge, and that disappear beneath the Potsdam rocks 1 or 2 miles to the northwest of the tin-bearing field.

"The tests to prove the existence of these ores were made by sinking, driving, or cutting pits, trenches, shafts or tunnels, at the points indicated, as hereinafter described in detail, mainly in a territory about 1½ miles long and 1¼ miles wide. At other points, outside of this territory, the existence of tin ore has been proved. The character of these test works and of the ore found at each, and therefore the present condition of information about these tin ores, based on what has been actually ascertained about them, can best be learned by a brief statement about each of these trial works.

"No. 1. This is known as the "Cash No. 1 Mine," as it is at the point on the Cash land where tin ore was first found in this region. This is an open cut about 60 feet long and from 3 to 10 feet deep, driven into the base of the spur of Cash mountain a few feet above the level of Painter branch. The tin-bearing vein here has an average thickness of about 84 inches; this consists of tin-stone disseminated in small grains and small pockety masses throughout a gangue of quartzose and micaceous rock that can be easily mined and crushed, and next to the wall, a persistent vein of solid tin-stone, or cassiterite, that averages one inch in thickness, and is sometimes 6 inches thick. Several branchings of veins from the main one, penetrating the crevices of the adjacent rocks, have also been discovered here. Portions of this large vein are occupied by masses of quartz rock.

"Professor Campbell sampled 72 inches of the thickness of this vein, including the wall rock involved with the ore, and found it to contain 66 pounds of metallic tin to the ton. Mr. McCreath analyzed a sample of this ore selected by Mr. Rittenhouse 'representing all grades, from pure tin crystals to quartz and rock containing little or no tin,' and found in it an average of 3.160 per cent. of metallic tin. The cassiterite will yield, by itself, from 65 to 70 per cent. of metallic tin.

"No. 2 embraces four openings; the second opening is a shaft 40 feet deep, said to include a vein of tin ore that is 36 inches thick at the surface and 120 inches thick in the bottom of the shaft where sinking was suspended. Mr. Cabell Whitehead found in an average sample of the ore of this vein, representing its whole thickness, after repeated assays, an average of 5 per cent. of metallic tin, or from 125 to 130 pounds of tin to the ton of ore. Professor Campbell made the percentage larger.

"About 3,000 pounds of the ore from this shaft were sent to England as a trial lot; the purchaser reported a considerable yield of metallic tin. I requested Mr. Massie, who selected the ore for that shipment, to sample the ore lying scattered around this shaft for me, so as to give me what would fairly represent the ore that was shipped to England. I witnessed the sampling, and am satisfied that it was fairly done. This sample of several pieces I submitted to Dr. Frank W. Traphagen, analytical and consulting chemist of the Staunton Male Academy, and he found in it, after repeating his analysis, 17.54 per cent. of binoxide of tin, or 13.79 per cent. of metallic tin. Nodules of cassiterite, from small sizes up to some 12 inches in diameter, have been found in this vein; there is no question about its richness. This shaft is on the slope of Painter mountain, and more than 400 feet above the level of Irish creek at the foot of the mountain to the north. No. 2*a* is a pit uncovering a large bowlder of quartz that is veined with crystals of tinstone; that will probably yield as well as the vein at the shaft, or No. 2, which is 70 feet above this in altitude, the intermediate ground being strewn with tin ore. No. 2*b* is an open drift, at a level 90 feet below No. 2, cut for 60 feet into the slope of the mountain, ending there about 15 feet deep, where a vein of tin ore, apparently averaging with that at No. 2, had been cut and found 108 inches thick. No. 2*c* is a trench on a tin-ore vein of about the same character as the preceding.

"No. 3 is some 500 feet above the level of the creek opposite, is a long trench, about 6 feet deep, exposing some 10 feet of a vein of tin stone that is 48 inches thick. An average sample of this ore, assayed by Prof. H. D. Campbell, yielded 0.292 per cent. of metallic tin; a sample assayed by Prof. M. B. Hardin, at Virginia Male Institute, yielded 0.41 per cent. A quartz vein is exposed near this, resembling the one near No. 2. Traces of ore extend from this to No. 2.

"No. 4 is a shallow cut, about 1 foot deep, exposing a tin vein 12 inches thick that yielded 0.19 per cent. when assayed by Prof. M. B. Hardin.

"No. 5 consists of three pits connected by a trench. The tin vein in the middle pit is 18 inches thick; samples from this yielded 5 per cent. metallic tin in an analysis by Professor Hardin. A sample from the upper cut, or pit, an average of the ore from 6 feet of length of vein, gave 0.799 per cent. of binoxide of tin on analysis by Prof. H. D. Campbell. In the upper cut the vein is one-half inch thick at the depth of 10 feet; it becomes thicker as it goes down, and will average 7 inches. A good many crystals of tinstone are found here.

No. 6 is a pit exposing a vein 12 inches thick; it widens in going down. An average sample yielded 0.28 per cent. of metallic tin as analyzed by Professor Hardin.

No. 7 is a pit showing a vein 18 inches thick; it is much like No. 6, but poorer.

No. 8 is a pit showing a vein 36 inches thick of lean ore.

No. 9 is a pit showing vein 4 inches thick; ore not assayed.

No. 10 is a shaft 40 feet deep, sunk on a vein 36 inches thick. A sample taken at the depth of 3 feet, before the shaft was sunk, representing an average of the exposed vein, yielded 1.12 per cent. of metallic tin to an assay by Dr. Dabney, of North Carolina; at a depth of 10 feet, 2 per cent. of cassiterite was found in an assay of the vein by Mr. A. D. Robertson. This vein is in trap rock. Three or four threads of ore come together in the bottom of the shaft.

No. 11 is a pit exposing a vein 43 inches thick containing a trace of tin.

No. 12 exposes a vein 12 inches thick containing a trace of tin.

No. 13 exposes a vein 8 inches thick containing a trace of tin.

No. 14 is a vein 48 inches thick of lean ore between trap and granite.

No. 15 is a trench exposing a 6-inch vein in quartz in which crystals of tinstone are found.

No. 16 is a tunnel in rotten granite 30 feet long, cutting a vein of lean ore from 3 to 12 inches thick.

Nos. 17, 18, 19, and 20 are pits exposing a 6-inch vein of lean ore.

No. 21 is a tunnel driven in rotten granite some 60 feet along an 18-inch vein. Professor Hardin assayed picked samples from this vein and obtained 3¼ per cent. of metallic tin. Professor Campbell assayed a sample, averaging 25 feet of the length of the vein, and obtained 0.582 per cent. of metallic tin. In a pit sunk above this tunnel this vein is also 18 inches thick.

No. 22 is a vein exposed by the roadside that is from 3 to 4 inches thick in solid rock; it is regarded as an offshoot thread from No. 21.

No. 23 is a pit and a short tunnel on a lean 10-inch vein.

No. 24 consists of two parallel veins about 10 feet apart, from 3 to 6 inches thick, which meet No. 25; this ore assays next to that of No. 21.

No. 25 is a vein about 12 inches thick, which crosses and dips towards No. 24; it assays about 0.25 per cent.

No. 26 is a tunnel about 30 feet long in a vein 24 inches thick in places; this assays 0.10 per cent.

No. 27 is a pit exposing two parallel veins about 6 feet apart, one 4 to 6 inches and the other 12 inches thick of lean ore.

No. 28 is a pit exposing a 24-inch vein of lean ore.

No. 29 is a drift cut some 30 feet long and over 30 feet deep at the end, exposing a vein of lean ore averaging 24 inches thick. Assays 0.10 per cent. This vein has been exposed for 400 yards, to the top of the mountain, where it is 120 inches thick; in places in the drift below it is 240 inches thick. The tinstone here is associated with quartz and iron pyrites. It is believed that this and Nos. 30, 31, and 32 will finally come together.

No. 30 is a vein 12 inches thick in very hard rock; an assay of a sample gave 1 per cent., but the average will be less.

No. 31 is a vein averaging 24 inches in thickness (36 in places). Professor Hardin obtained 0.17 per cent. of tin from an average of the whole vein. It also carries $1.86 of gold to the ton.

No. 32 is a vein 48 inches thick, averaging in richness between Nos. 30 and 31.

Nos. 33 and 34 are cuts on a quartz and pyrites vein containing traces of tin.

No. 35 is an outcrop of veins from which an 8-inch cubic block of crystals of tin stone was obtained. Not opened as yet.

No. 36 is a quartz vein 60 inches thick that yielded an average of 0.12 per cent. of metallic tin to assay of Mr. A. D. Robertson.

No. 37 is a vein 36 inches thick, on Mount Nettle, some 1,200 feet above Irish creek, in micaceous granite.

No. 38 is a 10-inch quartz vein containing iron pyrites and a trace of tin.

In the above notes the measurements of Messrs. Winslow and Robertson have been accepted and used, and the assays of Messrs. McCreath, Campbell, etc., as reported in published articles and as furnished to Mr. Robertson.

"The forty odd testing pits, trenches, shafts, tunnels, etc., above mentioned, are distributed over a territory nearly 10 miles wide and 4 miles long in the north and middle spurs, Mount Maria, Cash mountain, Painter mountain, Mount Elizabeth, Little Hill and Big Hill, and Mount Nettle, all spurs of the Blue Ridge projecting between the northeasterly and the easterly head branches of Irish creek. In all of these more or less metallic tin has been found, ranging from "traces" up to 70 per cent. Those that have been assayed may be recapitulated as follows:

No. 1, 0.292 to 65 or 70 per cent., 66 pounds to the ton average.

No. 2, 5 to 13.79 per cent., 125 to 130 pounds to the ton.

No. 3, 0.292 to 0.41 per cent.

No. 4, 0.19 per cent.

No. 5, 0.799; 17.58 pounds of "black" tin to the ton.

No. 6, 0.28 per cent.

No. 10, 1.12 to 2 per cent., 35 pounds of "black" tin to the ton.

No. 21, 0.582 to 3.25 per cent., 18 pounds of "black" tin to the ton.

No. 25, 0.25 per cent.

No. 26, 0.1 per cent.

No. 29, 0.1 per cent.

No. 31, 0.17 per cent. of tin and $1.86 of gold to the ton.

No. 36, 0.12 per cent.

The localities of the above and the per cents. of tin are:

No. 1, on Cash mountain, 31.60 to 70 per cent.

Nos. 2 and 3, on Painter mountain, 0.292, 0.41, 13.70 per cent.

Nos. 4 and 5, on Mount Elizabeth, 0.19, 0.799 per cent.

No. 6, on Little mountain, or hill, 0.28 per cent.

No. 10, on Big Hill, 1.12, 2 per cent.

Nos. 21, 25, 26, 29, and 31, on Mount Maria, 0.17, 0.25, 0.582, 0.1, and 3.25.

No. 36, on North Spur, 0.12 per cent.

"Omitting from the above the deposit on Cash and Painter mountains, assays Nos. 1, 2, and 3, the averages of yields from the other localities do not vary greatly among themselves, showing that these ores range in richness from 0.1 to 3.25 per cent.; the eleven assays of these localities averaging 0.805 per cent., or nearly 18 pounds of "black" tin to the ton. I see no reason why an abundance of ore should not be had from these, Mount Elizabeth, Little mountain, Big Hill, Mount Maria, and North Spur veins, that will yield this average result.

"The assays of the Cash and the Painter mountain ores range in richness from 0.292 to about 70 per cent., making an average for the five given of 23.218 per cent. This is probably too high an average for all the well-picked tin stone that could be obtained from these localities; and yet it would not, in my opinion, be very difficult to obtain from them a large quantity of ore that would run such an average. The prospecting that has been done, the condition of the veins as exposed, and their richness in metallic tin, I think, warrant the conclusion that an abundance of high-grade ore can readily be obtained from these localities.

"While the developments that have been made here are by no means extensive, and are not such as one would like to see, still they cover a very considerable area and fairly well expose the tin veins at moderate depths from the surface, and so that their character can be seen very well. More than this, the openings that have been made are so located as actually to expose to inspection fully 600 feet of the vertical depth of the tin veins of this region, some of them having been made near the level of Irish creek and others near the top of the spurs more than 600 feet above that level; horizontally these openings are many of them but a short distance apart, consequently it is fair to say that we have here, in this deeply and steeply eroded or naturally trenched region, the equivalent of shafts of varying depths, up to over 600 feet in a level country. For example, numbers 1 and 2 are but 1,600 feet apart horizontally, and yet they are over 300 feet apart vertically. It is considered that from these two and their surroundings there are nearly the same data for conclusion as would be obtained if the shaft at No. 2 were sunk to a depth of 320 feet. The same may be said of the other localities where the tin ore has been exposed. This knowledge has led me to the favorable conclusion above expressed in reference to the quantity and the quality of these ores.

"The geological and mineralogical conditions of the Irish Creek tin-bearing region are similar to, if not even identical with, those of the Cornwall (England) and other noted tin-producing districts. There are the same crystalline and metamorphic rocks, broken, fissured, and faulted by dikes of trap, basalt, and other igneous rocks, thus furnishing similar conditions for the formation of true, profitable, metalliferous, fissure veins, such as are caused by profound movements of the earth's crust—just such veins as those in which stanniferous ores of the Irish Creek district are found.

"The exposure of the Irish Creek tin veins, both natural and artificial, unmistakably leads to the conclusion that these veins compare in general character, extent, thickness, and richness in metallic tin, most favorably with those of the famous Cornwall district of England, while the mining conditions are better. I may add that no region can offer superior advantages for extensive mining and metallurgical operations; the climate is all the year round salubrious and favorable for work; the Blue Ridge proper of Virginia, unlike most mountain chains, is a very garden of fertility and varied productiveness, and the same may be said of Piedmont, Virginia, that flanks it on the east, and of the famous limestone valley that flanks it on the west. The forests of this region can be depended on for charcoal, and it is not far by direct railway to the best metal working and coking coals in the United States."

In conclusion, this report is emphasized by the opinion that this Irish Creek tin-bearing district, as above described, will prove abundantly productive in tin.

Foreign sources of tin.—The association of Cornwall, England, with the production of tin, and the enormous manufacture of tin plate in England, have led to popular reference to England as the principal source of that metal by the large majority of people outside of the trade.

although such expressions as "Banca," "Billiton," and "Straits" tin are trade acknowledgments of other important sources which contribute to the world's supply. Any one of these sources contributes as largely as England, and the whole production is derived from New South Wales, Queensland, Tasmania, the Straits Settlements, the Dutch East Indies, as well as from England. Occasional shipments are made also from Spain, Portugal, France, and South America.

The production from these sources is summarized by Messrs. Vivian, Younger and Bond, of London, in the following table:

	1880.	1881.	1882.	1883.	1884.	1885.
Total exports from Singapore and Penang:	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
To Great Britain, Europe, and America	11,908	11,216	12,104	17,145	17,547	17,182
To India and China	2,855	3,519	3,870	4,161	4,920	3,887
	14,763	14,735	15,974	21,306	22,467	21,069
Total exports from Australia to Europe and America	9,100	10,200	10,300	10,500	8,800	8,500
Total production in the United Kingdom	8,918	8,615	9,158	9,307	9,574	(*a*)9,000
Totals	32,781	33,550	35,432	41,113	40,841	38,569
Total visible supply December 31	22,248	19,241	17,924	19,263	16,774	16,116

a Estimated.

In England the low price of tin at the close of 1884 led to much discussion as to the possibility of reducing the cost of producing tin in Cornwall, and gave rise to a very valuable treatise on the Cornish system of dressing tin ores, by Mr. R. J. Frechville. The main principle in dressing these ores consists in crushing the tin-bearing rock by stamping, and obtaining therefrom 2 to 3 per cent. of cassiterite by washing off the lighter rock with large streams of water. The fact that the settlings from streams so used are sufficient to support plants for working them at intervals between the mines and the mouths of the stream, has given rise to many statements as to the wasteful character of this method of ore dressing, and the following extracts from Mr. Frechville's paper bear on the point and give to those interested in similar systems of mining many interesting facts from Cornwall:

That the loss by the processes to which the "tin stuff" is subjected at the mines is very considerable, is proved by the fact that, during 1884, 1,326 tons of black tin, sold to the smelters for £41,055, were obtained from the tin streams in the parishes of Camborne, Illogan, and Redruth alone, and the dressing operations carried on at Gwithian and Portreath beaches plainly indicate that even then the sands and slimes escaping from the mines were not perfectly untinned.

"Many imagine that the stream works that furnished the above quantity of black tin are all situated on the Red river. This is not the case. There are two separate and distinct rivers fed by the discharge from the dressing floors of two separate and distinct groups of mines. One of these rivers, which is called for the sake of distinction the Redruth river, flows along the southern base and eastern flank of Carn

Brea Hill, passes to the west of Redruth, by the east of the Wheal Agar stamps, and then continues its course northward to the sea at Portreath. The mines that contribute to it are West Basset, Wheal Basset, Wheal Uny, Wheal Agar, etc. During 1884, 172 tons of black tin, which realized £6,039, were obtained from it. The remaining and by far the most important stream, known as the Red river, which I take as an example in working out the problem before me, rises in Bolenowe Moor, to the south of Carn Brea Hill, and runs clear until it is joined by the water from the dressing floors of South and West Frances mines; it then flows northward between Carn Entral and Carn Arthen, through Brea and Tuckingmill to Roscroggan, at which place it turns to the west, and continues on this course through Reskadinnick, Coombe, Menadarva, and Reskajeage to the beach at Gwithian, where it empties into St. Ives bay. As far as Coombe, it forms practically the boundary between Camborne and Illogan parishes. From source to mouth its length is between 7 and 8 miles, and over this distance the various stream works succeed each other almost without intermission, and produced during 1884, 1,154 tons of black tin, which sold for £35,016.

"With respect to the quantity of sands and slimes from which the above amount of black tin was obtained, the following table gives for 1884 the names of the mines that discharged the waste from their dressing floors into the Red river, the number of tons of tin stuff of 21 cwts., dry weight, stamped and dressed at each mine, the black tin obtained therefrom in statute tons, and the value of the same:

Statistics of mines discharging the waste from their dressing floors into the Red river in 1884.

Mines.	Number of tons of "tin stuff" of 21 cwt. each, stamped and dressed.	Black tin obtained, in statute tons.	Value of ore at the mine.
West Basset (old stamps)	2,000	30	£1,273
West Frances	9,360	394	17,849
South Frances	15,000	434	19,861
South Condurrow	28,361	546	26,032
Wheal Grenville	19,227	463	22,174
Cook's Kitchen	12,312	178	8,035
Dolcoath	66,300	2,423	113,965
South Crofty	8,673	169	7,143
East Pool	45,982	1,573	69,343
Tincroft	29,930	456	19,705
Carn Brea	44,858	464	20,247
West Seton	10,650	204	9,238
Total	287,653	7,332	334,865

"It is the custom to reckon the ton of tin stuff as 21 cwts. dry weight; in addition, an allowance for water varying from 1 to 2 cwts. is made, so that the ton of tin stuff delivered to the dresser actually weighs from 22 to 23 cwts. In the assay of the samples, the black tin is calculated for the ton of 20 cwts., and is weighed dry, whereas the dresser returns the black tin moist, containing, on the average, 7½ per cent. water. All this is so strongly in favor of the dresser that there is no difficulty in understanding how he manages to return as much black tin as the stock book shows, and occasionally even more. Reducing the total number of tons stamped to statute tons, for the sake of dealing with uniform weights, and deducting from these statute tons the black tin obtained at the mines, as well as an estimated amount of 10,000 tons of sand, placed on the burrows at Tincroft, owing to a lack of water to carry it away from the floors, we get 284,703 statute tons as the quantity of sands and slimes that were discharged into the Red river—thus:

287,653 tons of 21 cwts.=302,035 statute tons.
302,035—7,332 —10,000=284,703 statute tons.

Subtracting from these latter figures the 1,154 tons of black tin returned from the Red river, gives 283,549 tons as the quantity of sands and slimes emptied into St. Ives bay. In order to estimate the total contents in black tin of the ore stamped and dressed at the mines, it is necessary to know how much escaped and was irrecoverably lost in these 283,549 tons. To ascertain this, samples of the flow of the river were taken from a point below the last stream works at different dates extending over the whole of 1884. These samples were taken by lowering buckets to the bottom of the stream, instantly pulling them up again, and then allowing the contents ample time to settle before pouring off the water. In this way sixty samples were collected and were assayed by Capt. John Moyle, of South Condurrow mine. These assays gave results varying from a trace up to 2¾ pounds black tin per ton of stuff. A produce of 1½ pounds per ton would be a fair average of the lot, so that the quantity of black tin carried into St. Ives bay by the 283,549 tons of sands and slimes discharged therein by the Red river during 1884 amounted to no less than 190 tons.

"The actual contents in black tin of the 302,035 statute tons of tin stuff stamped and dressed at the mines, as well as its market value, and the average price per ton realized for both mine and stream tin ore can now be computed thus:

Contents of tin stuff from Red river mine, Cornwall.

	Statute tons.	Price.	Average price per ton.
			£ s. d.
Black tin obtained at the mines	7,332	£334,865	45 13 5
Black tin obtained from the stream works	1,154	35,016	30 6 10
Black tin locked up in 10,000 tons of sand on Tincroft burrows (estimated value at £40 per ton)	14	560	....
Black tin finally lost in St. Ives bay (estimated value at average price of stream tin ore)	190	5,765	....
Totals	8,690	376,206	....

From the above, it appears that the tin stuff originally contained 64.44 pounds of black tin per statute ton. Of this amount, 54.37 pounds, or 84.37 per cent., was saved at the mines; 8.55 pounds, or 13.27 per cent., by the stream works; 0.11 pound, or 0.17 per cent., remains locked up in Tincroft burrows; and 1.41 pounds, or 2.19 per cent., was lost in the sea. It must, however, be taken into consideration that the black tin obtained from the stream works is not of the same value as that obtained at the mines. During 1884 the average produce in metal of the latter was 66 per cent., and of the former 53 per cent. only; so that it is more correct to make the above caculations on the basis of the market value of the ore. Thus, of the £376,206 worth of black tin contained in the tin stuff dressed, £334,865, or 89 per cent., is to be credited to the mines; £35,016, or 9.3 per cent., to the stream works; and the remainder, £6,325, or 1.7 per cent., constitutes the loss. All who have a practical knowledge of ore dressing must admit that the saving by the mines of 89 per cent. of the value of the stuff treated is a very good result indeed—in fact, much better than had been anticipated when this inquiry was commenced. Nevertheless, it is believed that it is possible in some slight degree to increase the efficiency of the process.

"*The cost of ore dressing.*—Having gone very carefully into this matter at two of the leading mines, it is found that, including every charge from the time that the tin stuff is delivered to the stamps until the ore is ready to be sent to the smelters, the cost amounts to 5*s.* per ton of tin stuff dressed. This includes a charge for repairing the floors, but not for depreciation in value of machinery. Adding 2*d.* per ton for this item, would make the total cost 5*s.* 2*d.* per ton. This is the weak part of the process. The cost, owing to the large amount of manual labor employed, is too high, and, in these days of improved machinery of all descriptions, should most certainly be reduced. During 1884 the mines that contributed to the Red river employed 4,725 persons; of these, 2,571 worked at the surface and 2,154 underground. Of the surface hands, 75 per cent., or 1,928 persons, were engaged on the dressing floors. Labor is cheap and plentiful in Cornwall, so that there is not the same necessity that exists in some other countries, the United States, for instance, of introducing automatically working machinery; but the employment of such an excessive amount of manual labor is an abuse of the advantages, and not in keeping with the scientific progress of the age.

"The system of dressing is of native growth, and naturally in many ways eminently suitable to local conditions; but it is thought certain details and appliances can be grafted on to it that will tend both to increase its efficiency and diminish its cost. In this connection the following suggestions occur:

"In the first place, as pointed out by Capt. William Rich, in a paper read before the Mining Institute, constant assays should be made by an independent man of the sands and slimes leaving the floors. This would act as a check on the dressers. An abundance of clear water is essential for good dressing; unfortunately the supply is deficient at the richest tin mines. Could it not, however, be supplemented by constructing reservoirs in suitable localities? Blake's stone breakers, although excellent and well-proved machines, are not nearly in such common use in the county as they should be; too much reliance is still placed on the muscular arms of the maidens. There can be no doubt but that great economy in stamping would result from the employment of Husband's oscillating cylinder-stamps.

The treatment of the stamped stuff should invariably be preceded by classification; that is, not only should the slime be separated from the sand, but the latter should be sorted according to the different sizes and weight of the grains. For this purpose funnel or pointed boxes are very suitable; if with an upward current of water, like those in use at Wheal Grenville, so much the better. They can be arranged so that each box delivers a certain size of grains to the buddles or other dressing machines employed, while the slimes flow over the end of the last box, and can be carried directly to the slime dressers or frames. Taking into consideration the fineness to which the stuff is reduced by the stamps, a division into three classes, namely, sands, middle fine sands, and slimes, would be amply sufficient. When the stuff is discharged from the stamps directly into a buddle, as is the practice at many of the mines, much of the slime tin passes to the tail, and not being saved by the subsequent operations to which this is subjected, finds its way into the Red river. As the "strips" that used to be universally used in front of the stamps to a certain extent classified the ore, their abandonment is decidedly a retrograde step in dressing. These "strips" are, however, by no means to be compared in efficiency with the pointed boxes, and besides the stuff deposited in them has to be shoveled out by hand, while from the pointed boxes it is delivered without expense and at any point required. At all of the mines, separators for classifying the stuff are employed below the slime pits. Ask any of the dressers why they use them, and they will answer, it is because they find it impossible to obtain good results by dressing the sand and slime together; yet to judge by their practice, one would imagine that directly in front of the stamps they believe the laws of specific gravity to be suspended. For the treatment of the coarser sand delivered by the pointed boxes, is recommended the employment of Rittinger's double side blow percussion table, a description and drawings of which are contained in a paper by Mr. Frechville, "On the Mining and Treatment of Gold Ores in the North of Japan," published in volume 75 of the "Minutes of Proceedings of the Institution of Civil Engineers." The table is perfectly automatic in its action, and would give three products, namely, ore fit to be sent to the calciner, ore associated with vein stuff for the pulverizers, and valueless waste. It is the best continuous working machine yet invented for dealing with the coarser portions of stamp work. Borlase's buddle is well adapted for the middle fine sands, and for dressing the slimes the Cornish frame is an excellent appliance, especially when carefully constructed and arranged like those to be seen in the stream works of Mr. John Williams, at Tuckingmill.

A great deal has been said of late years about the wonderful results that would be obtained if jiggers were used in dressing the tin stuff. With the object of ascertaining whether these assertions are well founded, samples of the stuff were taken at several mines just as it passed through the stamp grates, which in each case were of the size known as No. 36, the perforations of which are 0.028 of an inch in diameter. These samples were dried, weighed, and assayed. They were then sifted through a sieve with eighty holes to the linear inch. The portion that remained on the sieve and the portion that passed through were carefully weighed and assayed, the former being assayed without bruising or pulverizing as well as with bruising, the contention being that the extra amount of tin ore washed out after bruising is inclosed in particles of gangue, and would mostly be discharged with the tails of the jigger. As these experiments also throw some light on the disposition of the black tin in the stamped tin stuff, they are given in full in the accompanying table:

	South Condurrow.	East Pool.	Dolcoath.
Contents in black tin per ton of stuff leaving coffers..	235 pounds.	45 pounds.	45 pounds.
Percentage of stuff that passed through 80 sieve (*a*)..	61 per cent.	62 per cent.	62 per cent.
Percentage of stuff that remained on sieve (*b*).......	39 per cent.	38 per cent.	38 per cent.
Produce per ton in black tin of (*a*)...................	330 pounds.	62 pounds.	65 pounds.
Produce per ton in black tin of (*b*)...................	78 pounds.	25 pounds.	9 pounds
Produce per ton in black tin of (*b*), without bruising .	33 pounds.	11 pounds.	3 pounds.
Quantity of black tin in each ton of stamped tin stuff locked up in particles of gangue....................	45 pounds.	14 pounds.	6 pounds.

It will thus be seen that these samples of stamped tin stuff contained from 6 to 45 pounds of black tin per ton, which, owing to its physical condition, would be very unsuitable for concentration by jiggers.

The results obtained in these experiments are, to a certain extent, confirmed by the assay of some samples that were taken from Wheal Jane jiggers when that mine was in operation. Two samples of the classified sands entering the jiggers assayed at the rate of 22 and 25 pounds of black tin per ton of stuff, the hutch work at the rate of 2 cwts. black tin per ton, while the tailings leaving the jiggers, and which passed to waste, gave a produce of 7 pounds black tin per ton. Now, with Rittinger side blow percussion tables these particles of black tin associated with gangue would be given off as a middle product between the ore fit to be sent to the calciner and the waste, and could be discharged directly into a pulverizer, to be reduced for further treatment. Jiggers could no doubt be applied with advantage for the treatment of stuff where the grain of the black tin is coarse, such, for instance, as that produced by Mulberry & Drakewall's mines; but for the bulk of the ore yielded by the principal tin lodes it is not thought that they are likely to prove satisfactory machines.

In all departments of dressing, the object aimed at should be to attain the highest possible degree of efficiency consistent with the employment of the least possible amount of manual labor; not only on account of the greater cheapness of the work performed by self-acting machines, but also because, when the back of the master is turned, the quality of the work remains the same. With respect to the stream works, the 284,703 statute tons of sands and slimes discharged during 1884 into the Red river have been shown to have contained 1,344 tons of stream tin ore, representing a money value of £40,781, of which £35,016, or 85.9 per cent., was saved by the streamers. In other words, from stuff containing 10½ pounds of black tin per ton, the streamers caught 9 pounds per ton, allowing only 1½ pounds per ton to go to waste. Truly, an excellent result, speaking volumes in favor of the efficiency of the Cornish frame. It is improbable that the sands discharged into the sea will ever be made poorer than they are at present; but whether the stream works, considered financially, are equally successful, is another question. Taking into consideration the rates and dues that have to be paid, the large plant that has to be maintained, and the fact that during 1884 nearly nine hundred persons were employed on the Red river, it will readily be seen that, with the exception of the works immediately below the mines, not much more than a living can be made by the streamers with the present price of tin, and that they will have a very hard time of it indeed, should the mines eventually succeed in saving an increased percentage of the contents in black tin of the ore raised. Any improvement, however, in the efficiency of our dressing operations, or any lessening of their cost, would turn the scales between profit and loss at many of our mines, and, since a greater demand for labor would thus be created than exists at present, would prove of immense benefit to the country at large.

Prices.—Although the price of tin is subject to greater fluctuations than other metals on account of the operations of speculators, the year 1885 was marked by a comparatively steady rise in the value of the metal, from 17⅛ cents per pound in New York at the beginning of the year, to 20¾ cents at the close. In July the price rose for a short time to 22⅛ cents.

The following table gives the range in price for each month in the year:

Opening, highest, lowest, and closing prices of Straits tin at New York, in each month of the last three years.

Months.	1885.				1884.				1883.			
	Opening.	Highest.	Lowest.	Closing.	Opening.	Highest.	Lowest.	Closing.	Opening.	Highest.	Lowest.	Closing.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	16¼	17¼	16.10	17⅛	19	19¼	17.90	18½	21⅛	21½	21	21
February	17⅜	17⅝	17½	17⅝	18⅜	18⅜	17¾	17⅞	20⅞	21	20¾	20¾
March	17⅝	17.80	16.95	17.70	17¾	18⅝	17⅝	18½	20¾	22	20⅝	21⅞
April	17⅝	18¼	17⅜	18.20	18½	19¼	18½	19¼	21⅝	21⅝	21	21¼
May	18	19¼	18	19¼	19⅜	19⅜	18⅝	18¾	21¼	21⅞	21	21½
June	19¼	21⅛	19¼	21⅜	18¾	19¾	18.55	18¾	21½	21½	20¾	21¼
July	21¼	23½	21¼	22	18¾	18⅞	18.70	18¾	21⅜	21½	21⅛	21⅛
August	22	22	20⅛	20⅞	18¾	19⅜	18.15	18.15	21⅜	21⅜	21	21
September	20¾	21⅛	20¾	20.80	18⅛	18.20	18.95	18	21	21⅛	21	21⅛
October	20.70	20.70	20¼	20½	17¾	17¾	16¼	16⅝	21⅛	21¼	20⅛	20¼
November	20½	21¼	20.05	21⅛	16⅝	16⅞	16½	16½	20¼	20⅜	19	19
December	21⅛	21⅛	20.55	20.80	16⅛	16¼	16.10	16⅜	19	19	18½	19

Average prices realized at the Banca and Billiton sales in the last three years.

[Taken from the annual number of the *American Metal Market.*]

Months.	Banca.			Billiton.		
	1885.	1884.	1883.	1885.	1884.	1883.
	Florins.	*Florins.*	*Florins.*	*Florins.*	*Florins.*	*Florins.*
January	48½	51⅜	56⅝			
February				54.30	55.34	64⅛
March	48¼	52⅜	58¼			
April				54¼	58½	66⅝
May	52½	53⅛	58			
June				60¼	56.22	64.[illegible]
July	55½	51⅛	57¼			
August				60.30	55¾	63.[illegible]
September	55½	49¾	57⅝			
October				61¾	49¾	63¾
November	56¾	46½	53⅛			
December				63¾	50.13	56¾

Imports and exports.—The imports of pure tin in various forms decreased from 26,031,992 pounds in the fiscal year ending June 30, 1884, to 23,947,523 pounds in 1885; there was also a decrease in the importation of tin plates, sheets, etc., from 527,881,321 pounds in 1884 to 505,559,076 pounds in 1885, making a decrease in the total value of tin imports amounting to $3,486,704. The record of imports and exports for a number of years is given below:

Tin imported and entered for consumption in the United States, 1867 to 1885, inclusive.

Fiscal years ending June 30—	In blocks, bars or pigs, and grain tin.		In plates, sheets, etc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Cwts.		*Cwts.*		
1867		$1, 210, 354. 02		$6, 276, 136. 78	$7, 486, 490. 80
1868		1, 454, 327. 36		6, 893, 072. 07	8, 347, 399. 43
1869	80, 811	1, 709, 385. 00	1, 534, 324	8, 565, 432. 56	10, 274, 817. 56
1870	81, 702	2, 042, 887. 71	1, 333, 150	7, 628, 871. 51	9, 671, 759. 22
1871	106, 595	2, 938, 409. 82	1, 556, 023	9, 490, 778. 64	12, 429, 188. 46
1872	102, 006	3, 033, 837. 45	1, 617, 627	10, 736, 906. 59	13, 770, 744. 04
1873	130, 469	3, 938, 032. 25	1, 854, 956	15, 906, 446. 82	19, 844, 479. 07
1874	116, 442	3, 199, 807. 07	1, 553, 860	13, 322, 976. 14	16, 522, 783. 21
1875	102, 904	2, 329, 487. 96	1, 540, 600	12, 557, 630. 75	14, 887, 118. 71
1876	93, 176	1, 816, 506. 00	1, 767, 210	10, 226, 802. 87	12, 043, 308. 87
1877	98, 209	1, 783, 763. 00	1, 984, 893	9, 818, 069. 69	11, 601, 834. 69
1878	128, 849	2, 167, 350. 00	2, 166 489	9, 893, 639. 61	12, 060, 989. 61
1879	142, 927	2, 301, 914. 00	2, 487, 007	10, 248, 720. 34	12, 550, 664. 34
1880	290, 007	6, 153, 005. 68	3, 298, 534	16, 524, 590. 19	22, 677, 595. 87
1881	171, 146	3, 971, 756. 67	3, 366, 720	14, 641, 057. 87	18, 612, 814. 54
1882	187, 544	5, 204, 251. 68	3, 926, 311	16, 550, 834. 64	21, 755, 086. 32
1883	237, 348	6, 106, 250. 37	4, 051, 108	16, 688, 276. 67	22, 794, 527. 04
1884	(*a*)26, 031, 992	5, 429, 184. 01	(*a*)527, 881, 321	18, 931, 072. 70	24, 360, 256. 71
1885	23, 947, 523	4, 263, 447. 00	505, 559, 076	16, 610, 105. 00	20, 873, 552. 00

a Pounds in 1884 and 1885.

Value of tin manufactures exported from the United States.(a)

Fiscal years ending September 30, until 1843, and June 30 since.	Value.	Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1826	$4, 515	1846	$8, 902	1866	$79, 461
1827	2, 967	1847	6, 363	1867	40, 642
1828	5, 049	1848	12, 353	1868	27, 110
1829	1, 757	1849	13, 143	1869	18, 994
1830	4, 497	1850	13, 590	1870	46, 007
1831	3, 909	1851	27, 823	1871	70, 366
1832	3, 157	1852	23, 420	1872	67, 241
1833	2, 928	1853	22, 988	1873	69, 865
1834	2, 230	1854	30, 698	1874	62, 973
1835	2, 545	1855	14, 279	1875	48, 194
1836	5, 604	1856	13, 610	1876	48, 144
1837	10, 892	1857	5, 622	1877	87, 057
1838	10, 179	1858	24, 186	1878	116, 274
1839	19, 981	1859	39, 289	1879	103, 467
1840	7, 501	1860	39, 064	1880	144, 185
1841	3, 751	1861	30, 229	1881	498, 524
1842	5, 682	1862	62, 286	1882	198, 608
1843 (nine months)	5, 026	1863	41, 558	1883	191, 947
1844	6, 421	1864	46, 968	1884	166, 819
1845	10, 114	1865	106, 244	1885	162, 304

a Classed as "tin, and manufactures of," from 1851.

Oxide of tin imported and entered for consumption in the United States, 1869 to 1883, inclusive.(b)

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1869	$1, 524	1877	$1, 886
1870	2, 958	1878	929
1871	3, 061	1879	2, 138
1872	18, 414	1880	2, 849
1873	1, 475	1881	2, 510
1874	4, 962	1882	920
1875	14, 838	1883	4
1876	3, 484		

b Not enumerated in 1884 and 1885.

ARSENIC.

The steadily declining price of arsenic during 1885 prevented any attempt at utilizing the well-known sources in this country, which have been given in previous reports. The use of arsenic for the extermination of grasshoppers in California and elsewhere in the West assumed large proportions, and the local demand might be profitably filled by saving the arsenic which passes off in roasting many silver and lead ores.

The nearest source of the present supply of arsenic is from the Del Oro mine, in Hastings county, Ontario. As this mine is operated by an American company, its product is nearly all sold in New York. The mine furnished about 400 tons of "crude" arsenic (90 to 95 per cent. arsenious oxide) and 40 tons of refined, practically pure, arsenious oxide, although it was only in operation from September 15 to the end of the year.

The price of arsenic fell from 2½ to 2⅛ cents during 1885.

Imports.—The importations, including Canadian arsenic, are given below, from which it is seen that, notwithstanding the above reduction in price, there was no increase in the total consumption.

Arsenic imported and entered for consumption in the United States, 1867 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	....	$17,700	1877	2,588,948	$71,738
1868	1,442,142	19,191	1878	2,471,861	56,662
1869	1,442,576	29,450	1879	2,445,852	52,715
1870	566,500	12,643	1880	2,717,777	62,207
1871	1,329,693	29,822	1881	2,225,425	54,056
1872	1,109,811	30,337	1882	3,396,334	89,111
1873	612,116	16,373	1883	5,207,553	121,891
1874	1,636,335	39,985	1884	3,693,325	86,316
1875	2,327,742	49,430	1885	3,268,549	85,782
1876	447,019	13,784			

ANTIMONY.

Although the sulphide of antimony has been found in a number of places, particularly in California, and notably at the Stayton mine, San Benito county, it seems, according to Mr. DeGroot, to occur in large quantity only at the San Emigdio mine, Kern county. This deposit and the manner of working it having been fully described in former volumes of these reports, only the operations carried on there during the past year need be mentioned. An attempt was made early in 1885 to concentrate the ore, but this proving unsatisfactory the plan of "cruding" it was afterwards adopted, and has since been continued with good results. By this plan the silica and other gangue matter is removed, leaving it so reduced in bulk that its transportation to the refinery at San Francisco costs comparatively little. The San Emigdio mine has lately become the property of the Anglo-American Association, which will hereafter work it, treating the ore by the above method. This company shipped several carloads of metallic antimony to New York during 1885, and expects to increase the shipments largely during 1886. The Company is actively prospecting elsewhere, and is buying all the 50 per cent. ore which is offered at $40 per ton. During the year there was talk of resuming work at the Stayton mine, which has long been idle, but nothing further has yet been done. Mr. H. S. Back reports the discovery of a new deposit of sulphide of antimony and bismuth, containing 53 per cent. of the former. The mine is in Shoshone county, Idaho, about 3 miles from the junction of the South fork of the Cœur d'Alene river.

Imports.—With the exception of a small quantity smelted in San Francisco, the antimony used in the United States has been imported in the following quantities:

Antimony, and antimony ore, imported and entered for consumption in the United States,* 1867 *to* 1885, *inclusive.

Fiscal years ending June 30—	Crude and regulus.		Ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1867	....	$63, 919	....	....	$63, 919
1868	1, 033, 336	83, 822	....	....	83, 822
1869	1, 345, 921	129, 918	....	....	129, 918
1870	1, 227, 429	164, 179	....	....	164, 179
1871	1, 015, 039	148, 264	....	$2, 324	150, 588
1872	1, 933, 306	237, 536	....	3, 031	230, 567
1873	1, 166, 321	184, 498	....	2, 941	187, 439
1874	1, 253, 814	148, 409	....	203	148, 612
1875	1, 238, 223	131, 360	6, 460	609	131, 969
1876	946, 809	119, 441	8, 321	700	120, 141
1877	1, 115, 124	135, 317	20, 001	2, 314	137, 631
1878	1, 256, 624	130, 950	20, 351	1, 259	132, 209
1879	1, 380, 212	143, 099	34, 542	2, 341	145, 440
1880	2, 019, 389	265, 773	25, 150	2, 349	268, 122
1881	1, 808, 945	253, 954	841, 730	18, 199	272, 153
1882	2, 525, 838	294, 234	1, 114, 699	18, 019	312, 253
1883	3, 064, 050	286, 892	697, 244	11, 254	298, 146
1884	*a*1, 779, 337	150, 435	231, 360	6, 489	156, 924
1885	2, 668, 302	223, 741	243, 635	8, 783	232, 524

a Classed as regulus only.

Prices.—The prices of antimony ruled lower in 1885 than in 1884, falling as low as 8½ cents per pound towards the end of the year. The fluctuations in price during the year are shown in the following table:

Opening, closing, highest, and lowest prices of antimony of Cookson's brand and Hallett's brand in each month of the year 1885 (*a*) *compared with the same month in the years* 1884 *and* 1883 (*b*).

[Cents per pound.]

Months.	Cookson's.			Hallett's.		
	1885.	1884.	1883.	1885.	1884.	1883.
January:						
Opening	10¾	11¼	11¼	10⅛	10¼	10⅛
Highest	10¾	12	11¼	10⅛	11	10⅛
Lowest	10.40	11.15	11	9⅞	10.20	10
Closing	10.45	11¾	11	9⅞	11	10⅛
February:						
Opening	10.45	11¾	11	9⅞	11	10⅛
Highest	10.45	11⅞	11	9⅞	11⅜	10⅛
Lowest	10⅜	11½	10⅞	9⅞	11	9⅞
Closing	10⅜	11¾	10⅞	9⅞	11¼	9⅞
March:						
Opening	10¼	11¾	10¾	9¾	11¼	9⅞
Highest	10¼	11¾	10¾	9¾	11¼	9⅞
Lowest	10⅛	11⅜	10.70	9⅝	10¾	9¾
Closing	10⅛	11⅜	10.70	9⅝	10⅞	9¾
April:						
Opening	10.20	11¼	10⅝	9.70	10¾	9.70
Highest	10.20	11¼	10¾	9.70	10¾	9¾
Lowest	9¾	11	10⅝	9.45	10⅝	9.70
Closing	9¾	11	10.70	9.45	10⅝	9¾
May:						
Opening	9¾	11	10.70	9.45	10⅝	9.70
Highest	9¾	11¼	10.70	9.45	10⅝	9.70
Lowest	9½	11	10⅝	9⅛	10½	9⅝
Closing	9½	11	10⅝	9⅛	10½	9⅝
June:						
Opening	9½	11	10⅝	9⅛	10½	9⅝
Highest	9½	11	10⅜	9⅛	10½	9⅝
Lowest	9.35	10⅞	10½	8⅞	10.30	9½
Closing	9½	10⅞	10½	9	10.30	9½
July:						
Opening	9½	10.85	10⅜	9	10.30	9½
Highest	9½	10.85	10⅜	9	10.30	9½
Lowest	9½	10¾	10¼	8.90	10¼	9⅜
Closing	9½	10¾	10¼	8.90	10¼	9⅜
August:						
Opening	9½	10¾	10¼	8⅞	10¼	9¼
Highest	9.55	10¾	10¼	8⅞	10¼	9⅜
Lowest	9½	10½	10¼	8¾	10⅛	9⅛
Closing	9½	10½	10¼	8¾	10⅛	9⅛
September:						
Opening	9½	10½	10¼	8¾	10⅛	9⅛
Highest	9.65	10½	10¼	8¾	10⅛	9⅛
Lowest	9½	10⅜	10	8⅝	10	9
Closing	9½	10⅜	10⅛	8¾	10	9
October:						
Opening	9½	10.35	10⅛	8¾	9.95	9
Highest	9.55	10.35	10⅛	8¾	9.95	9
Lowest	9½	10¼	9⅞	8½	9⅞	8.85
Closing	9½	10¼	10	8½	9⅞	9
November:						
Opening	9½	10⅜	10	8½	10⅛	9
Highest	9.55	10⅝	11	8½	10⅜	10¼
Lowest	9.45	10¼	10	8.45	9⅞	9
Closing	9 45	10⅝	10¾	8½	10⅜	10¼
December:						
Opening	9.45	10½	11	8½	10¼	10¼
Highest	9½	11	11¼	8⅝	10¼	10¼
Lowest	9.45	10½	11	8½	10	10⅛
Closing	9.55	10¾	11¼	8½	10⅛	10¼

a From the *American Metal Market*, January 2, 1886.
b From the *American Metal Market*, January 3, 1885.

BISMUTH.

It is stated by eastern consumers that one ton of bismuth was produced experimentally in the United States during 1885. This was probably made at Loveland, Colorado. According to the present indications bismuth may be produced on a commercial scale during the coming year; the increased activity in its development being due to the advance in price of the metal. This advance from \$1.14 per pound, in 1884, to \$1.87½ in 1885, was caused by a combination of the four principal producing districts, the Bolivian company, the Royal Saxon company, and the proprietors of the Australian mines. Even \$2.25 was paid for the metal before the close of the year. Bismuth has lately been found in certain copper mattes from Montana, but none has been extracted from them.

Imports.—The imports of bismuth have remained practically without change during 1885, as shown in the following table. The use of the metal is limited.

Bismuth imported and entered for consumption in the United States, 1868 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1868	....	\$30,149	1877	....	\$12,279
1869	....	29,047	1878	....	45,838
1870	....	30,695	1879	....	47,523
1871	....	47,047	1880	....	82,711
1872	....	40,554	1881	....	83,209
1873	....	17,025	1882	64,837	111,087
1874	....	14,179	1883	54,702	89,683
1875	....	8,723	1884	61,208	98,548
1876	....	10,458	1885	61,024	84,425

ALUMINUM.

By R. L. Packard.

The notice of the manufacture and sale of aluminum published in the "Mineral Resources of the United States, 1883 and 1884," contained an account of the method of manufacture employed in this country and the uses to which the metal was then applied. It was used for the lighter parts of mathematical and physical instruments of various kinds, suture wire, delicate weights, and as leaf for decorators. Its use was reported as increasing slowly, its cost precluding extensive employment. Its price ranged from 50 cents to $1 per ounce in 1884, and 1,800 ounces of the metal were produced during that year. It was also coming into use in the manufacture of alloys, and aluminum bronze was particularly mentioned, although no statistics were available to show the amount of that alloy produced in this country.

In 1885 the use of the metal was increased for light articles, and surgical instruments, medals, druggists' weights (on account of the large size of the light weights), thimbles, spoons, foil, fancy articles, fittings of traveling bags, soap and brush boxes, and racing plates or horse shoes, are mentioned as articles made of aluminum. Its price ranged from 50 to 95 cents per ounce, and dealers were of the opinion that its use would be greatly extended when its price was lowered, on account of its lightness, strength, and resistance to tarnish.

Colonel Frishmuth, of Philadelphia, whose process of extracting aluminum was described in the last report, states that he manufactured about 3,400 troy ounces in 1885, against 1,800 ounces the previous year.

The imports for the fiscal year 1885 were 439 pounds, valued at $4,736.

The estimated sales for 1885 were about 8,000 ounces. The use of aluminum in alloys, and particularly as aluminum bronze, received a new impulse in 1885, and the manufacture of that alloy, together with others containing aluminum, was then, apparently, raised to the level of an industry in this country by the Cowles Electric Smelting and Aluminum Company, of Cleveland, Ohio. The old way of making aluminum bronze and other alloys of aluminum did not differ essentially from the ordinary way of making alloys, and consisted in adding the aluminum to the melted copper. There are directions for doing this, one of which is to push the requisite amount of aluminum down through the melted copper in the crucible and hold it submerged by means of a dry stick of hard wood. The old method required, of course, that metallic aluminum had first to be obtained by the costly process in vogue before it could be alloyed with the melted copper. By the new process alumina (oxide of aluminum) in the form of granulated corundum, is mixed with charcoal and granulated copper and placed between the large electrodes of a powerful dynamo-electric machine in a suitable furnace or receptacle of fire brick lined with charcoal and properly covered, and the current is then passed. Under the intense heat thus produced the alumina is reduced, and the aluminum set free forms an alloy with the copper melted at the same time, which alloy is afterwards remelted and the proper amount of copper is added to it to make the bronze required, containing 10 per cent. of aluminum, or 5 per cent., as the case may be. This method follows the line of older experiments which date back more than thirty years, but which did not have the advantage of the modern dynamo-electric machines, and appears to be a successful advance on the experiments of Sir W. Siemens, begun in 1878. The amount of aluminum bronze manufactured by the Cowles company in 1885 is stated by them to have been between 4,000 and 5,000 pounds. The market price of the bronze in 1884 ranged from $1 to $1.75 per pound. In 1885 the new method of manufacture brought its price down to 40 cents, or 30 cents in quantities of a ton or more. Castings of aluminum bronze containing 10 per cent. aluminum have reached a tensile strength of 110,000 pounds to the square inch cross section. Aluminum bronze is used for car and steamboat fixtures, and for decorations, chandeliers, engine bearings, journals, etc., and its proposed uses and those of other alloys of aluminum fill a long list, from large ordnance to small fancy articles.

Among the other alloys of aluminum manufactured by the Cowles Company are iron and aluminum containing 1 part of aluminum to 10 or 11 parts iron, sold at 50 cents per pound in ingots free on board at Cleveland, Ohio; aluminum brass containing from ½ to 3½ per cent. aluminum, and "aluminum silver," consisting of aluminum bronze (containing 5 per cent. of aluminum) and nickel, which is used for cutlery. All these alloys of aluminum are said to possess the faculty of not tarnishing, and have great tensile strength.

The electric furnace of the Cowles Company produced aluminum in the form of a black powder finely mixed with carbon dust and as metallic scales fused together with carbon. The amount so produced amounted in 1885 to perhaps 200 pounds, but it does not appear that it was utilized. Experiments have shown that this aluminum can be easily recovered, and it will probably soon be in the market.

A new use for aluminum was described by Mr. Petter Östberg, of Stockholm, Sweden, at the Pittsburgh meeting of the American Institute of Mining Engineers in February, 1886, and the following account is taken from the transactions of the society. This discovery, briefly described, is that the melting point of wrought iron, which is about 4,000° F. can be greatly reduced by adding a very small quantity of aluminum (in the form of an alloy of iron) to the charge of wrought iron in the crucible so that the metal can be poured and cast without difficulty, especially if certain other portions of his invention are used. He has a furnace of special construction heated by petroleum, with an arrangement for introducing the aluminum alloy into the metal without cooling the atmosphere surrounding the crucible. Mr. Östberg explains that in order to make a casting it is necessary to heat the metal to be cast a number of degrees above its melting point, otherwise it would cool below the latter during the transfer to the molds and could no tbe poured. While in this superheated state the metal absorbs oxygen and other gases which produce injurious effects. He claims to effect the superheating without raising the temperature; or in less paradoxical language, he lowers the melting point of wrought iron by adding to the metal in the crucible from 0.05 to 0.1 per cent. of aluminum, which reduces the melting point by from 300° to 500° F. The former melting temperature is therefore the present superheating temperature. This has its analogy, as Mr. Östberg explains, in the fact that alloys generally melt at a lower temperature than would be expected from the melting points of their ingredients.

The statistics of the American manufacture of aluminum since 1883 are as follows:

Production and value of American aluminum, 1883 *to* 1885, *inclusive.*

Years.	Ounces.	Value.
1883	1,000	$750
1884	1,800	1,350
1885	3,400	2,550

Aluminum imported and entered for consumption in the United States, 1870 *to* 1884, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1870		$98	1879	284.44	$3,423
1871		341	1880	340.75	4,042
1873	2	2	1881	517.10	6,071
1874	683	2,125	1882	566.50	6,459
1875	434	1,355	1883	426.25	5,079
1876	139	1,412	1884	595.00	8,416
1877	131	1,551	1885	439.00	4,736
1878	251	2,978			

The amount of aluminum bronze manufactured in 1885 is stated at from 4,000to 5,000 pounds, which, at 40 cents, would be worth $1,600 to $2,000. The information on which this article is based was obtained directly from the manufacturers and dealers, and from authentic articles in the transactions of the American Institute of Mining Engineers, and oft he Franklin Institute.

ZIRCONIUM.

By David T. Day.

The proposed use of zirconium oxide in electric lighting has made considerable inquiry of late for the mineral zircon in quantity. Patents are pending also on other applications of this mineral. This inquiry has developed the fact that zircon occurs in Buncombe county, North Carolina, in quantity sufficient for mining; it is in rock which has disintegrated to a considerable depth, and hence can easily be collected. In fact, 1,000 pounds were gathered at one time and 800 pounds at another, besides many small quantities for cabinet collections, etc., aggregating over 2,000 pounds in all taken from one locality.

A great drawback to the use of zirconium oxide has been the great difficulty in obtaining the substance in pure condition. Several methods have been used, but usually with poor results, especially when the zircon contains iron. The method which has yielded the best results so far, consists in fusing the finely powdered zircon with acid sulphate of potassium, which decomposes the mineral, converting the zirconium into a basic sulphate which is insoluble. This is fused with caustic soda, leaving zirconium hydroxide capable of solution in strong sulphuric acid. From this, zirconium hydroxide is again precipitated by ammonia, and after much washing, it is ignited. The method yields only fair results, and is long and tedious. Lately E. Linnemann (*Monatshefte für Chemie*, vol. 6, 335, 447) has added greatly to the chance of utilizing zirconium by publishing a better method for preparing the oxide. Zircon crystals are first exposed to fumes of hydrofluoric acid; after this they can be easily pulverized in an iron mortar. In order to decompose the powdered zircon, 25 grams are melted with 100 grams of caustic soda, and 10 grams of pure sodium fluoride in a silver crucible. In ten to fifteen minutes the principal reaction is over, and the mass is kept melted for half an hour, and then while melted poured out, and after cooling washed out with hot water. Zirconium oxide is left together with the oxides of other metals. From these, zirconium chloride is separated by treatment with a mixture of fuming hydrochloric acid (sp. gr.=1.17), absolute alcohol, and ether, in which zirconium chloride, $Zr\,Cl_4$, is almost insoluble while the other chlorides usually present are soluble. In order to purify the zirconium chloride completely it is recrystallized repeatedly from hot concentrated hydrochloric acid. It is then converted into zirconium oxide by ignition. The oxide thus obtained is quite pure, and has been used already in producing a light under conditions where lime could not be used. The same author has just described an oxyhydrogen light of peculiar construction by which an unusually high temperature is produced. The author says: "This blast lamp can be used advantageously for a lime light, or, since lime *melts*, for producing the zirconium light." He uses for this purpose plates of zirconium oxide 4 millimeters thick and 15 millimeters broad, set in a piece of platinum. The plates are made by igniting zirconium chloride and then pressing the resulting oxide strongly and repeating this several times. The light is steady and white, gives a continuous spectrum, which embraces the Fraunhofer lines A to H, and, with illuminating gas at a pressure of 2½ inches of water and oxygen, at a pressure sixteen times as great, a light of 60, 120, or 200 candles, according as 1, 1½, or 2 cubic feet of illuminating gas, and ½, 1, or 2 cubic feet of oxygen are used. It is highly probable that a light of this kind will be used largely to replace the lime light, since the pieces of zirconia are practically indestructible.

STRUCTURAL MATERIALS.

By H. S. Sproull.

From a few sections of the country reports indicate some falling off in the production of structural materials, but generally there has been a gain for standard descriptions, and occasionally of very decided character. The losses appear to be due to local influences alone, having no further bearing, while the increase may be accepted as a fair reflection from the entire country. The prime factor, leading to a fuller production, was the low ruling cost of material, which presented an attraction for consumption, and led to larger investments in real estate improvements, especially in the larger cities and their suburbs. Some increase in public works and improvements has opened the outlet still wider, and promises additional expansion. Notwithstanding the considerable increase in quantity of material produced in 1885, the value only exceeded that of 1884 in a few instances, and in some cases ran rather behind, as the result of the lower values brought about by various influences, as will be explained farther on. The profits of the manufacturing interest have naturally become somewhat curtailed, yet rarely to a serious extent, and there is very universal testimony to warrant the assertion that no attempt has been made to balance the shrinkage in price by lowering the grade of the product; but, on the contrary, every reasonable effort was put forth to enhance the quality and attractions as an additional stimulant to consumption.

The absence of complete and authentic records of production is strikingly noticeable in respect to all structural material proper. In a few cases the difficulty might be overcome by a systematic and unanimous action of manufacturers, but the scattered location and crude methods of the numerous small concerns engaged in the industry precludes the possibility of giving statistics of actual results, and estimates must therefore be depended upon. No estimates have been accepted, however, until consultation and comparison of views with responsible sources of information confirmed the amounts assumed; and the following reports may be considered quite as near positive records as it is possible to obtain with the means now available. Manufacturers and producers generally, however, are becoming impressed with the value of reliable figures, and through trade organizations or co-operation with the statistical departments of the States concerned in the production, it may become possible to secure a comprehensive record.

In the preparation of this report, statistics have been quoted from the United States Bureau of Statistics; the annual reports of industrial and statistical bureaus of most of the States referred to; from responsible trade journals published in various sections of the country, and from private records of the most reliable character. Information has also been obtained through the courtesy of Mr. Thomas B. Bancroft, chief inspector of mines for the State of Ohio; Messrs. James M. Swank and L. E. Schlauch, of Pennsylvania; Mr. J. B. Speed, of Kentucky; the Buffalo Cement Company; Messrs. George W. White and Jerome A. King, of New York City. The report for the Rocky mountain division has again been furnished by Mr. F. F. Chisolm, and that for California by Mr. C. G. Yale.

BUILDING STONE.

Present status.—The value of the building stone quarried in the United States during the past four years is estimated as follows:

Years.	Value.
1882	$21,000,000
1883	20,000,000
1884	19,000,000
1885	19,000,000

Preparatory to making the foregoing estimate for 1885, a wider expanse of territory was brought under investigation and a more thorough form of inquiry adopted than in 1884, with no better results in obtaining positive data. Indeed, the generally ambiguous and evasive replies to requests for actual figures forcibly indicated the absence of method among the majority of producers for compiling and preserving records of their output, and that in conjunction with almost insurmountable difficulties in the way of knowing and reaching all sources of supply, led to an early abandonment of the effort toward exact results by this means. Communication with numerous producers, distributors, and consumers, however, furnished valuable hints and suggestions from which an estimate corresponding with that for 1884 was fairly warranted, and $19,000,000 may be accepted as the nearest approximation to the value of the production for 1885, of which the available sources of information will admit. In adjusting the influences existing during 1885 it was found that on one side must be placed evidences of an increased output in many sections, and especially when tributary to some of the large cities of the interior; the opening up of new quarries; and the fact that a certain amount of surplus production was submitted to as a means for keeping desirable labor busy and contented. In opposition were to be found, several important localities showing a considerable decrease in consumption, and an almost universal admission of a lower value. While the actual amount of stone quarried may have been larger than in 1884 its value was no greater, according to the best authorities.

Not even an estimate can be ventured upon regarding the proportion of the numerous varieties of stone used, and probably there was no important variation from the previous year, yet granite and some of the harder descriptions of sandstone increased slightly in favor and the brown stones have fallen somewhat further into disrepute. The latter has been most marked in connection with the coarser varieties of brown stone quarried near and used in some of the prominent seaboard cities, where the severity of the weather requires something that will show more positive and longer resistance to defacement and disintegration. An importation of Scotch stone of light color and good promise as to durability has found some favor in that connection, yet quite as desirable and probably a better quality could be obtained from our domestic quarries, especially those located on deposits of refractory sandstone and the highly siliceous limestones, etc., all calculated to develop an extreme degree of durability and maintain a uniform shade. Probably the most reliable returns obtained from the question of production were those given for bluestone. It, in common with the figures for all other stone, is an estimate only, yet the result may be accepted as approximating closely the amount actually quarried. About the entire supply is taken from deposits in the State of New York, with the city of Rochester on the western boundary line of the working field, the Hudson River on the east, and thence running down into the Lehigh and Wyoming sections of Pennsylvania, an area, in connection with a few smaller and unimportant sources of supply, producing in 1885 some 250,000 long tons with a quarry value reaching $2,000,000, quite a falling off from the product of the preceding year, as will be seen in the annexed table. The valuations are included in the general estimate of the production of building stone.

Quantity and value of bluestone quarried in the United States in 1884 *and* 1885.

Years.	Quantity.	Value.
	Long tons.	
1884	300,000	$2,500,000
1885	250,000	2,000,000

New sources of supply.—Information concerning new sources of supply is not abundant, but the condition of trade in building stone was hardly calculated to stimulate unusual effort toward development. In Virginia the quarrymen have opened up a few new beds of granite contiguous to old working ground and showing no really new qualities. Between Richmond and Lynchburg the available supplies are becoming greater, and during 1885 a very fine quarry of brownstone was opened at Midway Mills. New Hampshire and Connecticut have added somewhat to their productive capacity. The production in Pennsylvania is increasing slightly, and just at the close of the year another granite quarry was opened near French Creek Falls, Chester county. At Rockfield, Kentucky, an oölitic limestone has been further developed, showing stone of exceptionally good quality, comparing favorably with the Portland oölitic stone of England. An extensive plant has been erected and the necessary rail connections made in order to place the stone upon the market. Considerable prospecting has taken place in the western and southern States, and some valuable quarries of building stone located. In Utah attention is turning toward the fine deposits of white and black marble and brownstone, but no active measures have as yet been taken to utilize the supply, partly owing to absence of proper transportation facilities. An excellent building stone is reported in the southeastern part of Minnesota, of bright-red color, and is called "Minnesota redstone," but no detailed description has been forwarded.

Rocky mountain division.—A bed of remarkably fine marble was opened during 1885 on one of the branches of Rock creek, Gunnison county, Colorado. The marble was made the subject of a special examination by the Union Pacific Railway Company, and all tests of its quality proved in the highest degree satisfactory. There is an abundance of the marble, but it is so difficult of access that it was found impracticable to attempt the development of the district. Marble of fair quality is found on the Upper Arkansas, near Grand Junction, and at other western points, but is nowhere mined or worked.

SLATE.

Production.—Slate deposits are known to exist from Maine to Michigan and from the Saint Lawrence to the Gulf States, but actual development is confined to comparatively few localities. Maine, Vermont, and New York produce moderate quantities, and small beds of very good slate are worked in Michigan and Virginia, but the great bulk of the total product of the United States comes from the immense quarries situated in Lehigh and Northampton counties, Pennsylvania. In the latter section over three thousand men were employed in 1885, mostly of Welsh and English nativity, and the result of their labor was a liberal increase in the product. The bulk of the manufacture is in the form of roofing slate, which is distributed over the entire country, and a fair proportion finds a foreign outlet. Various sizes are made, to meet architectural designs and other requirements of the trade. They are sold in "squares." A "square" is 100 square feet, weighs 600 pounds, and covers the same area as 1,000 shingles. The cost, delivered from the quarry, ready for shipment, in 1885, was $2.50 to $3.75 per square, against $3.50 to $4 per square in 1884. The scale of wages paid at quarries, in 1885, was as follows: Splitters, 18 to 20 cents per hour; blockmakers, 15 to 18 cents per hour; laborers, 10 to 13 cents per hour.

Production of roofing slate in all sections during the years 1884 *and* 1885.

[Squares of 100 square feet each.]

Sections.	1884.	1885.
Bangor and Pen Argyl region, Pennsylvania	195, 505	196, 832
Slatington section, Pennsylvania	104, 000	108, 000
Vermont	85, 000	130, 000
Maine	41, 000	34, 000
Chapman's	29, 499	26, 328
Peach Bottom	10, 000	14, 500
Virginia	9, 000	17, 300
Michigan	7, 000	10, 000
Total	481, 004	536, 960

Total yearly production of roofing slate from 1879 *to* 1885, *inclusive.*

Years.	Number of squares.	Average price per square, delivered on cars.	Value.
1879	367, 857		
1880	382, 867		
1881	454, 070		
1882	501, 000		
1883	506, 200		
1884	481, 004	$3. 85	$1, 851, 865
1885	536, 960	3. 07	1, 648, 467

Towards the close of the year a fine bed of slate was discovered on Fremont island, Great Salt Lake, Utah, and after a careful examination of the quarry by experts a company was formed to develop and work it. The production will find a western market at a great saving in transportation charges, and no doubt will stimulate consumption.

Condition of the slate industry.—The slate-quarrying industry of the country during the years 1884 and 1885 was, through various influences, suffering considerable depression and afforded little profit to the producer. A steady shrinkage in consumption, very active competition to secure such opportunities for the disposal of supplies as could be found, and scarcely any modification in the cost of production, were, in brief, the dominant factors under which the trade labored. There was nothing to indicate that roofing slate had lost favor, except in some of the cities, but accumulations of stock carried over from former seasons and a diminution in the erection of buildings upon which a covering of slate appeared to be an absolute necessity, placed the quarrymen at a decided disadvantage when attempting to dispose of the new output. One of the greatest checks to the demand was caused by general retrenchment in the matter of railway construction, improvement and repairs, since depots, freight sheds, engine stables, etc., during active periods of increase in railroad property, form a most liberal outlet for roofing slate. A curtailment of production was difficult to accomplish, except at the risk of still more disastrous results to the producer.

The labor employed in the quarries must be peculiarly skilled, and cannot readily be replaced, a fact that induced the policy of keeping the men at work, and forcing a sale of the product rather than of shutting down entirely, and this was carried out with no fairly compensating modification in the rate of wages. Thus, without securing much advantage on the cost of production, and being compelled to follow a small decline in the selling price during 1884, the margin of profit to the producer has been exceedingly small. Tile for roofing purposes has been used to some extent, but cannot be considered as a competitor with slate, owing to the non-absorbent qualities of the latter, and general ability to withstand the elements.

Exports.—For many years roofing slate has contributed a fair proportion to the export movement of the United States. During 1876, 1877, 1878, and partially again during 1880, Great Britain and the continent became very liberal customers, not the least remarkable feature of the trade being shown in the shipment of several cargoes direct to Welsh ports, thus practically selling at the very door of England's great base of supplies. Since 1881, however, the European demand has about all disappeared and left shippers dependent upon the custom of South America, the West Indies and Australia, the former two countries requiring small amounts, but the latter affording quite a marked outlet. Indeed, the latter trade increased very rapidly during 1885 as a result of the uncommonly low prices ruling, a large proportion of the stock having been sold and delivered on the pier alongside of vessels at $4 per square, and in some instances at 25 cents per square lower; a basis upon which it was found possible to compete with England in her own colonial market, and also to furnish a vent for the enforced surplus production of this country, to which reference has before been made. No general record of the export movement is obtainable, but probably 90 per cent. is shipped from the port of New York, and as the figures for that point were perfected under careful compilation they afford an excellent index to the foreign movement in roofing slate for a series of years.

Exports of roofing slate from the port of New York from 1876 *to* 1885, *inclusive.*

Years.	Tons.	Pieces.	Value.
1876	19,475	646,985	$377,233
1877	25,565	2,895,428	646,272
1878	12,320	1,834,225	308,852
1879	4,792	3,085,124	166,220
1880	11,267	1,698,522	220,292
1881	2,927	3,522,527	138,904
1882	864	4,337,801	153,318
1883	187	1,488,226	54,063
1884	50	2,776,236	90,262
1885	....	4,113,204	115,206

Slate is not confined to its use as a roofing material by any means, but, on the contrary, is probably more universally used than any other stone. In composition and texture it is admirably adapted to the reception of carved and molded designs, is susceptible of a high polish, and possesses great power of resistance to the principal destructive elements, besides having the additional merit of wide range of color, embracing black, dark blue, purple, purple-clouded green, gray-clouded green, light green, and a clear, bright red. The scope of consumption is rapidly expanding, and among the uses to which slate is applied the following may be enumerated: Flagging, flooring, floor tiles, molding for tiles, vestibule trimmings, slabs, etc., wainscoting, mantels, hearthstones, steps, risers, platforms, sills and lintels, turned balusters, laundry and bath tubs, sinks and wash trays, meat and water tanks, refrigerator and cooling-room shelves, cistern linings, brewers' vats, mangers, butchers' and curriers' tables, bar fixtures, billiard table beds, urinals, school slates and blackboards, countertops, vault work, grave linings and covers, and memorial tablets. Of the above no record of production or value can be obtained that would prove at all useful as a basis for estimates. Possibly a faint idea of the proportions devoted to these various uses might be obtained from the production of the Slatington section, where, besides an output of 108,000 squares of roofing slate, there were also made, in round numbers, 39,900 cases of school slates; 31,850 pieces, or 1,430 cases, or 27 carloads of flagging; 5,900 cases blackboards; 30 cases mantels and hearths, and 47 carloads of sawed and shaved slate. The export of manufactured slate has also proved a significant item for several years past, but it is generally understood that the stock handled on foreign orders was composed almost wholly of school slates, with possibly an occasional parcel of mantels and hearths. It is again necessary to rely upon the figures of the port of New York as an indication of the extent and progress of the business with foreign countries, but the annexed tables represent a very large proportion of the entire shipment of the United States.

Exports of manufactured slate from the port of New York, 1876 *to* 1885, *inclusive.*

Years.	Cases.	Value.	Years.	Cases.	Value.
1876	10,612	$87,500	1881	14,414	$62,109
1877	8,675	68,437	1882	14,625	68,150
1878	13,274	88,215	1883	8,943	40,674
1879	17,505	74,251	1884	12,189	53,021
1880	15,674	76,709	1885	10,573	49,965

Exports of all kinds of slate from the port of New York, 1876 *to* 1885, *inclusive.*

Years.	Value.	Years.	Value.
1876	$464,733	1881	$201,013
1877	714,709	1882	221,468
1878	397,067	1883	94,737
1879	240,471	1884	143,283
1880	297,001	1885	165,171

Imports and exports of building stone.—The following tables show the extent of the for foreign commerce of the United States in marble and other stone:

Marble imported and entered for consumption in the United States, 1867 *to* 1883, *inclusive.*

Fiscal years ending June 30—	Sawed, dressed, etc., not over 2 inches in thickness.	Sawed, dressed, etc., over 2 and not over 3 inches in thickness.	Sawed, dressed, etc., over 3 and not over 4 inches in thickness.	Sawed, dressed, etc., over 4 and not over 5 inches in thickness.	Sawed, dressed, etc., over 5 and not over 6 inches in thickness.	Veined and all other in blocks, etc.	White, statuary, Brocatella, etc.	Not otherwise specified.	Total.
1867	....	....	....	....	....	$192, 514	$2, 540	$51, 978	$247, 032
1868	....	....	....	....	....	309, 750	4, 403	85, 783	399, 936
1869	....	....	....	....	....	359, 881	3, 898	101, 309	465, 088
1870	....	....	....	....	....	332, 839	3, 713	142, 785	479, 337
1871	$5, 973	$168	$77	$44	$28	400, 158	1, 134	118, 016	525, 598
1872	3, 499	1, 081	452	....	318	475, 718	4, 017	54, 539	539, 624
1873	8, 124	21	....	....	....	396, 671	4, 148	69, 991	473, 955
1874	1, 837	....	....	....	....	474, 680	2, 863	51, 699	531, 079
1875	1, 456	427	96	....	....	527, 628	1, 623	72, 389	603, 619
1876	595	126	204	87	....	529, 126	1, 151	60, 596	591, 885
1877	2, 124	....	....	....	....	349, 590	1, 404	77, 293	430, 411
1878	198	11	8	....	....	376, 936	592	43, 915	421, 660
1879	184	....	....	....	....	329, 155	427	54, 857	384, 623
1880	....	....	....	....	....	531, 908	7, 239	62, 715	601, 862
1881	339	....	....	....	....	470, 047	1, 468	82, 046	553, 900
1882	655	....	....	....	....	486, 331	3, 582	84, 577	575, 145
1883	619	....	....	....	....	533, 096	2, 011	71, 905	607, 631

During the last two fiscal years the classification has been as follows:

Classification.	1884.	1885.
Marble:		
In blocks, rough or squared, of all kinds	$511, 287	$429, 186
Veined marble, sawed, dressed, or otherwise, including marble slabs and marble paving tiles	12, 941	43, 923
All manufactures of, not specially enumerated	67, 829	54, 772
Total	592, 057	527, 881

Building stone (exclusive of marble), paving stone, and stone ballast imported and entered for consumption in the United States, 1867 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Building stone, dressed.	Building stone, rough.		Sandstone.	Slate chimney pieces, mantles, etc.	Roofing slate.	Limestone.	Paving stones.	Ballast.	Total value.
		Quantity.	Value.							
		Long tons.								
1867	....	....	....	....	$37,510	$85,204	....	....	....	....
1868	$59,081	....	....	....	16,045	118,776	....	$5,718	....	....
1869	61,408	....	$8,237	$4,171	19,602	85,364	....	467	$3,987	....
1870	150,619	....	....	3,201	19,879	107,521	....	2,034	10,518	....
1871	145,759	1,455	16,982	3,660	21,381	117,484	....	....	34,703	....
1872	162,614	10,723	39,515	7,680	25,925	107,192	$2,459	5,529	11,303	$362,217
1873	218,236	20,226	73,889	6,160	26,643	91,503	1,486	3,788	17,143	438,848
1874	238,680	19,658	81,645	8,534	27,519	80,519	1,639	7,246	21,882	467,664
1875	275,633	15,748	67,357	10,986	42,022	16,342	2,023	2,017	9,025	425,405
1876	316,404	8,199	34,124	7,174	44,266	2,051	1,938	1,005	9,350	416,312
1877	201,034	7,584	25,571	5,492	34,479	4	1,705	485	6,272	275,042
1878	153,693	10,197	37,878	7,136	39,985	275	2,614	1,950	6,989	250,470
1879	125,493	6,845	24,531	13,956	46,260	620	1,456	2,943	2,365	217,624
1880	75,501	11,035	43,997	10,220	51,165	72	2,560	2,383	7,572	193,470
1881	76,741	15,867	65,950	15,115	46,862	2	1,990	3,799	5,401	215,860
1882	104,296	16,778	75,369	....	45,774	154	2,710	16,599	8,792	253,694
1883	127,476	14,324	64,767	....	44,375	2,813	1,841	2,629	5,745	249,646
1884	122,463	12,198	50,860	....	34,640	16,099	143	2,576	2,551	229,332
1885	145,344	13,183	64,680	....	56,913	5,196	....	....	4,056	276,189

Marble and stone of domestic production exported from the United States.

Fiscal years ending September 30, until 1842, and June 30 since.	Rough.	Manufactured.	Total.	Fiscal years ending June 30—	Rough.	Manufactured.	Total.
1826	....	$13,303	$13,303	1856	....	$162,376	$162,376
1827	....	3,505	3,505	1857	....	111,403	111,403
1828	....	3.122	3,122	1858	....	138,590	138,590
1829	....	2,647	2,647	1859	....	112,214	112,214
1830	....	4,655	4,655	1860	....	176,239	176,239
1831	....	3,588	3,588	1861	....	185,267	185,267
1832	....	3,455	3,455	1862	....	195,442	195,442
1833	....	5,087	5,087	1863	....	138,428	138,428
1834	....	7,359	7,359	1864	$57,715	144,647	202,362
1835	....	8,687	8,687	1865	74,261	183,782	258,043
1836	....	4,414	4,414	1866	89,703	112,830	202,533
1837	....	5,374	5,374	1867	53,983	138,558	192,541
1838	....	5,199	5,199	1868	60,399	105,046	165,445
1839	....	7,661	7,661	1869	62,266	87,135	149,401
1840	....	35,794	35,794	1870	42,227	138,046	180,273
1841	....	33,546	33,546	1871	135,672	137,613	273,285
1842	....	18,921	18,921	1872	156,976	165,311	322,287
1843 (nine months)	....	8,545	8,545	1873	96,735	189,795	286,530
1844	....	19,135	19,135	1874	126,669	168,977	295,646
1845	....	17,626	17,626	1875	125,968	254,356	380,324
1846	....	14,234	14,234	1876	95,480	236,255	331,735
1847	....	11,220	11,220	1877	131,716	917,937	1,049,653
1848	....	22,466	22,466	1878	142,661	597,356	740,017
1849	....	20,282	20,282	1879	143,457	430,848	574,305
1850	....	34,510	34,510	1880	199,051	453,912	652,963
1851	....	41,449	41,449	1881	220,362	409,433	629,795
1852	....	57,240	57,240	1882	180,774	433,656	614,430
1853	....	47,628	47,628	1883	152,182	389,371	541,553
1854	....	88,327	88,327	1884	188,245	415.015	603,260
1855	....	168,546	168,546	1885	182,719	(*a*)330,786	513,505

a Includes roofing slate.

Marble and stone, and manufactures of marble and stone, of foreign production exported from the United States, 1872 to 1885, inclusive.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1872	$1,929	1879	$6,364
1873	4,571	1880	6,816
1874	1,928	1881	709
1875	3,428	1882	4,848
1876	13,371	1883	490
1877	8,475	1884	8,420
1878	3,448	1885	14,406

Summarizing the foregoing statistics, the movement during the fiscal years 1882, 1883, 1884, and 1885 may be stated thus:

Balance of trade in marble and stone.

Fiscal years ending June 30—	Imports.	Exports.			Excess of imports over exports.
		Of domestic production.	Re-exports of foreign production.	Total exports.	
1882	$828,839	$614,430	$4,848	$619,278	$209 561
1883	1,475,658	541,553	490	542,043	933,615
1884	821,389	603,260	8,420	611,680	209,709
1885	804,070	513,505	14,406	527,911	276,159

BUILDING SAND.

Much has been written upon the proper theoretical proportions and qualities of building sand to be used in the preparation of mortar, etc. In actual mixing, however, the average consumer simply handles supplies according to his very practical ideas of cost and convenience, and quality is too frequently a secondary consideration. Cost as usual varies greatly, and while in the great cities 50 to 75 cents per ton might be named, those figures are far above the average, contractors in some localities even finding it necessary to pay for the privilege of disposing of the amount they excavate. Equally uncertain is the production; an approximation to the quantity of sand used simply as a constructive material may be reached by using the totals of other cohesive articles as a basis, and calculating the natural relative proportions used in the preparation of mortars as commonly made; deductions drawn from such suggestions indicate 52,116,000 long tons of sand worked up for building purposes during 1885. This estimate does not cover the supply used for paving and kindred purposes, nor the vast quantities of sand yearly removed from original beds and transferred to railway embankments, harbor and river improvements, etc. Of course supplies are inexhaustible, and outside of city limits can generally be found about where they are wanted.

Imports and exports of sand and gravel.

Fiscal years ending June 30—	Imports.	Exports.	Fiscal years ending June 30—	Imports.	Exports.
1864	....	$5,109	1877	....	$10,803
1865	....	9,438	1878	$31	17,017
1869	$12	629	1879	212	8,482
1870	65	3,983	1880	....	11,266
1871	2,191	7,069	1881	....	15,676
1872	4,102	5,893	1882	....	22,080
1873	981	11,522	1883	274	25,708
1874	813	13,802	1884	16,360	19,399
1875	100	8,509	1885	12,798	15,071
1876	....	9,013			

CEMENT.

Kinds made.—No new varieties have been developed, the product still consisting primarily of the natural rock cements in by far the largest proportion, and also furnishing the base from which is made the artificial description commonly known as American Portland. Nor has the use of the domestic article extended to any new outlets, except, possibly, to be handled a little more freely as a mixture with imported cement in the production of drain and sewer pipe. The consumption of pipe thus made is not of a general character, and is confined principally to districts where the drainage waste is of a comparatively pure character and free from acids and other rapidly destroying agents. Quality has shown about the usual difference according to the locality in which it is made, but every manufacturer has sought to sustain his former standard, and improve it if possible, in order to compete with foreign supplies. All hydraulic cements require an especially pure dry atmosphere, yet even that will not effectually retard deterioration in quality. It has been shown by long and constant experience that both domestic and foreign cements, when allowed to remain in store for a long period, no matter how dry the location, are sure to absorb some moisture and undergo chemical changes that must gradually impair their setting and hardening qualities. On the other hand, however, there is danger that underburned cement, especially the artificial product, may contain an excess of free caustic lime that can only be removed by careful air slaking, and would seriously threaten the solidity of work upon which it might be used if it passed directly from the factory into consumption.

Production.—The production of cements during 1885 was somewhat irregular. The works in many cases opened the season almost without orders, and made, in consequence, quite an accumulation of stock, but subsequently the calls were so liberal as to exhaust all stores and force the mills to full capacity up to the period of frost. The loss of business during the first part of the year was, in a measure, due to successful competition on the part of the foreign product, yet the production was afterwards increased to such an extent as to bring the final results somewhat in excess of 1884. The value has averaged lower; so low, indeed, as to scarcely leave a margin to the manufacturer, yet no serious losses are known to have occurred, and the industry as a whole is apparently upon a sound financial basis. In making up the figures of production it has been found possible to reach desirable and reliable information at all the principal centers of manufacture, and the resulting estimate approximates as nearly as possible to exact returns. In the Rosendale district, Ulster county, New York, the output was 1,750,000 barrels; in the Louisville district, 850,000 barrels; in the Buffalo and Akron districts, 600,000 barrels; Utica, Illinois, 300,000 barrels; Milwaukee, Wisconsin, 250,000 barrels; and scattering, 250,000 barrels. This makes a total of 4,000,000 barrels, and compares as follows with the output of previous years:

Production of cement made from natural rock in the United States from 1882 to 1885.

Years.	Barrels of 300 pounds.	Average price per barrel.	Total Value.
1882	3, 165, 000	$1. 10	$3, 481, 500
1883	4, 100, 000	1. 00	4, 100, 000
1884	3, 900, 000	. 90	3, 510, 000
1885	4, 000, 000	. 80	3, 200, 000

With the exception of a small deposit upon the Potomac river, and additional works noted in the Rocky mountains, no new sources of supply have appeared, while one of the western firms has gradually gone out of production in consequence of its failure to preserve a merchantable standard of quality.

The artificial cements (American Portland) have followed the common course of nearly all structural materials during 1885, and have shown an increased production at a diminished cost. A natural expansion of the outlets and the introduction of new and improved machinery may be briefly mentioned as the main factors leading to the results noted, though at one or two new localities tentative efforts in the way of manufacture were sufficiently successful to add somewhat to the production and to promise continuation with further growth. While admission of a modifying cost was readily made by manufacturers, a great deal of reticence developed at every attempt to reach an exact figure, and an estimated valuation became necessary in consequence, and $1.95 per barrel was finally decided upon as a conservative average representation of all views, the output of stock for the year on the closest indication obtainable showing about 150,000 barrels of 400 pounds each. The great bulk of artificial cement is made in the vicinity of Allentown, Pennsylvania, a fair quantity produced at South Bend, Indiana, not seeking an open market but going into local consumption for the manufacture of sewer pipe, etc.

Estimated production of American Portland cement from 1882 *to* 1885.

Years.	Barrels. of 400 pounds.	Average price per barrel.	Total value.
1882	85,000	$2.25	$191,250
1883	90,000	2.15	193,500
1884	100,000	2.10	210,000
1885	150,000	1.95	292,500

The total production of all kinds of cement during the past four years was about as follows:

Total production of all kinds of cement in the United States from 1882 *to* 1885.

Years.	Barrels.	Value.
1882	3,250,000	$3,672,750
1883	4,190,000	4,293,500
1884	4,000,000	3,720,000
1885	4,150,000	3,492,500

Imports.—The additions to production of domestic cements did not check imports, but, on the contrary, the arrivals of foreign stock made further increase, and reached the highest point on record during the year 1885. The total amount for the United States will approximate 650,000 barrels of 400 pounds each. New York is the principal port of entry, and the only point at which reliable figures of imports could be found. These are given below with comparisons, and very fairly indicate the rapid development of the importation of cement during the past nine years. The average cost of importation during 1885 was, at a full estimate, $2.05 per barrel laid down on the piers at New York, a decline much greater than upon any description of the domestic production.

It would hardly be fair to accept the liberal addition to importations of cement during 1885, in comparison with the preceding years, as a true index of corresponding growth in actual consumption. The foreign "Portlands" of good standard quality have undoubtedly grown in favor, owing to their adaptability and indeed superiority for numerous descriptions of work, besides as a matter of economy. Influences other than natural demand, however, had considerable force in stimulating importation during 1885, the most noticeable of which were: the removal of duty on packages, low ocean transportation charges, and very strong competition among the importers. The last was the most unsatisfactory feature, as it brought into the country a large quantity of low-grade stock, a considerable percentage of which remained unsold at the end of the year, and some was forced off at a heavy loss. The foreign producers are becoming convinced of the necessity for a standard test and grading, and are arranging for that end. Portland cements are receiving some very critical scientific attention and their properties are becoming better understood than any other similar product, a suggestion that might be taken into account by the manufacturers of domestic cements. An English scientist, after a detailed statement of methods and tests applied, reaches the following deductions as indicating the pre-requisites of a first-class cement:

"1. *Fineness.*—To be such that the cement will all pass through a sieve having 625 holes (25 by 25) to the square inch, and leave only 10 per cent. residue when sifted through a sieve having 2,500 holes (50 by 50) to the square inch.

"2. *Soundness.*—That a pat made and submitted to moist heat and warm water shall show no signs of blowing in twenty-four hours.

"3. *Tensile strength.*—Briquettes which have been gauged, treated, and tested in the prescribed manner shall carry an average tensile strain without fracture of at least 175 pounds per square inch at the expiration of three days from gauging, and those tested at the expiration of seven days from gauging shall show an increase of at least 50 per cent. over the strength of those at three days; but the briquettes broken at the seven days' test shall carry an average tensile strain without fracture of at least 350 pounds per square inch.

"Such a specification meets all requirements, and satisfies the peculiarities of nearly all cements, except perhaps the very quick setting ones, for which a slight variation in the tensile strength and the percentage of increase between the dates named would have to be made."

Imports of cement at New York, in casks of 400 pounds.

Years.	From Great Britain.	From European continent.	Total casks.	Cost on pier per cask.	Total value.
1877	47, 632	10, 818	58, 450	....	....
1878	51, 477	19, 040	70, 517	....	....
1879	80, 834	25, 212	106, 046	....	....
1880	120, 833	45, 080	165, 913	....	....
1881	149, 486	73, 186	222, 672	....	....
1882	171, 202	190, 924	362, 126	$2. 60	$941, 528
1883	158, 602	143, 363	301, 965	2. 70	815, 306
1884	155, 477	201, 085	356, 562	2. 50	891, 405
1885	187, 955	250, 860	438, 815	2. 05	899, 571

The total imports (classed as "Roman" cement at the custom houses) into the United States since 1868 have been:

Roman cement imported and entered for consumption in the United States, 1868 to 1885, inclusive.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Barrels.			*Barrels.*	
1868	....	$10, 168	1877	....	$201, 074
1869	....	9, 855	1878	....	184, 086
1870	....	18, 057	1879	....	212, 719
1871	....	52, 103	1880	....	373, 264
1872	....	172, 339	1881	....	441, 512
1873	....	209, 097	1882	370, 406	683, 684
1874	....	286, 429	1883	456, 418	802, 294
1875	....	261, 741	1884	(*a*)585, 768	825, 095
1876	....	247, 200	1885	(*a*)554, 396	874, 070

a Classed simply as cement; kind not specified.

Rocky Mountain division.—The works of the Denver Cement Company at Denver were run during a portion of 1885, but the production has not been very large. The cement produced by the company is of fair quality; it has been used in various buildings in Denver and has given very general satisfaction. The occurrence of the rock used in the manufacture has been given in previous issues of this report. Nothing of general interest developed in the business during 1885. Statistics of production could not be obtained from the manufacturers, and estimates are omitted as practically useless.

The Colorado Springs Stucco, Brick, and Cement Company, which manufactures plaster of Paris at Colorado City, is increasing the size of its plant, and proposes hereafter to produce hydraulic cement for the western markets. The material used in the production of the cement is found in abundance in the "Great Hogback" near Colorado City, and very convenient to the works. The combination of the manufacture of cement and plaster of Paris by one concern will probably enable the company to produce the former quite cheaply, so to compete with other Colorado companies, and with the Louisville and Portland cements.

Pacific coast.—Although a good hydraulic limestone has been found in California, and extensive works were put up near the town of Vallejo many years ago for manufacturing it into cement, very little of the latter has been made there for several years past, the English and eastern being preferred to the California article, for the alleged reasons that the latter has proved to be of an inferior quality. Some of the hydraulic limestone discovered a year or two ago near the town of Niles, Alameda county, has since been made into cement, which, it is claimed, equals the best made elsewhere. The quantity of cement received at San Francisco during a period of twenty odd years is shown by the table appended:

Imports of cement at San Francisco.

Years.	Barrels.	Years.	Barrels.
1864	13,322	1875	73,814
1865	26,270	1876	66,988
1866	34,360	1877	45,469
1867	31,666	1878	57,258
1868	31,954	1879	15,668
1869	54,697	1880	62,417
1870	42,377	1881	65,695
1871	32,602	1882	99,208
1872	54,746	1883	151,807
1873	61,911	1884	152,500
1874	79,435	1885	167,000

The prices of cement in the San Francisco market were at the beginning of 1886 as follows: California, $2 per barrel; Rosendale, $2.25 per barrel; and Portland, $3.25 per barrel.

LIME.

While the sources from which supplies of lime are drawn, continue practically immeasurable, there is a significant tendency towards the concentration of the production to certain localities. Increased facilities for transportation, with a natural sequence in lower cost of handling and delivery, permits the location of extensive works upon beds of excellent limestone which were previously neglected for want of an accessible market; this concentration and cheapening of production must gradually overshadow the old and somewhat crude systems, except in the most isolated localities.

With the actual output of some of the important manufacturing districts as a guide, and assisted by careful estimates from sections where no records are as yet preserved, an estimate of the total production of the United States for 1885 has been reached and placed in comparison with that of three preceding years, as follows:

Estimated production of lime in the United States from 1882 to 1885.

Years.	Barrels of 200 pounds.	Average value at kiln.	Total value.
1882	31,000,000	$0.70	$21,700,000
1883	32,000,009	.60	19,200,000
1884	37,000,000	.50	18,500,000
1885	40,000,000	.50	20,000,000

The increase of 3,000,000 barrels would have been exceeded but for certain local influences which have led to a curtailment of production in two or three districts of considerable manufacturing importance. All authorities agree that at 50 cents per barrel a fair average value is shown, there being little if any difference in that respect from the preceding year, while in quality some improvement may be credited. The most decided increase during the year was in the same direction noted in 1884. Following largely the Missouri and Mississippi valleys and making some growth on the Pacific coast, it spread somewhat more freely over Texas and made a slight showing in other Gulf States. Virginia and West Virginia are assuming greater importance as contributors to the general supply, and in the Housatonic valley, near Canaan, Connecticut, another considerable supply has become available. Of the latter a local consumption has been common for many years, but a new and improved plant and ample means for moving the product will greatly extend the area of distribution.

The following analysis of the Canaan, Connecticut, limestone has been furnished:

Analysis of lime from Canaan, Connecticut.

	Per cent.
Carbonate of lime	92.66
Magnesia	1.76
Oxide of iron and alumina	.14
Silica	5.44
Total	100.00

The use of lime in the manufacture of glass amounts on an average to about 11,000 long tons, and of limestone, some 33,000 tons are consumed. It is more than likely that those amounts were not quite reached during 1885, owing to curtailed glass production during a portion of the year.

Imports and exports.—The imports of lime have proved moderate, and in the main composed of selected varieties peculiarly adapted to some special work. At the port of New York, however, about 15,500 barrels of building lime were received as an experiment and secured fair favor. The cost on the pier was about 50 cents per barrel. The custom-house records still fail to make any division between lime and cement in statistics of exports, but the proportion of lime is unquestionably very small, probably not more than 10 per cent. of the exports named.

Lime imported and entered for consumption in the United States.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Barrels.			*Barrels.*	
1869		$10,800	1878		$14,344
1870		9,063	1879		13,196
1871		11,315	1880		15,852
1872		11,014	1881		24,968
1873		8,260	1882	73,093	36,879
1874		10,964	1883	76,889	41,224
1875		7,328	1884	53,505	26,370
1876		7,367	1885	54,676	28,270
1877		12,823			

Lime and cement of domestic production exported from the United States, 1864 *to* 1885 *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Barrels.			*Barrels.*	
1864		$86,386	1877	78,341	$97,923
1865		94,606	1878	82,507	98,334
1870	31,175	61,490	1879	60,657	74,097
1871	21,575	51,585	1880	41,989	52,584
1872	39,686	69,218	1881	57,555	83,598
1873	27,873	52,848	1882	67,030	100,169
1874	41,349	69,080	1883	74,687	120,156
1875	64,087	98,630	1884	65,768	108,437
1876	53,827	77,568	1885	79,627	127,523

Limestone flux.—The annexed estimates of the amount and value of limestone used in iron smelting from 1882 to 1885, inclusive, have been received from Mr. James M. Swank. Large quantities are also consumed in lead smelting, but estimates received are very indefinite and consequently omitted as practically useless.

Limestone used as flux in iron smelting in the United States from 1882 *to* 1885.

Years.	Quantity.	Average cost at quarry.	Total value.
	Long tons.	*Per ton.*	
1882	3,850,000	$0.60	$2,310,000
1883	3,814,273	.50	1,907,136
1884	3,401,930	.50	1,700,965
1885	3,389,313	.50	1,694,656

From the chief inspector of mines of the State of Ohio the following information is obtained: In 1884 the only record obtained was of limestone quarried for flux in smelting iron, amounting to 183,305 short tons. In 1885, however, an effort was made to extend research to building stone and the quantity burned for lime, with the appended results.

Production of limestone in the State of Ohio during 1885.

	Short tons.
For flux in iron smelting	141,957
For building purposes	311,971
For lime burning	662,447
Total	1,116,375

Pacific coast.—Mr. Yale furnishes the following:

The Pacific division of the continent abounds in limestone, there being enough produced in all the States and Territories of the West for local consumption. At one time there was thought to be but little stone of this kind in Oregon and in Washington Territory, but more careful search has brought to light an abundance of it there, and these regions have for the past two years been making enough lime for their own use, and have begun to ship it to California, the most of that exported coming from the vicinity of Puget sound.

California is prolific in limestone of every variety and of the best quality. The most extensive belt of this stone stretches north and south along the western foothills of the Sierra Nevada for a distance of nearly 150 miles, reaching from Mariposa county to Butte. It varies from a quarter of a mile to 3 miles in width, the rock near its southerly end, in the vicinity of Columbia, consisting of marble of good quality, and easily quarried. From 60 to 80 miles farther west a metamorphic limestone occurs in the Coast Range mountains, whence are obtained the supplies for the seaboard counties, the inland counties being supplied from the foothill belt, large quantities from the kilns there being also shipped to San Francisco. In El Dorado county, at Alabaster Cave, on this belt, are located the Alabaster lime works, consisting of a "Monitor" kiln capable of burning 3,000 barrels per month. The lime made is noted for its purity and whiteness, and is much used for the purification of gas. The extensive kilns erected a few years ago near Clipper Gap, Placer county, were purchased soon after by the H. T. Holmes Company, owners of the Alabaster works, and have since remained closed.

The most of the lime in the Coast Range is burnt near the towns of Santa Cruz and Felton, Santa Cruz county, where several companies have put up large works, facilities for manufacture and shipping being extremely good there. The rock is abundant, of the best kind, and easily quarried. Wood and water are plentiful and transportation to San Francisco can be had by either water or rail.

The three large companies operating here each make between 40,000 and 50,000 barrels of lime per year. Each gives employment the year round to about 40 men, wood choppers and teamsters included, at wages of $1.50 per day, though much of the work is done on contract. During the past two years lime burning has been carried on more generally over the State than was formerly the case, much having been burnt of late in the southern counties, where very little was made previously, owing to the limited demand, and in most localities, a scarcity of fuel. With the rapid increase in population of that section of the State, this industry has reached considerable proportions, there being no lack of good limestone there.

Several years ago the Hydrocarbon works, at Colton, San Bernardino county, began using crude petroleum as a fuel for burning lime. Although they have not abandoned its use, the experiment has not proved entirely satisfactory, owing to the great cost of this substance. Whether it can continue to be used with economy, the company has not yet determined, though the conditions favoring its employment are here as good as can be hoped for in the State, crude petroleum being cheap, but other fuel costly.

The production of lime in California amounted last year to about 220,000 barrels. The receipts at San Francisco were 160,000 barrels. Formerly some small lots of lime were exported from California to Oregon, Washington Territory and the Sandwich Islands. None, however, is sent away at present, these countries all making what they require at home. That made in the Sandwich Islands is burnt from coral. Though lacking in strength, this lime is of fair quality. The price of lime in San Francisco is lower at present than ever before, not exceeding $1.50 per barrel.

CLAYS.

In "Mineral Resources of the United States, 1883 and 1884," page 676 *et seq.*, will be found an exhaustive report upon the clays of the United States. Localities where deposits occur, an enumeration of articles manufactured from clay, together with a description of the methods of manufacture, and such reliable statistics as could be obtained, were given in detail, and nothing of importance can now be added beyond such information as has become accessible relating to the course of production during the year 1885.

As a basis for calculating the value of the total production of clays the assumption is made that the census report of 1880, naming $40,000,000 as the value of articles manufactured from clay in the United States, was approximately correct, and it now appears very safe to estimate an increase of fully 25 per cent. in the aggregate, and to place the present value at $50,000,000. In considering this amount an allowance must be made for a modified plane of cost as compared with that ruling at the period when information for the census report of 1880 was in course of collation, and it will be patent that the percentage of increase in quantity is still greater. Except in a few localities there was a positive absence of detail that would permit of a proper apportionment of the estimates to the various articles unnumbered among the products of clay; but building brick, general pottery, drain pipe and tile, terra cotta, and sewer pipe, in the order named, appear to show the greatest increase. Ornamental pottery, encaustic tiling, fancy pressed brick, etc., are all gaining, on account of marked improvement in American methods of manufacture, which allow American potters to compete quite successfully with foreign wares.

Carrying out the plan adopted in the last volume of "Mineral Resources," a compilation of such statistics as could be reached is given; with such additional information as may appear pertinent and interesting through the developments of the production of 1885.

Among the new deposits reported during 1885 may be noted a fine pottery clay in Lincoln parish, Louisiana; an 8-foot vein of fireclay at Saltsburgh, Pennsylvania; and a 9-foot vein of fine fireclay at Evansville, Indiana.

The quantity of fireclay mined in the State of Ohio in 1884 was 168,208 short tons, and the production for 1885 amounted to 153,756 short tons.

A new bed of fireclay has also been discovered at New Ross, Nova Scotia.

GENERAL CONDITION OF MANUFACTURES OF CLAY AND PRODUCTION STATISTICS.

EASTERN DIVISION.

Common brick.—Were it possible to obtain a comparative ratio of increase in production of all building material during the year 1885, it is almost a certainty that common brick would be found far in the van. Several influences have led up to this result, general details of which are unnecessary in this connection; but they may be summarily noted as embodying improved quality at lower cost, which attracted those seeking the cheapest material. The production has been aided to some extent by public work of various descriptions put under way in many parts of the country, but in the main the building of dwellings and other edifices afforded the largest consumption. Brick makers have contributed to the sale of their product very materially by setting a higher standard of quality and maintaining it; this feature was the more commendable from the fact that no new methods of manufacture were introduced, and the result was attained simply by increased care in handling the material through its various stages of manufacture. Naturally the older localities have shown this tendency in the highest degree, but it has been followed out so far as practicable in the newer works, partly as a competitive necessity. In the East there has been a revival of work on many clay beds that have been neglected for some time, and new deposits opened; a slight increase is evident in the States of New York, New Jersey, and Pennsylvania, quite a general growth in the producing States of the West, and as a very significant feature, an increase in the States of Tennessee, Florida, Georgia, and Texas. No idea of the quantity made in the latter section has been obtained, nor for that matter can a clear conception of the total amount for the United States be positively decided upon, owing to the innumerable small productive stations scattered throughout the country and turning the output into an immediate local exhaust. If the census figures placing the production for 1880 at 3,822,362,000 bricks is approximately correct, it is safe to estimate the total product of the United States for 1885 at 4,585,000,000 bricks, an increase of about 20 per cent. beyond the census year, most decided, however, during the last two years of the period covered. In the matter of value quite a wide difference of opinion has been encountered, but taking the average figure from those evidently calculating closest to actual productive cost, $25,000,000 would be a maximum estimate of value for all kinds of building brick made during 1885, a separation of common and "fronts" or pressed brick having been refused or overlooked by the majority of manufacturers in naming a "cost" price. In a few States where official statistics are prepared and other reliable sources of information can be reached, the figures of production are sufficiently authentic to be useful as a comparison, and probably convey some idea of the general growth of the manufacture of brick throughout the country, and upon that surmise the following statement has been prepared:

Production of building brick in five States for the years 1883, 1884, *and* 1885.

States.	1883.	1884.	1885.
New York	700,000,000	825,000,000	900,000,000
New Jersey	200,000,000	225,000,000	250,000,000
Pennsylvania	300,000,000	325,000,000	350,000,000
Ohio	300,000,000	325,000,000	350,000,000
Indiana	275,000,000	300,000,000	350,000,000

Production of common brick in Indiana.

Years.	Establishments.	Capital employed.	Value of product.	Hands. employed.	Wages.
1879 (*a*)	406	$448,200	$995,310	1,928	....
1882	173	346,550	993,425	1,357	$359,870
1886	396	861,872	2,170,277	3,012	....
1884	415	667,915	2,309,922	3,242	1,132,335

a Estimated; evidently too high.

In New Jersey a few new clay beds have been opened and work commenced, but it was impossible to obtain any statistics of the addition to capacity or the general aggregate of production. The wages paid to workmen in New Jersey during 1884 averaged per week: $14 to molders, $12 to pressers, and $11.37 to kilnsetters. Bricklayers secured $18.75 per week, and those rates did not differ materially during 1885. In other States, so far as any attempt at statistics has been made, the average cost differs only fractionally from the rates named above. In tests as to durability the terra-metallic bricks generally prove best. They are substantially the same as the English blue bricks; they are hard and tough, and have stood a crushing test of over 575 tons to the square foot. Quite extensive use has been made of them in foot paving, for which they appear peculiarly well adapted, in the construction of bank vaults, for engineering works, etc. During 1885 several experiments were made to test the strength of red brick. On a base area of 37.47 square inches there was an average stress of 255,950 pounds, when the brick cracked slightly. The pressure was equal to 6,830 pounds per square inch, or 439.2 tons per square foot, and the result may be accepted as a fair indication of the resistance of average brick to crushing force.

Hollow bricks, in common with fireproofing, were somewhat influenced by changes in the character of buildings constructed at former points of consumption, but were urged into notice in other directions and met with sufficient favor to keep the production up to the aggregate of 1884, at least, though at a lessened price. Suggestions as to the number made and value are too vague for use at this time. New Jersey turns out the largest amount, but establishments making kindred goods in western States are commencing to compete in a small way.

Pressed brick.—Some unimportant additions to the productive capacity were made, but few if any really new deposits of clay developed showing the standard of quality required in the manufacture of pressed and ornamental brick. The localities most prominent in making the descriptions under consideration, therefore, remain about the same as those named in the last report, with the exception that Trenton, New Jersey, should be added to the list as an old contributor of a very desirable article, with a quality about the same as "Philadelphias." The estimate of the output of pressed brick has been hampered slightly by a tendency to secrecy among a few manufacturers, but in round numbers 235,000,000 is the estimate decided upon, which is in fair proportion with common brick. The taste for elaboration in brick work, both exterior and interior, has led to the introduction of a great variety of colors; indeed almost any shade desired can now be produced on order, while the popular or standard hues are turned out for regular stock in some establishments. For producing encaustic colors in ornamental bricks the shading oxides are mixed with the clay in quantities of 7 to 10 per cent. Enameled brick are colored either under the glaze or in the glaze. When the application is to be made under the glaze it is customary to dip the burned bricks into a slip of colored clay composed, in most instances, of one part colored glass, ground, and two parts clay, the latter causing adhesion of the slip, and the brick is then fired, or, after being allowed to dry, is coated with a transparent glaze and then fired. When the color is to be applied in the glaze the brick is dipped into a transparent colored glaze, made of siliceous sand, salt, and oxide of lead, besides the coloring oxide. The one face or head to become the exposed surface of the walls when laid is usually treated in glazing and enameling. "Rights and lefts" are also made by subjecting one head and face to the necessary process, and the brick so prepared are used for the respective corners to which they are adjusted, for door jambs, reveals or windows, etc. For general outside or exposed work the colors most used are black, brown, chocolate, and buff, with brighter shades added in enameling, and for expensive interior decorative purposes there may be added gray, olive green, bronze green, pink, carmine, orange, purple, violet, turquoise, and indigo.

A few ornamental bricks are imported, but principally upon orders, as the wants of the open market are fairly well filled from the domestic product. French manufacturers have utilized the waste sand of glass factories for the production of siliceous bricks of fine white color which are very strong and durable for architectural purposes. The sand is subject to immense hydraulic pressure and then baked in furnaces at a high temperature. The specific gravity of the bricks is extremely low, and they will resist the action of the sun, rain, and acids. German chemists are also reported to have introduced a method for obtaining a product superior to ordinary bricks and tiles in resisting the action of acids, humidity, etc., and especially well adapted for the construction of sewers. After drying and grinding the clay, a mixture is made as follows:

Mixture for bricks and tiles.

	Per cent.
Clay	91.50
Iron filings	3.00
Table salt	2.00
Potash	1.50
Elder or willow wood ashes	2.00
	100.00

The whole is then heated to a temperature varying from 3,360° to 3,630° F. At the end of four or five hours the mixture is run into molds, then rebaked in ovens (always protected from air) at 840° to 930° F. The product may be colored by adding to 100 parts of the above 2 parts of manganese dioxide for a violet brown, 1 part of manganese dioxide for a violet, 1 part of copper ashes for green, 1 part arseniate of cobalt for blue, 2 parts of antimony for yellow, and 1½ parts of white arsenic and 1 part oxide of tin for white.

Unfortunately no report of cost is given for either of the two new products named.

Firebrick.—There was no incentive calculated greatly to stimulate the manufacture of firebrick during 1885. The dull and unpromising condition of the industries upon which firebrick depends for a market, small profit to the maker, and competition from the importer, all had a tendency to hold production in check, yet the reduction in output at the older establishments was really quite small, and with a few new manufacturers in the field the aggregate output exceeded but did not differ very materially from the product of 1884. Ohio, Pennsylvania, and New Jersey remain the principal producing States, but no complete returns can be obtained as to the amounts made. Careful estimates indicate the following results:

Estimated production of firebrick for 1883, 1884, *and* 1885.

	1883.	1884.	1885.
Ohio	23,000,000	25,000,000	25,000,000
Pennsylvania	55,000,000	50,000,000	50,000,000
New Jersey	21,000,000	20,000,000	20,000,000
Scattering	7,000,000	8,000,000	10,000,000
Total	106,000,000	103,000,000	105,000,000

During 1884 the production of firebrick was somewhat retarded and the sale impaired by a liberal offering of foreign-made stock at unusually low rates, the result of mere nominal freight charges and a determined effort to force the American market by some of the European makers. In 1885, however, importers were in a much more conservative mood and brought out supplies only on actual orders. The imports are principally at New York, and at that port the quantity received from foreign countries in 1885 was 1,081,625; in 1884, 1,524,000; in 1883, 1,250,135, and in 1882, 2,831,000 bricks.

As an indication of the relative position of values on January 1, for three years, the following comparison of prices is given:

Prices of firebrick in the New York market, per thousand.

Kinds.	1884.	1885.
Welsh	$30.00 to $35.00	$25.00 to $30.00
English	25.00 30.00	25.00 30.00
American, No. 1	33.00 35.00	30.00 35.00
American, No. 2	25.00 30.00	25.00 30.00

Door knobs, porcelain, hardware, and telegraph insulators.—Statistics of the production of these articles may be considered as almost impossible, but according to all trustworthy accounts quite as large quantities were made as during 1884, and possibly an excess, owing to their staple character and general consumption. Ohio and New Jersey turn out the largest quantity, but manufacturers of whiteware pottery in other sections are commencing to make small amounts, and if the ventures prove successful they will increase the production.

Glass pots and retorts.—Gas retorts have an even yearly production carrying with it no particular significance. Glass pots are, to a very large extent, made at the works where they are used, though in the West two or three establishments make them a specialty, and on orders have increased the output during 1885 by some 5 or 10 per cent.

Pottery, etc.—The location of clay deposits, and points of production remain substantially the same as set forth in detail on pages 698, 699, and 700 of "Mineral Resources of the United States, 1883 and 1884," no additions of importance having been made during 1885, so far as information is received. The absence of statistics from other than four of the principal States engaged in the manufacture of pottery, earthenware, etc., still impedes the effort to arrive at a really satisfactory conclusion respecting the value of the total output, but recent estimates have named $10,000,000 as representing the amount of capital employed, and $10,000,000 as the value of pottery and encaustic tiling produced in 1885. The condition of trade has been somewhat unsettled, with prices generally ranging lower and margins smaller to the manufacturer; for it was difficult, and in many cases simply impossible, to modify the cost of production to correspond with the selling plane, owing to the high scale of wages obtained by the skilled labor which it was necessary to retain. Competition also has been quite sharp, and some of the smaller potteries producing only the ordinary qualities of stoneware were compelled to shut down. Generally, however, the pottery production of the country has obtained an unassailable position as an established, profitable, industry. Especially noteworthy is the universal and more or less successful effort to increase the variety and elevate the standard of the better descriptions; and home production on a simple matter of quality even now, makes importations unnecessary, except in compliance with sentiment. The amateur decorator produced the incentive upon which the experimenter began, and from the latter came the rapid development of the capacity of the country into its present magnitude. At Cincinnati, Ohio; Trenton, New Jersey; and at Baltimore, Maryland, work of the most artistic character is now turned out. At Baltimore particularly great progress has been made during the year in increasing the assortment and bettering the condition of the pastes formed from clays of local deposits, and the wares thus produced have met prompt markets even in face of a comparatively dull general trade. Stoneware and earthenware were probably produced with less freedom in 1885, owing to the unprofitable character of the trade and its natural influence upon the numerous small manufacturers engaged, but whiteware made some increase in the volume of the output of plain white "C. C." and ironstone. No positively new works have come into existence, but old establishments made additions to their plants, nearly all for the purpose of raising the standard of quality in both plain and ornamental ware. The number of kilns now in operation in the entire country is not far from 300, with a capital of $9,000,000 to $10,000,000, and paying annually some $5,000,000 to the workmen employed.

A glance at the imports of earthen and china ware of late years shows a decided falling off, and while this is to some extent attributable to restricted comsumption, competition with the American product is the more potent factor through which the shrinkage has been brought about. The imports of earthen, stone, and china ware for the fiscal years ending June 30, 1883, were $8,693,273; for 1884, $4,368,531; and for 1885, $4,666,175. A more comprehensive exhibit is given in the following table, recently prepared and published by *Bradstreet's*, a New York trade journal:

Details of pottery and china ware importations.

	Values fiscal years ending June 30—			Values last six months (*a*)—	
	1870.	1880.	1885.	1885.	1884.
Brown earthen and common stone ware	$47,457	$31,504	$44,701	} $416,789	$625,045
China, porcelian, parian ware (plain)	420,442	334,371	823,334		
China, porcelain, parian ware (decorated)	530,804	1,188,847	2,834,718	1,740,943	1,869,064
All other earthen, stone, or crockery ware	3,461,525	3,945,666	963,422	611,408	420,569
Total	4,460,228	5,500,388	4,666,175	2,769,140	2,914,678

a Calendar years.

Between 1870 and 1880 the increase in the value of importations was $1,040,160, or about 23 per cent., and the falling off of imports from 1880 to 1885 amounted to $834,818, or 15.2 per cent. From July 1 to December 31, 1885, the decline in the value of imports was $145,538 as compared with the corresponding period in 1884. It is particularly significant as indicating the growth of the American industry that from 1880 to 1885 the decline in the imports of the plainer or common varieties was $2,480,600, and while the fine and decorated descriptions during the same period made a considerable increase, they too appear to commence shrinkage before the skill of the domestic producer, as shown in a reduced import of $128,121 for the last six months of 1885 against the same time in 1884.

Drain tile.—A steady growth in the production of drain tile has taken place, more decided, however, in the western than in the eastern States. In the latter section the farmers think old-fashioned ditching, etc., affords all the relief they require, but in the West new and improved methods are readily adopted by the agriculturist and the proper drainage of lands is very generally conceded to be best accomplished through the medium of tiling. Manufacturers are also aiding consumption by more careful methods in production, gradually studying the requirements of different soils, and making qualities adapted thereto, and while there is still room for vast improvement, a step in the right direction has unquestionably been made. Competition has also kept prices low and added another feature calculated to increase the use of tile among the farmers. It is a somewhat singular circumstance that sections in which the most benefit is derived from the use of drain tile contain the clays from which it is made, and this in natural order leads to many small local establishments manufacturing solely for a small area. Of these and of many of the more extensive producing localities and States no record even for an estimate can be obtained, but the principal manufacturing States furnish a clear statement from which an idea of the general growth of the industry may be formed.

The production of Indiana is reported as follows:

Production of drain tile in Indiana.

Years.	Number of establishments.	Capital employed.	Value of product.	Hands employed.
1879	297	$456,489	$623,720	948
1880(a)	486	700,000	900,000	2,187
1882	261	491,130	764,345	1,086
1883	387	759,562	1,133,515	1,517
1884	513	958,920	1,659,820	1,880

a Estimated; evidently too high.

During 1885 there was a still further growth, but in a somewhat lessened proportion.

Terra cotta.—While information as to the total amount of this material made during 1885 is very meager, sufficient has been elicited during the course of inquiry to indicate a further growth of the industry. New Jersey produces by far the largest quantity, followed in turn by Massachusetts, Illinois, Maryland, and Ohio, the latter State having in the last report received credit for a larger proportion than properly due under this classification. All the old established works have equaled the output of 1884, and some have reached an excess, while new plants of considerable magnitude were projected in the West, with an intention of commencing operations in time for the season of 1886. The use of terra cotta appears to have grown in about the same proportion as brick, as the use of the two materials in combination is not only a present fashion, but recognized upon a basis of economy, durability, and safety, with a gain rather than loss in the matter of attraction. Low cost, resistance to climatic changes, and ability to withstand fire, coupled with its adaptability to almost any desired style of trimming, has made the article one of the most popular for general building operations, and it is extending over a much wider area of consumption. The use of terra cotta is not free from objection when placed in position as a constructive material alone, or as an ornament when injudiciously applied, but as the faults are principally of an architectural character they are likely to be overcome by time and experience. Some excellent effects for interior work were brought out during the year, including beautiful designs for fireplaces, mantels, and hearths to match, and better appliances in the way of machinery have been introduced with most satisfactory results. The value of the terra cotta produced in New Jersey in 1883 was about $440,000, in 1884 well up to $450,000, and in 1885 not less than $500,000, with the amount of actual work really accomplished greater than represented by the mere difference in value, owing to modified cost of production.

Terra-cotta lumber has not become established as an article of practical value.

Fireproofing.—The production has been of an irregular character, with some conflict of opinion as to quantity, but the probabilities are in favor of a shrinkage as compared with 1884. The result was in no instance attributed to loss of confidence in the article, but principally to difference in the character of buildings constructed at some of the principal points of consumption. The bulk of the manufacturing is in the States of New Jersey and Pennsylvania, but Ohio is increasing somewhat, and other western States are experimenting.

Roofing tiles.—These have a somewhat irregular consumption, as they are used principally for fancy and striking effects upon detached structures, and as a rule are made only upon orders. Production in consequence runs close to the outlet, and the indications are that there was little if any increase during 1885. The material was certainly more in favor in some localities at least, but it is thought that it was scarcely urged into the prominence it deserved, and competition will probably be stimulated, as in addition to the works in New Jersey and Ohio, a new plant of considerable magnitude has been made at Indianapolis, Indiana, intended to produce a superior article at a low cost.

Sewer pipe.—Ohio is still considered the principal producing locality, with New York next; the output of the two States for 1885 amounted to fully $4,500,000, and while that sum does not exceed former annual estimates in point of valuation, it represents a larger quantity of pipe owing to lower cost. New Jersey will probably run about $400,000, but with no noticeable tendency to increase, as the western producer is a strong and successful competitor in all the markets to which New Jersey is tributary. Several other States are included in the list of producing localities from which it has been found impossible to obtain anything in the form of reliable statistics, but there is some indication of an increase for Illinois and Indiana in the order named. A very considerable increase in the manufacture of cement pipe has commenced to develop as the result of the large importation and cheapness of foreign cements. These used in conjunction with domestic cements produce a very good article in the way of sewer pipe, though not of a character to resist the action of powerful acids and similar agents to which the vitrified pipes are impervious. A small quantity of sewer pipe is imported yearly, but there appears to be no record of the amount, nor is it of great importance.

ROCKY MOUNTAIN DIVISION.

The manufacture of articles from clay in the Rocky Mountain district is limited to Colorado, in establishments located at Denver and Golden. The very imperfect character of the records kept by the manufacturers renders any definite statement of production impossible. While crucibles, scorifiers, muffles, etc., are regularly made, it cannot be ascertained how many of each were produced in 1885.

The amount of fireclay mined from 1880 to 1885 was about as follows:

Fireclay used by the Colorado works.

Works.	Location.	1880.	1881.	1882.	1883.	1884.	1885.
		Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Cambria Brick and Tile Company	Golden	....	2,000	3,000	3,000	500	....
G. A. Duncan & Co	....do	4,000	6,000	9,000	10,000	12,000	15,000
Golden Brick and Coal Company	....do	5,000	4,500	960	750	1,200	800
Denver Fireclay Company	Denver	1,200	1,200	1,500	1,200	3,200	4,500
Denver Firebrick Company	....do	....	....	4,000	1,600	....	....
Total		10,200	13,700	18,460	16,550	16,900	20,300

Pottery clay of fair quality occurs at several points on the "Great Hogback" in Colorado, but only drain pipes, tiles, flower pots, and crude manufactures are now produced from it. The Golden, Brick and Coal Company is the only concern now working pottery clays. The system of book keeping practiced by the clay companies is of such a character that no satisfactory statistics could be obtained. It is hoped taht through the efforts of the Denver Chamber of Commerce good and complete statements of both pottery and fireclays can be published in the next volume of the "Mineral Resources."

IMPORTS AND EXPORTS.

As will be seen from the following tables, there is a considerable importation of clay and its products, especially china, porcelain, etc., and a small export trade:

Clay imported and entered for consumption in the United States, 1867 to 1883, inclusive.

Fiscal years ending June 30—	Fuller's earth.		Kaolin.		Unwrought pipeclay and fireclay.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		*Long tons.*		
1867	280.25	$3,113			6,383.75	$72,204	$75,317
1868	211.00	2,522			8,384.75	66,958	69,480
1869	324.10	3,587			12,963.75	84,645	88,232
1870	239.40	2,619			8,014.15	76,057	78,676
1871	290.20	3,383			10,900.48	103,144	106,527
1872	274.00	3,358			13,081.20	128,130	131,488
1873	251.18	2,978	1,378.30	$13,091	12,883.82	141,927	157,996
1874	277.20	3,440	89.21	1,378	12,909.14	147,782	152,600
1875	300.06	3,694	130.47	1,977	10,374.65	116,307	121,978
1876	246.73	3,097	142.00	2,152	11,799.12	126,738	131,987
1877	400.00	4,460	204.26	3,009	11,680.14	129,016	136,485
1878	335.07	4,095	3,499.30	38,899	9,406.74	95,877	138,871
1879	361.21	4,269	4,774.60	45,272	8,477.80	87,948	137,489
1880	578.00	6,925	7,823.66	67,740	11,899.80	117,350	192,015
1881	267.55	3,207	6,887.37	66,654	12,444.28	123,545	193,406
1882	908.27	11,444	13,954.85	135,448	12,181.39	119,620	266,512
1883	1,241.27	14,309	12,870.60	115,492	7,841.32	74,673	204,474

Classified imports during the fiscal years 1884 and 1885.

Kinds.	1884.		1885.	
	Long tons.	Value.	Long tons.	Value.
China clay or kaolin	16,112	$131,063	10,626	$83,722
All other:				
Unwrought	11,021	85,990	9,736	76,899
Wrought	2,149	16,158	3,554	29,839
Total	29,282	233,211	23,916	190,460

Building brick imported and entered for consumption in the United States, 1868 to 1885, inclusive.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
1868		$44,453	1877	129,970	$897
1869		59,359	1878	25,170	166
1870		46,892	1879	918,840	4,534
1871		52,997	1880	349,000	1,662
1872		5,275	1881	539,600	3,002
1873	963,500	6,982	1882	711,150	9,168
1874	594,330	4,929	1883	764,700	7,958
1875	495,500	3,278	1884(*a*)	531,820	9,985
1876	411,550	3,147	1885	1,220,000	12,905

a Classed as "brick other than firebrick."

Bathbrick and firebrick imported and entered for consumption in the United States, 1868 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1868	$8,763	1877	$43,548
1869	86	1878	36,679
1870	19,112	1879	44,681
1871	18,215	1880	60,589
1872	47,502	1881	82,581
1873	60,442	1882	69,575
1874	66,428	1883	124,948
1875	50,325	1884	(a) 103,309
1876	69,063	1885	(a) 35,616

a Firebrick only.

Firebrick imported since 1877.

Fiscal years ending June 30—	Imports.	Fiscal years ending June 30—	Imports.
	Number.		*Number.*
1877	303,870	1882	2,831,033
1878	244,614	1883	1,250,135
1879	690,954	1884	1,524,000
1880	1,504,462	1885	3,401,449
1881	1,968,230		

Earthenware and china imported and entered for consumption in the United States, 1867 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Brown earthen and common stone ware.	China and porcelain not decorated.	China and porcelain decorated.	Other earthen stone, or crockery, glazed, etc.	Total.
1867	$48,618	$418,493	$439,824	$4,280,924	$5,187,859
1868	47,208	309,960	403,555	3,244,989	4,005,712
1869	34,260	400,894	555,425	3,468,970	4,459,549
1870	47,457	420,442	530,805	3,461,524	4,460,228
1871	96,695	391,374	571,032	3,573,254	4,632,355
1872	127,346	470,749	814,134	3,896,664	5,308,893
1873	115,253	479,617	867,206	4,289,868	5,751,944
1874	70,544	397,730	676,656	3,686,794	4,831,724
1875	68,501	436,883	654,965	3,280,867	4,441,216
1876	36,744	409,539	718,156	2,948,517	4,112,956
1877	30,403	326,956	668,514	2,746,186	3,772,059
1878	18,714	289,133	657,485	3,031,393	3,996,725
1879	19,868	296,591	813,850	2,914,567	4,044,876
1880	31,504	334,371	1,188,847	3,945,666	5,500,388
1881	27,586	321,259	1,621,112	4,413,369	6,383,326
1882	36,023	316,811	2,075,708	4,438,237	6,866,779
1883	43,864	368,943	2,587,545	5,685,709	8,686,061
1884	50,172	982,499	2,664,231	666,595	4,363,497
1885	44,701	823,334	2,834,718	963,422	4,666,175

Value of tiles imported for consumption in the United States, 1868 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Encaustic.	Roofing and paving.	Total.
1868	$11,423	....	$11,423
1869	7,599	$1,443	9,042
1870	8,549	875	9,424
1871	4,771	884	5,655
1872	8,083	31,453	39,536
1873	18,717	51,772	70,489
1874	14,193	51,010	65,204
1875	15,401	45,360	60,761
1876	15,267	29,903	45,170
1877	16,787	42,143	58,930
1878	13,112	41,032	54,144
1879	17,355	31,177	48,532
1880	16,896	34,063	50,959
1881	21,106	43,717	64,823
1882	27,729	46,562	74,291
1883	16,459	83,777	100,236
1884	16,011	115,770	131,781
1885	10,312	99,258	109,570

Value of clay exported from the United States, 1865 to 1885, inclusive.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1865	$29,975	1877	$5,493
1869	5,065	1878	8,384
1870	2,354	1879	6,314
1871	10,904	1880	8,355
1872	5,275	1881	8,762
1873	4,970	1882	17,458
1874	8,146	1883	17,790
1875	13,933	1884	7,725
1876	4,325	1885	8,225

Value of brick, etc., of domestic production exported from the United States.

Fiscal years ending September 30, until 1842, and June 30 since.	Brick and lime.	Brick, lime, and cement.	Firebrick and firetile.	Brick, other than fire.	Total.
1826	$6,075				$6,075
1827	3,365				3,365
1828	4,573				4,573
1829	3,717				3,717
1830	2,482				2,482
1831	4,412				4,412
1832	3,502				3,502
1833	3,866				3,866
1834	4,294				4,294
1835	4,133				4,133
1836	6,829				6,829
1837	29,626				29,626
1838	31,322				31,322
1839	16,298				16,298
1840	16,949				16,949
1841	14,064				14,064
1842	5,728				5,728
1843 (nine months)	3,883				3,883
1844	12,833				12,833
1845	8,701				8,701
1846	12,578				12,578
1847	17,623				17,623
1848	24,174				24,174
1849	8,671				8,671
1850	16,348				16,348
1851	22,045				22,045
1852	13,539				13,539
1853	32,625				32,625
1854	33,194				33,194
1855		$57,393			57,393
1856		64,297			64,297
1857		63,002			68,002
1858		103,821			103,821
1859		160,611			160,611
1860		154,045			154,045
1861		93,292			93,292
1862		83,385			83,385
1863		99,313			99,313
1864		49,106			49,106
1865		64,105			64,105
1866		146,874			146,874
1867		102,324			102,324
1868		140,338			140,338
1869		83,229			83,229
1870			$4,483	$25,091	29,574
1871			18,471	9,279	27,750
1872			10,233	14,305	24,538
1873			14,651	10,632	25,283
1874			22,365	11,290	33,655
1875			14,476	12,120	26,596
1876			20,348	18,035	38,383
1877			9,892	25,571	35,463
1878			13,900	254,446	268,346
1879			11,096	51,714	62,810
1880			12,027	36,299	48,326
1881			12,290	27,989	40,279
1882			30,649	50,870	81,519
1883			47,120	56,227	103,347
1884			41,012	60,702	101,714
1885			31,058	41,181	72,239

During the years given there were exported from the port of New York the following number of brick:

Building brick and firebrick exported from New York.

Calendar years.	Building brick.		Firebrick.	
	Number.	Value.	Number.	Value.
1877	13,603,475	$70,629	45,000	$2,185
1878	4,471,980	29,457	118,994	3,148
1879	1,381,775	9,371	94,976	6,867
1880	921,654	7,486	80,000	3,208
1881	971,500	8,663	181,359	8,361
1882	778,000	7,026	260,810	9,843
1883	2,642,625	21,737	358,616	11,039
1884	1,702,850	14,148	300,100	9,042
1885	973,000	8,894	....	12,059

Value of earthenware and stoneware of domestic manufacture exported from the United States.

Fiscal years ending September 30, until 1842, and June 30, since.	Value.	Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1790	$1,990	1845	$7,393	1866	$31,616
1791	1,984	1846	6,521	1867	29,368
1826	1,958	1847	4,758	1868	29,528
1827	6,492	1848	8,512	1869	19,213
1828	5,595	1849	10,632	1870	42,120
1829	5,592	1850	15,644	1871	37,383
1830	2,773	1851	23,096	1872	46,941
1831	7,378	1852	18,310	1873	53,909
1832	6,333	1853	53,685	1874	56,491
1833	12,159	1854	33,867	1875	92,253
1834	12,745	1855	32,119	1876	73,846
1835	16,427	1856	66,696	1877	87,355
1836	13,391	1857	34,256	1878	98,035
1837	14,249	1858	36,783	1879	80,898
1838	12,019	1859	47,261	1880	106,724
1839	11,645	1860	65,086	1881	123,177
1840	10,959	1861	40,524	1882	180,773
1841	6,737	1862	32,108	1883	227,547
1842	7,618	1863	88,244	1884	230,247
1843 (nine months)	2,907	1864	67,591	1885	135,385
1844	4,884	1865	93,258		

ABRASIVE MATERIALS.

BUHRSTONES.

The nearest approach to the hard French buhrstones is a stone occurring on an eminence known as Little Butte, in the Owen's River valley, Inyo county, California. It is hard, brecciated, and very much like the best French stone. The quantity has not been ascertained, but appears to be considerable. Although none of this material has been mined there is little doubt of its value for milling purposes, and it will probably be used in the future. In Ulster county, New York, the so-called Esopus stone has gained a definite footing as a substitute for buhrstone, for millstones for grinding chemicals and other materials except wheat. The production of this stone in 1885 is estimated at a value of $90,000. This, together with a less important production of Cocalico stone in Lancaster county, Pennsylvania, is the only domestic material used for millstones. The total value of all domestic millstones did not exceed $100,000 in 1885. The French millstones are seldom imported as such, but the stone is shipped in comparatively small pieces which are then dressed to a uniform size and carefully fitted together, making one millstone of the ordinary form. There is a continued decrease in the imports, due to the use of the roller process in flour mills.

Buhrstones and millstones imported and entered for consumption in the United States, 1868 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Rough.	Made into millstones.	Total.	Fiscal years ending June 30—	Rough.	Made into millstones.	Total.
1868	$74,224	....	$74,224	1877	$60,857	$23,068	$83,925
1869	57,942	$2,419	60,361	1878	87,679	1,928	89,607
1870	58,601	2,297	60,898	1879	101,484	5,088	106,572
1871	35,406	3,698	39,104	1880	120,441	4,631	125,072
1872	69,062	5,967	75,029	1881	100,417	3,495	103,912
1873	60,463	8,115	68,578	1882	103,287	747	104,034
1874	36,540	43,170	79,710	1883	73,413	272	73,685
1875	48,068	66,991	115,059	1884	45,837	263	46,100
1876	37,759	46,328	84,087	1885	35,022	455	35,477

GRINDSTONES.

The most noteworthy change in the grindstone industry during the year 1885 was the consolidation of the large producers in Ohio into the Cleveland Stone Company, which now furnishes nearly all the stone quarried in the State. The value of the total production may be estimated at $500,000, at an average value of $8 to $11 per ton.

Imports.—The importation of grindstones is given below.

Grindstones imported and entered for consumption in the United States, 1868 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Finished.		Unfinished or rough.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
1868	....	$25, 640	....	$35, 215	$60, 855
1869	....	15, 878	....	99, 715	115, 593
1870	....	29, 161	....	96, 444	125, 605
1871	385	43, 781	3, 957. 15	60, 935	104, 716
1872	1, 202	13, 453	10, 774. 80	100, 494	113, 947
1873	1, 437	17, 033	8, 376. 84	94, 900	111, 933
1874	1, 443	18, 485	7, 721. 44	87, 525	106, 010
1875	1, 373	17, 642	7, 656. 17	90, 172	107, 814
1876	1, 681	20, 262	6, 079. 34	69, 927	90, 189
1877	1, 245	18, 546	4, 979. 75	58, 575	77, 121
1878	1, 463	21, 688	3, 669. 41	46, 441	68, 129
1879	1, 603	24, 904	4, 584. 16	52, 343	77, 247
1880	1, 573	24, 375	4, 578. 59	51, 899	76, 274
1881	2, 064	30, 288	5, 044. 71	56, 840	87, 128
1882	1, 705	30, 286	5, 945. 61	66, 939	97, 225
1883	1, 755	28, 055	6, 945. 63	77, 797	105, 852
1884	....	....	....	....	86, 286
1885	....	....	....	....	50, 579

CORUNDUM.

Emery and corundum are found in many localities described in former reports, but all the emery used is imported, principally from Turkey, and the production of corundum is limited to the deposits at Corundum hill, North Carolina, and at Laurel creek, Georgia, as described in the last report. The production has not been reported. The mines are both operated by the Hampden Emery Company, of Chester, Massachusetts.

Foreign sources.—An interesting description of the corundum deposits in Asia Minor is contained in the report of Mr. W. E. Stevens, consul at Smyrna, abstracted below:

"Emery stone is found in nearly all parts of Asia Minor, and not unfrequently in the remote and almost inaccessible regions of the interior, where the natural obstacles are too great to offer any inducement to the miner. The principal mines are confined to the districts of Thyra and Aidin, situated to the southward from Smyrna, and not far distant from the line of the Ottoman railway. These are known as: The Tchavus, within one hour's ride from the town of Thyra, owned by Mr. Frederick Charnaud; the Hassan Tchaouslar, owned by Mr. Jackson; the Aladjali Tchiflik and Kourchak, owned by Mrs. Abbot; the Halka or Saladin, owned by Mr. Frederick Charnaud; the Akdere, owned by Mr. Glyka, and the Gurnush Dogh, owned by Mrs. Abbot. There is another mine near Milassa, the stone from which is brought for shipment to a place on the coast called Kuluk, near the gulf of Mendalia. It is either shipped direct from that place to foreign markets or brought to Smyrna in small sailing craft for reshipment.

"When well picked and free from unsound ore and waste, the emery from the Charnaud, Jackson, and Abbot mines is of good and nearly equal quality. The Glyka or Akdere stone is not as much sought after, while that excavated near Milassa, the larger part of which finds purchasers in the United States, is of inferior quality, the grain being smooth and a great deal of magnetic iron entering into its composition.

"The amount of stone annually shipped from Smyrna to Great Britain, the United States, France, Germany, and Belgium aggregates about 7,000 tons, the relative quantity consumed in each country being in the order named. In the matter of quality, manufacturers in France and Germany are extremely particular; they will have none but thoroughly picked stone, and willingly pay the highest prices to obtain it. In France, especially, Naxos emery, considered to be the best in the world, is used to the almost complete exclusion of all other kinds. In Great Britain, also, purchasers are particular as to quality; but in the United States, especially within a few years past, importers have encouraged the shipment of inferior or uncleaned stone, because of its lower price. Good clean lump emery stone can be contracted for here on board ships at $19.50 to $20.70 per ton of 2,240 pounds, and the same quality, but in smaller pieces, say 1¼ to 1½ inches, at $3.65 per ton less than these figures.

"The rates of freight for emery stone shipped in bulk by steamers to the ports of the north of France, the Netherlands, and Germany are from $3.90 to $4.38 per ton; to London, $2.33 to $2.92; to Liverpool, $3.90 to $4.87; to New York or Boston the freight is $1.22 to $2.44 per ton. Sailing ships with cargoes of licorice root require ballast, and so the stone is readily taken at almost a nominal freight.

"The customs duty is only 16 cents per ton, but as 'backsheesh' is indispensable in all dealings with Turkish customs officials, this charge is equivalent to 25 cents. The quay dues are 4 cents per ton. The Turkish Government levies a duty or royalty of $3.21 on every ton of emery shipped. In addition, the grantee must pay a tax of 2½ cents per acre on the area of land ceded him by his firman.

"The mines are opened by wells and galleries, and the stone is obtained in most instances by blasting, gunpowder and dynamite being freely used to extract it from between blocks of marble or masses of granite. The overseers and principal workmen at the mines are Italians, who are paid 82 cents per diem; the native workmen are paid only about half as much. In some cases the mining is attended with difficulty and expense. At the Jackson mine, for example, the stone is procured from a great depth, and is covered with water, necessitating the employment of a steam pump. At Kourchak, not even blasting is required, the emery being dug up from the red argillaceous earth wherewith it is mixed. The coating of the stone varies with the color of the earth or rock in which it is found—from red to brown, gray, or white; and, as a rule, no correct judgment of the quality can be formed from its outward appearance. But the grain must be closely examined. This should be hard, bright, and coarse, resembling gunpowder, and varying in hue from reddish black to dark bluish gray. The grain must be tested before one can certainly know its abrading power, which it has been ascertained does not solely depend upon the amount of alumina it contains, but also upon the particular way in which the particles have been placed by nature. In the Tchaous concession, near Thyra, a great deal of the emery is not mined, owing to the presence of mica in the grain.

"The emery is picked daily at the mines as fast as it is extracted, in some instances not one-half the quantity being selected. It is then conveyed by camels to the nearest railway station and from thence to Smyrna, where it is generally picked again previous to shipment. When the mines are situated on heights inaccessible to camels, the ore is brought down to the plain by donkeys. If the pieces are too large to be carried by camels, they are brought to the station in carts drawn by buffaloes. But these very large pieces are broken at the mines with sledge hammers, after having been subjected to the action of fire to facilitate their breaking. The railway rates are rather high; from Thyra to Smyrna, for instance, a distance of 60 miles, the charge is equal to $3.36 per ton; and from Cosbonnar, the railway station from which the greater part of the ore is brought, and distant 41 miles from Smyrna, the rate is $2.20.

"The mines are worked upon the strength of concessions, termed 'firmans,' granted by the Imperial Government for a period usually of ninety-nine years, or in cases where the emery has been found on 'nacouf' property, *i. e.*, belonging to the Turkish religious institutions, by special permit of the department at Constantinople which administers the 'nacouf' estates, and exacts payment to them of so much per kintol. A 'firman,' or concession, during the period it is in force, can be sold, transferred, and transmitted by inheritance, like other property in Turkey, provided due notice be given to the department of mines at Constantinople, and authorization formally obtained. The obtainment of a 'firman' is at all times attended with difficulties, loss of time, and expense. According to by-laws on mines, the formalities to be accomplished appear very simple and the cost of the concession reasonable, but an applicant soon finds all this to be a delusion. Its obtainment is at present still harder and more tedious to Europeans, owing to the reigning Sultan being averse to granting concessions to subjects of foreign Governments, although the grantee would always be amenable to Turkish law in all matters having reference to his concession. The difficulty can, however, be avoided by making the demand in the name of an Ottoman subject, and it would facilitate things all the more if he be, besides, a Mussulman. At all events, it is almost absolutely necessary that the demand of a foreigner be made at least jointly with an Ottoman subject, so that the latter's name may be also inserted in the firman presented for imperial sanction.

"*Naxos emery.*—The emery in the island of Naxos is farmed or let out by lease to firms or private individuals by the Greek Government for periods of twelve consecutive years. Sealed tenders are sent in by persons wishing to compete, and the contract is allotted to the highest bidder. The party who obtains the monopoly for twelve years has to deposit forthwith in the National Bank of Greece $19,300, to remain there as a guarantee for the fulfillment of his engagements during the whole period. He has to bind himself to take a minimum of 1,650 tons annually, at $42.50 per ton put free on board at Naxos, for the emery just as it is excavated, without selection.

"The lessee is free to take double or triple the quantity if he wishes but is obliged to take at least 1,650 tons. Formerly the price was higher and the minimum quantity fixed larger, but the contractors lost money. The lowest price at which Naxos emery could then be had from them was $48.70 per ton put free on board at Syra.

"The greater part of the emery has to be brought to the neighboring island of Syra, in sailing vessels, at the contractor's expense, where it is reshipped. Steamers or large vessels cannot load at Naxos, except during the fine season, owing to the absence of shelter, which renders the operation dangerous The contract of the present lessees, a Greek firm of Syra, has still about seven years to run. They will not sell to any one free on board, as their predecessors did, but have agencies and stocks in the principal markets of Europe and the United States."

Emery imported and entered for consumption in the United States, 1867 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Grains.		Ore or rock.		Pulverized or ground.		Powdered.	Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Tons.*		*Pounds.*			
1867	....	....	428	$14, 373	924, 431	$38, 131	....	$52, 504
1868	....	....	85	4, 531	834, 286	33, 549	....	38, 080
1869	....	....	964	35, 205	924, 161	42, 711	....	77, 916
1870	....	....	742	25, 335	644, 080	29, 531	....	54, 866
1871	....	....	615	15, 870	613, 624	28, 941	....	44, 811
1872	....	....	1, 641	41, 321	804, 977	36, 103	....	77, 424
1873	610, 117	$29, 706	755	26, 065	343, 828	15, 041	107	70, 919
1874	331, 580	16, 216	1, 281	43, 886	69, 890	2, 167	97	62, 366
1875	487, 725	23, 345	961	31, 972	85, 853	2, 990	20	58, 327
1876	385, 246	18, 999	1, 395	40, 027	77, 382	2, 533	94	61, 653
1877	343, 697	16, 615	852	21, 964	96, 351	3, 603	....	42, 182
1878	334, 291	16, 359	1, 475	38, 454	65, 068	1, 754	34	56, 601
1879	496, 633	24, 456	2, 478	58, 065	133, 556	4, 985	....	87, 506
1880	411, 340	20, 066	3, 400	76, 481	223, 855	9, 202	145	105, 894
1881	454, 790	22, 101	2, 884	67, 781	177, 174	7, 497	53	97, 432
1882	520, 214	25, 314	2, 765	69, 432	117, 008	3, 708	241	98, 695
1883	474, 105	22, 767	2, 447	59, 282	93, 010	3, 172	269	85, 490
1884	143, 267	5, 802	4, 145	121, 719	513, 161	21, 181	(*a*)....	....
1885	228, 329	9, 886	2, 445	55, 368	194, 314	8, 789	(*a*)....	....

a Not specified.

Exports of manufactured emery.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1878	$1, 608	1882	$813
1879	1, 265	1883	1, 857
1880	1, 312	1884	3, 565
1881	1, 242	1885	19, 232

INFUSORIAL EARTH.

The deposit of infusorial earth, locally known as "tripoli," on the Patuxent river, near Dunkirk, in Calvert county, Maryland, was referred to in the last report. Operations for mining this deposit upon an extended scale were begun in September, 1885, but the output was not over 250 tons before the close of navigation ended shipments for the year. It was shipped principally to New York for use as a nonconductor and also as a polishing powder. There is no record of work on the deposits near Richmond, Virginia, nor on those near Virginia City, Nevada, during 1885.

PUMICE STONE.

There was little change in the slight production of pumice stone near Lake Merced, a few miles from San Francisco, California. The production did not exceed 70 tons. The greater part of the pumice stone used for polishing wood surfaces, etc., is imported, according to the following table:

Pumice stone imported and entered for consumption in the United States, 1871 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1871	$6,448	1879	$12,892
1872	12,796	1880	15,520
1873	9,264	1881	19,052
1874	22,899	1882	29,370
1875	8,726	1883	50,634
1876	9,122	1884	26,667
1877	11,556	1885	14,147
1878	12,343		

NOVACULITE.

By George M. Turner.

The word novaculite (from *novacula*, a razor), according to its present use, is applied to a class of siliceous rocks which are valuable because of their grit or sharpening qualities as whetstones. This peculiar sharpening quality is due in some cases to crystalline silica, in others, according to a German writer, to small crystals of garnet or rutile.

Occurrence.—The principal source of the novaculite produced in this country at present, is the region embraced by Hot Spring and Garland counties, Arkansas. It is also quarried in Grafton county, New Hampshire, and in Orange county, Indiana. Quarries are reported in Onondaga county, New York, but no reliable information concerning them has been obtained.

Arkansas.—Although the main source of the Arkansas novaculite is in Hot Spring and Garland counties, a few deposits are found in Montgomery and Saline counties. The best oilstone comes almost entirely from Garland county. A tract of land about 50 miles long by 20 miles wide will include the area from which the oilstone is taken. Two varieties of novaculite are quarried here, and are commercially known under the names of "Washita" oilstone and "Arkansas" oilstone. The former is used by carpenters and wood workmen in general, while the latter is particularly adapted for the use of watchmakers, dentists, and surgeons.

The "Arkansas" stone is a very compact, bluish white, semi-translucent rock of uniform color and structure. The best "Washita" is less compact than the "Arkansas" stone, pure white and opaque. They are both composed of nearly pure, very fine-grained quartz, and differ from each other only in that the grains of quartz are finer and the spaces between them much smaller in the "Arkansas" than in the "Washita" stone. Both kinds are found in narrow leads from 5 to 15 feet wide, running northeast and southwest on the north side of the mountains of the Ozark range, and lying between walls of a very similar character. Some of these leads are less than a mile long, while others are several miles in length. The quality of the stone in the same lead often varies considerably as the quarrying progresses. Perfect whetstones of even grit, uniform in crystallization, and free from all impurities are found in only a few places, which are nearly always less than 100 feet in length, and are called pockets. The novaculite has been very much cracked and broken up by natural forces. The workable rock is often rendered worthless by the presence of vitreous lumps of quartz, which sometimes appear in the midst of the best producing rock, so that nearly one half of the rock taken out of the quarries goes into the waste pile. The hot springs occurring in the immediate neighborhood of the oilstone region probably play an important part in the deposition of silica in the form of novaculite. The structure of the Arkansas rock, from its appearance under the microscope, is similar to that of marble. The crystals in forming have so run into each other as to prevent the natural crystalline faces from appearing, but have left minute cavities between the quartz grains. Up to the present time no thorough investigation has been made as to how the silica came into solution and was deposited as novaculite. There are also no data which lead us to suspect that it was deposited in a different manner from the silica of the hot-spring region of the Yellowstone Park, which region has been carefully studied and described by Hayden in his report on the "Geological Survey of the Territories."

New Hampshire.—Although whetstone schists occur, according to Hitchcock's "Geology of New Hampshire," at Piermont, Lisbon, and Littleton, in Grafton county; Tamworth, Carroll county; and Connecticut Lake, Coos county, only the deposits in Littleton and Lisbon are worked. The novaculite taken from these quarries is known in the market as "chocolate" stone. It is very different, both in composition and structure, from the novaculite found in Arkansas. It is an argillitic mica schist of a dark gray color. Under the microscope were discernible: silica in the form of small quartz crystals; a substance which appeared black and could not be recognized by the microscope alone; minute crystals of garnet scattered through the whole mass; small plates of mica; and a few crystals of rutile. All the minute quartz crystals have their corresponding axes running parallel to each other. This arrangement, together with the mica present, gives to the rock its schistose structure and characteristic appearance. The small garnets present probably give to the rock its peculiar power for use as a whetstone. On a partial chemical analysis of the rock the substance which appeared black under the microscope proved to be a compound of manganese (probably one of the higher oxides) together with a small amount of iron.

Indiana.—Owing to the reticence of the firms with whom correspondence was undertaken concerning the so called "Hindostan" stone of Indiana, no reliable statements could be obtained from them. The only information upon which dependence can be placed is the account given of this whetstone in the Geological Report of Indiana for 1875, by E. T. Cox, the State geologist. The quarries are located near French Lick, Orange county. The rock is described as being of schistose structure, evenly stratified, and capable of being split with great ease. A large number of fossils of great beauty and size have been found in this rock; among them are beautifully preserved leaves and what appear to be crustacean tracks. There are also some fine dendrites. The stone quarried is of even texture and fine grained. The two forms under which it is placed on the market are the "Hindostan," which is white in color, and a buff variety known as the "Orange" stone. The novaculite of this locality, as determined by the fossils in the rocks, is said to be of the same geological horizon as the novaculite of Arkansas.

Production and prices.—About 500,000 pounds of the "Washita" and 30,000 pounds of the "Arkansas" stone in the rough are quarried and sold annually. The sound Washita is shaped into blocks of from 100 to 2,500 pounds, and shipped to the various whetstone factories throughout the country. The "Arkansas" stone is found in small pieces—sometimes as small as 2 pounds—and is packed in barrels for shipment. The stones are cut by means of saws. This method of preparing the stone for market is very slow, and hence the cost of the finished stone becomes greatly increased over that of the uncut. A gang of saws which will cut from 12 to 15 inches a day in marble will cut only about 4 inches of Washita and three-quarters of an inch of "Arkansas" stone. The rough Washita sells at the quarry at from 1 to 3 cents per pound, and the uncut "Arkansas" from 4 to 6 cents per pound. The latest price list of three combined firms (J. J. Sutton, of Hot Springs, Arkansas;

George Chase, of New York; and F. E. Dishman, of New Albany, Indiana) is as follows for the Washita stone:

Price list of Washita stone in 1885.

Grades.	Cents per pound.
Washita stone;	
No. 1 (extra)	25
No. 1	20
No. 2	16
Washita slips:	
No. 1 (extra)	50
No. 1	40

No. 1 is taken as their standard stone. "Arkansas" stone sells at from $1.25 to $2 per pound, according to the size of the piece. The great difference in price between crude and finished stone is due to the cost of preparing it for market.

The quarry of the "chocolate" stone has been, until quite recently, developed mainly for local use, so that only about 15,000 pounds of the stone are now annually taken from the quarry. The method of preparing this novaculite for market is practically the same as in case of the Washita and "Arkansas" stones. The stone is cut with iron blades by the use of sand and then finished on iron wheels with sand. This stone, not being as hard as the Washita and "Arkansas" stones, the cost of manufacture is much less. The estimated cost of preparing the "chocolate" stone for market is about 10 cents per pound.

Use.—Until quite recently the use of novaculite was confined to the sharpening of edged tools. Of late it has come into use for grinding, reducing, and finishing. It has invaded the limits of the grindstone, emery, rottenstone, tripoli powder, and has reached almost to rouge. It is cut and dressed in many different forms for varying purposes. In any hardware store it may be found in various shapes under the name of slips, adapted for sharpening tools of all forms. In dentists' supply stores it may be found in a number of cylindrical, circular, and ovoid forms, sufficiently small to be used between the teeth in dental work. In the manufacture and finishing of metals, novaculite is also used for truing turned and planed surfaces of iron and brass, slowly grinding down the imperfections left by the finish file and corundum wheel. Some varieties have also been used to a certain extent in the powdered form in place of emery.

PRECIOUS STONES.

By George F. Kunz.

In addition to the report on precious stones in the last volume, where the subject was treated in detail, the following pages are intended to show the progress in this field during 1885.

Work was carried on at the Mount Mica tourmaline locality, Paris, Maine, during the months of June, July, and August of the present year, but no crystals of any value were found, all efforts being directed to the removal of the rock above the tourmaline layer. Messrs. N. H. Perry and E. M. Bailey also worked at the Rumford locality for a few weeks, some good specimens were obtained.

For two months during the summer of 1885 work was carried on by the Emerald and Hiddenite Mining Company, at Stony Point, North Carolina, under the direction of the superintendent, Mr. W. E. Hidden, and with flattering success. A remarkably large pocket, containing fine crystals of muscovite with brilliant crystals of rutile implanted on them, was found and sold as cabinet specimens for $750. While they were working in the soil overlying the rock nine crystals of emerald were found all doubly terminated and measuring from 25 millimeters (1 inch) to 77 millimeters ($3\frac{1}{8}$ inches) in length and 42 millimeters ($1\frac{5}{8}$ inches) in width. This latter crystal is very perfect as a specimen; it is of a fine light green color and doubly terminated. It weighs $8\frac{3}{4}$ ounces, only one fourth ounce less than the famous Duke of Devonshire emerald crystal, and is held by the company at $1,500 as a cabinet specimen, the nine crystals together being held at $3,000.

Another of these crystals, which is doubly terminated, measures 63 millimeters ($2\frac{1}{2}$ inches) by 23 millimeters ($\frac{11}{12}$ inch), and is filled with large rhombohedral cavities, formerly containing dolomite. As mineral specimens these crystals are quite unique. The only gem which has been cut from this find was found in a pocket at a depth of over 43 feet. In color it is a pleasing light green, and weighs $4\frac{23}{32}$ carats. No crystal of finer color has yet been found in the United States, and this gem is held by the company at $200.

During the recent mining the largest fine crystal of lithia emerald ever found was also brought to light. It measures 68 millimeters ($2\frac{3}{4}$ inches) by 14 millimeters ($\frac{3}{5}$ inch) by 8 millimeters ($\frac{1}{3}$ inch). One end is of very fine color, and would afford the largest gem yet found of this mineral, weighing perhaps $5\frac{1}{2}$ carats. With this was a number of superior crystals and some ounces of common pieces of the same mineral. The owners estimate the worth of this entire yield of hiddenite at about $2,500.

A quantity of quartz filled with white byssolite or asbestiform mineral, which makes very attractive specimens, is valued at $250. On the whole this is an encouraging find for this line of minerals.

The locality for emeralds referred to in the last volume of "Mineral Resources of the United States," page 739, is only a duplication of the locality described as J. O. Lackey's in the *American Journal of Science*, III. series, Vol. XXVII., page 153.

Hiddenite has also been found during the past year in working the property known as the Morton tract, formerly known as Smeaton's and Lyon's properties ("Mineral Resources of the United States, 1883 and 1884," page 739).

Among the fictitous reports of the finding of gems may be mentioned that of the finding of three diamonds and about a dozen topazes in the gravel along the Sangamon river, near Springfield, Illinois.

What is perhaps the finest collection of rough diamond crystals in existence was exhibited during the past year by Messrs. Tiffany & Co. in New York. It consisted of 904 crystals, weighing in the aggregate 1,876$\frac{11}{32}$ carats, and was valued at $30,000. This has since been returned to Europe. For description see "Report of the American Association for the Advancement of Science, 1885," page 250.

At the meeting of the British Association, held at Birmingham, September, 1886, Prof. H. Carvil Lewis read a paper on "Diamond-bearing Peridotite," in which he said he had found in Kentucky, peridotite similar to that which occurs in the Kimberley mine, and was convinced that a search would reveal the presence of diamonds in that State. Now, the diamonds in the South African deposits are accompanied by carbonaceous shale which surrounds the mine, and is also scattered through the so called "blue stuff" in sizes varying from microscopic specks to large detached masses, and forming a sort of breccia, so to speak. The theory of the volcanic origin of these pipes was first advanced by Dr. E. Cohen. In the opinion of the writer the peridotite alone is not sufficient to account for the diamonds, but rather its mixture with the shale. Unless this carbonaceous shale is present under similar conditions in Kentucky the outlook for diamonds is not encouraging. In further confirmation of this view may be mentioned Prof. H. E. Roscoe's discovery of an aromatic hydrocarbon on treating diamond earth with hot water. This hydrocarbon, which he separated by digesting the earth with ether and allowing it to evaporate, was crystalline, strongly aromatic, volatile, burned with a smoky flame, and melted at 50° C. It was unfortunate that the quantity of the substance obtained was too small to admit of a full investigation. (Proceedings of Manchester Literary and Philosophical Society, October 17, 1884, page 5.)

A recent London periodical made the statement that any one who found the sapphire and ruby in its original matrix would soon be called the "King of Rubies," and that his fortune would be assured. This recalls the fact that Col. C. W. Jencks, of Boston, was the original finder of the true corundum gems *in situ* at the Jencks mine at Franklin, North Carolina; that he obtained from this locality nearly all of the fine crystals in the best American collections. One of the most interesting of his finds is a piece of a blue crystal with a white band running across it, and a place in the center where a nodule had dropped out.(*a*) This piece was cut and placed back in its original place, and the white band can be seen running across both gem and rock. Nearly all of the fine gems from this locality mentioned in the two previous reports were also brought to light by his mining. The gems were found here in their original matrix, but they were of such rare occurrence that it was not feasible to mine for them more thoroughly. The corundum mining has proved profitable, however, and is still carried on by Dr. Lucas.

A number of beryls of fine blue color, resembling the Mourne mountain beryls, have been found near Mount Antero, in the Arkansas valley, Chaffee county, Colorado. One of these was 4 inches long and three-eighths of an inch across with cutting material in it. The other crystals measured from 1 inch to 1¼ inches in length and one fifth to one third inch in width.

The large beryl mentioned in "Mineral Resources" for 1883 and 1884, has afforded the finest aquamarine of American origin known. It weighs 133¾ carats and measures 35 by 35 by 20 millimeters. It is a brilliant cut gem and with the exception of a few internal hair-like striations it is absolutely perfect. The color is a deep bluish green, equal to that of gems from any known locality.

Mr. George F. Breed, manager of the Valencia Mica Company, has cut from white beryls nearly 100 aquamarines, ranging from one half to 4 carats in weight, and of a light blue color, which were found in their mica mine at North Groton, Grafton county, New Hampshire.

A number of very fine, deep golden yellow, blue, and green beryls, equaling any ever found, were shown to the writer by Mr. M. W. Barse, of Olean, New York, taken from his mica mine between New Milford and Litchfield, Litchfield county, Connecticut. Some fine blood-red garnets from here were cut into gems. Some other parties have sold stones from the same locality which are possibly new gems nearly as hard as the sapphire, and said to come from South America. Since these statements gained currency abroad a correction was deemed necessary. They are undoubtedly American beryls from the above locality.

The finest large phenacite crystal ever found in the United States is the one in the possession of Mr. Whitman Cross. It was found at Crystal Park, Colorado, weighs 59 pennyweights 6 grains, and measures 46.5

a London *Jeweler and Metalworker*, August, 1886.

millimeters in length and 32 millimeters in thickness. Occasional transparent spots are noticeable. Full descriptions of phenacite from Crystal Park and Florissant, Colorado, and of topaz from near Pike's Peak and Devil's Head mountain, Colorado, and also of that found in nevadite at Chaltk mountain, in the same State, are given by Messrs. Cross and W. F. Hillebrand in "Bulletin No. 20 of the United States Geological Survey, Washington, 1885." Phenacite from the Florissant locality was also described by W. E. Hidden in the *American Journal of Science*, III. series, Vol. XXIX., page 249. These crystals at Florissant were first found by Mr. J. G. Heistand, of Manitou, Colorado.

Thousands of garnet crystals found at Ruby mountain, near Salides, Chaffee county, Colorado, have been made into paper weights and sold to tourists. Those weighing a few ounces sell for about 10 cents each, and one weighing 14 pounds was sold. Regular printed lists running up to 4 pounds weight are sent out with scale of prices attached. They have a chlorite coating which can easily be removed.

The finding in the heart of New York City, in Thirty-fifth street, between Broadway and Seventh avenue, of a garnet crystal as perfect as any ever found on this continent, and weighing 9 pounds 10 ounces, is of peculiar interest.

A full account of the wood jasper deposit of Arizona was published in the *Popular Science Monthly* for January, 1886, and in the *Scientific American* for January. Several thousands of dollars' worth of this material has been cut into paper weights, charms, and other articles of jewelry, or polished on one side for cabinet specimens. At the present time numbers of these articles are being cut and sold to tourists along the line of the Atchison, Topeka and Santa Fé railroad. The base of the *World*-fund memorial to be presented to the eminent sculptor, M. Bartholdi, was made out of pieces of this stone.

The compact quartzite of Sioux Falls, Dakota, has been quarried and polished for ornamental purposes. It is known and sold as "Sioux Falls jasper," and is really the stone referred to by Longfellow in his "Hiawatha" as being used for arrow heads. This stone is susceptible of a very high polish and is found in a variety of pleasing tints, such as chocolate, brownish red, brick red, and yellowish. The polished material has been sold to the amount of $15,000 during the last two years, and polishing works run by water power have been erected, and so ingeniously are they contrived that pillars, pilasters, mantels, and table tops can be made here as cheaply as anywhere. The pilasters of the German American Bank in Saint Paul, Minnesota, and the columns in the doorway of the Chamber of Commerce building in the same city are of this beautiful jasper. It is likely to become one of our choicest ornamental stones, especially effective in combination with the Minnesota red granite. Its great tensile strength, its high, almost mirror-like polish, the fact that though so highly polished, the stone is not slippery, the large pieces that can be quarried out, and the pleasing variety of colors, all combine to render this one of the most desirable building stones. Polishing mills have been built of sufficient capacity to polish $100,000 worth per annum, and in view of the unequaled facility with which it can be prepared for use, it could be made into tablets, blocks, columns, and tiles with advantage, and employed for fine interior and monumental work or in the more artistic branches of stone work. Some good results have been obtained with the sand blast on polished surfaces.

A remarkable mass of rock crystal was recently sent to Messrs. Tiffany & Co. from a place near Cave City, Virginia. Although it weighed 51 pounds this mass was only a fragment of the original crystal, which weighed 300 pounds, but was unfortunately broken in pieces by the ignorant mountain girl who found it. Still this fragment will furnish slabs 8 inches square and ½ to 1 inch thick. The original crystal, if it had remained intact, would have furnished a crystal ball perhaps 4½ to 5 inches in diameter and almost perfect. It is likely that further working in this locality would bring some fine material to light. (Trans. American Assoc. Adv. Science, 1886.)

Mr. F. C. Yeomans, of Washougal, Washington Territory, has found quite a variety of fine agates and moss agates at the above locality.

The menaccanite from Cumberland, Rhode Island, is often spotted with white quartz. Mr. E. Passmore, of Hope, Rhode Island, has cut it into oval stones several inches long, which admitted of a fine polish. This quality, coupled with its hardness, makes it a desirable ornamental gem stone.

It may be worthy of mention that the writer found pieces of peridot, of sufficient transparency to afford *gems* one-fifth inch long, in the largest mass of the Glorieta mountain, Santa Fé county, New Mexico, meteorite. (*American Journal of Science.*, III. series, Vol. XXXII., October, 1886.)

The turquois pseudomorph after apatite from Taylor's ranch on the northeast side of the Chowchilla river, California, has been described by G. E. Moore and V. von Zepharooich (*Zeitsch. fur Kryst. u. Min.*, Vol. X., p. 240). The turquois from Los Cerillos, New Mexico, has been fully analyzed and described by Prof. F. W. Clarke and Mr. J. S. Diller in the *American Journal of Science*, III. series, Vol. XXXII., page 211, September, 1886. Large quantities of this material have been sold, both as specimens and gems. Unfortunately many of those of finest color were found to have been artifically stained. A full series of this mineral has been presented to the National Museum.

Malachite in large masses has been found at the Copper Queen mine at Bisbee, Arizona. One of these masses weighed 15 pounds and others were nearly as large. All were of good enough quality and large enough for tablet tops.

Mr. F. F. Chisolm states that specimens of what appears to be amber were found in one of the Union Pacific coal mines in Wyoming in 1885, but the tests are not yet completed, so that its genuineness cannot be asserted. He says: "The material which was brought to Denver was hard, highly electric, and of a good clear yellow color. Its fusion point was a little low, and the odor of a burning fragment slightly resembled that of burning india rubber. In places the substance occurs 2 inches thick. The exact place of its occurrence has not yet been ascertained." A few of the choice minerals and gems in the collection of Mr. Clarence S. Bement were well described by Prof. Gerhard vom Rath in the *Jewelers' Circular*, Vol. XVI., No. 12, January, 1886.

Mr. William H. Andrews, of Gouverneur, Saint Lawrence county, New York, has a remarkable collection of 2,200 specimens of polished marbles, serpentines, jaspers, agates, and other ornamental stones, principally from Saint Lawrence, Jefferson, and adjacent counties. A variety of other minerals are also to be found in this collection, which, though the polishing is mainly the work of Mr. Andrews himself, is one of the most complete series of the kind in the United States.

Popular articles have appeared during the year on North Carolina gem stones by Mr. C. D. Smith; on diamonds by William Wareing Habersham (both of these appeared in *Dixie*, published in Atlanta, Georgia, January, 1886), and an article on how hiddenite was formed, by Mr. W. E. Hidden, in *Dixie*, December, 1885.

The National Museum collection of gems, formed by Prof. F. W. Clarke, is now one of the most complete for species in the United States, and as many of the gems are of more than average merit and all can have access to them, this is one of the best opportunities afforded the student in this country. The *Popular Science Monthly* for April, 1886, contains a description of this collection, which, with additions to date, will also appear in the bulletin of the National Museum.

An immense number of small collections of minerals have been sold during the past year, usually consisting of specimens not over $\frac{1}{4}$ to 2 inches square of a series of some ten to fifty of the principal minerals, or the minerals of a section, or of polished and ornamental stones; sets of fifty; selling for from $1 to $5, are arrayed in cases or pasted to boards. The name which is given to them is generally copyrighted. Thousands of these collections are sold annually.

PRODUCTION OF PRECIOUS STONES IN THE UNITED STATES.

While it is impossible to obtain exact returns of the values of the precious stones found in the United States, it is believed that the estimates given in the following table represent, roughly, the total values and the proportionate values of the several mineralogical species. Gold quartz, the value of which should be more properly perhaps included under the head of gold mining, is added at the close of the list.

Estimated production of precious stones in the United States in 1883, 1884, and 1885.

Species.	1883.			1884.			1885.		
	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
Diamond	....	....	....	....	$800	$800	....	....	....
Sapphire gems	$200	$2,000	$2,200	$250	1,500	1,750	....	$500	$500
Chrysoberyl	100	....	100	25	....	25	....	....	....
Topaz	1,000	....	1,000	200	300	500	$1,000	250	1,250
Beryl	200	300	500	300	400	700	250	500	750
Emerald	500	....	500	....	....	....	3,000	200	3,200
Hiddenite	100	500	600	....	....	....	500	2,000	2,500
Tourmaline	....	....	....	1,500	500	2,000	500	100	600
Smoky quartz	2,500	7,500	10,000	2,000	10,000	12,000	2,000	5,000	7,000
Quartz	10,000	1,500	11,500	10,000	1,500	11,500	10,000	1,500	11,500
Silicified wood	5,000	....	5,000	10,000	500	10,500	5,000	1,500	6,500
Garnet	1,000	5,000	6,000	1,000	3,000	4,000	200	2,500	2,700
Anthracite	....	2,500	2,500	....	2,500	2,500	....	2,500	2,500
Pyrite	1,500	500	2,000	2,000	1,000	3,000	1,500	500	2,000
Amazonstone	3,500	250	3,750	2,500	250	2,750	2,500	250	2,750
Catlinite (pipestone)	10,000	....	10,000	10,000	....	10,000	10,000	....	10,000
Arrow points	1,000	....	1,000	1,000	....	1,000	....	2,500	2,500
Trilobites	500	....	500	500	....	500	....	1,000	1,000
Sagenitic rutile	500	500	1,000	500	500	1,000	....	250	250
Hornblende in quartz	500	100	600	500	100	600	....	300	300
Peridot	50	250	300	50	100	150	....	50	50
Thompsonite	250	500	750	250	500	750	250	500	750
Diopside	200	100	300	....	....	....	100	....	100
Agate	1,000	500	1,500	4,000	500	4,500	1,000	1,000	2,000
Chlorastrolite	500	1,000	1,500	500	1,000	1,500	....	....	....
Turquois	1,500	500	2,000	1,500	500	2,000	1,500	2,000	3,500
Moss agate	1,000	2,000	3,000	1,000	2,000	3,000	500	2,000	2,500
Amethyst	2,000	250	2,250	2,000	250	2,250	2,000	100	2,100
Jasper	2,000	500	2,500	2,000	500	2,500	....	....	....
Sunstone	250	200	450	250	200	450	250	100	350
Fossil coral	500	250	750	500	250	750	....	....	....
Rutile	....	....	....	....	....	....	750	....	750
Total	47,350	26,700	74,050	54,325	28,650	82,975	42,800	27,100	69,900
Gold quartz	40,000	75,000	115,000	40,000	100,000	140,000	40,000	100,000	140,000

By recalculating from the value of the diamond carat as used in different countries the equivalents in the metric system, the weights in the four places of decimals, according to Mr. Louis D'A. Jackson, in his "Modern Metrology," page 377, will be found in the following table:

Weight of a diamond carat in different countries.

Countries.	Weight.	Countries.	Weight.
	Gram.		*Gram.*
Turin	.2135	Turkey	.2005
Persia	.2095	Spain	.1999
Venice	.2071	Java, Borneo	.1969
Austro-Hungary	.2061	Florence	.1965
France	.2059	Arabia	.1944
Portugal, Brazil	.2058	Egypt	.1917
Germany	.2055	Bologna	.1886
England, British India	.2053		
Holland, Russia	.2051	Average weight of diamond carat	.2020

IMPORTS.

Diamonds and other precious stones imported and entered for consumption in the United States, 1867 to 1885, inclusive.

Fiscal years ending June 30—	Glazier's.	Dust.	Rough or uncut.	Diamonds and other stones not set.	Set in gold or other metal.	Total.
1867	$906	....	....	$1,317,420	$291	$1,318,617
1868	484	....	....	1,060,544	1,465	1,062,493
1869	445	$140	....	1,997,282	23	1,997,890
1870	9,372	71	....	1,768,324	1,504	1,779,271
1871	976	17	....	2,349,482	256	2,350,731
1872	2,386	89,707	....	2,939,155	2,400	3,033,648
1873	....	40,424	$176,426	2,917,216	326	3,134,392
1874	....	68,621	144,629	2,158,172	114	2,371,536
1875	....	32,518	211,920	3,234,319	....	3,478,757
1876	....	20,678	186,404	2,409,516	45	2,616,643
1877	....	45,264	78,033	2,110,215	1,734	2,235,246
1878	....	36,409	63,270	2,970,469	1,025	3,071,173
1879	....	18,889	104,158	3,841,335	538	3,964,920
1880	....	49,360	129,207	6,690,912	765	6,870,244
1881	....	51,409	233,596	8,320,315	1,307	8,606,627
1882	....	92,853	449,313	8,377,200	3,205	8,922,571
1883	....	82,628	443,996	7,598,176	2,081	8,126,881
1884	22,208	37,121	367,816	8,712,315	(a)	9,139,460
1885	11,526	30,426	371,679	5,628,916	(a)	6,042,547

a Not specified.

Imports of substances not included in the foregoing table, 1868 to 1885, inclusive.

Fiscal years ending June 30—	Unmanufactured agates.	Bookbinders' and other manufactured agates.	Carnelian.	Brazil pebbles.	Amber.	Amber beads.	Unmanufactured coral.	Manufactured coral.	Unmanufactured meerschaum.	Total.
1868	......	......	......	......	......	......	......	$62,270	......	$62,270
1869	......	$70	$269	......	$427	......	......	22,417	$6,407	29,590
1870	......	......	766	......	1,433	......	......	18,975	3,998	25,172
1871	......	1	661	......	180	......	......	37,877	698	39,417
1872	......	529	207	......	2,426	......	$83	59,598	2,194	65,037
1873	$151	1,310	......	$1,237	1,534	$595	230	63,805	5,608	74,470
1874	177	1,524	......	......	1,448	1,057	527	28,152	270	33,155
1875	520	5,165	......	57	7,169	715	1,278	33,567	2,902	51,373
1876	293	1,567	......	......	15,502	187	109	33,559	21,939	73,156
1877	579	1,904	(a)69	......	17,307	329	718	28,650	9,304	58,860
1878	82	404		76	13,215	1,119	1,252	12,667	16,308	45,123
1879	138	364	......	......	17,821	203	147	11,327	19,088	49,088
1880	57	2,346	......	......	36,860	2,317	62	5,492	30,849	77,983
1881	486	1,700	......	5	42,400	1,102	89	2,501	72,754	121,037
1882	901	5,084	......	111	72,479	4,174	1,474	669	56,118	141,010
1883	14	2,895	......	......	40,166	3,472	681	1,303	58,885	107,416
1884	......	6,100	......	3,496	56,301	4,692	158	(b)	43,169	113,916
1885	124	......	......	6,541	21,722	3,242	659	(b)	42,590	74,878

a Not separately classified since 1877.

b Not specified.

FERTILIZERS.

PHOSPHATE ROCK.

By David T. Day.

SOUTH CAROLINA.

The production of phosphate rock in South Carolina increased during 1885, but the conservative influence of the Phosphate Miners' Exchange limited the extension of mining territory, as the mines already opened had capacity fully equal to the demands of the trade. The shipments from Charleston increased slightly. From Beaufort there was a decided increase, both in foreign and domestic shipments. Thus the total production, including foreign and domestic shipments and the home consumption, amounted to 437,856 long tons for the calendar year 1885, an increase of 40,118 tons over the calendar year 1884, or of 6,077 tons over the fiscal year 1884. Of this amount 189,096 tons were shipped from Charleston, an increase of 613 tons over 1884. From Beaufort 188,760 tons were shipped, an increase of 39,505 tons. The amount consumed by home fertilizer works, 60,000 tons, was about the same as the year before. This is all for the calendar year, while in the table to follow the years are trade years except 1885, in which the seven months are given to complete the calendar year.

Phosphate rock (washed product) mined by the land and river mining companies of South Carolina.

Years ending May 31—	Land companies.	River companies.	Total.
	Long tons.	*Long tons.*	*Long tons.*
1867	6	....	6
1868	12,262	....	12,262
1869	31,958	....	31,958
1870	63,252	1,989	65,241
1871	56,533	17,655	74,188
1872	36,258	22,502	58,760
1873	33,426	45,777	79,203
1874	51,624	57,716	109,340
1875	54,821	67,969	122,790
1876	50,566	81,912	132,478
1877	36,431	126,569	163,000
1878	112,622	97,700	210,322
1879	100,779	98,586	199,365
1880	125,601	65,162	190,763
1881	142,193	124,541	266,734
1882	191,305	140,772	332,077
1883	219,202	159,178	378,380
1884	250,297	181,482	431,779
1885	225,913	169,490	395,403
1885 (June 1 to December 31)	149,400	128,389	277,789

The following table gives the distribution of the phosphates. The foreign shipments from Charleston decreased slightly over the previous year, but the shipments to domestic ports increased. The total amount exported has increased. The shipments to the West have also increased, although manufactured fertilizers are sent westward in greater quantity than phosphate rock.

Detailed statement of total foreign and coastwise shipments and local consumption since June 1, 1874.

Periods.	Shipments and consumption.	Beaufort.	Charleston.	Other points.	Total.
		Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
June 1, 1874, to May 31, 1875	Foreign ports	44, 617	25, 929		70, 546
	Domestic ports	7, 000	25, 560		32, 560
	Consumed		19, 684		19, 684
	Total	51, 617	71, 173		122, 790
June 1, 1875, to May 31, 1867	Foreign ports	50, 384	25, 431		75, 815
	Domestic ports	9, 400	28, 831		38, 231
	Consumed		18, 850		18, 850
	Total	59, 784	73, 112		132, 896
June 1, 1876, to May 31, 1877	Foreign ports	73, 923	28, 844		102, 767
	Domestic ports	6, 285	40, 768		47, 053
	Consumed		13, 400		13, 400
	Total	80, 208	83, 012		163, 220
June 1, 1877, to May 31, 1878	Foreign ports	100, 619	21, 123		121, 742
	Domestic ports	8, 217	60, 729		68, 946
	Consumed		17, 635		17, 635
	Total	108, 836	99, 487		208, 323
June 1, 1878, to May 31, 1879	Foreign ports	97, 799	21, 767		119, 566
	Domestic ports	8, 618	52, 281		60, 899
	Consumed		18, 900		18, 900
	Total	106, 417	92, 948		199, 365
June 1, 1879, to May 31, 1880	Foreign ports	47, 157	14, 218		61, 375
	Domestic ports	13, 346	94, 002		107, 348
	Consumed		22, 040		22, 040
	Total	60, 503	130, 260		190, 763
June 1, 1880, to May 31, 1881	Foreign ports	62, 200	8, 568		70, 768
	Domestic ports	65, 895	91, 929		157, 824
	Consumed		38, 142		38, 142
	Total	128, 095	138, 639		266, 734
June 1, 1881, to May 31, 1882	Foreign ports	89, 581	22, 905		112, 486
	Domestic ports	57, 465	111, 314	7, 875	176, 654
	Consumed		42, 937		42, 937
	Total	147, 046	177, 156	7, 875	332, 077
June 1, 1882, to May 31, 1883	Foreign ports	94, 789	28, 251		123, 040
	Domestic ports	36, 175	150, 545	26, 000	212, 720
	Consumed		42, 620		42, 620
	Total	130, 964	221, 416	26, 000	378, 380
June 1, 1883, to May 31 1884	Foreign ports	132, 114	20, 539		152, 653
	Domestic ports	34, 711	181, 363	6, 329	222, 403
	Consumed	5, 800	50, 923		56, 723
	Total	172, 625	252, 825	6, 329	431, 779
June 1, 1884, to May 31, 1885	Foreign ports	111, 075	11, 495		122, 570
	Domestic ports	30, 963	161, 700	13, 170	205, 833
	Consumed	12, 000	55, 000		67, 000
	Total	154, 038	228, 195	13, 170	395, 403
June 1, 1885, to Dec 31, 1885	Foreign ports	105, 761	8, 581		114, 342
	Domestic ports	16, 321	112, 126		128, 447
	Consumed	5, 000	30, 000		35, 000
	Total for seven months	127, 082	150, 707		277, 789

Prices.—The combination of producers called the "Phosphate Miners' Exchange," advanced the price of phosphates during 1885, and kept it uniform at $6.50 per long ton for "crude," and $7.50 for "hot-air dried" "land" rock delivered in Charleston. At the mines near Charleston both crude and hot-air dried are worth about 20 per cent. less. For the past two years some companies have ground the rock for treatment with acid at the same time that it is dried. This ground rock was sold for $2 per short ton more than hot-air dried; lately the price has declined to 50 cents above hot-air dried. "River" rock is worth intrinsically $1 less per ton than land rock, based upon its lower percentage of phosphoric acid, by which all the valuations are made. While the above prices ruled steadily during 1885, a marked change came shortly after the close of the year. In February, 1886, the Phosphate Miners' Exchange was dissolved and prices became irregular; they declined to $4.50 to $5 per ton for crude rock.

The problem of extending river mining to deeper water has been actively discussed during 1885. It is claimed that an advance in this direction has been made by the introduction of the Brotherhood dredge, mention of which was made in the preceding report. The machine differs from the ordinary clam-scoop dredge by having the scoop in parts like the petals of a tulip. In descending these are opened, and the points striking the smooth layer of phosphate rock are intended to break into it and close upon the loosened pieces. It is generally supposed to be a success. It brings up loose rock rapidly and has undoubtedly done good work in some strata, but whether deep-water mining has been successfully solved remains a question. Many doubt the machine's ability to break up thick strata with smooth surface in deep water. The only actual defect thus far encountered is that in breaking up smooth strata much extraneous matter is brought up. This goes with the phosphate directly to the crusher, giving no chance for separation.

The following is a list of the phosphate mining companies in South Carolina:

List of phosphate mining companies in South Carolina.

LAND COMPANIES.

Charleston Mining and Manufacturing Company, Ashley river.
Bolton mines, Ashley river.
C. C. Pinckney, Ashley river.
Rose Mining Company, Ashley river.
William Gregg, Ashley river.
Saint Andrew's Mining Company, Stono river.
A. B. Rose, Ashley river.
Wando Company, Ashley river.
J. F. Fishburne, Ashley river.
F. C. Fishburne, Edisto river.
L. N. Chisolm, Ashley river.
Cahill & Wise, Wando river.

Charles H. Drayton & Co., Ashley river.
Pacific Guano Company, Bull river.
E. Willis, Charleston.
G. H. Linstedt, Charleston.
Charleston Phosphate Company, Charleston.
Dotterer & Ravenel, Charleston.
D. W. Ebaugh, Charleston.
W. L. Bradley, Rantowle's creek.
C. O. Campbell, Charleston.
Kiawah Company, Charleston.

RIVER COMPANIES.

Coosaw Company, Coosaw river.
Farmers' Company, Coosaw river.
Oak Point Mining Company, Bull river.
Carolina Phosphate Company, limited, Beaufort.
Phosphate Mining Company, limited, Beaufort.
J. B. & J. Seabrook, Beaufort.
W. T. Seward & Co., Beaufort.
J. G. Taylor, Beaufort.
W. W. Farr, Beaufort.
Tideman & Venning, Charleston.
Sea Island Chemical Company, Saint Helena sound.
John Hanson, Charleston.

The quantity of phosphates used in manufacturing fertilizers in Charleston remains practically constant. The following is a list of those engaged in the manufacture and a table is given of the shipments of manufactured fertilizers from Charleston:

List of manufacturers of superphosphates and fertilizers in South Carolina.

Name.	Capital.	Location.
Wando Phosphate Company	$100,000	Ashley river.
Atlantic Phosphate Company	200,000	Do.
Stono Phosphate Company	135,000	Do.
Pacific Guano Company	1,000,000	Do.
Edisto Phosphate Company	200,000	Cooper river.
Etiwan Phosphate Company	300,000	Do.
Ashepoo Phosphate Company	125,000	Ashley river.
Charleston Phosphate Company	50,000	Do.
C. C. Pinckney Company	100,000	Do.
H. Bulwinkle Company	50,000	Do.
Wilcox, Gibbes & Co	100,000	Charleston.
Woodstock Lime Company	100,000	Woodstock.
Domestic Fertilizer Company	50,000	Columbia.
Sea Island Chemical Company	100,000	Beaufort.
W. T. Seward & Co	500,000	Do.
Port Royal Fertilizer Company	125,000	Do.

Statement of manufactured fertilizers shipped from Charleston since 1878.

Calendar years.

By—	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
South Carolina railway:								
January	6,789	6,559	17,449	14,930	18,391	17,721	21,443	23,299
February	12,662	14,445	17,368	18,523	19,837	32,618	29,171	27,175
March	15,019	12,044	10,814	18,721	12,107	21,626	18,118	26,846
April	1,795	2,513	2,761	3,599	1,711	2,971	5,019	4,813
May	44	53	707	189	548	720	441	210
Northeastern railroad:								
January	879	285	1,381	2,186	2,424	5,430	5,194	7,070
February	1,817	3,231	3,366	3,256	5,362	9,708	12,318	11,398
March	3,371	2,731	3,382	4,939	7,285	9,091	7,822	10,570
April	1,579	634	977	3,044	955	1,638	2,413	2,001
May	141	48	201	28	198	216	220	119
Charleston and Savannah railway:								
January	676	1,016	1,102	951	690	2,059	4,196	3,435
February	584	1,791	1,249	1,155	1,272	2,888	5,373	4,457
March	436	1,444	476	2,375	594	1,003	3,525	2,466
April	95	675	203	629	100	225	1,234	640
May	2	5	9	50	14	33	20	27
Georgetown, Peedee, Santee, and Edisto steamers:								
January to June	1,263	1,364	2,560	2,950	2,002	3,517	6,309	6,869
Total five months	47,152	48,838	64,005	77,525	73,490	111,464	122,816	131,395
For remainder of year	4,848	11,162	15,995	25,000	29,000	20,000	17,184	18,605
Grand total	52,000	60,000	80,000	102,525	102,490	131,464	140,000	150,000

NORTH CAROLINA.

New localities, lying 25 to 50 miles to the north, west, and south from the field defined in the report for 1883 and 1884, have been found, and some slight use of the beds has been made, as indicated in the following extract from a letter from Dr. Charles W. Dabney, jr., director of the North Carolina Experiment Station:

"There are no agents in the field, but the people send specimens and descriptions showing that fragments of beds at least exist throughout a much larger territory than was at first supposed.

"The following analyses of these specimens have been made at the station:

Analyses of North Carolina phosphates.

Kind.	Locality.	Sender and address.	Sand and insoluble matter.	Carbonate of lime.	Phosphate of lime.	Phosphoric acid.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*
Coprolite	Bladen county	D. A. Lamont, Brinkland			16.56	7.56
Do	do	do			14.43	6.61
Phosphate rock		General W. G. Lewis, Goldsborough.	7.09	18.42	47.50	21.76
Do	Pender county		22.75	16.06	43.72	20.03
	Edgecombe county	Dr. A. B. Nobles, Tarborough.	43.32	14.55	21.52	9.86
		D. S. Cowan, Robeson	38.99	7.67	25.12	11.50

"No attempts have been made at the utilization of the simple phosphates. The low price of Charleston phosphates, the vast quantity which may be said to be 'in sight' there and which can be prepared for the market on short notice, and the advantages explained in your report for 1883 and 1884, which Charleston possesses, have deterred capital from developing our phosphate fields for a time at least. The country through Duplin county, etc., is undulating, and the beds, though very easily and economically workable, are small. Still 40,000 tons of superphosphates are sold along the Wilmington and Weldon railroad, within 50 miles of the phosphates, every year. It was shown that crude North Carolina rock could be put on this railroad for about $3 per ton, and that it would make, with 650 pounds of 47° Baumè acid, good 12 per cent. soluble superphosphate. The rock must come into use eventually.

"Much more practical interest is being taken in the phosphatic conglomerate, which occurs in such masses near the surface at Castle Haynes, Rocky Point, etc. This is ground fine and sold at retail in bags for $7 and $8 per ton, to be used as lime, ashes, plaster, etc., have been used, that is, on clover, peas, grasses, winter crops, and as an ingredient of composts. The material, as marketed, contains 25 to 35 per cent. of phosphate and 50 to 60 per cent. of carbonate of lime. Mixed with German kainite and a large quantity of manure, and put through a good rotting, it will be understood that this makes a valuable farm fertilizer. This is getting to be the practice. Three mills are already doing a fair business in grinding this rock and others are proposed for next season. All the mills together sold about 4,000 tons of the ground conglomerate under the names 'carbo-phosphate,' 'lime phosphate' 'coprolite manure,' etc."

FLORIDA.

Distribution of phosphates.—It was mentioned in the last report that phosphates have been noticed in several counties in Florida, particularly in Clay, Alachua, Duval, and Gadsden counties. During 1884 and the early part of 1885 explorations were made by Dr. Lawrence C. Johnson which threw considerable light upon the situation of these deposits and the chances of their being utilized as fertilizers.

The deposits follow an irregular line from Thomasville, Georgia, down through Hamilton, Suwanee, Alachua, Marion, Sumter, and Polk counties, disappearing in Manatee county in the region of Charlotte Harbor. They have been noticed more particularly from Live Oak, Suwanee county, to Ocala, in Marion county, and only this region has been studied with any care. The region north has been traced by popular report, not by careful survey. South of Ocala the information is by no means exact, but many specimens have been examined which seem to ally the rock to that northward. The deposits are in high land, and the line of phosphates is generally coincident with the upper part of a ridge running approximately north and south and containing the highest elevations in the State. The phosphates may be said, therefore, to extend along the backbone of the State. As usual, the elevation of this ridge has become very irregular by processes of erosion, and hence the deposits of phosphates jut out irregularly along the line traced out. In many places erosion by floods, etc., has carried large quantities of phosphatic bowlders to adjacent lower tracts of land.

Character of the rock.—Commencing with the upper limits of the deposit, it is impossible to say how much of the rock is really phosphatic and how much is Vicksburg limestone, with which the former has been confused. From Live Oak to Ocala there is little of the limestone, but the phosphate rock is very abundant. It is usually a very porous rock, containing through its mass the bones and teeth of various vertebrates, principally reptiles and sharks, with a few obscure casts of mollusks. In badly-drained spots it is wet and then soft, so that it can be easily broken, but on drying it becomes so much harder that it is valued as a building stone, and has been much used for chimneys and underpinning for houses; it is known as "chimney rock" by the people. In some localities the rock *in situ* is not so porous and contains more fossils. Geological observations make it appear that the deposits, which are estuary formations, extend through all the Tertiary strata, but are possibly more frequent in the Miocene. As the ridge with its phosphate deposit skirts the great region of depression which includes the sinks of Alachua county, it is probable that the phosphates mark an old shore line on the east side of a series of lagoons, of which the depressions are remnants. South of Ocala the character of the rock changes; it becomes oolitic in appearance, and seems to belong to a later formation. Here again there is no accurate information as to just how much of the rock is phosphatic. The deposits which have been carefully examined lie between Live Oak and Ocala. Of these the more interesting are the following:

Preston's sink.—Two and one-half miles north of Waldo, in Alachua county, there is a large dry sink in which Mr. John A. Preston found phosphate rock at a depth of 50 to 75 feet. The deposit is large and very abundant in fossils it is probably the richest in quality, the indications being that it may contain 25 per cent. phosphoric acid. At Fort Harley, 3½ miles north northwest of Waldo, phosphate rock is found *in situ*. Santa Fé lake, in this same region, has many deposits around its borders.

The Devil's Millhopper.—This is another sink about 5 miles west of Gainesville. It contains loose bowlders of phosphate rock in large quantity. Near it is a large quarry of building rock, also phosphatic, situated 2 miles southwest of Gainesville. This is probably not as rich as the others, but it is of great extent.

Simmon's quarry.—Three miles west of Hawthorne, in Alachua county, there is a deposit in land which is slightly higher than the surrounding country. There cannot be less than 35 acres of the deposit, and it may exceed 50 acres. It was analyzed by Prof. C. A. Colton, of Terre Haute, Indiana, as follows:

Analysis.

	Per cent.
Calcium phosphate	45.72
Calcium carbonate	22.00
Moisture	5.00

This is the only known quantitative analysis of phosphate rock in Florida.

Newnansville.—Three miles northwest of this place there is a very large deposit, the quality of which is unknown. Much phosphatic marl is also found on the Santa Fé river in this neighborhood.

History and utilization.—Dr. C. A. Simmons, of Hawthorne, was the first to discover that the principal building rock of central Florida contains a considerable amount of phosphoric acid. In 1879 he located the quarry near Hawthorne, and two years ago began mining the rock and converting it into a fertilizer, this has now been discontinued, owing to lack of capital. Dr. Simmons is thus entitled to the credit of first recognizing Florida phosphates. In 1884 Mr. John A. Preston noticed the peculiar odor characteristic of phosphate rock while digging out stone for a house foundation in the sink on his land near Waldo; finding also many sharks' teeth and bones; he tried it on some very poor land; it proved so valuable as a fertilizer that he has used it ever since. In the same year Judge James Bell, of Gainesville, discovered phosphates in the Devil's Millhopper. All the other deposits have been recognized as phosphates by Dr. Lawrence C. Johnson, United States Geological Survey.

Phosphate rock and phosphatic marl have been noticed in some isolated spots in other parts of the State. Some of these have been used locally as fertilizers; this is, however, the only test to which they have been subjected. At Enterprise an oölitic rock has been found similar to the southern part of the ridge deposits. The shell formation at Rock Ledge, on the Indian river, has been subjected to a quantitative analysis by Mr. G. M. Turner, of Johns Hopkins University, which showed a trace of phosphoric acid. At Black creek, in Clay county, phosphate rock similar to that in Alachua county has been found. In digging the pump well for the Jacksonville water works, on the northern boundary of the city, phosphates were noticed. The well is 50 feet in diameter and 32 feet in depth. At a depth of 20 to 23 feet a layer of greenish-brown marl 3 to 5 inches thick was found, which contained sharks' teeth and apparently considerable calcium phosphate. This layer is on top of rock composed of limestone from marine shells, sand, etc.; some of this limestone rock has such perfect casts of shells that they can be dentified; there are also cavities in this rock filled with the phosphatic marl. Marl beds containing fossils have been observed by Mr. John F. Rollins on the bank of Fort George inlet, in Duval county, near the mouth of the St. John's river.

Review.—It seems probable that the phosphate beds already described are by no means the only ones in the State. Indeed, it is a common opinion that phosphates underlie nearly all of the so-called "high hammock land." This statement lacks verification, but the deposits already located should be sufficient to institute active measures towards their utilization. The prospect of manufacturing superphosphates from them is certainly as good as in the new field in North Carolina, the need of fertilizers is as great, and the competition of South Carolina rock less to be feared. As the matter rests now, it remains for the owners of the mines to repeat the energy shown by the North Carolina Experiment Station in finding by accurate analyses the phosphates which are best suited for manufacture. These will probably be found in the neighborhood of Gainesville, where the deposits are probably sufficiently rich, and freight facilities good. But experience has shown in other fields that good phosphates are frequently close beside those too poor in phosphoric acid to be profitably mined. Hence much careful selection and analytical work must precede the successful manufacture of fertilizers in Florida.

MISSISSIPPI.

The cretaceous marls of Alabama, described in the last report, extend into Mississippi, and are found in many places in the northeastern portion of the State. Their occurrence, principally as greensand marls, in the greater portion of Tippah, Tishomingo, Pontotoc, Itawamba, Chickasaw, Monroe, Oktibbeha, Lowndes, Noxubee, and Kemper counties, was emphasized by Professor Hilgard in the State Geological Survey report published in 1860. This has led to considerable local use of the marls by the farmers as a dressing for the soil. Greensand and clay marls are met with in a line crossing the State from Vicksburg to the Alabama line. Tertiary marls are scattered quite generally over the southern portion of the State. In the neighborhood of Byram station and near Jackson, in Hinds county, and near Meridian, Lauderdale county, these marls have lately been sold as an ingredient for fertilizers, consisting principally of cotton-seed meal mixed with the marl. The largest deposit known in the State is near Shuqualak station, in Noxubee county; here the phosphoric acid reaches perhaps an average of 5 per cent. The deposit is similar to that at Coatopa, Alabama.

The analyses published by Hilgard and later reports from the State chemists limit the usual amount of phosphoric acid to 1 or 2 per cent.; but at the points mentioned 10 per cent. of phosphoric acid is claimed in some of the marls sold. The existence of beds of phosphatic nodules similar to those developed in Alabama has been traced into Mississippi, and their development will probably depend upon the result of the efforts to put the Alabama phosphates on the market. It is probable that in the search for marls rich in phosphoric acid the fact has been partly overlooked that the greensand marls now in use are chiefly valuable from the amount of potassium salts which they contain.

OTHER STATES.

In Georgia active preparations are being made to mine phosphate rock. In Glynn county the Georgia Phosphate Company owns 1,200 acres of phosphate deposits at the headwaters of the Little Satilla river. Operations will begin as soon as machinery can be put in at St. Simon's mill, where steam power is available. The company will also erect permanent works in Brunswick. Another factory for fertilizers is to be erected at Williams island. There has been no effort to use the phosphates extending south from Thomasville.

There have been no further developments of the phosphates and green-sand marl in the Black Belt of Alabama, described by Professor Stubbs in the last report. In Arkansas it is proposed to open the mine at Crowley's ridge, in Crittenden county.

FOREIGN SOURCES.

For a complete and extremely accurate report on all the foreign sources of phosphates, there is no better work than that published by Dr. Charles U. Shepard, jr., in the report of the Commissioner of Agriculture of South Carolina for 1880. Since the publication of that report the following changes in these sources have been made: The Ardennes and other deposits of coprolites in France have become more important sources of supply, and they may in time enter into the supply of England. The mines of Caceres, in the province of Estramadura, in Spain, increased their exports to England 53,600 tons in 1883, and there are indications of much greater activity throughout the province. A decline in the English prices will probably cause the erection of superphosphate works at Bilboa by the "Sociedad General de Fosfatos de Caceres." In 1884 there were only two small superphosphate works in all Spain, one in Logrono and one in Valencia. Phosphorite has also been found, but little worked, at Zarza la Mayor and Ceclavin, on the Portuguese border, in the province of Estramadura. The phosphorite here is unusually pure. A considerable deposit of phosphate rock has been discovered since the last report in the southwestern part of Tunis, by P. homas (*Chemiker Zeitung*, Vol. X). It occurs in the lower Tertiary strata, which extend over a large territory. The phosphate is found in cylindrical coprolites of all sizes, and in yellow bowlders weighing many pounds. These are accompanied also by smaller, white or sometimes dark-colored bowlders. The coprolites contain 70.80 per cent., the yellow bowlders 52.10 per cent., while the small black and white bowlders, which are more frequent, contain only 3.34 per cent. of tricalcium phosphate. The discoverer does not doubt their industrial application.

Imports.—The following tables show the imports from islands controlled by the United States, and also the regular importations of Peruvian guano, together with the ordinary phosphate occasionally brought from England:

Guano brought from islands, rocks, and keys appertaining to the United States, 1869 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Long tons.			*Long tons.*	
1869	15,622	$253,545	1878	17,930	$211,239
1870	14,318	356,830	1879	8,733	95,137
1871	14,154	340,235	1880	12,795	147,051
1872	4,209	60,865	1881	16,883	179,882
1873	11,014	161,690	1882	15,249	160,016
1874	6,877	100,345	1883	7,873	92,130
1875	7,269	122,012	1884	9,333	106,431
1876	14,785	192,972	1885	12,100	86,166
1877	6,060	79,822			

Phosphates imported and entered for consumption in the United States, 1868 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Guano.		Crude phosphates and other substances used for fertilizing purposes.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
1868	99,668	$1,336,761		$88,864	$1,425,625
1869	13,480	217,004		61,529	278,533
1870	47,747	1,414,872		90,817	1,505,689
1871	94,344	3,313,914		165,703	3,479,617
1872	15,279	423,322		83,342	506,664
1873	6,755	167,711		218,110	385,821
1874	10,767	261,085		243,467	504,552
1875	23,925	539,808		212,118	751,926
1876	19,384	710,135		164,849	874,984
1877	25,580	873,459		195,875	1,069,334
1878	23,122	849,607		285,089	1,134,696
1879	17,704	634,546		223,283	857,829
1880	8,619	108,733		317,068.	425,801
1881	23,452	399,552		918,835	1,318,387
1882	46,699	854,463	133,955.50	1,437,442	2,291,905
1883	25,187	537,080	96,585.86	798,116	1,335,196
1884	28,090	588,033	16,542.00	237,594	825,627
1885	20,934	393,039	21,418.56	264,079	657,118

APATITE.

There has been no effort to use the apatite occurring in the New England States, but the mines in Canada, particularly in Ottawa county, Quebec, are growing in importance, and those in Lanark, Leeds, and Frontenac counties, Ontario, are being slowly developed. An important deposit has been noticed at Lake Clear, Renfrew county, and there are a number of small beds in other parts of the Dominion. The mode of occurrence in Canada has been studied carefully by a number of expert engineers, and the following characteristics are summarized by Dr. Robert Bell, in the *Engineering and Mining Journal*, May 9, 1885:

The apatite-bearing rocks appear to constitute one of the higher members of the Laurentian system. Although this system extends over such vast tracts of country in the northern regions of the Dominion, rocks like those among which the apatite occurs appear to occupy but a small proportion of the whole area. In the great regions referred to scarcely anything is found but the commonest varieties of grayish and reddish feldspathic and quartzose gneiss, which are massive, highly crystalline, hard and granitoid. In the apatite regions, on the other hand, the rocks are, geographically speaking, arranged in great belts, differing more or less from one another and individually traceable for long distances. The limestone bands that they contain constitute the great distinguishing feature in which these strata differ from the bulk of the Laurentian rocks. While the common Laurentian gneiss holds but a small variety of minerals, the rocks of the apatite regions have already yielded upward of sixty species. Besides the limestone, the apatite regions have associated with them bands of schists, slates, pyroxenite, quartzite, jasper, etc. And they also contain serpentine, graphite, pyrite, pyrrhotite, and ores of iron, copper, lead, and other metals. In brief, the conditions under which apatite may always be sought are: A somewhat regular, large scale structural arrangement of the gneiss in bands, having distinctive characters and accompanied by limestones; a considerable number of Laurentian minerals, and the presence of pyroxenite or of mottled diorite. The author uses these signs to predict the discovery of apatite in the Parry Sound district and in the rocks northeast of Georgian bay. Apatite is sometimes found in large regular veins of a very ancient date, but in the great majority of cases the deposits, whether of the pure phosphate or a mixture of this with other minerals, appear to differ from the fissure veins, and to be extremely capricious and uncertain in their forms. The mineral is often mingled with the pyroxenite, but it always has a tendency to form itself into floors and branching veins, having two principal local courses. Dr. Bell believes these lines to mark approximately the original jointing of the rock. These ancient joints belong to three sets, two nearly vertical, intersecting each other, and one nearly horizontal, analogous to the three sets of dry joints of more recent date that are usually set in massive rocks at the present day. In the course of the disturbances to which these phosphate-bearing pyroxenites and gneisses were subjected, the angular masses into which they had been divided by these joints became in places separated and displaced, leaving the spaces that are now filled with the apatite. The process was one of segregation, and similar to that by which the irregular veins in other varieties of the Laurentian rocks have been filled with quartz and orthoclase. Tribasic phosphate of lime shows an unusually strong tendency to segregate or separate itself from mixtures containing it. Hence we should expect to find that even when it formed only a small proportion of the constituents of the rock in which the cavity occurred it would fill it up to the partial or complete exclusion of the more abundant minerals. There is little doubt that the apatite has been derived principally from the pyroxenite. There is no evidence whatever that the Laurentian apatite has had the remotest connection with organic life, although it is a rather curious circumstance that the average proportion of fluorine in this anciently formed mineral should approximate that contained in the bones of mammals.

Character of the mineral.—Although the qualitative composition of the apatite in various mines is tolerably constant, the percentage of tricalcium phosphate differs slightly, but is usually between 80 and 90 per cent. Generally speaking it contains little oxide of iron. The various forms in which it is found in the Ottawa region are: As crystals sometimes of large dimensions in masses varying from compact to coarse granular, in strata of laminar texture, and in a friable variety which is abundant, known as "sugar phosphate." The latter on account of its friability is much easier to grind than the compact masses, but is harder to handle. The color varies through shades of green, blue, red, and brown; and it is sometimes yellow or white.

Production.—Mining these phosphates is of comparatively recent date and is carried on principally in the townships of Buckingham, Templeton, Portland, Hull, and Wakefield, in Ottawa county. The mines follow the Lièvre river, and are richer nearer the stream; the proportion of limestone increases with the distance from the bank. The apatite is rafted down the river, which is a deep sluggish stream, to the village of Buckingham, from thence it is taken by the Canadian Pacific railroad. Nearest to the railroad station is the Emerald mine, 9 miles up the river. This was one of the earliest opened, and is one of the most productive. The property includes 100 acres of land, all bought by the Ottawa Phosphate Company at a reported price of $100,000. The Washington mine adjoins the Emerald, and is being worked by a company of American capitalists. Desirous of developing the property they have removed a large amount of dead rock, and thus developed deposits of considerable extent. The Little Rapids mine, on the east side of the river, 2 miles farther north, is comparatively new. It has been opened very successfully by drifting. Next to this is the North Star mine, of an American company. At one place on this property a small "show" of phosphate on the surface only about 3 inches in width was selected for the spot where a test shaft should be sunk. At a depth of 100 feet this small vein was found to have widened out to 5 feet, and at a still farther depth it occupied the whole width and extent of the shaft. The High Rock mine lies on the west side of the Lièvre river, about 18 miles above Buckingham village, and is one of the extensive mines now worked. It belongs to the Phosphate of Lime Company of London. The property covers 1,200 acres, and the mine has been the most productive of all in Canada, having yielded during the four years of its present management 20,000 tons of high-grade phosphate. The profits of the last 3 years have been sufficient, according to Mr. H. B. Small, to cover all the outlay, and to admit of a dividend of 25 per cent. last year. The Union mines, 1 mile farther south, belong to an American company owning 2,000 acres of land. The original capital, $100,000, was nearly all spent in plant, road making, etc. Yet, after one year's operations, a dividend of 30 per cent. was declared. The total production for Canada is given in the following table:

Production of Canadian apatite from 1878 *to* 1885 *inclusive.*

Years.	Long tons.
1878	8,701
1879	11,927
1880	7,974
1881	15,601
1882	17,181
1883	17,840
1884	22,143
1885	24,290

This table represents the shipments but does not fairly represent the production for the last year, since there is always a large amount mined too late in the winter to be transported to the railroad. This may hereafter be avoided by combined river and railroad transportation. The cost of a ton of phosphate delivered alongside a vessel in Montreal is from $7 to $10.50 at the most. Ocean freight ranges usually from $1.50 to $2 per ton. The price paid in Montreal varies from $12 to $22 per ton, according to the percentage of tricalcium phosphate. The higher the percentage becomes, the higher the unit of value. The average value in 1884 and 1885 was $17 per long ton. Although a large amount of American capital is invested in the mines, almost the whole of the apatite is shipped to Great Britain and continental Europe, only a trifling quantity finding its way to the United States. Considerable crude phosphate as well as large amounts of superphosphate are annually imported into the United States from England, and it is probable that much of the former is of Canadian origin, imported to aid in producing very high-grade superphosphates by firms in the northern States. The reason why Canadian phosphates thus cross the ocean twice is probably that, since American dealers were in the habit of importing from England before the Canada mines were developed, no effort has been made to turn the trade to a more direct course. It seems probable that the use of Canadian apatite may increase in the western States, particularly the rock from Kingston, Ontario.

GYPSUM.

By H. S. Sproull.

Eastern division.—The report for 1884, page 809, gives a list of States in which gypsum occurs, and on pages 814 and 815 may be found an enumeration of the uses to which the mineral is applied. No additions of any practical value have since been made, nor does the industry differ in general from its condition in 1884, though in volume there is some falling off. Michigan and Ohio retain their position as the principal producing States, and indeed appear to contain within their borders the only rock from which it has yet been found possible to secure, through the usual course of burning and grinding, a merchantable article of plaster of Paris or stucco. Even this production is not entirely free from blemish, a granular or sandy condition being developed to a greater degree in the Michigan than in the Ohio product, though it serves all ordinary purposes of consumption. About 10,000 tons of rock are quarried in Virginia yearly and find comparatively local consumption for fertilizing purposes only, manufacturers evidently having found no inducement to attempt calcining. In the counties of Onondaga and Cayuga, New York, there is a considerable annual output from a stratum of slate and gypsum containing about 45 per cent. of the latter on the average. The two are so intermingled as to prevent a disintegration that would leave the gypsum in a proper condition for burning, and the mass of rock as quarried is, therefore, simply ground into land plaster of ordinary quality. Nothing reliable as to the amount of the product can be obtained. In other States the production from native deposits is of a desultory character and is unimportant in volume, and confined simply to the quarrying and grinding of the stone into proper condition for fertilizing purposes. The Grand River Plaster Company of Canada sends about 5,000 tons of white gypsum into the United States annually, nearly all of it going to the West to be used on the farming lands; and the quality is considered to be on a par with that of domestic production. During the early portion of 1885 a deposit of gypsum was struck in the western part of New York, but soon proved to be valueless, as shown by the following report from the Buffalo Cement Company, limited:

"Gypsum was discovered here at a depth of about 45 feet. The diamond-drill cores show that it extends down to a depth of 700 feet and is intermixed with layers of limestone and shale. It can never be utilized for commercial purposes on account of the great volume of water encountered, and a shaft started with the intention of working the mine has been abandoned."

The largest and most important production of calcined and land plaster is upon the Atlantic seaboard, and, as in 1884 and the year preceding, solely from imported stone supplied by the Nova Scotia quarries. Of the amount of gypsum received into the United States from this source, Maine receives about 10,000 tons annually, and the remainder of the importation, varying according to the requirements of trade, all gravitates toward the New York district. In 1885 the importation at the port of New York fell off 28,000 tons, as compared with 1884, due in a measure to the destruction by fire, early in the season, of one of the largest manufacturing establishments in the harbor, and in a measure, to lessened consumption. Of the 71,000 tons received, somewhat in excess of 50 per cent. was used for fertilizing purposes, and the balance was calcined for trade use, indicating a production of about 218,000 barrels of 250 pounds net. The average cost of rock delivered at New York was $2.65 per ton, and the average price of the calcined product $1.25 per barrel.

According to official reports the production of gypsum in Nova Scotia in 1883 was 144,668 long tons; in 1884 it was 111,068 long tons; and in 1885 it was 87,644 long tons.

The gypsum beds of Nova Scotia contain the purest deposits yet discovered, and apparently are of sufficient magnitude to supply the present outlet for many years, but during the past two seasons somewhat annoying evidences of hard rock have been encountered, and the necessity for ultimately resorting to mining instead of quarrying is suggested.

The general condition of business during 1885 was somewhat dull under the influence of more careful methods of buyers, and a reduced consumption of both land plaster and the calcined product. The relations of manufacturing localities with the quarries, however, were of such a character that the output of stone could be fairly adjusted to actual requirements of the market, and a surplus accumulation was in consequence prevented. Prices were very well sustained at all points for the calcined goods, and there was a slight advance in the New York district. There appears to have been no special effort to widen the use of gypsum either in the old or new form, reports from all sections agreeing upon that point; but some experimenting has taken place. The claim is made that gypsum becomes harder by placing the calcined product for a few minutes in a mixture of water with 8 per cent. of sulphuric acid and then calcining again. Another suggestion is to immerse the freshly burned gypsum in a solution containing 90 parts of water and 10 parts of alum and then calcine again, with the assertion that the product will give a plaster, which after proper molding can be made to receive a polish like marble.

A considerable importation from Europe is reported yearly at New York under the name of gypsum. It is, however, as a matter of fact, only an artificial sulphate of lime made from the refuse of chemical factories at Newcastle, and brought out for the use of paper manufacturers. The importations have been as follows:

Imports classed as gypsum at New York.

Years.	Packages.
1881	1,472
1882	2,806
1883	3,563
1884	4,906
1885	3,692

Notwithstanding the inability to reach exact records of the quantity of gypsum calcined and ground on the seaboard, the proportion used for fertilizing purposes is quite accurately given, and on the natural assumption that the remainder of the rock known to have been imported or quarried was converted into stucco a close approximation to the production may be made. Upon that basis the following table was prepared:

Estimate of production of gypsum upon the Atlantic seaboard, principally from Nova Scotia stone.

Years.	Land plaster.	Stucco.
	Long tons.	*Barrels.* (*a*)
1881	40,000	247,000
1882	45,000	332,000
1883	60,000	417,000
1884	63,000	358,000
1885	50,000	288,000

a 250 pounds net.

The following table gives the quantities and average values of the total imports of gypsum imported into the United States during the period from 1877 to 1885, through the port of New York, and the average price of calcined plaster during the same period:

Amount of unground gypsum entered at the port of New York during the years 1877 *to* 1885, *inclusive, and average prices per ton January* 1; *also price of calcined plaster per barrel.*

Years.	Tons.	White lump, per ton.	Blue lump, per ton.	Calcined plaster, per barrel.
1877	48,833	$3.00	$2.75 to 3.00	$1.25 to 1.50
1878	42,575	3.00	2.75 to 2.80	1.15 to 1.25
1879	44,031	2.80	2.75	1.00 to 1.15
1880	60,952	3.25 to 3.50	3.00 to 3.25	1.00 to 1.15
1881	60,236	3.00 to 3.25	2.75 to 3.00	1.20 to 1.25
1882	77,463	3.75 to 4.00	3.00 to 3.25	1.30 to 1.40
1883	104,542	3.00	3.00 to 3.25	1.30 to 1.35
1884	99,144	3.00	2.75	1.30 to 1.35
1885	71,099	2.75 to 2.85	2.50 to 2.65	1.20 to 1.30

Nearly the entire export movement takes place at New York, and the following table gives a close record of the trade with foreign countries during the years named:

Exports of calcined plaster from the port of New York, 1877 *to* 1885, *inclusive.*

Years.	Packages.	Value.	Years.	Packages.	Value.
1877	17,083	$26,040	1882	25,765	$38,025
1878	17,257	23,073	1883	18,085	25,713
1879	11,732	14,902	1884	21,491	30,372
1880	11,191	15,321	1885	30,313	43,312
1881	17,391	24,419			

The production of Michigan is given in the following tables:

Amount of land plaster and calcined plaster produced in Michigan.

Years.	Land plaster, short tons.	Stucco, barrels of 300 pounds.	Years.	Land plaster, short tons.	Stucco, barrels of 300 pounds.
Land plaster, previous to 1866	100,000	....	1875	27,019	61,120
1866	14,604	....	1876	(a)39,131	64,386
1867	17,439	....	1877	(a)40,000	(a)55,000
Stucco, previous to 1868	....	(a)80 000	1878	40,000	48,346
1868	28,837	34,966	1879	43,658	50,800
1869	29,996	41,187	1880	49,570	106,004
1870	31,437	46,179	1881	38,178	112,813
1871	41,126	48,685	1882	37,821	125,165
1872	43,536	59,767	1883	(a)40,082	(a)159,100
1873	44,972	82,453	1884	27,888	156,677
1874	39,126	82,449	1885	28,181	141,575

a Partly estimated.

In 1883, 1884, and 1885 the total production of the several manufacturers in Michigan was as follows:

Aggregate production of land and calcined plaster in Michigan during the years named.

Manufacturers.	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*
Grand Rapids Plaster Company	9,843	6,528	7,928
F. Godfrey & Brother	9,968	8,940	8,887
Noble & Co	8,716	7,529	7,663
Union Mills	8,698	6,496	5,899
Wyoming Mills	7,483	4,925	5,656
Alabastine Company	9,415	8,307	5,053
B. F. Smith	9,227	7,545	7,317
Total	63,350	50,270	48,403

The production of Ohio is given by Mr. George A. Marsh, Sandusky, Ohio. The works and quarries are at Gypsum.

Production of stucco and land plaster in Ohio.

Years.	Stucco.			Land plaster.		
	Barrels.	Average price per barrel.	Total value.	Short tons.	Average price per ton.	Total value.
1881	12,409	$1.55	$19,234	3,705	$4.35	$16,117
1882	16,888	1.46	24,656	4,404	4.33	19,069
1883	20,919	1.41	29,496	4,678	4.15	19,414
1884	20,307	1.38	28,024	4,217	4.09	17,248
1885	(a)8,686	1.31	11,379	4,038	4.03	16,273

a This is the production of five months only, the mills having remained closed during the busiest portion of the season in consequence of the introduction of new machinery.

Estimated total production of plaster in the United States during 1885.

	Land plaster.	Calcined plaster.	Total.
	Short tons.	*Short tons.*	*Short tons.*
From native stone	49,100	26,000	75,100
From imported stone	51,500	46,200	97,700
Total	100,600	72,200	172,800

The estimated value of the product for 1885 was $379,500 for land plaster, and $580,100 for stucco or calcined plaster; total value, $959,600.

Rocky Mountain division.—Some new deposits have been discovered since the last report, but remain undeveloped, and have added nothing to the production. The bed of gypsum opened by the Colorado Stucco, Brick, and Cement Company, at Colorado City, is fully capable of supplying the entire demand from the country tributary to Denver for many years. There is consequently no incentive to open the numerous bodies of gypsum known to exist in all the Rocky Mountain territory. The production of Colorado City amounts to about 8,500 sacks, of 100 pounds each, yearly.

Pacific division.—There is little to be added to former remarks on the occurrence of gypsum in the States and Territories of the Pacific coast, no new discoveries of importance having been reported for that region during the past year. The manufacture of plaster from this material has, however, been sensibly increased, more especially in California, where 10 per cent. more plaster of Paris was made than during any previous year. The whole of this continues to be made at the Golden Gate mill in San Francisco, the only one on the coast. During the past year 2,500 tons of gypsum were received and ground at this mill, most of it coming from the deposits lately discovered in Santa Barbara county. A small quantity was imported from Lower California, whence the entire supply was formerly obtained. The increased consumption of plaster of Paris last year was due to a marked increase in building, more particularly in the city of San Francisco. The use of gypsum as a fertilizer continues to be limited on the Pacific coast, but as the soil becomes impoverished, it will, no doubt, gradually increase, and ultimately reach large proportions.

Imports of plaster at San Francisco.

Years.	Barrels.	Years.	Barrels.
1875	22,782	1881	5,850
1876	14,918	1882	4,777
1877	14,487	1883	6,300
1878	11,038	1884	5,700
1879	5,400	1885	9,690
1880	3,200		

The decreased importation, from 22,782 barrels in 1875 to 9,690 in 1885, is due to a considerable home production.

Plaster of Paris was selling at the close of last year for $2.50 to $2.75 per barrel in San Francisco.

TOTAL IMPORTS.

Gypsum imported and entered for consumption in the United States, 1867 *to* 1885, *inclusive.*

[Long tons and hundredweights, of 2,240 and 112 pounds, respectively.]

Fiscal years ending June 30—	Ground or calcined.		Unground.		Manufactured plaster of Paris.	Total.
	Quantity.	Value.	Quantity.	Value.		
	Tons.		*Cwts.*			
1867	....	$29,895	1,959,020	$95,386	....	$125,281
1868	....	33,988	1,753,881	80,362	....	114,350
1869	....	52,238	2,740,785	133,430	$844	186,512
1870	....	46,872	2,144,733	100,416	1,432	148,720
1871	....	64,465	2,008,010	88,256	1,292	154,013
1872	....	66,418	1,906,787	99,902	2,553	168,873
1873	....	35,628	2,378,520	122,495	7,336	165,459
1874	....	36,410	2,474,350	130,172	4,319	170,901
1875	....	52,155	1,875,440	115,664	3,277	171,096
1876	....	47,588	2,794,263	127,084	4,398	179,070
1877	....	49,445	1,953,120	105,629	7,843	162,917
1878	....	33,496	1,784,774	100,102	6,989	140,587
1879	....	18,339	1,939,259	99,027	8,176	125,542
1880	....	17,074	2,406,540	120,642	12,693	150,409
1881	....	24,915	2,572,140	128,107	18,702	171,724
1882	5,737.14	53,478	2,567,740	127,067	20,377	200,922
1883	4,291.34	44,118	3,157,020	152,982	21,869	218,969
1884	4,996.25	42,904	3,326,200	168,000	(*a*)	210,904
1885	6,418.00	54,208	2,343,220	119,544	(*a*)	173,752

a Not specified.

Alabaster and spar ornaments imported and entered for consumption in the United States 1867 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1867	$26,129	1877	$16,006
1868	27,891	1878	8,148
1869	21,564	1879	7,986
1870	22,982	1880	9,730
1871	47,633	1881	19,078
1872	23,108	1882	34,292
1873	22,011	1883	23,179
1874	16,463	1884	38,982
1875	16,185	1885	31,796
1876	18,323		

MARLS.

The production of marls for use as fertilizers is limited to the sections in which marl can be had for the cost of digging, and even in such places its use is giving way to manufactured fertilizers. New Jersey has used more marl than all the rest of the country, but the substitution of superphosphates is increasing rapidly. The production of marl in New Jersey in 1885 amounted to perhaps 875,000 short tons, about the same as in 1884. As stated in connection with phosphates, the use of phosphatic nodules and marls in Alabama and Mississippi is extending, and will probably become a regular industry in the latter State.

MANUFACTURED FERTILIZERS.

There has been little change in the sources of manufactured fertilizers. The amount of bones used has increased somewhat. This is felt particularly in the West, where the large amount of cattle killed and dressed before shipment to the East has increased the yield of bones very largely; these have been worked into fertilizers in the large western cities to supply the increasing demand for fertilizers in the Mississippi valley. There has been a corresponding increase in the domestic sources of nitrogen from the same slaughtered cattle, including dried blood, tankage, pork scrap, etc., and a decrease in the other sources of nitrogen, particularly sodium nitrate ("nitrate of soda"), which is used for fertilizers as well as in the manufacture of sulphuric acid. The use of crude ammonium sulphate imported from English gas works has also increased.

Among the mineral constituents of fertilizers, with which this report has particularly to deal, the South Carolina phosphates continue to be the great source of supply of phosphoric acid; but in regard to the sources of potassium, or "potash" as it is more frequently miscalled, there has been much agitation, particularly as to the relative value of the individual salts offered to the trade for furnishing potassium to the soil. The following description of the sources of potassium will show the different substances which enter into this discussion, with the advantages and disadvantages that have been claimed for each.

Sources of potassium.—The only source of potassium which this country utilizes is the carbonate of potassium or "potash lye" obtained from wood ashes. The aggregate of this substance made, particularly in a small way, all over the country is quite large, but not more than sufficient for use in a multitude of industries calling for "potash" in a tolerably pure and convenient form, so that practically none of the potash of domestic production enters into the composition of fertilizers. The large quantities demanded for this industry are imported from Germany in one of three forms, kainite, potassium chloride ("muriate of potash",) and medium and high grade potassium sulphate. Of these the most important is kainite. Although it does not contain as much potassium as either of the others, it is cheap, and has in its favor the prejudice of farmers who have tried it successfully on cotton and tobacco fields. It is sold with a guarantee that it shall contain 24 per per cent. potassium sulphate, K_2SO_4, and is sold "flat," that is, the purchaser has the advantage of all over 24 per cent. In 1885 the average price, delivered in the United States, was $8 per ton. It is sold nearly as dug from the earth at Stassfurt, Germany, being merely picked over, when sent to this country, so as to bring the percentage to the proper amount. Potassium chloride ("muriate of potash") is sold in increasing quantities. It is much richer in potassium than kainite; it is sold on a basis of 1.75 cents per pound when 80 per cent. pure. If the analysis shows any lot to be purer than this an additional charge is added. It is still a much disputed question whether potassium chloride is sufficiently superior to kainite, agriculturally, to justify the difference in price, a difference maintained partly by the use of potassium chloride in other industries, such as the manufacture of potassium bichromate and potassium nitrate. It is not probable that the use of potassium chloride would have increased as it has done had it not been for the strong efforts of a syndicate of producers in Stassfurt to spread this substance, which they make from kainite, as part of the Stassfurt industry. It seems therefore that commercial causes, such as the effort to make a market for potassium chloride, have been the reason for the agitation against the use of kainite during 1885. The high grade and medium grade "sulphate of potash" is only sparingly used for fertilizers. A poor class of potassium compounds called kieserite is also used. The price for medium grade potassium sulphate was 1.2 cents in 1885. High grades were sold in proportion to their composition. Kieserite is also bought according to its composition. The amounts imported of these substances are given in the following tables. The tables of kainite imports and part of that for potassium chloride have been arranged from the trade lists of imports. The remainder was obtained from the Bureau of Statistics.

Imports of potassium chloride (muriate of potash) from 1872 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Tons.	Value.	Fiscal years ending June 30—	Tons.	Value.
1872	2,579	$126,418	1879	9,524	$250,818
1873	3,467	158,768	1880	10,725	331,489
1874	3,323	134,289	1881	10,179	335,799
1875	5,242	190,587	1882	19,409	743,825
1876	4,413	157,542	1883	13,729	535,259
1877	6,133	209,413	1884	21,751	731,409
1878	8,784	292,603	1885	20,420	613,674

Distribution of potassium chloride imports from 1881 *to* 1885, *inclusive.*

Ports	1881.	1882.	1883.	1884.	1885.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
New York	8,290	11,600	12,620	13,730	13,870
Philadelphia	....	2,117	1,599	1,645	1,850
Baltimore	4,155	4,406	3,500	2,896	2,290
Boston	....	....	....	....	1,594
Charleston	....	....	....	....	1,097
Savannah	....	....	....	....	50
Port Royal	....	....	....	....	150
Other ports	....	....	....	....	295
Total	12,445	18,123	17,719	18,271	21,196

The potassium chloride above is sold on a basis of 80 per cent. It is frequently less pure than this, and is then imported as "agricultural salt," of which the following amounts have been imported, containing usually about 70 per cent. pure potassium chloride:

Imports of agricultural salt from 1869 to 1885.

Fiscal years ending June 30—	Tons.	Value.	Fiscal years ending June 30—	Tons.	Value.
1869	....	$1,752	1880	....	$21,667
1870	....	9,698	1881	....	8,187
1871	....	2,436	1882	....	55,622
1874	....	114	1883	....	43,363
1875	....	1,867	1884	1,400	42,640
1879	....	2,480	1885	600	18,360

Distribution of kainite imports from 1881 to 1885, inclusive.

Ports.	Years.				
	1881.	1882.	1883.	1884.	1885.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
New York	31,045	7,127	24,012	24,119	16,967
Philadelphia	....	10,204	4,579	15,120	14,102
Baltimore	40,645	12,315	30,738	22,146	24,984
Charleston	....	14,823	25,050	27,975	16,335
Savannah	....	4,169	8,365	5,371	2,488
Wilmington, N. C.	....	5,494	9,020	13,355	9,330
Boston	....	....	....	....	492
Norfolk	....	....	....	991	500
Other ports	....	....	....	1,851	2,437
Total	71,690	54,132	101,764	110,928	87,635

Imports of medium grade potassium sulphate (containing 48 to 50 per cent. K_2SO_4*).*

Years.	Short tons.	Years.	Short tons.
1880	300	1883	1,000
1881	500	1884	2,500
1882	700	1885	7,525

Of high-grade potassium sulphate 450 short tons were imported in 1885.

Prices.—During 1885 kainite sold quite uniformly at $8 per long ton. The price of the other sources of potassium is kept uniform by the German syndicate at 1¾ cents per pound for potassium chloride which is 80 per cent. pure, and a proportional advance for higher percentages. Medium potassium sulphate sells at $1.20 per hundred pounds.

Methods of manufacture.—There has been little change in the methods of making fertilizers, except mechanical improvements in grinding phosphate rock and in drying it thoroughly at the time it is taken from the water. The proportion of sulphuric acid to rock is now less than in England, where the extreme cheapness of acid makes it profitable to use more. But both England and Germany have taken the lead in a new, manufacture which may have great significance for the fertilizer trade and will doubtless be a feature in American works before the next report. This is in the use of basic iron slags as a fertilizer.

The Thomas-Gilchrist slag as a fertilizer.—Reference was made in the last report to a patent obtained in 1882 by G. Rocour, of Luttich, Germany, for using the phosphorus found to a greater or less extent in iron slags; and to the modification by which C. Scheibler, in 1884, actually put these slags to practical use. But just at this time the Thomas-Gilchrist process for producing good iron from ores containing phosphorus began a revolution in the manufacture of iron, the importance of which cannot yet be fully measured. The process consists, in a word, in making a lining to the furnace of some highly basic material, such as lime, and introducing a much greater proportion of lime into the slag material than in older processes; with this arrangement, ores containing so much phosphorus as to render them worthless in the ordinary process are converted into good iron, the phosphorus going into the slag as calcium phosphate. The slag as now produced crumbles easily to a kind of meal. It contains much lime, but also phosphoric acid to the amount of 15 to 20 per cent. This large percentage of phosphate rendered the slag admirably suited for Scheibler's process, to which it was applied at Schalke and Stolberg. But meanwhile chance experiments showed that this slag itself, when applied to land in the form of meal, has acted in well recorded cases as a good fertilizer. These trials have not been limited to one place, nor to one experimenter, but both in England and Germany the testimony shows an agricultural value for this raw slag which is comparable, though probably not equal, to that of superphosphates. The interest naturally awakened by such an application of what has been hitherto waste material is shown all through Europe. The value of the slag as a fertilizer seems established, and there is much discussion as to whether it is better to use it simply ground or converted into soluble phosphates. Besides calcium phosphate there is a large amount of lime which is frequently but not always useful. There is some metallic iron and a large percentage of ferrous oxide, which is supposed to be injurious, and also sulphides of iron and calcium. Further, the presence of lime prevents the use of the slag with manures containing nitrogen, as it causes liberation and waste of ammonia. It has been proposed to rid the slag of part of these materials by passing sulphur dioxide and air through it. This is said to convert the lime and sulphide of calcium into harmless gypsum, and to oxidize the iron. But in how far this process can be made complete and economical is very uncertain. It has been found that the price of hydrochloric acid is too high for Scheibler's process, and hence it seems that unless some new process is found the slag will be used in the crude state as a fertilizer. The use of the Thomas-Gilchrist process in America has begun. A large tract of iron ore in Virginia, too rich in phosphorus for the old process, has been bought by a Philadelphia company for use with the new method, and the production of a fertilizer from the slag will be part of the plant.

Production and prices.—Fertilizers are made and shipped during the winter and spring, hence the production is given to April 30 of each year. Mr. A. de Ghequier, secretary of the National Fertilizer Association, has computed the product from May 1, 1884, to April 30, 1885, at 1,023,500 short tons. It was produced by the following States:

Estimated production of manufactured fertilizers, years ending April 30.

States.	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*
Alabama	3,000	4,000	4,000
Connecticut	15,000	15,000	15,000
Delaware	40,000	45,000	50,000
District of Columbia	7,000	7,000	7,000
Georgia	25,000	30,000	35,000
Illinois	30,000	35,000	35,000
Indiana	3,000	4,000	5,000
Iowa	1,000	1,000	1,000
Kentucky	2,500	3,500	4,000
Louisiana	2,000	2,500	3,000
Maine	6,500	7,000	7,500
Maryland	260,000	290,000	300,000
Massachusetts	75,000	80,000	85,000
Michigan	2,000	3,000	3,000
Missouri	6,000	6,000	6,000
New Jersey	85,000	90,000	95,000
New York	90,000	95,000	100,000
North Carolina	15,000	15,000	15,000
Ohio	15,000	15,000	18,000
Pennsylvania	60,000	65,000	70,000
Rhode Island	12,000	12,000	12,000
South Carolina	90,000	100.000	110,000
Virginia	30,000	40,000	40,000
West Virginia	2,000	2,000	3,000
Total	877,000	967,000	1,023,500
Value	$23,680,000	$26,110,000	$27,640,000

By obtaining statements of fertilizer shipments from the various transportation lines, Mr. de Ghequier has been able to approximate the consumption in the following States:

Estimated consumption of manufactured fertilizers in the following States, years ending April 30.

States.	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*
Alabama	45,000	45,000	45,000
Delaware	10,000	20,000	20,000
Florida	5,000	5,000	10,000
Georgia	125,000	170,000	180,000
Illinois	5,000	7,500	7,500
Indiana	8,000	8,000	10,000
Kentucky	6,000	6,000	10,000
Louisiana	5,000	5,000	5,000
Maryland	60,000	75,000	75,000
Michigan	5,000	5,000	5,000
Mississippi	20,000	10,000	10,000
Missouri	5,000	5,000	5,000
New York	30,000	30,000	35,000
New Jersey	35,000	40,000	45,000
New England States	60,000	75,000	100,000
North Carolina	90,000	95,000	90,000
Ohio	20,000	20,000	20,000
Pennsylvania	80,100	100,000	100,000
South Carolina	90,000	110,000	100,000
Tennessee	10,000	10,000	15,000
Virginia and West Virginia	80,000	100,000	100,000
Western States	26,000	25,000	30,000
	840,100	966,500	1,017,500

Some of each year's product is left on hand at the end of the year, so that the total production and consumption are not the same. From May 1, 1885, to April 30, 1886, the production will be the same as for the previous year, within a few tons. The consumption will be less, viz., about 1,006,631 tons.

Valuation.—The agricultural experimental stations and State boards of agriculture in many of the southern States endeavor, in addition to analyzing all the fertilizers sold, to make values for them on the basis of these analyses. These values are obtained by assigning a definite value per pound for each constituent of a fertilizer, finding the number of pounds per ton of each, and thus arriving at a value which is a good basis for comparing different fertilizers. But whether it would represent the absolute value of each one would depend upon the value given for one pound of each component. Since this value cannot be uniform for different places, the valuation cannot be the fixed price at which the fertilizer shall be sold. But, unfortunately, the consumers of fertilizers, not caring to study the meaning of analyses, accept the official relative valuations for more than they are intended, and hence they produce such confusion between buyer and manufacturer that the system becomes of doubtful value. The values adopted in North Carolina during 1884–85 were the average values of a pound of each constituent in the principal interior towns, that is:

	Per pound.
	Cents.
Available phosphoric acid	9
Ammonia	20
Potash	5

The values for 1885–86 are for the principal seaports, and are uniform in most of the southern States.

	Per pound.
	Cents.
Available phosphoric acid	7½
Ammonia	16
Potash	5

The method by which these analyses are made public is shown in the appended table, taken from the monthly bulletin of the Department of Agriculture in South Carolina.

Analyses of fertilizers by the South Carolina Department of Agriculture, season of 1884-'85.

[Philip E. Chazal, E. M., chemist.]

Sample drawn.	Where drawn.	Brand of fertilizer.	Moisture.	Phosphoric acid.					Potential ammonia.	Potash.	Commercial value per 2,000 pounds.	Manufacturer's minimum guarantee.				By whom manufactured.
				Total.	Insoluble.	Soluble.	Reduced or reverted.	Available.				Available phosphoric acid.	Potential ammonia.	Potash (K_2O.)	Commercial value per 2,000 pounds.	
1885.	SOUTH CAROLINA.															
Mar. 2	Darlington	Ash Element	5.85	10.50	....	.....	.....	.....	....	4.13	$4.13	(*a*)	....	3.00	$3.00	Stono Phosphate Company, Charleston.
12	Marion	Ashepoo Dissolved Bone with Ammonia and Potash.	13.65	13.70	3.52	7.30	2.88	10.18	1.24	1.54	18.49	10.00	1.00	1.00	17.00	Ashepoo Phosphate Company, Charleston.
13	Marion	Accabee Fertilizer	11.90	11.33	2.27	6.27	2.79	9.06	2.89	2.07	22.52	8.00	2.00	1.00	17.40	Ashepoo Phosphate Company, Charleston.
21	Columbia	Acid Phosphate	14.08	14.40	2.05	9.02	3.33	12.35	....	0.98	17.04	10.00	....	1.00	14.00	Georgia Chemical Works, Augusta, Ga.
27	Batesburg	Alkaline Guano, the Great Potash Fertilizer.	13.20	12.74	2.88	7.30	2.56	9.86	2.38	1.54	21.50	10.00	2.00	1.50	20.50	
May 20	Orangeburg	Ammoniated Bone Superphosphate.	15.00	10.53	1.28	7.17	2.08	9.25	2.93	2.37	23.19	10.00	2.43	1.50	21.79	E. Frank Coe, 16 Burling slip, New York.
Jan. 28	Anderson	Bone Superphosphate	17.43	13.31	4.13	5.95	3.23	9.18	0.58	1.64	15.31	10.00	....	1.50	14.50	Russell Coe, Linden, N. J.
May 20	Orangeburg	Bone Meal	6.78	19.32	....	....	.....	.....	4.04	.....	.....	.....	.....	......	.....	
Feb. 12	Chester	Baltimore Crown Guano	13.45	11.33	3.28	5.25	2.80	8.05	2.08	2.16	18.47	8.00	2.00	(*b*)4.00	20.70	Chesapeake Guano Company, Baltimore.
Mar. 13	Marion	Baltimore Soluble Bone	15.95	14.85	2.05	7.87	4.93	12.80	....	.....	16.64	12.00	....	....	15.60	Baltimore Guano Company, Baltimore.
28	Trenton	Bald Eagle	12.73	12.64	4.13	6.27	2.24	8.51	2.03	1.47	18.62	8.00	2.00	1.00	17.40	Georgia Chemical Works, Augusta, Ga.
Feb. 19	Camden	Cotton Seed Meal	.....	2.16	....	.....	.....	.....	8.00	1.53	.....	.....	....	....	.....	Desoto Oil Company, Memphis.
Mar. 20	Columbia	Cotton and Corn Compound	12.20	7.81	1.07	4.74	2.00	6.74	3.25	2.90	21.41	6.00	3.25	3.00	20.55	Ashley Phosphate Company, Charleston.
Feb. 25	Timmonsville	Cotton Seed Meal	.....	2.43	....	.....	.....	.....	8.23	1.62	.....	.....	....	....	.....	Charleston Oil Manufacturing Company, Charleston.
Mar. 28	Johnston	Cranston's Ammoniated Dissolved Bone.	19.05	10.56	1.98	6.53	2.02	8.58	2.73	1.16	20.50	8.00	2.00	1.00	17.40	R. P. Sibley, general agent, Augusta, Ga.
Jan. 28	Anderson	Dissolved Bone	16.60	11.26	2.56	6.78	1.92	8.70	2.23	0.89	18.89	8.71	2.00	0.58	17.90	F. W. Wagner & Co., Charleston.
Mar. 21	Columbia	Dissolved Bone Phosphate of Lime.	14.10	15.94	2.99	9.60	3.35	12.95	....	.....	16.84	10.00	....	....	13.00	Pacific Guano Company.

a Bone phosphate of lime 22 per cent.

b Sulphate of potash.

The plan of branding with italics the fertilizers which fall even slightly below the manufacturer's guarantee has been severely criticized; for the method of collecting samples is not perfect enough to prevent good fertilizers from being included among bad, and thus permanently damaged.

Methods of fertilizer analysis.—At a meeting in Washington, in September, the Association of Official Agricultural Chemists recommended that the method of determining phosphoric acid which was adopted at Atlanta in 1884 should be followed rigorously during the coming year, with a few slight changes in applying the method to rock phosphates and natural guanos. It is possible that they will, however, soon follow the lead of the chemists of the experimental stations, and the manufacturers of south Germany, in adopting the method of Paul Wagner for determining phosphoric acid. This method, which is intended to compare the agricultural values of different phosphates, is based on experiments with plants which show that a certain solution of acid ammonium citrate will extract phosphoric acid from fertilizers in proportion to their ability to fertilize soil. Thus, bi-calcium phosphate is 30.6 per cent. as good a fertilizer as phosphoric acid, which is soluble in water, and the solution recommended dissolves this amount of phosphoric acid from bi-calcium phosphate. Again, a superphosphate from which the water-soluble phosphoric acid has been thoroughly washed is still able to fertilize 3 per cent. as well as phosphoric acid, and the solution also extracts this percentage from the fertilizer. The solution consists of 150 grams of citric acid dissolved in water, neutralized with ammonia, and diluted to 5 liters; then 10 grams of citric acid are added. The fertilizer is treated directly with this solution, and after standing for eighteen hours at the ordinary temperature of the room, the extracted phosphoric acid is determined as usual.

At the meeting of fertilizer manufacturers held at Mayence, on November 30, 1885, eight samples of different fertilizers were prepared by a commission of chemists and manufacturers and distributed to twelve laboratories. The variations between the separate analyses and the mean average were as follows:

	"Soluble" phosphoric acid.
	Per cent.
I. With high-class superphosphate	±0.27
II. With high-class superphosphate	.38
III. With phosphorite superphosphate	.30
IV. With phosphorite superphosphate	.32
Mean	±0.32

Against this the variations in the determinations of the phosphoric acid soluble in water made by the same chemists amounted to—

	Phosphoric acid soluble in water.
	Per cent.
I. With high-class superphosphate	±0.39
II. With high-class superphosphate	.36
III. With phosphorite superphosphate	.13
IV. With phosphorite superphosphate	.18
Mean	±0.26

From this we see that the mean differences in the determinations of the "soluble" phosphoric acid exceed those of the phosphoric acid soluble in water by only 0.06 per cent. The representatives of the manure manufacturers and those of the experimental stations of Bonn, Darmstadt, Speier, and Wiesbaden, have therefore agreed unanimously to accept this method for the analysis of all superphosphates from January, 1886, and in consequence thereof, to advertise in their price lists a guaranteed percentage of "soluble" phosphoric acid in the different superphosphates.

In the case of Thomas precipitated phosphate the results obtained were not sufficiently concordant, and the commission was requested to look closer into the matter and to report again in due course.

Exports.—In the calendar year 1885, 161,353 long tons of crude phosphates were exported, principally to England and Germany. Besides this, a small amount of manufactured fertilizers are also exported, record of which was kept to 1883, as follows:

Fertilizers of domestic production exported from the United States, 1864 *to* 1883, *inclusive.*

Fiscal years ending June 30—	Guano.			Other substances used for manures.
	Quantity.	Value.	Average value.	
	Long tons.			
1864				$40,353
1865				47,896
1866				
1867	2,203	$25,395	$11.53	28,360
1868	1	228		35,404
1869		3,220		20,508
1870	1,551	61,097	39.39	53,913
1871	1,203	35,000	29.09	264,837
1872	193	11,601	60.11	427,797
1873	258	8,210	31.82	224,084
1874	90	4,325	48.06	279,551
1875	316	9,305	29.45	608,806
1876	156	4,859	31.15	917,362
1877	954	41,530	43.53	1,076,602
1878	161	3,720	23.11	1,208,049
1879	354	8,741	24.69	1,231,841
1880	475	14,891	31.35	588,777
1881	959	29,581	30.85	583,361
1882	681	24,870	36.52	997,499
1883	1,231	52,823	42.91	1,029,678

SALT.

In accordance with the tendency indicated in 1884, the low price of salt has driven the production more and more into the hands of the large producers, principally in Michigan and New York, leaving the margin for profit in West Virginia and other States small indeed.

Production.—The following table shows the total production in barrels of 280 pounds in the United States during the last three years:

Salt product of the United States in 1883, 1884, *and* 1885.

	1883.	1884.	1885.
	Barrels.	*Barrels.*	*Barrels.*
Michigan	2, 894, 672	3, 161, 806	3, 297, 403
New York	1, 619, 486	1, 788, 454	2, 304, 787
Ohio	350, 000	320, 000	306, 847
West Virginia	320, 000	310, 000	223, 184
Louisiana	265, 215	223, 964	299, 271
California	214, 286	173, 571	221, 428
Utah	107, 143	114, 285	107, 140
Nevada	21, 429	17, 857	28, 593
Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories, estimated	400, 000	400, 000	250, 000
Total	6, 192, 231	6, 514, 937	7, 038, 653

The total yield exceeded that of 1884 by 523,716 barrels. The total value of all salt produced was $4,825,345, an increase of $627,611, which was due partly to the increased value of the Michigan product and also to the large increase in production in western New York.

Michigan.—According to the "Mineral Resources of Michigan," by Commissioner Charles D. Lawton, Michigan produced in 1885 more than one-third of all the salt consumed in the United States, and within a fraction of one-half of the total production. The advantages which the manufacturers of salt in this State possess include very rich brines and large lumber mills near by, thus securing slabs, pine sawdust, and waste steam at no cost, as the salt wells and lumber mills are worked by the same companies. Six new steam salt blocks were erected at Manistee, three at Ludington, one at Algonac, one at Frankfort, and four at Marine City, which go into operation during 1886. The estimated capacity of these new blocks is 700,000 barrels. The average depth of salt wells in Michigan is about 880 feet and the average strength of the brine is 91¼°. The manufacture of salt in Michigan began in 1860. In 1869 the present law, requiring all salt to be inspected, went into effect. The yield since that time is given in the tables to follow.

Salt made in Michigan, 1880 to 1885, inclusive, by counties.

[Barrels of 280 pounds each, as in each subsequent reference in this section.]

Counties.	1880.	1881.	1882.	1883.	1884.	1885.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Bay	1, 081, 841	1, 107, 617	1, 158, 279	1, 106, 461	1, 110, 445	951, 810
Gratiot			3, 285	6, 186	3, 500	3, 115
Huron	256, 841	326, 852	255, 012	256, 965	313, 832	306, 664
Iosco	147, 800	147, 579	211, 667	210, 644	224, 687	236, 543
Manistee		1, 642	41, 562	48, 544	123, 033	432, 637
Midland	41, 462	74, 537	80, 239	66, 135	65, 726	62, 710
Saginaw	1, 148, 644	1, 083, 990	1, 287, 273	1, 185, 957	1, 245, 912	1, 178, 910
Saint Clair				4, 780	74, 671	125, 014
Total	2, 676, 588	2, 742, 217	3, 037 317	2, 885, 672	3, 161, 806	3, 297, 403

The following table shows the amount of salt inspected in Michigan since 1869, the first year of the establishment of the State salt inspection, for the years specified:

Grades of salt made in Michigan as reported by the inspectors.

Years.	Fine.	Packer's.	Solar.	Second quality.	Total for each year.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1869	513, 989	12, 918	15, 264	19, 117	561, 288
1870	568, 326	17, 869	15, 507	19, 650	621, 352
1871	655, 923	14, 677	37, 645	19, 930	728, 175
1872	672, 034	11 110	21, 461	19, 876	724, 481
1873	746, 702	23, 671	32, 267	20, 706	823, 346
1874	960, 757	20, 090	29, 391	16, 741	1, 026, 979
1875	1, 027, 886	10, 233	24, 336	19, 410	1, 081, 865
1876	1, 402, 410	14, 233	24, 418	21, 668	1, 462, 729
1877	1, 590, 841	20, 389	22, 949	26, 818	1, 660, 997
1878	1, 770, 361	19, 367	33, 541	32, 615	1, 855, 884
1879	1, 997, 350	15, 641	18, 020	27, 029	2, 058, 040
1880	2, 598, 037	16, 691	22, 237	48, 623	2, 685, 588
1881	2, 673, 910	13, 885	9, 683	52, 821	2, 750, 299
1882	2, 928, 542	17, 208	31, 335	60, 222	3, 037, 307
1883	2, 828, 987	15, 424	16, 735	33, 526	2, 894, 672
1884	3, 087, 033	19, 308	16, 957	38, 508	3, 161, 806
1885	3, 230, 646	15, 480	19, 849	31, 428	3. 297, 403

Salt production of Michigan previous to 1869.

Years.	Barrels.	Years.	Barrels.
1860	4, 000	1865	477, 200
1861	125, 000	1866	407, 077
1862	243, 000	1867	474, 721
1863	466, 356	1868	555, 690
1864	529, 073		

Average price of Michigan salt in different years, 1866 to 1885, inclusive.

Years.	Price per barrel.	Years.	Price, per barrel.
1866	$1.80	1876	$1.05
1867	1.77	1877	85
1868	1.85	1878	85
1869	1.58	1879	1.02
1870	1.32	1880	75
1871	1.46	1881	85
1872	1.46	1882	75
1873	1.37	1883	81
1874	1.19	1884	75
1875	1.10	1885	90¾

The total value of the salt made in Michigan in 1885 was $2,967,663.

New York.—The total production of salt in the State during 1885 was 11,523,934 bushels of 56 pounds each, with a total value of $874,258. The Onondaga reservation contributed 6,934,299 bushels to the above total; and the Warsaw district, together with the outlying wells, 4,589,635 bushels, according to the manufacturers' returns. The production for the past three years has been:

	1883.	1884.	1885.
	Bushels.	*Bushels.*	*Bushels.*
Onondaga reservation	7,497,431	6,942,270	6,934,299
Warsaw district	600,000	2,000,000	4,589,635
Total	8,097,431	8,942,270	11,523,934

Of the production on the Onondaga salt reservation, Mr. P. J. Brummelkamp reports that 4,494,967 bushels were produced in the fine-salt works by artificial heat, and 2,439,332 bushels of coarse solar salt. The total for the reservation is nearly the same as last year; it is divided among the following districts, the production of each of which is given for 1885:

Salt inspected at the Onondaga salt springs in 1885.

Places.	Solar.	Fine.	Ground solar.	Fine growth.	Aggregate.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Syracuse, district No. 1	307,709	818,917	64,397	138,494	1,329,517
Salina, district No. 2	597,871	1,151,232	65,451	178,596	1,993,150
Liverpool, district No. 3	639,034	352,397	....	....	991,431
Geddes, district No. 4	764,871	1,503,730	....	351,600	2,620,201
Total	2,309,485	3,826,276	129,848	668,690	6,934,299

The gross revenue derived by the State for furnishing the brine, at the rate of 1 cent per bushel of salt produced, was $69,342.99. The surplus revenue above all expenditures leaves a profit to the State of $5,349.59. The following is a statement of the number of bushels of salt made at the Onondaga salt springs since June 20, 1797, the date of the first lease:

Production of the Onondaga district 1797 *to* 1885, *inclusive.*

[Bushels of 56 pounds.]

Years.	Solar.	Fine.	Total.	Years.	Solar.	Fine.	Total.
	Bushels.	*Bushels.*	*Bushels.*		*Bushels.*	*Bushels.*	*Bushels.*
1797		25,474	25,474	1842	163,021	2,128,882	2,291,903
1798		59,928	59,928	1843	318,105	2,809,395	3,127,500
1799		42,704	42,704	1844	332,418	3,671,134	4,003,552
1800		50,000	50,000	1845	353,455	3,408,903	3,762,358
1801		62,000	62,000	1846	331,705	3,507,146	3,838,851
1802		75,000	75,000	1847	262,879	3,688,476	3,951,355
1803		90,000	90,000	1848	342,497	4,394,629	4,737,126
1804		100,000	100,000	1849	377,735	4,705,834	5,083,569
1805		154,071	154,071	1850	374,732	3,894,187	4,268,919
1806		122,577	122,577	1851	378,967	4,235,150	4,614,117
1807		175,448	175,448	1852	633,595	4,288,938	4,922,533
1808		319,618	319,618	1853	577,947	4,826,577	5,404,524
1809		128,282	128,282	1854	734,474	5,068,873	5,803,347
1810		450,000	450,000	1855	498,124	5,584,761	6,082,885
1811		200,000	200,000	1856	709,391	5,257,419	5,966,810
1812		221,011	221,011	1857	481,280	3,830,846	4,312,126
1813		226,000	226,000	1858	1,514,554	5,518,665	7,033,219
1814		295,000	295,000	1859	1,345,022	6,549,250	6,894,272
1815		322,058	322,058	1860	1,462,565	4,130,682	5,593,247
1816		348,665	348,665	1861	1,884,697	5,315,694	7,200,391
1817		408,665	408,665	1862	1,983,022	7,070,852	9,053,874
1818		406,540	406,540	1863	1,437,656	6,504,727	7,942,383
1819		548,374	548,374	1864	1,971,122	5,407,712	7,378,834
1820		458,329	458,329	1865	1,886,760	4,499,170	6,385,930
1821		526,049	526,049	1866	1,978,183	5,180,320	7,158,503
1822		481,562	481,562	1867	2,271,892	5,323,673	7,595,565
1823		726,988	726,988	1868	2,027,490	6,639,126	8,666,616
1824		816,634	816,634	1869	1,857,942	6,804,295	8,662,237
1825		757,203	757,203	1870	2,487,691	6,260,422	8,748,113
1826		811,023	811,023	1871	2,464,464	5,910,492	8,374,956
1827		983,410	983,410	1872	1,882,604	6,048,321	7,930,925
1828		1,160,888	1,160,888	1873	1,691,359	5,768,998	7,460,357
1829		1,129,280	1,129,280	1874	1,667,368	4,361,932	6,029,300
1830		1,435,446	1,435,446	1875	2,655,955	4,523,491	7,179,446
1831		1,514,037	1,514,037	1876	2,308,679	3,083,998	5,392,677
1832		1,652,985	1,652,985	1877	2,525,335	3,902,648	6,427,983
1833		1,838,646	1,838,646	1878	2,788,754	4,387,443	7,176,197
1834		1,943,252	1,943,252	1879	2,957,744	5,364,418	8,322,162
1835		1,209,867	1,209,867	1880	2,516,485	5,482,265	7,998,750
1836		1,912,858	1,912,858	1881	3,011,461	4,905,775	7,917,236
1837		2,167,287	2,167,287	1882	3,032,447	5,307,733	8,340,180
1838		2,575,033	2,575,033	1883	2,444,374	5,053,057	7,497,431
1839		2,864,718	2,864,718	1884	2,353,860	4,588,410	6,942,270
1840		2,622,305	2,622,305	1885	2,439,332	4,494,967	6,934,299
1841	220,247	3,120,520	3,340,767				

During 1885 ten new wells were drilled near Syracuse: six in the Salina district, three in the Gere group, and one in the Geddes group; while one of these proved a comparative failure, the other nine are unusually successful, furnishing a large supply of brine at an average strength of 77° by the salinometer. The cost of these wells was $13,096.65

The following table shows the strength of the brines in each district for each month in the season, as reported by Dr. F. E. Englehardt, State chemist:

Strength of Onondaga brines for the year 1885.

Months.	Syracuse.		Salina.		Liverpool.		Geddes.	
	Fahrenheit.	Salinometer.	Fahrenheit.	Salinometer.	Fahrenheit.	Salinometer.	Fahrenheit.	Salinometer.
	°	°	°	°	°	°	°	°
April	55.50	71.18	56.00	74.40	56.00	74.40	55.00	70.29
May	56.66	69.28	55.33	72.70	55.33	72.70	56.00	70.70
June	57.66	66.83	56.33	69.33	56.33	69.33	58.00	69.21
July	57.50	66.38	57.50	68.70	57.50	68.70	59.00	66.76
August	55.80	67.72	56.75	70.64	56.75	70.64	55.80	69.17
September	54.80	67.07	56.60	70.43	56.60	70.43	56.40	70.46
October	52.50	67.00	53.50	72.32	53.50	72.32	53.50	70.74
November	52.00	69.41	53.00	72.93	53.00	72.93	53.33	72.06
Total average	55.38	68.09	55.63	71.43	55.63	71.43	55.88	69.67
At 60° Fahr.	....	67.63	....	70.99	....	70.99	....	69.25

Grand total at 60° Fahr., 69.72° salinometer.

The average salinometer strength of the brines for the year 1885 shows a decrease of about one-half degree as compared with 1884. The Salina, Liverpool, and Geddes supply has been higher than that at Syracuse, the first two by 3½ degrees, and the Geddes by 1.6 degrees. This variation in strength of the four districts is partly due to the greater strengh of the Salina, Liverpool, and Geddes wells, and partly to the fact that when the greatest amount of brine is required by the salt works, these wells are unable to supply the required amount; hence the deficiency must be supplied from Syracuse, whereby the strength of the latter's wells naturally becomes reduced. The new wells drilled in 1885 will remedy this difficulty, and the average will be higher.

A table is appended showing the average strength of the brines in degrees of the salinometer (reduced to correspond with a temperature of 60° Fahr.) in the years from 1865 to 1885, inclusive, except 1868, for which year there are no records:

Average strength of Onondaga brines.

Years.	Syracuse.	Salina.	Liverpool.	Geddes.	Average.
1865	66.17	66.47	60.65	66.17	64.86
1866	65.90	65.81	58.34	65.90	63.98
1867	64.44	64.35	64.35	63.95	64.27
1869	60.98	60.36	60.36	59.02	62.88
1870	59.49	58.94	58.94	59.34	59.22
1871	63.00	62.35	62.35	63.82	62.88
1872	65.10	66.00	67.00	66.20	65.82
1873	63.43	65.33	65.43	67.52	65.45
1874	63.80	66.15	66.15	67.15	65.81
1875	63.88	66.38	66.38	69.50	66.54
1876	66.75	67.70	67.70	69.33	68.15
1877	68.94	69.19	69.19	69.59	69.26
1878	69.93	70.58	70.58	70.02	70.27
1879	66.61	67.47	67.47	67.16	67.20
1880	66.13	67.10	67.10	67.55	66.97
1881	67.02	66.68	66.68	68.21	67.36
1882	67.75	67.24	67.24	68.63	67.71
1883	66.67	68.30	68.30	69.34	68.15
1884	67.88	71.58	71.58	70.10	70.28
1885	67.63	70.99	70.99	69.25	69.72

The wells of the Warsaw district have increased to eight altogether, and interest in this part of the State has caused much prospecting to extend the territory under which the bed is known to exist. The most remarkable movement has been at Pifford station, Livingston county, where a shaft 1,200 feet deep has been sunk to a bed of rock salt which is to be mined as such. The layer is said to be 50 feet thick, and has been analyzed as follows:

Analysis of rock salt from Livingston County, New York.

	Per cent.
Sodium chloride	97.84
Calcium sulphate	1.04
Moisture	.08
Residue insoluble in water	.43
Magnesium sulphate	Trace.
Loss	.61
Total	100.00

At Barker, 5 miles from Whitney's Point, Broome county, and at Clifton Springs, Ontario county, discoveries of rock salt were claimed, but the brines pumped from them were so weak as to lead to doubt as to the deposits.

Ohio and West Virginia.—The production decreased in both of these States in 1885, in spite of a slight advance in price to 65 cents per barrel.

Estimated production of salt in Ohio, 1882 *to* 1885.

Years.	Barrels.	Value.
1882	400,000	$300,000
1883	350,000	231,000
1884	320,000	201,600
1885	306,847	199,450

Estimated production of salt in West Virginia, 1882 *to* 1885, *inclusive.*

Years.	Barrels.	Value.
1882	400,000	$300,000
1883	320,000	211,200
1884	310,000	195,300
1885	223,184	145,070

Louisiana.—The production from the great mass of rock salt of Petite Anse, near New Iberia, increased during 1885; the total yield of various grades was 41,898 short tons, valued at $139,911. The following table shows the varieties of salt made since 1882:

Production of the Petite Anse mine in 1882, 1883, 1884, *and* 1885.

Grades.	1882.	1883.	1884.	1885.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Lump	20	405	1,485	3,267
Crushed	5,995	10,595	7,550	11,038
Coarse	16,595	22,480	15,750	20,585
Fine	2,940	3,625	6,280	6,958
Table	....	25	290	50
Total	25,550	37,130	31,355	41,898

The average price of lump salt was $5 per ton and the others $2.75. The demand for this salt increases, particularly from packers of meat who prefer it to Turk's Island or Mediterranean salt, on account of its its greater purity. The finer grades of ground salt have been improved by screens which remove the dust, and thus make the salt less liable to cake, which has been an objection. During 1885 a shaft was sunk 70 feet below the floor of the old workings; the salt obtained does not differ in quality from that above.

PACIFIC COAST.

The consumption of salt on the Pacific coast, owing to a somewhat lessened demand for metallurgical purposes, has not been so large during the past two or three years as formerly. The greatest decrease in consumption has occurred probably in Nevada and Arizona.

California.—The manufacture of salt has suffered little or no diminution in California, resulting in lower prices and an accumulation of stocks. Most of the salt produced in this State continues to be made at the extensive works located on the eastern shore of the San Francisco bay, where the manufacture is effected wholly by the process of solar evaporation.

The quantity of salt made in California during the past six years has been as follows, the amount made in excess of receipts at San Francisco being estimated:

Production in California, 1880 *to* 1885.

Years.	Short tons.
1880	14,000
1881	17,000
1882	19,000
1883	30,000
1884	25,000
1885	31,000

The season of active operations, which usually extends from about the 1st of May to the middle of November, was much shortened in 1884, by reason of long continued spring rains, and the output of the Bay Salt Works was considerably less in that year than it otherwise would have been. The working season in 1885 was long and otherwise favorable, and the production large, amounting to fully 25,000 tons in San Francisco. While a variety of improvements have been introduced at these works during the past year, their productive capacity has undergone little or no enlargement, the low prices ruling for salt of late having discouraged efforts in that direction. The prices of salt have not been so low in San Francisco for several years. Liverpool salt averaged throughout the year 1885 not more than $14 per ton, the year closing at about that figure, with large stocks on hand.

The imports of salt at the port of San Francisco during the past five years have been as follows:

Imports of salt at San Franscisco.

	1880.	1881.	1882.	1883.	1884.	1885.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds*	*Pounds.*	*Pounds.*
English	13, 828, 066	7, 745, 468	12, 841, 212	8, 543, 878	8, 500, 000	13, 200, 320
Carmen Island	3, 542, 000	2, 730, 000	761, 600	21, 046	15, 000	....
Peru	....	....	1, 200, 000	....	....	....
Total	17, 370, 066	10, 475, 468	14, 802, 812	8, 564, 924	8, 515, 000	13, 200, 320

The exports of salt from San Francisco amount to several thousand tons per year. The most of this is sent to Oregon, Washington Territory, and British Columbia, with small lots to Mexico and the Sandwich Islands.

It is not profitable to export salt to Australia, owing to a duty of $10 per ton being imposed by the several colonial goverments. Some small shipments made to New Zealand, where it is admitted duty free, have, however, proved remunerative. The quality of the salt produced in California improves every year, and much of that now made is considered equal to the best imported.

The Liverpool Salt Company, a California corporation, which opened a new saline on the Colorado desert in 1884, producing that year 1,500 tons of salt, has since more than doubled its output, having in the mean time put up a mill for grinding salt for table and other domestic uses. This mill, which is driven by steam and has a capacity to grind 25 tons per day, is located at Salton, the nearest station and shipping point on the Southern Pacific railroad. It is connected with the salt bed, 2 miles distant, by rail. Salton is 6½ miles to the west of Dos Palmas, a former station on the railroad, which has been discontinued. The summer climate here is excessively hot, the temperature for six or seven months in the year averaging over 100° during the day in the shade and rising often as high as 140° in the sun. The atmosphere is at the same time exceedingly dry, the annual rainfall amounting to not more than 4 or 5 inches; evaporation goes on with great rapidity, rendering the production of salt by the process here in use an easy matter. The water supplied to the mill, being brought for a distance of less than a mile, through iron pipes laid on top of the ground, becomes so hot that it is injected into the boiler at quite an elevated temperature.

The salt at this place occurs in the form of a crust, 1 foot or more thick, resting on a shallow lake of brine. This crust, which is covered with a thin coating of drift sand and dust, is cut away in longitudinal sections and, falling into the water below, is cleansed of the impurities that adhere to it. After this, having been thrown on a platform and left till the water drains off, this salt is ready to be taken to the mill for grinding, or to be sacked and sent to market. Over these open places a new crust at once commences to form, and the salt, crystallizing from the water below, soon fills them up again. The salt obtained here, even in its natural condition, is remarkably pure, an analysis recently made giving the following results:

Analysis of salt from Dos Palmas, California.

	Per cent.
Chloride of sodium	97.76
Sulphate of sodium	.70
Chloride of calcium	.27
Moisture	.96
Insoluble matter	.20
Total	99.89

This company is now supplying salt to the southern counties of California and a large portion of Arizona. It also commenced shipping small lots last year into the northwestern parts of Mexico, but this was checked soon after by the Mexican Government raising the duty on imported salt from $5 to $10 per ton, a duty which the company could not afford to pay. What has enabled this company to supply such a large extent of territory has been the low freights at which the Southern Pacific railroad has carried the product of the works. On that road this salt goes as far east as El Paso, and north to the Tulare country.

During the past year a heavy and what promises to be a valuable bed of salt was discovered in the northeastern part of San Bernardino county. It lies in a dry valley about 6 miles from the south end of Old Woman mountain and about 25 miles in a southeasterly direction from Danby station on the Atlantic and Pacific railroad, from which there is a wagon road to the salt deposit. The salt occurs here in strata, each about 2 feet thick, separated from each other by a seam of clay half an inch thick. The deposit, which has been opened to a depth of 10 feet, and from which 200 tons of clean and nearly pure crystallized salt have been taken, covers, so far as traced, an area of some 40 acres, though it is supposed to be much larger, being covered with a thin layer of drift sand and dust. It is probable that the mines in this part of San Bernardino county, and as far west as the Calico district, and also the northern parts of Arizona, will ultimately be supplied with salt from this source.

Salt is still made in considerable quantity from the well bored some two years ago near the town of Yreka, Siskiyou county. An excellent article is produced by the method of graduation here in use. The manufacture of salt at this point has been found profitable, by reason of a very considerable local demand, and on account of the cost of transportation from other producing or supplying localities. Salt in small quantities continues to be made also at several other places in California, only enough being produced to meet the wants of the immediate neighborhood.

Nevada.—In the other States and Territories lying west of the Rocky mountains no important changes have taken place in the salt industry during the past year, either as regards new discoveries or quantity made. In Nevada small lots have been taken from the numerous salines scattered over that State, the most of it for beneficiating the silver bearing ores, not more than a few hundred tons having been refined at the several works formerly erected there. For the year the total production in the State has not exceeded 4,000 short tons; the prospect for the incoming year indicates a slight increase.

Arizona.—While the domestic consumption in Arizona has been about the same, the demand for the ore reduction works was less last year than for several preceding years. The most notable salines in this Territory consist of the several lagoons situated in Apache county near the New Mexican line, and from one of which about 500 tons of crystallized salt of good quality are shoveled up and carried away every year. This salt contains a small percentage of saltpeter, an addition which is said to improve it for meat packing. The present consumption of Arizona may be set down at about 3,500 tons per year.

Utah.—In Utah about 15,000 tons of salt, the average quantity of late years, was produced, the most of it by solar evaporation from the water of Great Salt Lake. More than half the salt made here is sent to Nevada, Colorado, Idaho, and Montana, to be used in ore reduction, for which it answers very well despite the considerable amount of dust and sand which, blowing into the evaporating basins, become mixed with it while it is being made. This salt can be produced and loaded on the cars, after hauling it 6 miles, at the rate of $5 per short ton. The shipments of Utah salt to Montana fell off heavily last year, several of the mills at Butte City having shut down in consequence of the high freight—$20 per ton—charged for its transportation over the Utah and Northern railroad, the mining companies claiming that they could not mill their ores with any profit with such transportation charges on salt. For the past three or four years the ores about Butte have been growing steadily poorer and at the same time baser. On an average they yield now not over 35 ounces of silver per ton, while they require from 12 to 15 per cent. salt for successful treatment. Though they have plenty of ore of this grade, it is not available, so the miners contend, with salt at $25 per ton.

Idaho.—The Oneida Company produced last year at their works in southeastern Idaho about 800 tons of salt, for a portion of which a market was found in the neighborhood, the bulk of it being consumed in the mines of Idaho and Montana. At the above point numerous salt springs occur, the water from which is evaporated by artificial heat. Oregon and Washington Territory obtain their supply of salt from California, a little being made in the former from the brine of salt springs.

Imports and exports.—The imports of salt into the United States since 1867 and the exports from this country since 1790 have been carried forward from the last report and are shown in the following tables. While the quantities are doubtless given correctly, there are apparent discrepancies in the values as reported:

Salt imported and entered for consumption in the United States, 1867 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Cake, over 30 per cent. of potash.		In bags, barrels, and other packages.		In bulk.		For the purpose of curing fish.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*		
1867	....	....	254, 470, 862	$696, 570	229, 304, 323	$336, 302	....	....	$1, 032, 872
1868	....	....	308, 446, 080	915, 546	219, 975, 096	365, 458	....	....	1, 281, 004
1869	....	$1, 752	297, 382, 750	895, 272	256, 765, 240	331, 168	......	...	1, 248, 192
1870	....	9, 698	288, 479, 287	797, 194	349, 776, 433	507, 874	68, 597, 023	$87, 048	1, 401, 814
1871	....	2, 436	283, 993, 799	800, 454	274, 730, 573	355, 318	64, 671, 139	66, 008	1, 224, 216
1872	....	....	258, 232, 807	788, 893	257, 637, 230	312, 569	57, 830, 929	60, 155	1, 161, 617
1873	....	....	239, 494, 117	1, 254, 818	388, 012, 142	525, 585	86, 756, 628	86, 193	1, 866, 596
1874	....	....	358, 375, 496	1, 452, 161	427, 294, 209	649, 838	105, 613, 913	126, 896	2, 228, 895
1875	....	1, 867	318, 673, 091	1, 200, 541	401, 270, 315	549, 111	110, 249, 440	119, 607	1, 871, 126
1876	....	....	331, 266, 140	1, 153, 480	379, 478, 218	462, 106	118, 760, 638	126, 276	1, 741, 862
1877	....	....	359, 005, 742	1, 059, 941	444, 044, 370	532, 831	132, 433, 972	140, 787	1, 733, 559
1878	....	....	352, 109, 963	1, 062, 995	414, 813, 516	483, 909	100, 794, 611	96, 898	1, 643, 802
1879	....	2, 480	375, 286, 472	1, 150, 018	434, 760, 132	532, 706	94, 060, 114	95, 841	1, 781, 045
1880	....	21, 667	400, 970, 531	1, 180, 082	449, 743, 872	548, 425	109, 024, 446	119, 667	1, 869, 841
1881	1, 397, 579	8, 187	412, 442, 291	1, 242, 543	529, 361, 042	658, 068	133, 395, 065	144, 347	2, 053, 145
1882	8, 954, 834	55, 622	329, 969, 300	1, 086, 932	399, 100, 228	474, 200	134, 777, 569	147, 058	1, 763, 812
1883	7, 863, 756	43, 363	312, 911, 360	1, 035, 946	412, 938, 686	451, 001	142, 065, 557	154, 671	1, 684, 981
1884	(*a*)8, 416, 147	40, 046	340, 759, 010	1, 093, 628	441, 613, 517	433, 827	126, 605, 276	122, 463	1, 690, 564
1885	(*a*)11, 614, 534	52, 334	351, 276, 969	1, 030, 029	412, 322, 341	386, 858	140, 067, 018	121, 429	1, 590, 650

a Classed as "salt cake;" amount of potash not specified.

Salt, of domestic production, exported from the United States.

Fiscal years ending September 30 until 1842, and June 30 since—	Quantity.	Value.	Fiscal years ending September 30 until 1842, and June 30 since—	Quantity.	Value.
	Bushels.			*Bushels.*	
1790	31, 935	$8, 236	1857	576, 151	$190, 699
1791	4, 208	1, 052	1858	533, 100	162, 650
1830	47, 488	22, 978	1859	717, 257	212, 710
1831	45, 847	26, 848	1860	475, 445	129, 717
1832	45, 072	27, 914	1861	537, 401	144, 046
1833	25, 069	18, 211	1862	397, 506	228, 109
1834	89, 064	54, 007	1863	584, 901	277, 838
1835	126, 230	46, 483	1864	635, 519	296, 088
1836	49, 917	31, 943	1865	589, 537	358, 109
1837	99, 133	58, 472	1866	670, 644	300, 980
1838	114, 155	67, 707	1867	605, 825	304, 030
1839	264, 337	64, 272	1868	624, 970	289, 936
1840	92, 145	42, 246	1869	442, 947	190, 076
1841	215, 084	62, 765	1870	298, 142	119, 582
1842	110, 400	39, 064	1871	120, 156	47, 115
1843 (nine months)	40, 678	10, 262	1872	42, 603	19, 978
1844	157, 529	47, 755	1873	73, 323	43, 777
1845	131, 500	45, 151	1874	31, 657	14, 701
1846	117, 627	30, 520	1875	47, 094	16, 273
1847	202, 244	42, 333	1876	51, 014	18, 378
1848	219, 145	73, 274	1877	65, 771	20, 133
1849	312, 063	82, 972	1878	72, 427	24, 968
1850	319, 175	75, 103	1879	43, 710	13, 612
1851	344, 061	61, 424	1880	22, 179	6, 613
1852	1, 467, 676	89, 316	1881	45, 455	14, 752
1853	515, 857	119, 729	1882	42, 085	18, 265
1854	548, 185	159, 026	1883	54, 147	17, 321
1855	536, 073	156, 879	1884	70, 014	26, 007
1856	698, 458	311, 495	1885	(a)4, 101, 587	26, 488

a Pounds.

BROMINE.

BY DAVID T. DAY.

Present state of the industry.—The principal development of the bromine industry duiing the past year has been at the Michigan salt wells, and in western Pennsylvania. Until very recently the attempts to make bromine from the Michigan brines were unsuccessful, bromides being present in only very slight traces. At Midland, in Midland county, Michigan, an isolated system of wells yields bittern containing 4.2 per cent. of bromine, according to the analysis of Mr. Ayres, of the University of Michigan. This bittern is now worked and produces about one-eighth of the United States supply. It is a singular fact that brines in Saginaw, only 25 miles distant, yield scarcely a trace of bromine. This new development in Michigan has peculiar significance inasmuch as the monopoly in the production of bromine which West Virginia and Ohio have hitherto enjoyed has aided those regions in their competition with the Michigan salt industry. Bromine has been a valuable by-product in the manufacture of salt; and if enough is found in Michigan to supply the trade it will be a severe blow to the salt works on the Ohio river.

The method of manufacture of bromine in Michigan is different from the common process in West Virginia and elsewhere. The conditions are different in Michigan, and they seem best met by the use of potassium chlorate as an oxidizing agent in place of manganese dioxide, which is in general use on the Ohio river. As the former substance is made with chlorine, which in turn is made by the oxidizing effect of manganese dioxide, it would seem that oxidation by potassium chlorate is in the end only a repetition of the effect of manganese dioxide, and that it would be a direct saving of labor and of the inevitable waste in producing potassium chlorate if manganese dioxide were used to oxidize the hydrobromic acid which is the product of treating bittern with sulphuric acid; and doubtless this would be true were it not for the fact that bromides form only a small part of the Michigan bittern. It contains also much calcium chloride. This substance causes such inconvenient precipitates of calcium sulphate, with sulphuric acid, that it becomes desirable to use the minimum quantity of that acid. This is best effected by using potassium chlorate, with which less than half as much sulphuric acid is necessary as with manganese dioxide. This point in favor of potassium chlorate is declared sufficient to justify its use when selling at, or below, 17 cents per pound, and its use is spreading to those wells in West Virginia in which calcium chloride is found in unusual quantity.

In western Pennsylvania the salt wells at Tarentum have been yielding bromine for some time. In Allegheny three firms are now producing bromine.

In West Virginia and Ohio, the bromine industry is suffering from the depression in the salt trade brought about by the Michigan industry. At Charleston, West Virginia, for instance, out of forty-five salt furnaces in operation forty years ago, only one remains, and that has been disabled by the recent freshets in the Kanawha river. The greater part of the bromine is, however, still produced in West Virginia and Ohio. The proportion of bromides to salt in the Pomeroy region is now such as to yield 1 pound of bromine for 2 barrels of salt.

Production.—The amount of bromine produced during 1885 was slightly greater than the product of 1884, being about 310,000 pounds, of which 110,000 pounds were made in the Pomeroy region; 15,000 pounds in the Tuscarawas valley, Ohio; 85,000 in West Virginia; 60,000 in Pennsylvania, and 40,000 in Michigan. The following table gives the production of bromine during the last three years:

Production of bromine in the United States, 1883, 1884, *and* 1885.

Source.	1883.	1884.	1885.
	Pounds.	*Pounds.*	*Pounds.*
Pomeroy, Ohio	171,116	159,881	110,000
Tuscarawas valley, Ohio	23,334	21,710	15,000
West Virginia	106,650	99,509	85,000
Pennsylvania			60,000
Michigan			40,000
Total	301,100	281,100	310,000

Price.—Early in 1885 a combination was effected among nearly all the producers of bromine throughout the United States; the product was pooled and sold through the agency of Mr. D. G. Hildt, of New Philadelphia, Ohio. Owing to this combination the price rose steadily from about 25 cents per pound to 30 cents in April, and to 33 cents before the close of the year, with a promise of higher prices. The greater part was sold to manufacturers of bromides in Philadelphia and Boston, and a small portion was exported to France.

IODINE.

BY DAVID T. DAY.

The iodine imported during 1885 amounted to 238,994 pounds, valued at $310,015. This is called "crude iodine." A trifling amount of "resublimed" iodine was also imported, amounting to only 4 pounds, valued at $16. The importations from 1867 to 1885, inclusive, are given below.

Iodine imported and entered for consumption in the United States, 1867 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Crude.		Resublimed.		Iodine salts.	Total.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
1867	12, 347	$28, 013	3, 199	$6, 764	....	$34, 777
1868	18, 994	55, 869	5, 527	16, 178	....	72, 047
1869	17, 241	50, 625	5, 882	18, 356	$3, 589	72, 570
1870	27, 825	70, 777	2, 233	6, 251	....	77, 028
1871	74, 320	212, 195	956	3, 499	....	215, 694
1872	81, 437	292, 998	258	2, 166	41	295, 205
1873	48, 991	206, 783	10	87	....	206, 870
1874	23, 861	89, 305	2	16	....	89, 321
1875	26, 058	74, 357	54	171	3	74, 531
1876	24, 913	55, 443	....	....	....	55, 443
1877	50, 123	111, 494	....	....	....	111, 494
1878	73, 687	230, 041	....	....	12	230, 053
1879	31, 779	122, 571	....	....	....	122, 571
1880	104, 703	501, 957	2	12	....	501, 969
1881	162, 863	336, 998	13	30	648	337, 676
1882	119, 952	213, 311	15	28	1, 266	214, 605
1883	140, 642	162, 036	5	8	5, 972	168, 016
1884	153, 550	173, 251	336	493	(*a*)	173, 744
1885	238, 994	310, 015	4	16	(*a*)	310, 031

a Not specified.

The iodine thus imported comes principally from Chili and Peru, the production in Scotland having declined considerably. It is not possible to find the exact proportion of South American iodine to that from Great Britain. It is quite nearly represented, however, in the following table, in which are given the receipts in New York from South America direct and those from European ports. Some of the latter may be re-shipments of South American iodine.

Receipts of iodine at New York.

Years.	From South America.	From Hamburg, London, and ports other than South America.
	Kegs.	*Packages.*
1883	414	28
1884	1, 138	165
1885	981	24

The production of iodine in South America has grown steadily. A table in the last report gave the estimated annual yield; this has been replaced by the following table containing the exact shipments from Iquique, from 1881 to 1885, inclusive, with estimates for previous years. These have been obtained from Messrs. Gehe & Co., of Dresden, through the courtesy of Messrs. Powers & Weightman.

Production of iodine in South America.

Years.	Pounds.	Years.	Pounds.
1873	30,000	1880	380,000
1874	100,000	1881	308,700
1875	(a)100,000	1882	453,789
1876	110,000	1883	421,984
1877	200,000	1884	526,439
1878	280,000	1885	529,200
1879	350,000		

a From 131 manufactories.

The Scotch iodine industry.—It is needless to say that strenuous efforts have been made by those interested in the utilization of Scotch and Irish seaweed to keep pace with South American progress. At the International Inventions Exhibition in London in this last year, Mr. E. C. C. Stanford, of Glasgow, gave an interesting exhibition of the iodine industry as developed in Scotland. This included the various processes that have been suggested to prevent waste in burning the seaweed. Mr. Stanford has introduced many of these improvements, notably the "char process," in which the weed is submitted to destructive distillation in iron retorts, leaving behind a loose porous charcoal containing the salts and iodine, and yielding in the distillate, ammonia, acetic acid, and tar. In a still later process, he proposed to extract first the potassium chloride ("muriates"), potassium sulphate, and "kelp salt" (sodium chloride containing some sodium carbonate and including the iodides) by simple maceration in cold water. The amount so removed from air-dried Laminaria is about one-third of its weight, of which 20 to 22 per cent. consists of mineral salts, and the balance of dextrine, mannite, and extractive matter, leaving two-thirds of the plant for further treatment. The residue contains a peculiar new substance called "algin," and cellulose. This algin resembles albumen, but is distinguished by not coagulating on heating. It is proposed to use it for sizing fabrics, as a mordant in dyeing and printing, as an article of food in place of gelatine, and, when pressed with cellulose, as a basis for artificial wood. Its separation from cellulose caused the following modification of the process: The freshly dried seaweed is boiled with sodium carbonate, the solution filtered and treated with sulphuric acid; this precipitates the algin. The solution is next neutralized with limestone, filtered from the resulting gypsum, and evaporated until sodium sulphate crystallizes out. The mother liquor containing all the potassium salts and iodine is carbonized, forming "kelp substitute," from which iodine is obtained in the ordinary way. The relative economy of the old process, the char process, and the "wet process," as this last improvement is called, may be compared in the following scheme:

Kelp (or native) process.

100 tons dry seaweed yield 18 tons of kelp, containing—
- 9 tons of potassium and sodium salts.
- 270 pounds iodine.
- 10 tons waste salts and loss.

Distillation process ("char" process).

100 tons dry seaweed yield—
- 36 tons charred residue, containing..............
  - 15 tons of potassium and sodium salts.
  - 600 pounds iodine.
  - 20 tons charcoal.
- Acetic acid.
- Ammonium acetate.
- Tar.

Wet process

100 tons dry seaweed yield—
- 33 tons water extract, containing ....
  - 20 tons of potassium and sodium salts.
  - 600 pounds iodine, dextrine, etc.
- 20 tons algin.
- 15 tons cellulose.

Price.—The combination among producers has kept the price of crude iodine quite uniformly at 9 pence per ounce, or $2.88 per pound, during 1885. The only variations from this figure were caused by irregular sales of iodine in second hands at from 8⅝ to 8⅞ pence per ounce. With the increasing production it does not seem possible for the price to keep its present place, even with the help of the combination. The following table gives the price of iodine since it first became an article of commerce:

Kelp imports into the Clyde, and price of iodine.

Years ending June 30—	Kelp imports.	Price of iodine.	Years ending June 30—	Kelp imports.	Price of iodine.
	Long tons.	*Per pound.*		*Long tons.*	*Per pound.*
1841	2,565	$1.20	1866	8,858	$2.40
1842	1,887	1.12	1867	8,174	2.88
1843	1,965	1.44	1868	8,116	3.04
1844	3,263	2.88	1869	8,978	3.12
1845	6,086	7.46	1870	9,257	3.04
1846	3,627	5.34	1871	9,384	3.44
1847	4,000	2.64	1872	10,049	8.16
1848	4,400	2.64	1873	9,449	5.12
1849	4,731	2.64	1874	10,923	(*a*)3.52
1850	11,421	2.56			(*b*)2.94
1851	7,320	2.08	1875	8,643	(*a*)2.44
1852	5,418	3.64			(*b*)2.25
1853	6,491	3.72	1876	....	(*a*)1.92
1854	4,679	2.88			(*b*)1.87
1855	5,826	3.20	1877	....	(*c*)3.28
1856	6,349	3.28	1878	....	(*c*)4.00
1857	8,641	2.96	1879	....	(*c*)4.48
1858	8,123	2.52	1880	....	(*d*)1.92
1859	8,190	2.32	1881	....	(*d*)2.00
1860	7,754	2.04	1882	....	(*d*)1.60
1861	9,722	1.68	1883	....	(*d*)1.28
1862	9,414	1.36	1884	....	(*d*)1.20
1863	14,018	1.20			(*e*)2.88
1864	11,349	2.00	1885	....	(*e*)2.88
1865	13,741	1.84			

a Scotch. *b* Peruvian. *c* Combination. *d* Combination broken. *e* Recombination.

BORAX.

California and Nevada.—These are the only States that produce any borax, and the only ones on the western Continent that produce salts of boracic acid steadily and in considerable quantity. For several years past the production of borax in these two States has afforded the manufacturer but little profit, owing to the extremely low prices which have ruled in the leading markets of the world. Commercial borax, which sold in San Francisco less than four years ago at 11 cents per pound for concentrated and 13 cents per pound for the refined salt, is selling there now for 6 and 8 cents per pound respectively. The causes for this unexampled depression in price having been sufficiently explained in previous reports of this series, need be stated here only in general terms. Prominent among these causes are overproduction, rivalry between companies competing for the market, and overestimates of the California and Nevada resources, to which may be added a strange misapprehension shown at times in regard to the future of the trade. The industry having outlived these disturbing features, appears to have settled finally to a more certain and stable basis. Under these more normal conditions the trade will be likely to fluctuate less both as regards production and prices hereafter, and will prove in general more satisfactory to the manufacturer. Meantime, the home and foreign producers have been brought into greater harmony with each other, and will no doubt find it to their interest to act concertedly.

With the prevailing low prices the consumption of borax is evidently increasing in the various arts and manufactures in which it has been employed, while new uses are continually being found for it. In this extended consumption manufacturers will, no doubt, find some compensation for the present low prices. Once introduced, the price may be advanced without diminishing its use markedly. It is probable that the present output of the California and Nevada companies now in the field will be kept up, and may even be slightly increased for some time to come. It is not at all likely, however, that any of the unimproved salines in these States, of which there are several, will be utilized at once, there being nothing to encourage further investments in the business at present. Only the practice of the strictest economy has enabled existing companies to continue operations till the present time.

The annual production of borax on the Pacific coast during the past ten years has been approximately as follows:

Production of borax.

Years.	Pounds.
1876	5,180,810
1877	3,727,280
1878	2,802,800
1879	1,584,966
1880	3,860,748
1881	4,045,405
1882	4,236,291
1883	6,500,000
1884	7,000,000
1885	8,000,000

It should be stated that the above figures, while they cannot be far out of the way, are not absolutely correct. There being no official record of the quantity of borax made annually by the several companies engaged in the business, round numbers have latterly been adopted in estimating the same. The employment of more precise figures has been found impracticable on account of the practice of individuals and small companies in the borate fields of making a few tons of borax and selling it to the local merchants, who in turn dispose of it directly to buyers and consumers in San Francisco. None of these parties keep any account of the small lots so handled.

Shipments of borax from California and Nevada in 1883, 1884, *and* 1885.

To—	1883.	1884.	1885.
	Pounds.	*Pounds.*	*Pounds.*
East by rail	3,288,200	2,995,880	1,500,000
New York by sea	1,911,116	3,446,326	5,081,557
Liverpool	1,287,777	740,291	2,312,827
China	20,231	33,862	28,656
Japan	8,882	3,327	20,498
Victoria	1,200	2,487	
Mexico	6,301	3,555	7,916
Honolulu	4,200	475	120
Australia	820	21,542	29,589
Central America		200	600
Antwerp		22,500	
British Columbia			807
France			23,630
Total	6,528,727	7,270,445	9,006,200

Borax, boracic acid, and borate of lime imported and entered for consumption in the United States, 1867 to 1885, inclusive.

Fiscal years ending June 30—	Refined borax.		Crude borax.		Boracic acid.		Borate of lime.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*		
1867	49,652	$6,601	5,672	$711	770,756	$73,396	....	....	$80,708
1868	79,183	10,127	22,293	2,985	243,993	22,845	....	....	35,957
1869	89,695	12,799	54,822	8,011	988,033	109,974	....	....	130,784
1870	97,078	14,511	2,616	322	1,166,145	173,806	33,529	$1,666	190,305
1871	134,927	20,705	5	1	1,204,049	185,477	45,600	2,248	208,431
1872	35,542	6,288	....	....	1,103,974	191,575	22,500	800	198,663
1873	9,284	2,152	....	....	1,222,006	255,186	....	....	257,338
1874	3,860	1,253	588	78	233,955	52,752	....	....	54,083
1875	5,153	1,224	....	....	41,742	6,280	....	....	7,504
1876	3,145	691	....	....	137,518	15,711	....	....	16,402
1877	3,500	676	55	12	107,468	11,231	....	....	11,919
1878	3,402	514	286	61	178,798	14,925	....	....	15,500
1879	3,472	490	....	....	306,462	21,888	....	....	22,378
1880	15,278	2,011	....	....	243,733	18,473	22,122	742	21,226
1881	4,136	865	....	....	187,053	15,771	....	....	16,636
1882	15,710	3,774	....	....	536,334	71,343	....	....	75,117
1883	5,611	1,359	....	....	4,334,432	580,171	....	....	581,530
1884	7,332	1,691	142	34	44,512	4,494	....	....	6,219
1885	240	41	....	....	48,517	4,035	....	....	4,076

Imports of boracic acid in 1884 *and* 1885.

	1884.		1885.	
	Pounds.	Value.	Pounds.	Value.
Commercial	42,900	$4,103	42,165	$3,208
Pure	1,611	301	6,352	827

SULPHUR.

BY WILLIAM C. DAY.

Since the publication of the last report, 1883 and 1884, the most important advance in connection with the sulphur industry in this country is the result of the operations upon the deposits at Cove Creek Fort, Millard county, Utah. These deposits were described in the last report, and the fact was stated that a considerable amount of money had been invested for the purpose of extracting and refining crude sulphur. A company known as the Dickert & Myers Sulphur Company, of which Mr. Daniel Myers, of Cleveland, is president, has been incorporated with a capital stock of $2,000,000.

In 1870 Mr. Ferdinand Dickert, secretary, treasurer, and general manager of this company, visited Sicily for the purpose of examining the sulphur mines and the methods employed to extract and refine sulphur, as well as to determine the nature and extent of the competition to which similar operations upon American sulphur would be subjected. Mr. Dickert has recently taken out United States patents on improvements in the steam process of extraction which he found employed with only indifferent success at mines near Palermo in 1871. He has also patented improvements on the chloride of calcium process. As a result of this preliminary investigation on the part of its general manager the company is well prepared to compete with the introduction of foreign sulphur.

About two years ago operations upon the claim known as the Cleveland were begun, and have been continued with few and short interruptions to the present. The process of extraction now used at this claim is as follows: There are in operation four steam cylinders, with a total capacity of 14 tons in twenty-four hours. These cylinders are made of heavy castings, the upper and lower portions being separated by a perforated partition upon which the crude sulphur is placed. The upper portion has a capacity of about 2 tons admitted through a trap in the top, which is afterwards closed and made steam tight. Steam at a pressure varying from 60 to 70 pounds is admitted; the sulphur is melted in two or three hours and separated from impurities by flowing into the lower portion. This process is in general similar to that used at the Rabbit-Hole mines, having, however, in addition certain improvements patented by Mr. Dickert. The melted sulphur is drawn off into conical molds, after which it is ground to flour and packed in sacks for shipment. Thus obtained it is said to be 99.80 fine; it is used for "sheep dip," a purpose said to consume annually many tons west of the Mississippi river. The immediate erection of chambers for the manufacture of "flowers of sulphur" is contemplated. These works are situated 23 miles east of Black Rock station on the Utah Central railroad. To this point the product is hauled in wagons. Thus far the output has been 53 car loads or 715 short tons.

The following information in regard to the geological features of the Cove Creek deposits has been obtained from a paper by Prof. G. vom Rath, from the *Neues Jahrbuch fur Mineralogie, etc.*, Band I., 1884, p. 259. "In the claim known as the 'Mammoth' a cut revealed limestone alternating with slaty clay. Limestone and slate are so impregnated with sulphur that pieces a foot in thickness consist almost entirely of sulphur in which only fragments of the neighboring rocks are contained, thus forming a conglomerate in which the largely predominating cement, sulphur, binds together small angular fragments of limestone and slate. In this claim, as also in others to be mentioned, gypsum, as a transformation product of limestone, appears in abundance. In all clefts and cavities the sulphur forms small octohedral crystals. Frequently the sulphur has a granular structure, the granules, 1 to 3 millimeters in size, consisting either entirely of sulphur or inclosing a very small fragment of rock. At the 'Sulphur King' claim the disintegrated rock was also observed to be impregnated with sulphur and in places essentially changed into sulphur. The surrounding rock is different from that of the Mammoth, consisting of a decomposed andesite of a friable character and filled with particles of sulphur. The four claims, Clear Creek, Cleveland, Cove Creek, and Washington, are included in an almost circular valley. Here, for a depth of about 28 feet, and covering the entire area of the circular plain, sulphur occurs either pure or richly impregnating disintegrated andesite. A number of excavations about 12 feet deep reveal the fact that the formation of sulphur is still taking place. In several excavations an elevated temperature, also water vapor and hydrogen sulphide, were noticed, and in clefts the most delicate crystals of sulphur, evidently newly formed. Gypsum is of very frequent occurrence in this valley; anhydrite also occurs, according to Mr. C. A. Semler. The surrounding region, as well as that more remote, abounds in warm springs and sulphur springs. The mass of sulphur in these four claims, according to the most moderate calculations (area 300,000 square meters, thickness 3 meters, mean percentage of sulphur 75), is calculated to be 1,350,000 tons.

"Among the almost numberless discoveries of volcanic origin there appears to be none which, in massiveness, can even approximately compare with the Cove Creek deposits, which are, futhermore, remarkable for high percentage of sulphur, averaging at least 75 per cent. and frequently exceeding 90 per cent."

One of the great obstacles encountered both in Sicily and in the western part of this country, where the processes of extracting and refining sulphur have been carried on, is scarcity of fuel. This difficulty is not found at Cove Creek, cedar wood being abundant and cheap; the price paid is $1.50 per cord, delivered on the premises. Water is piped a distance of 9,100 feet from the range, and has a head of 800 feet. Wages for men and teams are reasonable. It is claimed that the chief difficulty opposed to successful competition with Sicilian sulphur lies in the fact that practically refined sulphur is admitted as crude, thereby escaping the duty of $10 per ton imposed upon the refined article. The tariff limit for "crude" is 95 per cent.

The operations at Rabbit-hole springs, Humboldt county, Nevada, which, according to the last report, were declining, have since ceased altogether, owing to heavy running expenses incident to the barrenness of the country, and high transportation charges. It does not seem probable that the Humboldt company will resume operations very soon, owing to the great disadvantages with which it has to contend.

The consumption of sulphur on the Pacific coast is estimated at 3,500 tons per annum; nearly all of this is imported. Three thousand tons are used in the manufacture of sulphuric acid, the remainder supplying various demands, such as those of sheep herders, vine growers, etc. The price in San Francisco is at present $35 per ton.

The Louisiana sulphur beds, near Lake Charles, Calcasieu parish, on the line of the New Orleans and Texas railway, already mentioned and described in the last report, are now in the hands of a company of which Hon. Duncan F. Kenner is president. Nothing has as yet been accomplished toward extracting the sulphur, although there are indications that operations may be commenced in the near future. The difficulties to be encountered in extracting the sulphur from these deposits, according to Mr. D. M. Jewett, C. E., are not serious, and are mainly incident to the necessity of penetrating a stratum of quicksand 60 feet thick. Fuel and labor are cheap in this locality, and as the railway nearly touches the property containing these beds the transportation facilities are excellent. It is believed that sulphur from these beds could be delivered at the seaboard in New Orleans or Galveston at $20 per ton at a large profit.

New discoveries.—In regard to the sulphur referred to in the last report as occurring in Tom Green county, Texas, Mr. Jewett states that it is of excellent quality as revealed by specimens submitted to him, the impurity consisting of only 10 per cent. of gypsum. Beyond this little is known in regard to it.

Mr. Jewett further reports sulphur deposits north of Lone mountain or Red peak, 5 miles distant from the town of White Oaks, New Mexico. In these deposits the percentage of sulphur is about 50; gypsum occurs with it. The extent of these deposits is unknown.

A deposit of sulphur is also reported by Mr. C. G. Yale as having been discovered in Kern county, California, during the last year. It is said to furnish quite pure sulphur, though nothing is yet known of its extent.

No attempt was made during 1885 to develop the known sulphur beds in Wyoming and other Rocky Mountain Territories, but the beds have been made the subject of careful study and investigation, and it seems likely that during 1886 an attempt will be made to produce sulphur for the market, either from the beds near Evanston, Wyoming, or else from those on the Utah Central railway in Utah.

Imports.—The amounts of crude and refined sulphur imported during 1885 show only slight changes over the two previous years. The following table shows the importations to 1885, inclusive:

Sulphur imported and entered for consumption in the United States, 1867 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Crude.		Flowers of sulphur.		Refined.		Ore. (*a*)	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Value.	
	Long tons.		*Long tons.*		*Long tons.*			
1867	24, 544. 10	$620, 373	110. 05	$5, 509	250. 55	$10, 915	....	$636, 797
1868	18, 150. 55	446, 547	16. 48	948	64. 75	2, 721	....	450, 216
1869	23, 589. 69	678, 642	96. 59	4, 576	645. 04	27, 149	....	710, 367
1870	27, 379. 60	819, 408	76. 34	3, 927	157. 24	6, 528	$1, 269	831, 132
1871	36, 131. 46	1, 212, 448	65. 54	3, 514	92. 26	4, 328	754	1, 221, 044
1872	25, 379. 55	764, 798	35. 97	1, 822	56. 94	2, 492	....	769, 112
1873	45, 533. 27	1, 301, 000	55. 29	2, 924	35. 97	1, 497	....	1, 305, 421
1874	40, 989. 55	1, 260, 491	51. 08	2, 694	56. 68	2, 403	....	1, 265, 588
1875	39, 683. 10	1, 259, 472	17. 83	891	....	....	....	1, 260, 363
1876	46, 434. 72	1, 475, 250	41. 07	2, 114	43. 87	1, 927	....	1, 479, 291
1877	42, 962. 69	1, 242, 888	116. 34	5, 873	1, 170. 80	36, 962	....	1, 285, 723
1878	48, 102. 46	1, 179, 769	156. 71	7, 628	149. 51	5, 935	....	1, 193, 332
1879	70, 370. 28	1, 575, 533	137. 60	6, 509	68. 94	2, 392	....	1, 584, 434
1880	87, 837. 25	2, 024, 121	123. 70	5, 516	158. 36	5, 262	....	2, 034, 899
1881	105, 096. 54	2, 713, 485	97. 66	4, 226	70. 96	2, 555	....	2, 720, 266
1882	97, 504. 15	2, 627, 402	158. 91	6, 926	58. 58	2, 196	....	2, 636, 524
1883	94, 539. 75	2, 288, 946	79. 13	3, 262	115. 33	4, 487	....	2, 296, 695
1884	105, 113. 19	2, 242, 697	178. 00	7, 869	126. 00	4, 765	....	2, 255, 331
1885	96, 839. 44	1, 941, 943	120. 56	5, 351	114. 08	4, 060	....	1, 951, 354

a Latterly classed under head of pyrites.

Importation from Japan is increasing, and would be more regular but for the necessity of buying the article several months before it can reach New York; meanwhile the price may change.

Statement by countries and by customs districts, showing the imports into the

[Quantities expressed in long cwts.]

Countries whence exported and customs districts through which imported.	1876.		1877.		1878.		1879.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.								
Austria	......	....	3,320	$7,098	......	....	......	....
Belgium	......	....	......	....	2,590	$5,242	......	....
Brazil	......	....	246	833	......	....	......	....
England	371	$914	298	806	168	469	352	$693
Scotland	358	683	214	427	......	....	......	....
France	1,666	4,071	4,577	10,780	3,850	9,174	4,774	10,270
Germany	......	....	......	....	......	....	......	....
Italy	......	....	16,800	22,720	20	39	......	....
Japan	......	....	3,584	6,204	......	....	......	....
Total	2,375	5,668	29,039	48,868	6,628	14,924	5,126	10,963
DISTRICTS.								
Boston & Charlestown, Massachusetts	......	....	......	....	......	....	......	....
New York, New York	338	683	21,170	32,348	76	166	915	1,534
Philadelphia, Pennsylvania	......	....	......	....	2,590	5,240	......	....
San Francisco, California	2,037	4,985	7,869	16,520	3,962	9,518	4,211	9,429
Total	2,375	5,668	[a]29,039	48,868	6,628	14,924	5,126	10,964

a The total imports entered for consumption in the United States in the fiscal year 1885 were 2,411 "refined sulphur," valued at $4,060.

Statement by countries and by customs districts, showing the imports into the United

[Quantities expressed in long tons.]

Countries whence exported and customs districts through which imported.	1876.		1877.		1878.		1879.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.								
Austria	......	....	......	....	......	....	......	....
Dutch West Indies and Dutch Guiana	1,515	$15,427	......	....	......	....	......	....
England	30	1,211	425	$14,631	(?)	$16	2	$335
Scotland	24	910	472	13,231	160	3,961	806	19,287
Gibraltar	......	....	290	7,789	......	....	......	....
Quebec, Ontario, Manitoba, and the Northwest Territory	......	....	......	....	12	264	......	....
France	......	....	......	....	......	....	......	....
French West Indies	......	....	......	....	......	....	......	....
Greece	......	....	......	....	......	....	......	....
Italy	46,941	1,439,839	41,819	1,194,000	47,494	1,161,367	64,420	1,453,138
Japan	456	16,291	437	13,137	256	7,548	224	4,528
Portugal	......	....	......	....	......	....	467	10,410
San Domingo	......	....	......	....	......	....	......	....
Spain	......	....	......	....	......	....	......	....
Spanish Possessions in Africa and adjacent islands	......	....	......	....	......	....	......	....
Total	48,966	1,473,678	43,443	1,242,788	47,922	1,173,156	65,919	1,487,698
DISTRICTS.								
Baltimore, Maryland	5,157	157,828	3,882	105,175	5,455	138,202	6,969	157,243
Barnstable, Massachusetts	......	....	......	....	......	....	600	13,780
Beaufort, South Carolina	......	....	......	....	......	....	......	....
Boston & Charlestown, Massachusetts	5,031	154,883	3,931	101,215	5,795	131,945	7,841	173,506
Charleston, South Carolina	......	....	......	....	526	12,267	605	13,812
Delaware, Delaware	450	13,500	......	....	......	....	890	21,907
Huron, Michigan	......	....	......	....	12	264	......	....
Middletown, Connecticut	......	....	......	....	......	....	......	....
Newark, New Jersey	......	....	1,071	31,802	462	13,240	443	10,175
New Orleans, Louisiana	172	5,705	150	4,750	......	....	100	2,087
New York, New York	24,524	721,092	21,867	654,997	28,240	690,989	36,543	827,193
Philadelphia, Pennsylvania	12,549	385,071	9,216	256,224	6,657	167,222	11,704	263,467
Providence, Rhode Island	600	18,232	1,739	45,487	519	11,479	......	....
Richmond, Virginia	......	....	......	....	......	....	......	....
San Francisco, California	483	17,367	862	27,768	256	7,548	224	4,528
Savannah, Georgia	......	....	725	15,370	......	....	......	....
Total	48,966	1,473,678	43,443	1,242,788	47,922	1,173,156	65,919	1,487,698

United States of refined sulphur each fiscal year, from 1875 *to* 1885 *inclusive.*

[Quantities expressed in long cwts,]

1880.		1881.		1882.		1883.		1884.		1885(*a*).	
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
......	......	......	......	......	......	......	......	......	......	......	......
......	......	201	$389	......	......	212	$473	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......
624	$1,169	397	763	388	$862	495	1,089	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......
2,556	4,361	2,354	4,728	5,901	11,333	1,708	3,357	......	......	......	......
......	......	......	......	106	254	97	231	......	......	......	......
......	......	120	241	1,496	3,202	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......
3,180	5,530	3,072	6,121	7,891	15,651	2,512	5,150	6,080	12,634	......	......
440	671	......	......	......	......	......	......	......	......	......	......
10	30	322	635	16	122	5	16	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......
2,730	4,829	2,750	5,486	7,875	15,529	2,507	5,134	......	......	......	......
3,180	5,530	3,072	6,121	7,891	15,651	2,512	5,150	6,080	$12,634	4,693	$9,431

long hundredweights of "flowers of sulphur," valued at $5,351 ; and 2,282 long hundredweights of

States of crude sulphur or brimstone each fiscal year, from 1875 *to* 1885 *inclusive.*

[Quantities expressed in long tons.]

1880.		1881.		1882.		1883.		1884(*a*).		1885(*a*).	
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......
1	$22	......	......	......	......	13	$379	......	......	......	......
1,664	36,444	1,668	$43,311	755	$20,294	3	88	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......
988	23,580	......	......	526	13,770	34	858	......	......	......	......
......	......	......	......	2	8	......	......	......	......	......	......
......	......	......	......	500	13,927	......	......	......	......	......	......
80,301	1,862,712	102,771	2,645,293	92,944	2. 504,862	92,861	2,248,870	......	......	......	......
282	4,744	691	16,253	2,980	66,356	1,038	23,714	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	240	7,875	......	......	......	......	......	......
......	......	308	8,637	......	......	500	12,856	......	......	......	......
......	......	......	......	9	310	87	2,030	......	......	......	......
83,236	1,927,502	105,438	2,713,494	97,956	2,627,402	94,536	2,288,795	105,143	$2,242,678	96,839.44	$1,941,943
13,827	313,342	16,477	430,917	13,781	364,384	11,977	286,438	15,037	303,226	......	......
......	......	......	......	......	......	......	......	650	16,163	......	......
......	......	......	......	540	13,889	......	......	600	13,259	......	......
8,207	183,486	8,860	226,801	7,467	194,317	7,756	173,569	5,294	112,152	......	......
1,061	25,398	3,065	78,741	6,025	161,281	4,051	100,235	6,125	132,570	......	......
......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	9	310	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......
280	7,121	100	2,646	220	6,516	428	10,378	......	......	......	......
46,657	1,083,784	57,608	1,463,082	46,531	1,260,222	45,385	1,110,313	52,478	1,135,725	......	......
10,679	254,892	17,987	477,547	14,839	408,611	22,772	549,095	18,786	401,468	......	......
1,255	31,155	650	17,507	1,244	33,036	535	13,830	651	15,517	......	......
......	......	......	......	660	17,760	......	......	......	......	......	......
1,270	28,324	691	16,253	6,054	151,234	1,072	24,572	5,522	112,598	......	......
......	......	......	......	586	15,842	560	14,365	......	......	......	......
83,236	1,927,502	105,438	2,713,494	97,956	2,627,402	94,536	2,288,795	105,143	2,242,678	96,839.44	1,941,943

a Sources not reported.

In addition to the above amounts some lac sulphur has been imported as follows:

Lac sulphur imported and entered for consumption in the United States, 1879 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.
	Pounds.	
1879	10,012	$880
1880	13,903	1,238
1881	....	775
1882	28,217	2,137
1883	30,197	2,072
1884	36,083	2,954
1885	(*a*)	(*a*)

a Not specified.

Prices.—The price of refined sulphur has not changed markedly; it averaged $40 per ton during 1885. Crude sulphur advanced slightly early in the year, but at the close had reached $22.75 per long ton. The average price was $22.40.

Utilization.—In addition to the more common and well-known purposes for which sulphur is used and which were discussed in the last report, its use as a "sheep dip," for the prevention of certain skin diseases in these animals, is one which is creating a large and increasing demand for the article. As already stated, large amounts are now used for this purpose west of the Mississippi river.

The crude sulphur imported from Sicily is largely used for the manfacture of sulphuric acid; of this substance it is estimated that 290,000 short tons were made from sulphur, and 153,000 tons from pyrites during the year 1885.

The total production and foreign shipments of Italian sulphur have been furnished through the courtesy of the Italian secretary of legation, Mr. A. de Forestà, as follows:

Production and foreign exports of sulphur in Sicily, 1882 *to* 1885, *inclusive.*

Years.	Production.	Exports.
	Metric tons.	*Metric tons.*
1882	394,093	265,557
1883	391,689	281,746
1884	367,712	270,704
1885	371,745	279,206

Total production for the Kingdom of Italy, 1882 *to* 1885, *inclusive*

Years.	Production.	Exports.
	Metric tons.	*Metric tons.*
1882	445,918	273,347
1883	446,518	288,381
1884	410,987	277,210
1885	419,538	289,257

PYRITES.

BY HERBERT J. DAVIS.

OCCURRENCE IN THE UNITED STATES.

New Hampshire.—Since the report for 1884, considerable and radical changes have been made in handling the output of the Milan mine, at Milan, Coos county. Increasing quantities of copper and silver, and, in some parts of the mine, gold, have caused the managers to pay more attention to smelting the ores, and to this end extensive works have been erected at Portland to handle the entire output. The ore is now sorted into two grades:

Analyses of Milan pyrites.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Sulphur	46.00	35.00
Copper	3.75	5.00
Iron	40.00	30.50
Silica, etc	6.25	21.50
Zinc	4.00	8.00
Totals	100.00	100.00

Both No. 1 and No. 2 ores find a ready market among the acid manufacturers. The cinder is returned to Portland and is smelted with raw "fines" and raw siliceous ores from the mine, containing from 3 to 4 per cent. of copper. The smelting is done in Bartlett water-jacket furnaces at small expense. A large proportion of the zinc is saved as oxide by a special process. The concentration of the gold and silver in the mattes is quite remarkable; the silver contents latterly amounting to nearly the same value as the copper, while the slags are so free from silver that fire assays usually give blank results. One notable feature, which may be mentioned in connection with this mine, is the fact that the ore is so well liked among the acid men that no trouble is experienced in getting ores burned when running as low as 33 per cent. in sulphur contents, while the demand for the No. 1 ore is at all times far ahead of the capacity of the mine. Contrary to the published opinion of experts, no difficulty is found in burning low-grade ores; no particular excess of air is required over that actually needed to oxidize the sulphur, since the density of the gas is kept up by using an increased thickness of ore on the grate bars of the burners, as much as 3 feet 6 inches thickness having in many cases proved not excessive, nor has clinkering been great enough to cause any trouble. Grates burning 700 to 800 pounds of rich ore will burn 1,100 to 1,200 pounds of this low-grade ore, consequently the labor bills are considerably larger than in the case of high-grade ore.

No excessive faulting nor diminution in the ore bodies has yet been encountered in working the Milan mine, and it is reasonable to suppose that the deposit will last an indefinite time. The output of the mine at the present time is 2,600 tons per month, divided as follows:

Monthly output of the Milan mine.

	Tons.
No. 1 ore	1,000
No. 2 ore	800
Fines and copper ore	800
Total	2,600

Vermont.—The pyrites deposits of Vermont are probably greater in extent than any others in the United States. Unfortunately, little, if any, of this large quantity is of any value for making sulphuric acid, as it is mostly pyrrhotite. The Elizabeth mine, at South Strafford, has perhaps the largest deposit of pyrites. It is considered to be a contact vein, and is very wide, being in some places upwards of 40 feet. This mine is not at present in operation, the low price of copper making it impossible to work it profitably. The ore was dressed to 6.5 per cent. copper.

Analysis of pyrites from the Elizabeth mine.

	Per cent.
Sulphur	33.00
Iron	50.00
Copper	3 50
Silica and insoluble matter	13 50
Total	100.00

The Ely mines at West Fairlee have also a large deposit of pyrrhotite and have been very extensively worked for copper. At present the mines are idle, only sufficient work being done to keep them free from water. A considerable quantity of the ore raised has been mundic, nearly barren of copper, and its sulphur contents are of no value for making acid.

At Walcotville there is a large deposit of pyrrhotite on which but little work has been done. There are one or two other points where pyrrhotite exists in quite large quantities, but no work has been done on them for several years, the copper contents being too low, and the sulphur valueless. The analysis of the Walcot ore is:

Analysis of pyrites from Walcotville, Vermont.

	Per cent.
Sulphur	34.40
Iron	32.70
Copper	3.27
Silica and insoluble matter	29.50
Total	99.87

Massachusetts.—The Davis mines, situated in the southeastern part of Rowe, Franklin county, are the only producers of pyrites in this State. These mines were opened in June, 1882, on the top of an immense outcrop of almost pure iron pyrites. The main shaft is now more than 400 feet in depth, following the dip (21°) of the deposit. There are five levels and the same number of stopes opened in both directions along the strike of the ore body. The vein or ore body maintains its size, and in several places is more than double the surface width. The policy of the company has been to drive the development work at least one year ahead of its requirements, and by this means there are always tens of thousands of tons of ore that can be extracted at any moment quickly and cheaply. The quantity mined during 1885 was upwards of 30,000 tons, nearly all of which was sold for consumption. The company keeps an ore reserve at the mines and railway of about 10,000 tons. This is in the form of lump, broken, and "smalls" ore, separated and prepared for immediate shipment. This quantity is in excess of the regular shipments.

Proportion of monthly shipments of lump, broken, and "smalls" ores.

Sizes.	Tons.
Lump ore, 3 inches in diameter and over	800
Broken ore, less than 3 inches in diameter and over three-fourths inch in diameter	1,900
"Smalls" ore, nothing larger than one-fourth inch in diameter	900
Total	3,600

But one grade of ore is produced, the lowest workings yielding identically the same grade of ore as the first openings of the mine. The width and continuity of the ore body, as well as its great length, depth, and purity make it one of the most remarkable pyrites deposits known. The following analysis is the mean of over one hundred separate tests:

Analysis of pyrites from Rowe, Massachusetts.

	Per cent.
Sulphur	49.27
Iron	45.30
Copper	1.47
Silica and insoluble matter	3.83
Total	99.87

The company has recently secured the property north of the present mines, which is known to carry the vein. Surveys are being made at the present time for a standard gauge railroad to run from the mines, connecting with the State railroad at a point about half a mile below the Charlemont station.

New York.—Saint Lawrence is the only county at present producing pyrites on a commercial scale in this State. The mines are at Hermon, about six miles from the railway at De Kalb Junction on the Rome, Watertown and Ogdensburg railroad. The pyrites from these mines is a bisulphide and burns freely, parting with its sulphur readily, the siliceous character of the ore permitting larger quantities than usual to be burned in a kiln. These ores are very hard and make few smalls. Most of the product for 1885 was shipped to acid works in the West; it amounted to about 2,000 tons. The following is the analysis:

Analysis of pyrites from Saint Lawrence county, New York.

	Per cent.
Sulphur	38.00
Iron	34.00
Copper	3.00
Silica and insoluble matter	25.00
Total	100.00

Near Ellenville, Ulster county, is a deposit of pyrites which has been worked more or less during the past year. The vein matter is about 6 feet wide, and the ore between 2 and 3 feet. The main shaft is about 40 feet deep, with the vein widening as it descends. The water came in so freely that the work was stopped until pumping facilities could be provided. The following is the mean of two analyses:

Analysis of pyrites from Ulster county, New York.

	Per cent.
Sulphur	39.12
Iron	34.16
Silica	26.69
Copper	Trace.
Total	99.97

Virginia.—The mines at Tolersville, Louisa county, on the Chesapeake and Ohio railroad, are the only pyrites mines at present operated in this State.

The mines of the Arminius Copper Mines Company are situated about 1½ miles from Tolersville, and have a tramway and railway from the mines to the main line of the Chesapeake and Ohio railroad. This company has four shafts sunk to various depths through the "iron hat," in the pyrites deposit. The main shaft has been sunk to a depth of

375 feet on the dip of the deposit (63°), all in ore. The ore in sight amounts to many thousand tons. During 1885 the company mined about 9,000 tons. New crushing and concentrating machinery for working the ores on a large scale for copper, together with an air compressor for running power drills and underground pumping machinery, have been added in the past year. The following is the analysis:

Analysis of pyrites from the Arminius mines, Virginia.

	Per cent.
Sulphur	49.50
Iron	43.55
Copper	.48
Silica and insoluble matter	6.43
Total	99.96

The Sulphur Mines Company, of Virginia, has a large body of pyrites situated about 1 mile northeast of the Arminius mines, on the same deposit. There is a branch railway from Tolersville to the mines. The workings are quite extensive, and several shafts have been sunk upon the vein and through the gossan to the pyrites. The analysis of the ore is practically the same as that of the Arminius. The output from these mines in 1885 was about 4,000 tons.

The property owned by Mr. Charles Lennig has not been worked since the last report.

North Carolina.—There is a deposit of pyrites near Gastonia, in Gaston county. This deposit is small on the surface, being about 2 feet in width, and can be traced for half a mile or more. A shaft was sunk on the vein to a depth of about 45 feet, when the ore gave out. The analysis gave the following results:

Analysis of pyrites from Gaston county, North Carolina.

	Per cent.
Sulphur	44.00
Iron	36.00
Copper	Trace.
Silica and insoluble matter	20.00
Total	100.00

This ore was supposed to carry from $6 to $10 per ton in gold, which proved not to be the case.

Near Charlotte, Mecklenburgh county, is a pyrites mine, which is being worked for gold and apparently, with success. The average is nearly $7 per ton in gold. The sulphur is not utilized, as it is too much mixed with rock. The vein varies from 1 to 7 feet in width, the deepest workings being over 300 feet. The ore is crushed and pulverized, and the gold is saved on Rittinger tables.

There are many places where the promise of pyrites is good, but on investigation the deposits are usually found to be narrow and of no value unless they contain gold in workable quantity.

Georgia.—Some 4 miles south of Dallas, in Paulding county, on the East Tennessee, Virginia and Georgia railway, is a pyrites mine which has produced considerable ore, supplying the acid works at Atlanta, Georgia, and later those at Nashville, Tennessee. The ore channel is about 7 feet wide and dips about 40°. The shaft is a little more than 200 feet deep. There has been some faulting of the ore body, but there is little doubt that it will easily be found, and be as productive as ever. This mine is quite similar to the one in Haralson county, described in the last report. The analysis of the Paulding county ore is:

Analysis of pyrites from Paulding county, Georgia.

	Per cent.
Sulphur	41.00
Iron	37.00
Copper	4.00
Silica and insoluble matter	18.00
Total	100.00

Tennessee.—Ducktown, in the extreme southeasterly part of the State, contains the largest known deposit of pyrites south of Virginia. The immense body of pyrites here is like the deposits of Vermont—mainly a pyrrhotite, and of little value as an acid producer. These mines have been worked extensively for copper since 1852. The composition of the ore is:

Analysis of pyrites from Ducktown, Tennessee.

	Per cent.
Sulphur	35.00
Iron	40.00
Silica	12.00
Copper	5.00
Lime	6,00
Alumina, etc	2.00
Total	100.00

Alabama.—The pyrites deposits of Alabama are at present too far from means of transportation to be of value. As railroads are run nearer to the bodies of pyrites known to exist in this section, no doubt they will become of importance for making acid for treating the phosphates required in Alabama and contiguous States.

FOREIGN DEPOSITS.

Canada.—The mines at Capelton produced less pyrites in 1885 than in the year previous. The mines of the Canadian Copper and Sulphur Company have been idle the entire year. The Albert mine has slightly increased its output, and the Orford Copper and Sulphur Company's mine has yielded about its usual yearly quantity. The output of these two mines in 1885 was about 35,000 tons. This ore was first burned for making sulphuric acid, and the cinder smelted into copper matte, the greater part of which was shipped to England for refining. These ores carry about an ounce of silver for each per cent. of copper which is extracted from the matte. Both of these mines are in a flourishing condition and are in the midst of large ore bodies. Their capacity to produce merchantable ore is only limited by the number of men they employ. Messrs. G. H. Nichols & Co. have built an elevated tramway from their mine to the station at Capelton. This will give them a carrying capacity of nearly 400 tons daily, at a minimum cost. The Orford company runs its ore in the same cars in which it is raised from the mine, through an adit of about 1,000 feet in length, thence to the cobbing shed and Passumpsic River railway at Eustis, half a mile below Capelton. These ores, while carrying workable quantities of copper, burn with great freedom. The Albert and Orford mines are on the same deposit, and adjoining, and while the ore differs slightly in some respects, the main part of the ore mined is practically the same in both mines. The analysis, taken from an average of several, is as follows:

Analysis of pyrites from Capelton, Canada.

	Per cent.
Sulphur	40.21
Iron	35.20
Silica	19.43
Copper (wet assay)	5.10
Total	99.94
Copper (dry assay)	3.80

Newfoundland.—There have been several offers of pyrites from Newfoundland mines during the past season. About 2,500 tons were received, but did not give satisfaction, the user returning to his former source of supply. There are unquestionably some good deposits of iron pyrites in Newfoundland, but they are all on the northeastern coast, nearly 400 miles from Saint John, and inaccessible for the greater part of the year.

Spain and Portugal.—The enormous deposits of pyrites of Spain and Portugal have been the subject of several exhaustive and able articles, which have been published from time to time during the past two or three years, in nearly all the scientific and technical journals of Europe and America. It will only be necessary to repeat their general bearing upon this country.

The quantities of pyrites extracted from the Rio Tinto mine during the last four years have been as follows:

Pyrites production of the Rio Tinto mine.

Years.	Exported for making acid.	For treatment at the mines.	Total.	Average copper contents.
	Tons.	*Tons.*	*Tons.*	*Per cent.*
1882	259,924	688,307	948,231	2.805
1883	313,291	786,682	1,099,973	2.956
1884	312,028	1,057,890	1,369,918	3.234
1885				

There is about 1 ounce of silver per ton in the Spanish ores, and about 9 grains of gold. The silver is saved at small expense, but the gold, it is believed, has not been extracted at a profit. The analyses of the Spanish and Portugese pyrites are practically the same. The Rio Tinto and Tharsis mines are in Spain, and the San Domingo or Mason & Barry Company's mine in Portugal. Huelva is the shipping port in Spain, and Pomaron in Portugal. Most of the pyrites coming to this country is shipped as ballast in vessels carrying fruit or other cargoes that require a certain quantity of some very heavy compact material. The rate of freight is from $2 to $3 per ton to United States ports.

The following analyses are the mean of several and give the character of the pyrites for shipment:

Analyses of Spanish and Portuguese pyrites.

	Rio Tinto.		Tharsis.		San Domingo.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Sulphur	47.76	48.98	47.21	48.11	49.00	48.60
Iron	43.99	43.00	43.50	41.20	43.50	43.70
Copper	3.69	3.29	3.21	3.11	2.76	2.90
Lead	.10	1.47	1.22	2.20	.02	.11
Zinc	.24	.62	.27	.81	.10	.17
Arsenic	.83	.90	.83	1.21	.68	.47
Silica and insoluble matter	2.99	1.74	3.71	3.26	3.89	4.05
Totals	99.60	100.00	99.95	99.90	99.95	100.00

In order to evade paying duty on the copper contents of pyrites, the shippers have recently sent pyrites to the United States graded below the tariff copper limit (3½ per cent.) and paying duty only as pyrites ore. The cinder, of course, has no value, and is not returned, the buyers agreeing not to use or allow others to make commercial use of it.

DOMESTIC PRODUCTION.

Quantity and spot value of pyrites mined in the United States (in part estimated).

Years.	Quantity.	Average value per ton.	Total value.
	Long tons.		
1882	12,000	$6.00	$72,000
1883	25,000	5.50	137,500
1884	35,000	5.00	175,000
1885	49,000	4.50	220,500

MANUFACTURING.

Works burning pyrites and quantity burned annually in the United States.

Districts.	Number of works in 1885.	Consumption (long tons).				
		1881.	1882.	1883.	1884.	1885.
Boston and eastern district	6	....	2,500	7,500	14,500	25,800
New York district	7	7,000	23,900	29,500	39,000	44,600
Philadelphia district	2	....	2,500	5,000	5,500	11,500
Baltimore and southern States	3	....	....	2,000	4,000	7,500
Western district	1	....	....	1,000	2,000	2,000
Total	19	7,000	28,900	45,000	65,000	91,400

Pyrites mined, imported, and consumed in the United States, 1881 *to* 1885, *inclusive.*

Years.	Mined.	Imported.	Total.	Consumed.	Stock on hand December 31.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1881	....	11,927	11,927	7,000	4,927
1882	12,000	29,818	41,818	28,900	17,845
1883	25,000	35,811	60,811	45,000	33,656
1884	35,000	44,250	79,250	68,500	44,406
1885	49,000	47,500	96,500	91,400	49,500

The stock on hand December 31, 1885, is distributed as follows:

	Long tons.
At works	28,500
At mines	21,000
Total	49,500

IMPORTS.

Imports of pyrites into the United States from 1881 *to* 1885, *inclusive.*

Fiscal year ending June 30—	Canadian.					Newfoundland.	Spanish and Portuguese	Total.
	Quantity.	Copper contents. (*a*)		Value.	Duty.			
	Tons.	*Per cent.*	*Pounds.*			*Tons.*	*Tons.*	*Tons.*
1881	10,812	4.0	982,899	$102,543	$29,786	....	1,115	11,927
1882	23,980	3.0	1,591,814	160,473	47,754	....	5,838	29,818
1883	25,211	2.5	1,403,900	134,400	39,879	....	(*b*) 10,600	35,811
1884 (*c*)	26,000	3.7	2,154,800	....	....	2,000	16,250	44,250
1885 (*c*)	34,123	3.85	2,949,363	280,189	73,734	2,500	16,600	53,223

a Copper contents—these are "dry assays"—1.30 per cent. less than actual (wet) assays. The Spanish ore imported has contained an average of only 1.25 per cent. copper (wet assay). Newfoundland ore contained about 3 per cent. wet assay.

b "Spanish" pyrites includes 1,473 tons Portuguese (Mason & Barry) in 1883. The balance is almost all Rio Tinto ore.

c All the figures for 1884 and 1885 are estimated, as also is the quantity of Spanish ore for 1883. This has been rendered necessary by the practice of some of the custom-houses not keeping pyrites separate from iron ores.

Quantity of imported pyrites containing not more than 3½ per cent. copper.

Years.	Tons.	Value.	Duty.
1884	16,250	$50,632	$12,532
1885	6,078	18,577	4,559

Above quantities are included in table of imports.

It will be observed that the greater part of the imported pyrites contains over 3½ per cent. copper. From this it appears that it does not pay to import pyrites with copper contents too low to pay for its extraction.

Approximate pyrites consumption of the world in 1885.

Countries.	Consumption.
	Long tons.
Great Britain	620,000
France	200,000
Germany	150,000
United States	91,400
Hungary	60,000
All other countries	80,000
Total	1,201,400

It is possible that this estimate is not large enough by at least 200,000 tons, for many small works using pyrites or blendes mined in their neighborhood make no report.

Annual export of crude brimstone from Sicily.

Years.	Total exports.	Imported into the United States.
	Metric tons.	*Long tons.*
1865	138,232	24,544
1870	172,751	27,379
1875	217,926	39,683
1880	376,316	87,837
1885	289,257	96.839

This table shows at a glance the increased use of brimstone as well as pyrites since 1865. The quantity of sulphuric acid required throughout the world is increasing annually, and notwithstanding the success of the ammonia-soda process the quantity demanded is still very large even in England. So far as can be seen there is no prospect of the extinction of the Le Blanc process. Several of the large chemical companies in England have bought salt lands in South Durham, and will produce their own salt at a minimum cost.

The quantity of acid required to make high explosives is also very large, caused mainly by the increased use of power drills in most mines, railway tunnels, and quarries, and a consequent increased use of dynamite. Pyrites acid has been used for this purpose.

Artificial fertilizers are consuming about 45 per cent. of the sulphuric acid manufactured in the United States. That this quantity will be greatly exceeded very soon is unquestioned. The amount of artificial fertilizers sold in the United States is upwards of 1,000,000 tons annually, the greater part of which is prepared by the use of sulphuric acid. Well informed persons express themselves as confident that this quantity will be more than doubled within the next five years. The quantity of 50° acid required to acidulate one ton of Charleston rock is about 1,700 pounds.

The increased use of pyrites in the United States during the year 1885 has been very marked. The increase has been mostly through the addition of new furnaces by those who had previously adopted pyrites, a most positive proof of its success. These additional furnaces have been for the greater part smalls (or fines) furnaces, the lower prices of pyrites in this form being sufficient inducement for their erection. With one or two exceptions this increase has been north of Philadelphia, and confined to the vicinity of New York, and to New England. Several works in the West are now building pyrites furnaces, and will become consumers by midsummer of 1886. The apathy of manufacturers of sulphuric acid in the South toward pyrites as a raw material is inexplicable. One looks to the manufacturers of phosphates at the center of production as the natural users of a reagent which so materially reduces the cost of the merchantable article. That a very large saving is effected in the manufacture of artificial fertilizers by the use of pyrites acid is no longer questioned.

The indications for the year 1886 point to a further increase in the use of pyrites. The domestic mines show larger quantities mined than in the previous year, and they are also opening and developing the ground and works to such an extent that a scarcity is impossible.

There have been no new pyrites mines opened in the United States in 1885 where the product has sought a market with the acid makers. The mines already developed have increased their output sufficiently to supply the additional demand. Stocks of pyrites have not unduly accumulated at the mines, the owners preferring not to mine more ore than the trade demands. At all of these mines, however, the machinery has been greatly augmented, and the work of development has been driven ahead of the present requirements. The machinery and equipments are of the most improved and modern patterns. It is believed that there are few mines in the United States where the machinery is of a better type, or where the average cost of mining is as low per ton of dressed ore, as at those of the different pyrites companies. The facilities for transportation have been greatly improved, and by the end of 1886 the leading companies will have direct railway connections with the mines,

PREPARATION OF ORE.

The American consumer requires that the ore be prepared for him of the proper size for the furnace, before shipment. In fact, this is a great advantage to the consumer, as he thereby obviates the necessity for the outlay of money for a crusher, engine, etc., and the more annoying expenses attending their operation. He also escapes the loss in the nut-size ore, which is made to the extent of about 5 per cent. of the whole, and which is too small for grate, and too large for small furnaces without crushing.

Consumers can now purchase their ore of any domestic producer, broken to the proper size for their grate furnaces (not larger than 3 inches or smaller than 1 inch in diameter) or the smalls screened through a one-fourth inch mesh screen for their smalls furnaces, these sizes being best adapted for perfect and rapid burning and leaving nothing that will not go through the furnace with good results.

This matter of breaking has heretofore been an unknown quantity to the acid maker, and one on which he had no basis for costs, which, taken with the resulting fines and intermediate sizes which he could not use, has prevented his adopting pyrites until he could see his way more clearly. This he can now do by buying exactly the size he wishes to use.

At one time it looked as if the price of brimstone would gauge the price of pyrites, but this has been found not to be the case. The cost of pyrites acid is so much less than that made from brimstone that they have never actually been in competition. Sulphuric acid, for certain purposes, will probably always be made from brimstone, but the large bulk of acid must naturally be made from the cheaper material. That the present prices will be maintained is not certain, the tendency naturally being for the miners of domestic pyrites to hold the trade if possible against foreign competition. Miners working on a large scale and able to sell all their output, can produce ore at a lower cost than when obliged to be idle part of the year, or to stock large quantities, requiring special capital and entailing additional expense in handling, whereby more or less loss is occasioned. The economy is much greater if the ore is shipped to the consumer as fast as it comes from the mine.

DAILY SAMPLING AND TESTING.

The daily drawing and testing of samples is not considered of sufficient importance to pay for the labor and expense, and it is only by some accident that imperfect and wasteful burning is discovered. Even when discovered it is only partially remedied. In drawing samples of cinder for a test it is quite essential that samples from separate furnaces should be drawn, as well as a thoroughly mixed sample of the whole. In this way those furnaces doing well or ill can be noted, marked, and watched day by day until all are as nearly perfect as possible. It is a mistake to suppose that any ignorant laborer is competent to burn pyrites after a few days' teaching, but the fact that any result regularly under 10 per cent. is not considered sufficiently bad work to call for investigation and correction by the manager, will account for the supposition. It is just as easy to do good as bad work in burning pyrites, and a month's average should not show over 5 per cent. sulphur left in the cinder, and even this can be improved upon. One thing is certain: if the cinder contains over 5 per cent. on a month's average, there is something wrong, and some one is incompetent, or not attending to his duties. The following rapid and reliable method of testing cinder is in daily use in one of the leading chemical works in England, and its accuracy can be relied upon:

ESTIMATION OF SULPHUR IN PYRITES CINDERS.

Reagents used.—(1) Semi-normal solution of sulphuric acid 1 cubic centimeter $=.0245$ grm., $H_2SO_4=.0155$ grm., $Na_2O=.008$ grm. S.

(2) Bicarbonate of soda, the standard acid value of which is determined each time the reagent bottle is refilled, by titrating 3.2 grms. with the standard acid. Generally about 77 cubic centimeters $\div 2 = 38.5$ cubic centimeters per 1.6 grms.

Process.—Two grams of the very finely powdered sample of cinder and four grams of the bicarbonate of soda are carefully mixed in a porcelain crucible and heated to dull redness over a Bunsen burner for about forty minutes, with occasional stirring. The contents of the crucible are now washed into a 250 cubic centimeter flask, made up to the mark with boiling water, emptied into a beaker and well stirred; then allowed to settle for a minute or two, and a quantity of the supernatant liquid passed through a dry filter; 100 cubic centimeters of the clear filtrate are measured into a beaker, cooled and titrated with semi-normal sulphuric acid solution, using methyl orange as indicator.

Suppose 35 cubic centimeters required:

c. c. $\frac{n}{2}$ acid required for 1.6 grms. bicarbonate of soda.......	38. 5
c. c. $\frac{n}{2}$ acid required for 100 cubic centimeters filtrate.......	35. 0
Difference = percentage sulphur in cinder	3. 5

By the above process a test can be completed in an hour, and six (or more) samples can be finished in an hour and a quarter. The results are almost identical with those obtained by oxidation with nitro-hydrochloric acid and precipitation with barium chloride. The only point requiring special care is the heating over the Bunsen burner (or spirit lamp). But as long as a dull red heat is not exceeded there is no danger of loss of sulphur, unless the amount in the cinder is very high. Constant stirring is not necessary, so that the operator can carry on other work while this is going on. Observe that the percentage of sulphur found in a given quantity of cinder is not the same percentage as on raw pyrites.

Pyrites loses in burning from 20 to 35 per cent. of its weight, after allowing for the absorption of oxygen. One hundred pounds of siliceous ore, containing 4 per cent. copper, will weigh, after burning, about 80 pounds, while a cinder of nearly pure pyrites, low in silica and copper, will weigh about 70 pounds. Hence, if the sulphur in the cinder of the latter is found to be 5 per cent., it will be on the basis of raw pyrites, 3.5 per cent.

CUPRIFEROUS PYRITES CINDER.

A novel and ingenious method of treating cupriferous pyrites cinder has recently been adopted. The copper mattes from siliceous ores are broken to the required fineness and mixed with ordinary pyrites cinder low in silica, and are then treated by the Henderson process, the copper and silver being saved as usual by the wet method. This is comparatively an inexpensive way of saving the silver in the matte, and the residue is a merchantable purple ore, worth several dollars per ton.

ORDINARY IRON PYRITES RESIDUE.

At present, in the United States, not less than 40,000 tons annually of cinder from pyrites are thrown away or used for filling. The average contents are:

Analysis of ordinary pyrites residue.

	Per cent.
Peroxide of iron	88.00
Sulphur	5.00
Silica and insoluble matter	4 50
Lime	1 00
Copper	1.50
Total	100.00

It is safe to say that all of this cinder carries fully 60 per cent. metallic iron and is free from phosphorus.

The use of commercial acid comprises only about 10 per cent. of all the acid consumed, the remainder being used for fertilizers and oil refining. If the use of pyrites should become general for the purposes for which it is as well adapted as brimstone, the direct annual saving to the manufacturer would be, basing the present consumption of brimstone for acid making at 90,000 tons, $630,000, a difference of $7 per ton in favor of pyrites.

There has been great reluctance on the part of acid makers to allow the quantities of pyrites used, or acid produced therefrom, to be published in connection with their works; the quantity has therefore been given in the aggregate. The amount was arrived at by the number and kinds of furnaces in use, and taking their capacity. Due allowance has been made for stoppages.

INCREASED USE OF SULPHURIC ACID.

By reference to the table of imports we find that in 1884 upwards of 105,000 tons of brimstone were imported, and in 1885 nearly the same. Most of this was consumed, leaving the 91,400 tons of pyrites as showing the natural increase of sulphuric acid used. The average of brimstone imports for the past five years is slightly over 100,000 tons, showing an increase since 1878 of over 100 per cent. Reducing the consumption of pyrites for 1885 to its equivalent in brimstone gives, in round numbers, 42,000 tons. This added to the brimstone shows an increase of over 300 per cent. since 1878.

FURNACES.

During the past year the majority of the new furnaces built have been for burning smalls ore, the Spence mechanical and ordinary shelf-burner being the styles adopted. The double Spence furnace can be erected for about $3,800, exclusive of labor, and requires 20 cubic feet of chamber space to 1 pound of sulphur burnt off. It will burn 60,000 pounds of 48 per cent. ore per week, without undue escape of fumes.

RAW MATERIALS FOR THE MANUFACTURE OF SULPHURIC ACID.

Iron pyrites as bisulphide of iron.—There are few minerals which are found in such profusion and abundance as iron pyrites. It often occurs in bodies of large extent, laterally and in depth. Pyrites to be of value for making sulphuric acid must be the bisulphide of iron. This when pure is of the following composition:

Typical composition of iron bisulphide.

	Per cent.
Sulphur	53.30
Iron	46.70
Total	100.00

When silica, copper, zinc, and some other minerals form a part of the combination, the sulphur and iron are reduced in proportion, but so long as the combination is a bisulphide, the burning qualities are but slightly affected. Of course if the sulphur contents are reduced, a larger quantity of pyrites must be handled to obtain the same amount of sulphur—this also at an additional expense of time and extra loss in cinder.

Pyrrhotite or magnetic pyrites.—A great part of the deposits of pyrites are the magnetic or pyrrhotite varieties, of which the following is the composition:

Typical composition of pyrrhotite.

	Per cent.
Sulphur	39.50
Iron	60.50
Total	100.00

It varies from Fe_7S_8 to $Fe_{10}S_{11}$ and is never a true protosulphide. Possibly this may account for its reluctance in parting with its sulphur. These varieties are worse than useless for acid making, for not only is the sulphur in less quantity in the pyrites, but the combination is of such a nature that it will not readily give up its sulphur. It has thus far been found impracticable to burn these ores and utilize the gas for acid making. The sulphur can be burned off when placed in piles in the open air, assisted by a liberal quantity of wood, thereby preparing it for copper smelting; but in kilns it has invariably been found either to become cold and dead, or so hot as to melt into a solid mass in the furnace. Many thousands of dollars have been lost in trying these experiments, and failure has been the invariable result.

Marcasite is sometimes used as a raw material for making acid. Its composition is represented by FeS_2, the same as ordinary pyrites. It is usually found in bituminous slate and coal, but not often in sufficient quantity to pay for mining.

Zincblende (sphalerite) is also used as a raw material, but usually only preparatory to further metallurgical treatment. The sulphur in zincblende does not burn readily, and the calcining must be finished in a reverberatory furnace. A mixture of blende and pyrites is sometimes utilized.

Galena cannot be used for acid making, as it parts with its sulphur, only at a strong white heat.

Matte.—The sulphur in mattes is often saved for acid making, generally where the noxious vapors are not permitted by law to escape into the atmosphere.

Sulphur from coal gas.—Spent oxides from the purification of coal gas are also used to some extent under favorable conditions.

Mispickel or arsenical pyrites is too low in sulphur contents to be of value, even if the arsenic did not prevent its use.

Auriferous pyrites.—The auriferous pyrites of the Rocky mountains and the far West are destined to bear an important part in the gold production of the United States. Almost all the pyrites in this section carry gold in paying quantities. Where the pyrites are found as bi-sulphides there can be no question that with close concentration they would be available as a raw material for making sulphuric acid. One ton of concentrates containing 40 per cent. sulphur would produce one ton of sulphuric acid of 66° Baumé, worth in some parts of the West not less than $50. If the pyrites is in the form of troilite, which, unlike pyrrhotite, is a true protosulphide, there is little doubt that it could, if in sufficient quantity, be made available for making sulphuric acid.

Troilite when pure contains:

Typical composition of troilite.

	Per cent.
Sulphur	36.36
Iron	63.64
Total	100.00

If 25 per cent. of the sulphur could be saved as sulphurous acid, 1,500 pounds of 66° acid could be made from one ton of concentrates. The acid would be very valuable for generating chlorine for chloridizing ores, and would make many otherwise worthless ores pay handsome profits. The expense of a plant to make 10 or 15 tons of acid per day would not be excessive.

MICA.

New mica deposits have been found in Franklin and Cleveland counties, North Carolina; in the latter there are ten new mines said to be of good quality and unusually extensive. In Pennsylvania a new mine has been opened on South mountain near Newmanstown, and will probably be a source of supply during 1886. Several mines have been added to those in the neighborhood of Groton, New Hampshire, and a mining company has begun operations in Nashua in the same State. The principal yield in New Hampshire was from the Valencia mine in Groton. The property here comprises 300 acres, only a very small part of which has been opened, although the mine has been worked since 1883, with a force of about 55 men in winter and 75 in summer. The yield increased to 29,000 pounds in 1885. In the Black Hills mining has been suspended, and those well posted on the subject have failed to find a single mine which produced any mica during 1885. In Colorado a vein of mica was found about 65 miles from Pueblo. It is 5½ feet wide, lying in white quartz, and has been traced for 3,000 feet. Mica of good quality and in large sheets has also been reported from the neighborhood of Fort Collins. The Denver Mica Company after a short trial run ceased mining and cutting mica. The sheets available were too small, and the business was entirely unremunerative. In Wyoming, Idaho, and Montana, nothing of interest has been noted except the location of a new mine about 9 miles from Rockford, in Spokane county, Wyoming. Specimens from this mine seem unusually clear. In New Mexico work has been steadily prosecuted at the Cribbensville mines, at Petaca in Rio Arriba county. Here the mica occurs in the general mass of eruptive granite, the quartz, mica, and feldspar being seggregated into masses. Fluorspar is noted as occurring with the mica, which is found in pockets or masses having a general northwest course. The mica-producing belt is about 14 miles long by 4 miles wide. The mica is clear, tough, and of an olive-green to gray-green color. The largest sheet yet cut was 12 by 14 inches in size, but the average size is 3 by 5½ inches. It is sent direct to the factory of the owners in Chicago. During 1885, 12,000 cubic feet of rock were excavated and 20 tons of mica taken out, of which 2,000 pounds were salable, showing a yield of 5 per cent. good mica. The mine is worked regularly.

Mica is an abundant mineral in all the Pacific States and Territories. Mr. C. G. Yale states, however, that it has been mined only in a few places and nowhere with results that have led to a long continuance of the business. The deposit of mica discovered in the Salmon mountain, Siskiyou county, California, and alluded to in the last volume of the "Mineral Resources of the United States," has been worked to some extent since; but it produced little marketable mica and work has been suspended upon it. Most of the mica found is of a stained or impure character, though in some deposits very large clear sheets are obtained. Even with good quality, however, no market for it has been found. In explanation of the condition and prospects of the industry in that region the following is quoted from the fourth annual report of Mr. Henry G. Hanks, State mineralogist of California:

"Mica, in sheets or plates of the size and quality that adapt it for the uses to which it is mostly applied, is a mineral that can be mined with profit where the conditions are favorable. Nevertheless, much misapprehension seems to exist among miners as to the requirements of the trade and the prices usually paid for this mineral; the idea having obtained among this class that mica is so scarce and in such demand that there is always a market for it at extravagantly high figures. But this is a mistake; it is only sheets of superior quality and extra large size, such as are rarely found, that meet with ready sale at high prices. Owing to the erroneous notions entertained on this point, the several attempts that have been made at working the mica deposits of California and Nevada have resulted in disappointment and loss, the parties who engaged in these enterprises having failed to realize for their product such prices as they had counted upon, chiefly because it did not quite meet the wants of purchasers. The outlook for this industry is, however, by no means desperate, as there are many promising deposits of mica in California, and elsewhere on the coast, and there is a chance that the quality of the article will improve when the mines come to be opened to greater depths."

Production.—In 1885 the production of mica amounted to about 92,000 pounds, valued at $161,000. The decrease from 147,410 pounds in 1884 was due to suspension of western mining, and also to a decrease in North Carolina.

The production for 1884 and 1885 may be divided as follows:

Production of mica in 1884 *and* 1885.

	1884.	1885.
	Pounds.	*Pounds.*
North Carolina	100,000	60,000
Valencia mine, New Hampshire	25,000	29,000
Other mines in New Hampshire	3,260	1,000
Cribbensville mines, New Mexico	1,000	2,000
Black Hills	18,150	....
Total	147,410	92,000

Estimated total production since 1882:

Years.	Pounds.	Value.
1882	100,000	$250,000
1883	114,000	285,000
1884	147,410	368,525
1885	92,000	161,000

Prices.—The fact that fine, large sheets of mica have a value of several dollars per pound, reaching in exceptional cases as much as $10 per pound for special pieces, has led to popular misaprehension in regard to the average value of this mineral. In the West, particularly, mica has been sold at from $3 to $4.50 per pound on which the price has since been reduced below the limits of profitable mining. The average for 1885 may be put at $1.75 per pound. The mica from North Carolina is best in quality and demands the highest price. That from New Hampshire ranks next in quality, while that in the West has come to be regarded as poorest, and the price has fallen in many instances to $1.25 per pound.

The imports of manufactured mica recently have been:

Unmanufactured mica imported and entered for consumption in the United States, 1869 *to* 1885, *inclusive.*

Fiscal years ending June 30—	Value.
1869	$1,165
1870	226
1871	1,460
1872	1,002
1873	498
1874	1,204
1875	....
1876	569
1877	13,085

Fiscal years ending June 30—	Value.
1878	$7,930
1870	9,274
1880	12,562
1881	5,839
1882	5,175
1883	9,884
1884	28,284
1885	28,685

ASBESTUS.

There was very slight production of asbestus during the past year, owing to the competition of Canadian producers, who have extended their facilities of mining. They are also connected with the principal manufacturers in this country in such a way as to make it comparatively easy for them to dispose of their material in New York and Boston.

The Asbestus Felting Works have estimated the production of asbestus in the United States at 300 short tons during 1885, valued at $15 to $50 per ton, as taken from the ground. The attempt will possibly be made to mine a deposit recently opened in northern Georgia, when transportation facilities admit. An attempt is being made to mine asbestus in Windsor, Sonoma county, California.

Besides the localities already mentioned in the former reports of this series, asbestus has been found in Del Norte and Yolo counties, California. Some of these deposits appear to be better in quality than any others in the State, and the quality it improves with the depth. There is plenty of asbestus in California for manufacturing purposes which could probably be delivered in San Francisco for $35 per ton, but the demand for the products is not sufficient to justify large mining operations. There is one factory in San Francisco which produces asbestus paint, coating for steam boilers and pipes, packing for engines, and asbestus for roofing and like purposes.

Foreign sources.—The importations, particularly from Canada, increased during the past year. The Canadian mines are located in Thetford and Coleraine townships, Quebec. The total production in Canada during 1885 was 1,800 short tons, with an average value of $70 per ton. It has only been possible to work the mines from April 15 to November 15 of each year. The new mine at Gundagai, in New South Wales, is likely to enter the market not only as a source of crude, but of manufactured asbestus.

Value of asbestus imported and entered for consumption in the United States, 1869 to 1885 inclusive.

Fiscal years ending June 30—	Unmanufactured.	Manufactured.	Total.
1869	....	$310	$310
1870	....	7	7
1871	....	12	12
1872	....	....	....
1873	$18	....	18
1874	152	....	152
1875	4,706	1,077	5,783
1876	5,485	396	5,881
1877	1,671	1,550	3,221
1878	3,536	372	3,908
1879	3,204	4,624	7,828
1880	9,736	....	9,736
1881	27,717	69	27,786
1882	15,235	504	15,739
1883	24,369	243	24,612
1884	48,755	1,185	49,940
1885	69,489	248	69,737

Domestic exports of manufactured asbestus.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1879	$2,335	1883	$17,865
1880	7,848	1884	30,846
1881	30,785	1885	....
1882	18,923		

Uses.—Although little asbestus was mined during 1885 in the United States, it has been manufactured here into various useful forms. There are many substances which have assumed industrial importance because of their inability to burn, and being also such poor conductors of heat as to protect other material from fire; but asbestus has the additional advantage of fibrous structure which admits its use for fire-proof fabrics.

Of these there are many which would be more useful if fire proof, and although even the best asbestus is somewhat brittle, there are enough fabrics, such as theater curtains and, particularly, asbestus filtering cloth, to give a market value of $100 to $500 for Italian asbestus, which is best suited for weaving. The principal use for asbestus is for packing steam joints and others where a high temperature is attained. For this purpose it is made into millboards and rope, and is much superior to any other packing. The use of asbestus as a non-conducting covering for boilers has increased markedly during 1885. This is the most interesting use to which it has been put, for the sheathing can be made of the cheap variety of asbestus common in this country. It is probable also that the use of asbestus cloth for filter bags in sugar refineries will follow the lead of the French, Austrian, and German refineries.

ELDSPAR.

BY WILLIAM C. DAY.

Occurrence.—Since the publication of the last report on feldspar in "Mineral Resources of the United States, 1883 and 1884," orthoclase, the only variety of feldspar used in the arts, has been discovered in the following localities:

At Embreville, on the Wilmington and Northern railroad, Chester county, Pennsylvania, a deposit has recently been opened which reveals good prospects both as regards quality and quantity, but, as yet, developments have been insufficient to allow anything further to be said.

Samples of orthoclase of fine quality have been taken from a deposit in the neighborhood of Ishpeming, Michigan.

In Missouri, on the Iron Mountain railroad, some distance southwest of Saint Louis, a good deposit is said to exist.

The only deposit thus far found on the Pacific coast was recently discovered in Tehachapi cañon, Kern county, California. The extent of this deposit is not known, but the quality is said to be very fine, and, if sufficiently abundant, the mineral could be profitably worked and shipped to market on account of its close proximity to the Southern Pacific railroad.

Production.—Two of the most prominent pottery manufacturers independently estimated the total consumption of feldspar in the United States at 10,000 long tons in 1885. Detailed returns from producers and consumers give 13,600 as the exact production, leaving some stock on hand at the end of the year.

Production of feldspar in 1883, 1884, *and* 1885.

States.	1883.	1884.	1885.
	Long tons.	*Long tons.*	*Long tons.*
Maine	3,200	900	2,500
Connecticut	6,000	6,000	4,500
Massachusetts	500	500	1,000
New York	500	500	2,000
Delaware	900	1,000	2,250
Pennsylvania	3,000	2,000	1,350
Total	14,100	10,900	13,600

Value.—Crude feldspar is valued at $5 per long ton. Pulverized feldspar is valued at $11 per ton in Trenton, New Jersey, and $12 per ton in East Liverpool, Ohio, in which places most of the mineral is used.

MINERAL PAINTS.

By Marcus Benjamin.

White lead.—The number of white-lead corroders has been increased during 1885 to thirty-three, by the establishment of works at Pittsburgh, and at New York City. It is estimated that 60,000 short tons of white lead were produced during the year. The price is higher, and from 4¾ to 5¾ cents per pound is asked for the dry pigment; ground in oil it brings one-half cent per pound more. The imports at New York during the year were 622,924 pounds.

Litharge and red lead.—In consequence of the advance in price of pig lead these pigments are sold at about one-fourth cent per pound higher than in the preceding year.

Orange mineral is an oxide of lead made by throwing white lead on the hearth of a reverberatory furnace. The carbon dioxide is expelled and the lead oxide remains behind. This color is extensively used as a base, with which eosine and similar aniline colors are mixed to produce an artificial vermilion. It is worth from 7¼ to 8 cents per pound. Orange mineral is made by a number of the corroders, and it is also imported.

Zinc white.—This pigment continues to be made directly from the ore by the zinc works in the United States (see page 921 of "Mineral Resources for 1883 and 1884," and pages 358–386 of the 1882 report). The production of the different companies is estimated to have been about 15,000 short tons, of which two-thirds was consumed by the paint trade. The price of this pigment remains at 3 to 4 cents, according to the quality. There are at present three brands of zinc white imported into the United States, the most important of which is the French or Veille Montagne, and it is estimated that 7,000 casks (of 220 pounds each) of this brand were imported during 1885. Of the "B. and S." brand, which is said to be finer than the French, and which commands a slightly higher price, some 2,300 casks, or 508,300 pounds, were received from Germany at New York during the past year; while 1,500 casks, or 330,000 pounds, of the German "L. Z. O." brand were imported during the same time. The total importations of zinc oxide at New York during 1885 amounted to 2,364,561 pounds.

Barytes.—The eastern demand for barytes is largely supplied by Burgess & Newton, of New Haven, Connecticut. The crude material used by this firm is entirely imported, mostly from Germany. During 1885 about 4,000 short tons were received by them, costing from $7 to

$8 per ton at the port of entry. Only the very highest grade of barytes, perfectly free from quartz or lime, and testing 99.50 per cent. pure barium sulphate, is ground; and, as it is perfectly clean, no sorting is required. The mineral is first crushed, then washed, and conveyed into vats, where it is thoroughly heated, and then sulphuric acid is added, after which it is steamed until all impurities and stains are eaten away. The process extends over thirty-six hours, for after the steaming the mineral is allowed to stand and "cook." The acid is then drawn off and the barytes thoroughly cleansed by several washings with pure water. It is then dried and sent to the mills for grinding. Finally it is barreled, ready for delivery. The price during the current year was from $18.50 to $21.50, according to quantity, delivered in New York.

Tanner, Bliss & Co., of Lynchburg, Virginia, grind barytes mined at several localities in Virginia. The process employed is similar to the one previously described, and the annual output from this source is about 3,000 tons, which sells in New York at prices ranging from $18 to $20 per ton, according to quantity. An "off-color" barytes, worth from $12 to $14 per ton, is likewise on the market, and is used principally in the mixing of colored paints.

The Page & Krausse Manufacturing and Mining Company, of Saint Louis, Missouri, obtained from deposits at and around Cadet and Potosi, Washington county, Missouri, about 3,000 tons of barytes during 1885, having a value of from $4.50 to $5.50 per ton on the cars at the localities mentioned. There are also mines in Cole, Franklin, Jefferson, and Maries counties, in the same State, that have not yet been properly opened or fully developed, from which the above firm received 1,000 tons during 1885. The process of manufacture is as follows: The crude mineral is first sorted and cleaned; then it is crushed or broken into pieces about the size of the tip of a finger. Next it is refined and purified by boiling in acid until the impurities are entirely removed; after which it is boiled in distilled water, then dried by steam, and finally ground in mills until every particle of coarse material has disappeared. This refined product sells in New York at from $26 to $27.50 per ton, according to quantity. The "floated barytes" is further treated by being mixed with water and run through troughs or sluice ways into a large receiving vat, whence it is taken, again dried by steam, and, lastly, barreled. The "cream floated" is quoted in New York at from $32 to $32.50 per ton, according to quantity. The greater portion of this company's output is consumed by paint makers. A mixture consisting of 60 parts of zinc oxide and 40 parts of cream-floated barytes is recommended by them as forming a good and very durable paint. Their product is likewise bought by ham curers or pork packers, who use it in canvasing hams to stop the meshes of the canvas with a view to stopping the ingress of insects and air.

The Pittsylvania Milling and Mining Company, of Warm Springs, North Carolina, grind and sell barytes, but their sources of supply and output have not been reported.

Terra alba.—The gypsum which is ground to produce this material is all imported. Two grades exist, known as No. 1, mined at Hillsboro, Canada, and worth laid down in New York from $5 to $7 per ton; and No. 2, mined at Windsor, Nova Scotia, valued at $3 to $3.50. The crude mineral is ground at New York by the Phœnix Plaster Mills, and at Newburg by the Newburg Plaster Works. The terra alba is worth from $14 to $15 per ton for No. 1, and from $8 to $10 per ton for No. 2. It is impossible to estimate the amount of this substance used by paint manufacturers, for the reason that sales are chiefly made through brokers who handle the product for the works. A finer grade of terra alba is imported from France, and a very small quantity from England. It is worth from $15 to $16 per ton on the dock in New York.

Whiting.—During 1885 there were imported 105,280,000 pounds of chalk into the United. States. Of this amount 71,680,000 pounds were received at New York and 33,600,000 pounds at Philadelphia. At these two cities it is ground into whiting. The price of the common grade of whiting has advanced and it is now quoted at 40 to 45 cents per hundredweight. Whiting is used by the manufacturers of calcimine, rubber, wall paper, picture-frame moldings, oilcloth, and paints, and by potters. The sales during 1885 aggregated 275,000 barrels, having an average weight of about 340 pounds.

Paris white.—There were imported into the United States during 1885 13,492,800 pounds of cliffstone, which was ground into Paris white; 347,000 pounds of Paris white manufactured abroad were also imported during the same time. The present selling price is from $1 to $1.25 per hundredweight. Paris white is used in the same manufactures, excepting those of picture-frame molding, but not so extensively as whiting, and the consumption during 1885 is estimated at 12,400,000 pounds.

Ultramarine.—The production of ultramarine in the United States during 1885 was slightly diminished by the partial burning of the American Ultramarine Works at Newark, New Jersey. The exact output from this factory has not been obtained, but it is estimated to have been not less than 1,000 tons. The Germania Ultramarine Works, at Whitestone, Long Island, produced 857,816 pounds. A plant known as the International Ultramarine Works was established during 1885 at Roseville, New Jersey, but its product was not placed on the market during the year. The prejudice which formerly existed against American ultramarine has been reduced steadily, and at present the domestic brands compete very successfully with the foreign.

Ocher.—This is a term familiarly applied to a well-known pigment, varying in color from a light yellow to a deep orange or brown, and consisting of iron peroxide and water, with varying proportions of clay in a state of impalpable subdivision. Strictly speaking, ocher is a hydrated peroxide of iron consisting of about 80 per cent. peroxide and 20 of water, but it is very rarely found absolutely pure and appears to be a product of decomposition. The foregoing definition, taken from David Page's "Handbook of Geological Terms," is given in order that an exact scientific explanation of the term may be had before its trade significance is mentioned. In commerce the word ocher is applied to the lighter yellow earths containing iron peroxide, and the term "metallic paint" is used to designate the brown and darker shades. As the information here presented has been obtained from commercial sources this classification will be used. Ochers may be divided into common ochers, medium ochers, and high grade imported ochers.

Common ocher.—This grade of material is largely mined in Maryland, Pennsylvania, and Vermont. It has a value of from $10 to $15 per ton, and is entirely consumed by floor-cloth manufacturers. It is used by them in the preparation of the body of the cloth, and has no value as a pigment on account of its dull color.

Medium ocher.—This grade includes the French ochers and the best class of ochers produced in this country. The consumption of this material aggregates about 3,000 tons per annum, having a value of from 1 cent to 1½ cents per pound.

High grade ocher.—This grade is principally used by paint grinders. Owing to its strength, as it contains a large amount of iron, only a small quantity of oil is required in mixing; hence it can be made into a profitable paint. The consumption is about 1,000 tons per annum, and the value is from 2 to 3½ cents per pound. The principal American producers of ocher are the Bermuda Ocher Company, the Oxford Ocher Company, Henry Erwin, and the Franco-American Mining and Ocher Company, all of New York.

The Bermuda Ocher Company has a deposit on the north bank of the Appomattox, in Chesterfield county, Virginia, near Bermuda Hundred. The crude ocher is washed, dried, and then ground into an article which in fineness of quality and in adaptation to all the purposes for which a light-yellow ocher is used, is unexcelled by that from any other deposit known in this country. Three grades are made, all of the same tint but of different degrees of fineness, namely, single washed, double washed, and extra floated. At the shipping point in Virginia these grades have a value, respectively, of $18, $21, and $27 per ton. To this price must be added the freight to the locality at which the ocher is to be used. This company has facilities for mining and manufacturing 2,500 to 3,000 tons of ocher per annum, an amount sufficient to supply the entire trade of the United States with this grade of material; but the output during 1885 did not exceed 1,000 tons.

The Oxford Ocher Company mines an ocher near Marksville, in the

Shenandoah valley, Virginia, which has approximately the following composition:

Analysis of ocher mined near Marksville, Virginia.

	Per cent.
Iron peroxide	39.0
Alumina	15.0
Silica	33.0
Potash and other alkalies	.5
Water	11.5
Total	99.0

The output of this company during 1885 was between 800 and 1,000 tons, having a value in its crude condition at the mine of $15 per ton. Ground and barreled, it sells at New York at $20 per ton.

These ochers from Virginia are considered fully equal to the foreign brands sold in the United States under the trade names of "Havre" and "Rochelle."

The deposits marketed by Henry Erwin are located in the vicinity of Bethlehem, Pennsylvania. The ore includes all grades. It is estimated that the output during 1885 was between 1,500 and 2,000 tons. The crude material is washed, floated, and then ground. Its average value on the cars at Bethlehem is stated to be $10 per ton. A so-called "Bonne Fortune" ocher has recently been discovered near Bethlehem, which is said to have a greater strength than the standard French ochers. This material, when washed, floated, and dried, commands $40 per ton. A steadily increasing demand is said to exist for this new American variety of high grade ocher.

The Franco-American Mining and Ocher Company owns several deposits of an excellent grade of ocher. One of the mines is located in Scott county, Missouri, about 160 miles south of Saint Louis, from which, during 1885, 500 tons of the crude material were shipped to New York, where it was ground and made into the dry pigment. Other deposits of high grade ochers are said to exist in the vicinity of Saint Louis, but no definite information as to their character has been received.

A so-called "Peruvian" ocher is found in deposits between strata of iron and manganese ore in Fulton county, near Atlanta, Georgia, of which some 300 tons were mined during 1885. It is ground, washed, dried, and then sent to New York. The prepared pigment is said to contain from 85 to 90 per cent. of iron peroxide and is worth from $70 to $80 per ton in New York. This deposit, although small, is said to yield a product superior to any that is imported. The American ocher, while identical in chemical composition with the French, seems to exist in a different state of combination. The silica in the imported ocher appears to be free, while in American ocher it is chemically combined with the alumina, forming a clay. American ochers are doubtless finer, but most of them require more oil for grinding, and hence the paint produced is more expensive, as oil is worth 7 cents per pound, and the ocher only about 1½ cents. The free silica of the French ocher causes it to work more freely, and it also imparts to the pigment the valuable property of catching and holding to the fibers of wood, thus acting as a filler.

Imported ochers.—These are obtained principally from France. The "Rochelle" ochers are mined near Neuvy-sur-Loire, a small village on the railroad to Lyons, about 100 miles south of Paris. The "N. M. B." brand is the one best known in this country. The crude ocher is placed in drying houses similar in construction to those used for drying whiting; when sufficiently dry it is ground in buhr mills, bolted, and packed in casks for shipment. The spot value of this ocher was, in 1877, 1½ francs per 200 kilos (440 pounds) at the mouth of the shaft. During 1885 2,500 casks of 750 pounds each were imported at New York. It sells at from 1.32½ to 1.35 cents per pound in quantity. The "Auxerre" ochers, mined in the same district, contain a larger percentage of iron; they are darker in color and require to be washed. During 1885 about 2,000 casks of 750 pounds each of this variety of ocher were received at New York. It is of a higher grade than the "N. M. B.," and sells at 1¾ to 3½ cents per pound. The "Havre" ocher, which formerly met with considerable sale, is now in slight demand, owing to the amount of sand contained by it. Fine ochers are found in England, Germany, and Italy, but in amount trifling in comparison with the French product. From England there is annually imported from 1,500 to 2,000 tons of a red coloring substance, variously known as oxide of iron, colcothar, crocus, and crocus martis, most of which is used by paint manufacturers; 600 tons are consumed by the paper trade, and it is also used as a polishing material. It is principally mined in the Forest of Dean, in South Wales, and at localities near Bristol, England. The crude material contains as much as one-third moisture, and therefore it is generally calcined before it is sold.

Metallic paint.—Under this title there will be considered, the products manufactured by the Prince Manufacturing Company, Lowe's Metallic Paint Company, the Ironclad Paint Company, and F. W. Devoe & Co.

The Prince Manufacturing Company, of New York, sells a metallic paint which is made from a blue magnetic iron ore, containing about 50 per cent. of iron peroxide, 25 per cent. limestone, and 25 per cent. sulphur. It is mined in Carbon county, Pennsylvania, and the output during 1885 was some 3,000 tons, worth, in its crude condition, about $10 per ton. The ore is broken into small pieces, roasted, and then ground. During this process it loses one-third of its weight by the volatilization of the sulphur and other constituents, so that only 2,000 tons of the refined product were shipped from the works during the past year. The prepared pigment is said to contain 72 per cent. of iron peroxide and 28 per cent. of hydraulic cement. It is mixed with oil and one color (brown) only is made. This paint is principally recommended as an indestructible coating for iron, tin, and wood. It likewise finds application in the manufacture of linoleum, oilcloth, and floor cloth. The dry pigment is sold in New York at from $25 to $27.50 per ton.

Lowe's metallic paint, manufactured at Chattanooga, Tennessee, is made from red fossiliferous iron ore mined at Atalla, Alabama, and at Ooltewah, Tennessee. An analysis of the paint shows its composition to be:

Analysis of Lowe's metallic paint.

	Per cent.
Iron peroxide	78.87
Alumina	3.29
Silica	11.96
Water	5.07
Phosphoric acid, lime, manganese, etc	.80
Total	99.99

The crude ore is valued at $2 per ton at the mine, and 2,000 tons are annually ground into pigment. The mineral is crushed, then spread on steam pans and thoroughly dried, passed through buhr mills, bolted, and finally re-ground. The finished product is worth, barreled, $20 per ton at New York.

The Ironclad Paint Company, of Cleveland, Ohio, manufactures four varieties of mineral pigments. No. 1, called "Rossie red," is made from ore mined in Wayne county, New York, and has the following composition:

Analysis of No. 1.

	Per cent.
Iron peroxide	60.50
Alumina	5.63
Calcium carbonate	15.66
Silica	18.00
Moisture	.33
Total	100.12

No. 2, or "light brown," is prepared from an ore mined in the iron district of Lake Superior, Michigan.

Analysis of No. 2.

	Per cent.
Iron peroxide	77.26
Alumina	7.00
Calcium carbonate	1.84
Silica	13.84
Loss	.06
Total	100.00

No. 3, called "brown purple," is made from an ore coming from the Jackson mine, Michigan.

Analysis of No. 3.

	Per cent.
Iron peroxide	93.68
Alumina	3.06
Silica	3.20
Sulphur and loss	.06
Total	100.00

No. 4. or "brown," is also derived from ore mined in the Lake Superior district. The value of the crude material at Cleveland is as follows: No. 1, $4.50; No. 2, $5.50; No. 3, $6.50; No. 4, $6 per ton. The prepared pigment is sold in quantities less than 5 tons at the following figures: No. 1, $30 per ton; Nos. 2 and 3, $50 per ton. The preparation consists in crushing the mineral and then grinding by several runs of buhrstones until an impalpable powder is obtained. This paint is said to have unusual anti-rust qualities, as the ores are not submitted to a calcination process. It is said to be valuable for painting railroad cars, bridges, ships, barb-wire fences, barns, wagons, carriages, roofs, shingles, agricultural implements, etc.

"*Rocky Mountain vermilion.*"—Under the foregoing title a red pigment has recently been introduced in the Eastern markets by F. W. Devoe & Co., of New York. The following information has been supplied by Mr. F. F. Chisolm: The ore is found near Rawlins, Wyoming, and is considered the most valuable deposit of its kind in the Rocky Mountain region. The mineral as it occurs is a hydrated oxide of iron with a fine dark-red color. An analysis made of this ore shows the following composition:

Analysis of ore from near Rawlins, Wyoming.

	Per cent.
Iron peroxide	90.2
Sulphur and lime	1.4
Insoluble matter	7.2
Water	1.2
Total	100.0

In 1878, when the mine was purchased by the Union Pacific Railway Company, the deposit was estimated to show in sight from 5,000 to 6,000 tons of the paint. The deposit has not been worked largely, the principal consumption being by the railway company. The supply during 1885 was about 200 tons, shipped directly from ore already on the dumps, so that no new material was mined. Of this amount 100 tons were used by the railway company in painting cars, water tanks, roofs, etc., while the remainder was used by F. W. Devoe & Co. The latter firm has found a similar application for the paint, and has furnished this pigment to the elevated railway systems in New York and Brooklyn, whose structures have been coated with it. The large amount of iron contained in the paint shows its strength, and excellent results have followed from its use. The price of the ore at the mine is $30 per ton, and its value in New York is increased by the cost of transportation and grinding. It is estimated that from 2,000 to 3,000 tons of pigment made from fossiliferous iron ore are annually ground and sold by mills in Tennessee, Georgia, and Alabama.

Mr. C. G. Yale sends the following report from the Pacific coast: A pigment, some of it of an ocherous and some of a talcose nature, called mineral paint, is met with in many places in the Pacific division, especially in California. It occurs in lodes and beds and is found of various colors—yellow, brown, blue, and black. A black variety resembling asphaltum has been found in quantity on the beach in Los Angeles county. A deposit of mineral paint is known near Olmstead's Mills, Sonoma county, and another near Martinez, in Contra Costa county. A paint mine has been opened at a point 2 miles north of Reno, in Nevada. A good deal of the material obtained in the far West has been ground and found to give satisfactory results in the coarser kinds of work.

Sienna.—There are about twelve mines of this material in the United States, but from most of them an inferior product is obtained. The principal deposit is located in the vicinity of Bethlehem, Pennsylvania, and from it the best quality of domestic sienna is mined. The discovery of a valuable deposit at Lisbon, Maine, was reported during the year, but its quality is said by experts to be inferior to the imported. A deposit, controlled by Henry Erwin, has been opened recently at Valley station, near West End, New Jersey. A small quantity of it has been placed on the market. It is of excellent quality, and by many it is considered equal to the foreign. After it is burnt, it sells in New York at 4 cents per pound. The Bethlehem sienna sells in New York at from $25 to $30 per ton. The imported article continues chiefly in demand, and the imports at New York during 1885 were 971,854 pounds, as compared with 392,119 pounds for 1884.

Umber.—Owing to the steady decline in price of the Turkish umbers during the past year, the output from American mines has diminished. The principal deposits in the United States are in Pennsylvania. An amount not exceeding 1,000 tons of this pigment was placed on the market during 1885. During the year there were imported at New York 748,031 pounds of umber.

Slate.—The use of ground slate and similar materials mixed with white lead and ground in oil is quite common, although such paints are not sold by the large dealers. Slate by itself has little or no covering power, but in combination with other ingredients it forms a durable paint suitable for roofs and other common outdoor work.

The Grafton Paint Company mines annually in the vicinity of the works at Grafton, near Troy, New York, from 1,500 to 2,000 tons of a slaty mineral which after being ground sells in New York at from $10 to $15 per ton. The output from this deposit is variable and depends upon the condition of the weather. The spot value of the ore is about $1 per ton.

The Indiana Paint and Roofing Company, which mines slates for mantels, consumes annually a considerable amount of refuse slate, which is ground into powder at the company's quarries at Slatington, Pennsylvania. It is mixed with other pigments and ground with oil into paint. Its principal use is as a paint for roofs.

The Plastic Slate Roofing Company, of New York, manufactures a plastic slate which is composed of slate, asphalt, and oil. This material spread on roofs and exposed to the sun and atmosphere is said to be slowly reconstructed into slate stone. In this condition, it retains a certain amount of elasticity and is fire, water, and frost proof. From 150 to 200 tons of the crude slate are annually consumed, having a value of from $10 to $15 laid down in New York.

Graphite.—A paint is manufactured by the Joseph Dixon Crucible Company which consists of a mixture of perfected graphite and pure linseed oil, so thoroughly mixed that when applied with the brush the work receives a coat of thin flakes of graphite, and this coating once secured, it is claimed that the metal will resist any heat that iron work will ordinarily receive, and that it likewise stands extreme cold or a change from the highest heat to 40° below zero equally well, and also is not affected by acids. This paint is used for tin or metal roofs, locomotive or steamboat stacks, ashpans, and exposed ironwork. The crude graphite is obtained from the mines of Ticonderoga, New York. It is estimated that 7,500 pounds were ground into paint during 1885. The retail price of graphite paint prepared for the market is from 12 to 15 cents per pound, according to the quantity purchased.

TALC.

By G. F. Perrenoud.

In the town of Edwards, about 11 miles in a southerly direction from Gouverneur, Saint Lawrence county, in the State of New York, there exists a large deposit of what is locally known as talc, but while its chemical components are those of this mineral, its crystallization and its physical properties but partially resemble it. Its appearance, particularly after being pulverized, would indicate that asbestus, as much as talc, entered into its composition, for, added to the unctuous feeling of the latter, it possesses in an eminent degree the fibrous nature of the former. A diligent search over an area of many miles around Gouverneur has failed to reveal the existence of this particular mineral elsewhere than at the point named. There it occurs in a bed, the dip of which is at an angle of about 45°, of a thickness varying from a few inches to 30 feet, with both hanging and foot walls of white quartzose rock. At various points along this deposit shafts have been sunk, and these have been worked as adjuncts to several mills, all within a mile or two of Gouverneur, to which the mineral is hauled by teams, to be prepared for market. As many systems as there are mills have at various times been used for pulverizing this talc, but all have been supplanted by the one existing at the present time, it being the only one found to work satisfactorily. It is as follows: The talc is first put through a crusher with jaws sufficiently close to admit of the product being received by buhrstones, to which it is conveyed; coming from these, it is placed in large iron cylinders, porcelain lined, (to prevent the contact of the talc with the iron, as this would render it valueless for the uses to which it is generally put) in charges varying from one-half to two tons, and is there kept revolving from one to three hours, according to the degree of fineness required. These are known as the Alsing cylinders, the pulverization being effected by the friction against each other and against the sides of hard flint pebbles, revolving with the charge. From these the talc is packed in burlap or paper bags, ready to be shipped to the consumer, who receives it under names varying with the fancy of the manufacturer, as pulp, mineral pulp, agalite, asbestine pulp, etc.

The stocks of the manufactured article, carried over from year to year, having heretofore been very small, the shipments are a fair index of the annual production, and they were as follows:

Shipments of talc from Saint Lawrence County, New York.

Years.	Tons of 2,000 pounds.
1882	9,000
1883	11,000
1884	13,000
1885	15,000

Companies engaged in the business of pulverizing this talc, the capacity of their plants, and capital.

	Capacity 24 hours.	Capital.
	Short tons.	
Saint Lawrence Fiber Pulp Company	5	$200,000
Agalite Fiber Company	15	600,000
Natural Dam Pulp Company	18	250,000
Adirondack Pulp Company	14	750,000

As these companies control the deposit, and each produces only enough for its own requirements, there is of course no price for the crude material. That of the ground stock has, within the last two years, owing to the competition resulting from the enlargement and consequent increased capacity of some of the mills, steadily declined from $16 and $18 per ton of 2,000 pounds, to $12 and $13, its present price. Some of the stock, requiring particular selection and manipulation, still commands the higher figures, but the demand for this is limited.

The uses of this material when ground are many, but with the exception of that for paper making, which industry consumes about the entire supply, none bear mention, from their want of importance. It is shipped to paper mills all over the country, where it is used as a filler in the manufacture of paper of all grades, save the very finest and the coarsest. The fibrous nature of this talc, added to its chemical properties and light specific gravity, admits of its entire amalgamation with other paper stock, thus entailing but a limited loss of material in the manufacture and hence being more economical as a filler at a higher price than would be clays and kindred materials which it replaces.

MINERAL WATERS.

By A. C. Peale.

The returns of mineral waters received for 1885 show an increase of thirty-five in the number of springs, the waters of which were placed on the market. Notwithstanding this fact the production and its value were slightly less than during the previous year. This reduction occurred almost entirely in the North Atlantic, and Southern Central States, and is distributed among only five States in those sections, all the others showing an increase. The principal springs throughout the country not only hold their own, but report increased sales. The general decrease, which is slight, appears to be among some of the smaller and less-known springs, which in first putting the water on sale fixed the prices too high and have since had to reduce them. It is possible also that some of the reports from localities used as resorts, also included the local consumption, which has been eliminated in the reports for 1885. A number of localities used commercially as well as for resorts in 1884, sold no water during 1885, but furnished it free of charge to their guests and made no effort to push the water in the general market. A large number also have been furnishing the water at simply cost of freightage, with the view of introducing it, so that an increase may be expected in future figures.

Alabama.—Of the six mineral springs of Alabama, recorded as placing their waters on sale, only one makes no report for 1885, and of the five sending statistics in 1884 one reports no sales for 1885. The figures included in the statistics are made up from figures given by the following, viz: Bailey springs, Bailey Springs, Lauderdale county; Cullum springs, Bladen Springs, Choctaw county; Bladen springs, Bladen Springs, Choctaw county; Healing springs, Healing Springs, Washington county; White sulphur springs, Sulphur Springs, Calhoun county.

Alaska and *Arizona* report no mineral waters used commercially.

Arkansas.—In 1884 Arkansas reported six springs, the waters of which were used commercially. One of these now furnishes the water without charge.

The following list records the commercial waters of the State so far as we have received reports: Siloam springs, Siloam Springs, Benton county; Fairchild's potash sulphur springs, Potash Sulphur Springs, Garland county; Eureka springs, Eureka Springs, Carroll county; Mountain Valley springs, Mountain Valley, Garland county.

California has at least ten mineral waters of present commercial value. Only two of these were reported last year.

In the present report the following have given statistics of sales: Pacific Congress springs, Saratoga, Santa Clara county; Castalian mineral water, Olancha, Inyo county; Napa soda springs, Napa Soda Springs, Napa county; Litton's seltzer spring, Litton's Station, Sonoma county; Geyser soda spring, Litton's Station, Sonoma county.

Colorado.—The springs of Colorado are used mainly as resorts. Statistics have been received from but one spring in the State as to commercial use of the water, viz: Seltzer springs, Springdale, Boulder county.

Connecticut.—The report of the previous year contained no statistics from Connecticut, although the two springs reporting this year were noted and placed on the list. They are, Bozrah or Stark mineral springs, Bozrah, New London county; Oxford springs, Oxford, New Haven county.

Dakota, Delaware, District of Columbia, and Florida are not represented in the list of commercial mineral waters.

Georgia.—Only two springs report the sale of waters, viz: Daniel mineral springs, Union Point, Greene county; Ponce De Leon springs, Atlanta, Fulton county.

Idaho reports no waters on sale.

Illinois.—Of the four localities in Illinois whose mineral waters are said to have a commercial value, the following report their figures for 1885: Perry's springs, Perry Springs, Pike county; Zonian springs, near Elgin, Kane county; Glen Flora mineral springs, Waukegan, Lake county.

Indiana.—Although six of seven mineral springs of Indiana reported sales for 1884, this year only five have sent in figures. They are: West Baden springs, West Baden, Orange county; King's mineral springs, Wilson's Switch, Clarke county; New Point Comfort springs, Blue Lick, Clarke county; French Lick springs, French Lick, Orange county; La Fayette artesian well, La Fayette, Tippecanoe county.

Indian Territory has no mineral springs of present commercial value so far as the sale of the waters is concerned.

Iowa.—The list of commercial mineral waters for Iowa is increased to four, from three in the previous year. Of these, however, only the following three report figures: Ottumwa mineral springs, Ottumwa, Wapello county; Dunbar's mineral springs, College Springs, Page county; Colfax springs, Colfax, Jasper county.

Kansas.—The two springs on the list of Kansas mineral waters in 1884 have increased to five for 1885. They are: Iola mineral well, Iola, Allen county; Kansas artesian mineral wells, Manhattan, Riley county; Baxter's medical springs, Baxter Springs, Cherokee county; Geuda mineral springs, Geuda Springs, Sumner county; Arrington mineral springs, Arrington, Atchison county.

Kentucky.—The present list credits Kentucky with six springs whose waters are on the market—an increase of two over the previous year. Only three report figures of production: Upper Blue Lick springs, Davidson, Nicholas county; Bedford springs, Bedford, Trimble county; Lower Blue Lick springs, Blue Lick Springs, Nicholas county.

Louisiana.—So far as learned none of the Louisiana mineral waters are used commercially.

Maine.—Seven of the eleven springs of Maine send statistics of sales for 1885. They are: Rosicrucian spring, Rosicrucian, Lincoln county; East Boothbay spring, East Boothbay, Lincoln county; Poland mineral spring, South Poland, Androscoggin county; Auburn mineral spring, Auburn, Androscoggin county; Summit mineral spring, Hamson, Cumberland county; Hartford cold spring, Hartford, Oxford county; Scarborough mineral spring, Scarborough, Cumberland county.

Maryland.—The only mineral spring of Maryland reporting sales of the water is Strontia mineral spring, Brooklandville, Baltimore county.

Massachusetts.—The number of mineral waters on sale from Massachusetts in 1885 is reported as seven, instead of three, as given in the previous report. They are the following: Everett Crystal mineral spring, Everett, Middlesex county; Echo Grove mineral spring, Lynn, Essex county; Berkshire soda and sulphur springs, Sheffield, Berkshire county; Bethlehem springs, Holliston, Middlesex county; Commonwealth mineral springs, Waltham, Middlesex county; Allandale mineral spring, West Roxbury, Suffolk county; Crystal mineral spring, Stoneham, Middlesex county.

Michigan.—Four mineral springs of Michigan have waters on sale. Three of these report the sales for 1885. They are as follows: Mount Clemens mineral springs, Mount Clemens, Macomb county; Ypsilanti mineral springs, Ypsilanti, Washtenaw county; Moorman well, Ypsilanti, Washtenaw county.

Minnesota.—The only spring in Minnesota reporting sales of water is Inglewood spring, Minneapolis, Hennepin county.

Mississippi reports sales of waters from four springs in 1885 as against one in 1884. The springs reporting are Godbold mineral well, Summit, Pike county; Castalian spring, Durant, Holmes county; Chalybeate acid spring, Grenada, Grenada county; Cooper's well, Raymond, Hinds county.

Missouri.—Six Missouri mineral springs are included in the returns. They are the following: Mooresville mineral springs, Mooresville, Livingston county; Eldorado springs, Eldorado Springs, Cedar county; Randolph springs, Randolph, Randolph county; Reiger springs, Mercer county (P. O. address, Lineville, Iowa); Sweet springs, Brownville, Saline county; Montesano springs, Kimmswick, Jefferson county.

Montana has none of her mineral waters on the market at present.

Nebraska has no commercial mineral waters.

Nevada is not represented in the list of statistics for the Western States, as none of her mineral waters are put up for sale, so far as ascertained.

New Hampshire.—Of five springs whose waters are sold, the following four have sent in figures for 1885: Birchdale medicinal springs, Concord, Merrimack county; Bradford mineral springs, Bradford, Merrimack county; Moultonborough mineral springs, Moultonborough, Carroll county; Milford (or Ponemah) springs, Milford, Hillsborough county.

New Jersey has no mineral springs whose waters are found in the market.

New Mexico.—Joseph's hot springs, Ojo Caliente (Joseph's), Ojo Caliente, Taos county, are the only ones in New Mexico furnishing any figures for 1885, and are probably the only springs in the Territory which at present regularly utilize the waters commercially, although the water of Aztec springs is sold to some extent in Santa Fé.

New York.—Twenty of the thirty-four localities in New York whose waters are on sale report figures for 1885, and one, Cayuga spring, reported the waters as free.

The statistics included in the tables are based on reports from the following: High Rock spring, Saratoga Springs, Saratoga county; Vichy spring, Saratoga Springs, Saratoga county; Champion spouting spring, Saratoga Springs, Saratoga county; Star spring, Saratoga Springs, Saratoga county; Putnam spring, Saratoga Springs, Saratoga county; Union spring, Saratoga Springs, Saratoga county; Excelsior spring, Saratoga Springs, Saratoga county; Victor spring, Darien Center, Genesee county; Sharon spring, Sharon Springs, Schoharie county; Deep Rock spring, Oswego, Oswego county; Artesian lithia spring, Ballston Spa, Saratoga county; Verona mineral spring, Verona, Oneida county; Diamond Rock spring, Williamson, Wayne county; Nunda mineral spring, Nunda, Livingston county; Massena springs, Massena, Saint Lawrence county; Richfield springs, Richfield Springs, Otsego county; Chlorine springs, Syracuse, Onondaga county; Adirondack springs, White Hall, Washington county; Oak Orchard acid springs, Alabama, Genesee county; Lebanon springs, Lebanon Springs, Columbia county.

North Carolina has seven springs whose waters have a commercial value. Four of these have reported. One locality, Lemon Springs, which reported sales for 1884, now reports that the water during 1885 was distributed gratuitously. The following are the springs reporting figures: Panacea springs, Littleton, Halifax county; Leinster poison spring, Statesville, Iredell county; Parks alkaline spring, Casewell county (P. O. address, Danville, Va.); Seven springs, Seven springs, Wayne county.

Ohio.—The Ohio list for 1885 includes seven springs, an increase of one. The following have sent reports: Electro-Magnetic springs, Woodstock, Champaign county; Green springs, Green Spring, Seneca county; Wyandot magnetic springs, Upper Sandusky, Wyandot county; Len-a-pe Magnetic springs, Delaware, Delaware county; Ohio Magnetic springs, Magnetic Spring, Union county; Cuyahoga lithia spring, Parma, Cuyahoga county.

Oregon has three springs whose waters are offered for sale. The two reporting are: McCallister's soda springs, 35 miles east of Jacksonville, Jackson county; Wilhoit springs, Wilhoit, Clackamas county.

Pennsylvania.—Five Pennsylvania springs report figures for 1885. They are the following: Black Barren mineral springs, Pleasant Grove, Lancaster county; Bedford springs, Bedford, Bedford county; Gettysburg Katalsine and Lithia springs, Gettysburg, Adams county; Minnequa springs, Minnequa, Bradford county; Gulyck and Gaylord spring, Blossburg, Tioga county.

Rhode Island.—The list for 1884 contained no data as to the springs of Rhode Island. Since then reports have been received from the following springs in that State: Holly spring, Woonsocket, Providence county; Ochee springs, Providence, Providence county.

South Carolina.—The statistics given for 1885 include figures from three of the South Carolina springs as against one for the previous year. They are: Glenn springs, Spartansburgh, Spartansburgh county; Garrett's spring, Spartansburgh, Spartansburgh county; Chick's spring, Chick's Springs, Greenville county.

Tennessee reports sales of eight mineral waters in the State, an increase of one as compared with the return for 1884. The springs reporting are the following: Tate's epsom springs, Tate Springs, Grainger county; Rhea springs, Rhea Springs, Rhea county; Red Boiling springs, Red Boiling Springs, Macon county; Idaho springs, near Clarksville, Montgomery county; Mineral Hill spring, Bean's Station, Grainger county; West End mineral spring, Nashville, Davidson county; Hurricane springs, Tullahoma, Coffee county; Horn's mineral spring, Lebanon, Wilson county.

Texas has eight springs whose waters are sold to a greater or less extent. Seven of these report as follows: Wootan wells, Wootan Wells, Robertson county; Mineral wells, Mineral Wells, Palo Pinto county: Texas sour springs, Luling, Caldwell county; Crabtree sour wells, Sulphur, Hopkins county; Sour Lake springs, Sour Lake, Hardin county; Hynson's Iron Mountain springs, Marshall, Hamson county; Dalby springs, Dalby Springs, Bowie county.

Utah.—So far as learned none of the Utah mineral waters are seen in the market.

Vermont.—Only four of the eight springs on the list, credited to Vermont, make reports for 1885. They are: Clarendon springs, Clarendon Springs, Rutland county; Alburgh springs, Alburgh springs, Grand Isle county; Elgin springs, Panton (P. O., Vergennes), Addison county; Brunswick white sulphur spring, Brunswick, Essex county.

Virginia.—Sixteen of Virginia's springs report sales for 1885. The entire list includes twenty-one or twenty-two springs. The following are those reporting figures: Jordan white sulphur springs, Stephenson's Depot, Frederick county; Farmville lithia springs, Farmville, Prince Edward county; Blue Ridge springs, Blue Ridge Springs Botetourt county; Seven springs, Abingdon, Washington county; Rawley springs, Rawley Springs, Rockingham county; Massanetta mineral springs, Harrisonburg, Rockingham county; Bath Alum springs, Bath Alum, Bath county; Rockingham Virginia springs, Rockingham, Rockingham county; Healing springs, Healing Springs, Bath county; Wolf Trap lithia springs, Richmond, Henrico county; Hunter's Pulaski alum springs, Dublin, Pulaski county; Rock Enon springs, Rock Enon Springs, Frederick county; Shenandoah alum springs, Shenandoah Alum Springs, Shenandoah county; Cold sulphur springs, Goshen, Rockbridge county; Wallawhatoola alum springs, Millborough Depot, Bath county; Buffalo lithia springs, Buffalo Lithia Springs, Mecklenburgh county.

Washington Territory.—The Medical Lake, Medical Lake, Spokane county, is the only mineral water of the Territory on sale. The waters are evaporated and the residuum is largely sold in addition to the water.

West Virginia.—All of the six localities of West Virginia whose mineral waters are on sale have sent reports for 1885. These springs are as follows: Greenbrier white sulphur spring, White Sulphur Springs, Greenbrier county; Salt sulphur springs, Salt Sulphur Springs, Monroe county; Irondale springs, Raccoon, Preston county; Mineral wells, Parkersburg, Wood county; Capon springs, Capon Springs, Hampshire county; Red sulphur springs, Red Sulphur Springs.

Wisconsin.—About fifteen of Wisconsin's mineral waters are used commercially. Of these, reports have been received from thirteen, as follows: Glenn spring, Waukesha, Waukesha county; Shealtiel springs, Waupaca, Waupaca county; Mineral Rock spring, Waukesha, Waukesha county; Vesta mineral spring, Waukesha, Waukesha county; Zenobias fountain spring, Palmyra, Jefferson county; Bethesda mineral springs, Waukesha, Waukesha county; White Rock mineral spring, Waukesha, Waukesha county; Siloam mineral spring, Waukesha, Waukesha, county; Horeb mineral springs, Waukesha, Waukesha county; Saint Croix mineral spring, Farmington, Polk county; Gihon mineral spring, Delavan, Walworth county; Iodo magnesian spring, Beloit, Rock county; Prairie du Chien artesian well, Prairie du Chien, Crawford county.

Wyoming Territory.—None of the mineral waters of Wyoming are used commercially.

Summary of reports of mineral springs for 1885.

	Springs reporting statistics.	Springs not reporting.	Total springs used commercially.
North Atlantic States:			
Maine	7	4	11
New Hampshire	4	1	5
Vermont	4	4	8
Massachusetts	7	0	7
Rhode Island	2	0	2
Connecticut	2	0	2
New York	20	14	34
New Jersey	0	0	0
Pennsylvania	5	0	5
South Atlantic States:			
Delaware	0	0	0
Maryland	1	0	1
District of Columbia	0	0	0
Virginia	16	5	21
West Virginia	6	0	6
North Carolina	4	3	7
South Carolina	3	0	3
Georgia	2	1	3
Florida	0	0	0
Southern central States:			
Kentucky	3	3	6
Tennessee	8	0	8
Alabama	5	1	6
Mississippi	4	0	4
Louisiana	0	0	0
Texas	7	1	8
Indian Territory	0	0	0
Arkansas	4	1	5
Northern central States:			
Ohio	6	1	7
Indiana	5	2	7
Illinois	3	1	4
Michigan	3	1	4
Wisconsin	13	2	15
Minnesota	1	0	1
Iowa	3	1	4
Missouri	6	1	7
Dakota	0	0	0
Nebraska	0	0	0
Kansas	5	0	5
Western States and Territories:			
Alaska	0	0	0
Wyoming	0	0	0
Montana	0	0	0
Colorado	1	0	1
New Mexico	1	1	2
Arizona	0	0	0
Utah	0	0	0
Nevada	0	0	0
Idaho	0	0	0
Washington	1	0	1
Oregon	2	1	3
California	5	6	11
Total	169	55	224

PRODUCTION.

Natural mineral waters sold in 1883, 1884, *and* 1885.

	Springs reporting in 1883 and 1884.	1883.		1884.		Springs reporting in 1885.	1885.	
		Gallons sold.	Value.	Gallons sold.	Value.		Gallons sold.	Value.
North Atlantic States	38	2,470,670	$282,270	3,345,760	$328,125	51	2,527,310	$192,605
South Atlantic States	27	312,090	64,973	464,718	103,191	32	908,692	237,153
Northern central States	37	1,435,809	323,600	2,070,533	420,515	45	2,925,288	446,211
Southern central States	21	1,441,042	139,973	1,526,817	147,112	31	540,436	74,100
Western States and Territories	6	169,812	52,787	307,500	85,200	10	509,675	86,776
	129	5,829,423	863,603	7,715,328	1,084,143	169	7,411,401	1,036,845
Estimated	60	1,700,000	256,000	2,500,000	375,000	55	1,737,000	276,000
Total	189	7,529,423	1,119,603	10,215,328	1,459,143	224	9,148,401	1,312,845

In the last report the figures for the northern central States included the entire output of the artesian wells of Madison, Wisconsin, the greater portion of which, however, was used as the regular city supply for domestic purposes. This consumption, although of a strictly "mineral water," is now excluded from the computation, and in the foregoing table the figures for 1883 and 1884 have been somewhat changed from those given in the preceding report, the reduction being more in point of quantity than in value.

IMPORTS.

Mineral waters imported and entered for consumption in the United States, 1867 to 1883, inclusive.

Fiscal years ending June 30—	In bottles of 1 quart or less.		In bottles in excess of 1 quart.		Not in bottles.		All, not artificial.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Bottles.		*Quarts.*		*Gallons.*		*Gallons.*		
1867	370,610	$24,913	3,792	$360	....	$137	....	....	$25,410
1868	241,702	18,438	22,819	2,052	554	104	....	....	20,594
1869	344,691	25,635	9,739	802	1,042	245	....	....	26,682
1870	433,212	30,680	18,025	1,743	2,063	508	....	....	32,931
1871	470,947	34,604	2,320	174	1,336	141	....	....	34,919
1872	892,913	67,951	....	....	639	116	....	....	68,067
1873	35,508	2,326	....	....	355	75	394,423	$98,151	100,552
1874	7,238	691	....	....	95	16	199,035	79,789	80,496
1875	4,174	471	....	....	5	2	395,956	101,640	102,113
1876	25,758	1,899	....	....	....	....	447,646	134,889	136,788
1877	12,965	1,328	....	....	....	22	520,751	167,458	168,808
1878	8,229	815	....	....	....	....	883,674	350,912	351,727
1879	28,440	2,352	....	....	3	4	798,107	282,153	284,509
1880	207,554	19,731	....	....	....	....	927,759	285,798	305,529
1881	150,326	11,850	....	....	55	26	1,225,462	383,616	395,492
1882	152,277	17,010	....	....	....	....	1,542,905	410,105	427,115
1883	88,497	7,054	....	....	....	....	1,714,085	441,439	448,493

It appears from the foregoing table that previous to 1873 natural mineral waters were not distinguished from the artificial waters. Since 1884 the artificial waters have not been classified according to the receptacles in which they have been imported.

Imports for the fiscal years 1884 and 1885.

	1884.		1885.	
	Gallons.	Value.	Gallons.	Value.
Artificial mineral waters	29,366	$4,591	7,972	$2,157
Natural mineral waters	1,505,298	362,651	1,660,072	397,875
Total	1,534,664	367,242	1,668,044	400,032

EXPORTS.

Exports of natural mineral waters, of domestic production, from the United States.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1875	$162	1881	$1,029
1876	80	1882	421
1879	1,529	1883	459
1880	1,486	1884 and 1885	None.

The amount of artificial mineral waters exported is also trifling.

CLASS MATERIALS.

By Jos. D. Weeks.

The chief materials used in glass making, silica, soda, potash, lime, lead, and manganese, were so fully discribed in the volume of "Mineral Resources" for 1883 and 1884, as to render unnecessary any general discussion of their production, characteristics, or uses in the report for the present year.

There are, however, some other materials to which but brief reference was made last year, and which, by reason of the extension of their use in glass making, are of growing importance, and may be described and their uses pointed out. There are also additional facts regarding some of the materials treated of in the last report, especially soda and its occurrence and manufacture in this country, that are of interest. Further, a more thorough investigation into the consumption in the glass industry of the substances which are here classified as glass materials, has made possible the presentation of more accurate statistics this year than ever before.

COLORING MATERIALS.

In the report on glass materials in the last volume of "Mineral Resources," it was stated that several of the metallic oxides, as well as occasionally some of the other compounds of the metals, are at times found in glass as coloring materials. These were not described, however, since until quite recently but little colored glass, with the exception of common black and amber bottles, was made in this country. Now quite a number of glass works are engaged in its manufacture exclusively, and at others it forms a large part of the product. Some of the most beautiful colored glass produced in the world, rivaling in depth and richness of coloring, as well as in beauty of design, that from the famous works of Europe, is made at the flint glass works of the United States.

The coloring materials most largely employed are iron, manganese, copper, cobalt, and gold. These are generally used as oxides, though in some cases, but very rarely, other compounds are used. In addition to the above, arsenic. uranium, chromium, and silver, are occasionally employed.

As was pointed out by Bontemps, many years ago, the coloring properties of the metallic oxides are greatly modified by the degree of heat to which the glass is subjected and by other circumstances. Not only will different temperatures give different shades of the same color, but even different colors. Manganese, for example, which is the great decolorizer of glass, so universally used for the purpose as to be known as "glass-maker's soap," is used as a colorer chiefly to impart a pink or purple to glass. If, however, the glass so colored remains too long in the furnace, it becomes pale or reddish brown, then yellow, and finally green.

From the oxides of iron all the colors of the spectrum may be produced, and in the order in which they appear in the spectrum. Its primary effect upon glass is to give it a green tinge. Hence in the manufacture of white glass, sand containing much iron is carefully avoided; what little it does contain, and there is always more or less present, is neutralized by the oxide of manganese. Oxide of iron, however, produces other colors than green. Indeed, the green of this oxide has but little brilliancy, and when rich emeralds are desired other materials, are used, such as the oxide of copper. Iron will produce in enamels, which are only glasses, a fine purplish red, or under a stronger heat an orange. If a piece of iron is thrown into the pot of a flint-glass house during the blowing, the glass in its neighborhood will be orange or yellow. In window-glass houses the addition of a small proportion of oxide of iron gives a bluish tint to the glass, while it is well known that the glass left in the pots of the bottle houses becomes an opaque blue.

Oxide of copper is chiefly used to produce reds, rubies, and purples, in the cheaper kinds of glass. To produce these reds with copper, however, requires skillful manipulation, as they are not at all fixed.

The temperature must be kept at the lowest possible point, otherwise the glass changes to a purple, and then to a sky blue with a tendency to green. A heat between the maximum, which gives a blue, and the minimum, which gives a red, produces a purple.

The finest rubies, reds, purples, violets, etc., are produced by gold. The purple of Cassius, which is a mixture of the oxides of gold and tin, or some similar preparation of gold, is used. The coloring power of gold is so great that one part of gold will give a full rich body of color to from 600 to 1,000 parts of glass. The glass colored with gold can be made to assume a scarlet, carmine, rose, and ruby.

Cobalt gives a blue which is unalterable in any fire. It is also used for some of the finer blacks.

Carbon, usually as powdered cannel coal, is the coloring matter chiefly used in the manufacture of black and amber bottles. Plumbago was at one time largely used and still is to some extent.

SAND.

Sand is used for two purposes in glass making: as mixing sand in the batch, the melting of which produces glass, and as sand for grinding in plate-glass works, and, in the manufacture of fruit jars and similar articles, for grinding the tops, etc. In the year 1885 the amount of mixing sand used in the glass works of the United States was 221,543 long tons, and of grinding sand, 61,284 long tons.

The sources from which the mixing sand is chiefly derived were pointed out in the last report, and its character and analysis given and discussed.

In the year just passed, the value of the mixing sand, at the works, has varied from 60 cents to $10.25 per ton; the total value of the 221,543 tons used being $507,178. The very low price of 60 cents was paid at works mining their own sand, the price covering only the labor and expense of mining, which was a trifle. The highest price was for a very fine sand, delivered at a works remote from the source of supply.

The total value of the 61,284 long tons of grinding sand used was $31,610, the average value but 51½ cents per ton, while the range of values was from 50 cents to $10, as almost all the grinding sand used was consumed at plate-glass works. This was chiefly river sand dredged out of the river or procured from the river bank near the works, and was worth only the cost of dredging or loading. At works other than plate-glass works using grinding sand, mixing sand is generally used for grinding.

SODA.

The consumption, in the glass houses of the United States, of what is generally, though not with absolute correctness, termed soda, was as follows:

Consumption of various sodium compounds in the glass works of the United States in 1885.

	Long-tons.
Soda ash	60,050
Salt cake	23,419
Nitrate of soda	2,987
Common salt	2,323

An interesting fact, shown by a comparison of this table with those of previous years, is the increased consumption of salt cake in the manufacture of glass. In the writer's census report on glass, it was shown that, of the total consumption of soda ash and salt cake during the census year, only 14 per cent. was salt cake. In 1885 salt cake was 28 per cent., while the actual consumption was more than four times what it was in 1879-'80.

The average price of soda ash at the glass works in 1885 was $34.18 per long ton, the range of prices from $27 to $45.33⅓, or from 1⅓ cents to 2 cents per pound, the price varying with the distance from the seaboard. The average price of salt cake was $16.95 per long ton, or about one-half that of soda ash; the range of prices was from $8 to $40 per ton. This price of $8 is probably an error.

The average price of nitrate of soda was $49.18 per ton; of salt the average price was $6.32 per long ton.

As will appear from the table given below, most of the soda ash and salt cake used in the country is imported from England. There was but one works in the country making soda ash in any considerable quantity in 1885, that of the Solvay Process Company, at Geddes, New York. This establishment with the process used was described at length in the last report. The following additional facts may be not without interest:

These works were started in the fall of 1881. The Solvay Process Company was incorporated, under the laws of the State of New York, with a capital of $300,000, for the purpose of making soda ash or carbonate of soda, under the patents of the Messrs. Solvay, and by the process as perfected by them and employed in their works in Belgium, France, Germany, Austria, and Russia, as also by their licensees in England. This process is called the ammonia process in distinction from the Le Blanc process.

The incorporators of the American company were, Hon. Rowland Hazard, of Rhode Island, and Messrs. William B. Cogswell, William A. Sweet, Earl B. Alvord, and George E. Dana, of Syracuse.

A tract of land, containing about 50 acres, was purchased, and work begun on the building in September, 1881. The site selected for the works, on this land in Geddes, about 3 miles west of Syracuse, combines good facilities both for receiving the raw materials and supplies for the manufacture and for shipping the finished product either by rail or canal. The tracks of the New York Central and Hudson River railroad enter the yard, and the Erie canal passes the shipping-room door.

The work was diligently prosecuted, and the capital increased from time to time until, in January, 1884, the manufacture was put in successful operation, with a capital of $500,000.

For the first few months the greatest difficulty was experienced in teaching the men their duties. As the work is different from that in any other establishment in this country, this could only be done by the constant and patient supervision of the small corps of assistants, who had studied in the French works of Messrs. Solvay & Co. With the hot weather of 1884 also came many troubles and difficulties which were not thoroughly understood at the time, but which have since been corrected and overcome.

The works started January 10, 1884, and should have run continuously night and day. Out of a possible 355 days they actually ran 332 days, and produced about 11,000 long tons of 58 per cent. alkali. By an accident in January, 1885, which destroyed the roof of the main building, the works were closed for 30 days. Since that time, however, they have been in continuous and successful operation. The production of 58 per cent. alkali for the year 1885 was about 15,000 long tons, notwithstanding the serious interruption in the early part of the year.

Early in the year 1885 arrangements were made to erect a second building, which would more than double the output of the works. Improvements and perfections were also made in the original plan, by which a much greater efficiency was obtained. The work on the new building was vigorously pushed, and was finally brought to completion early in February, 1886, and the works were successfully started. Since that time the production of 58 per cent. alkali has been at the rate of nearly or quite 40,000 long tons per year. The capital of the company was again increased, and is now $1,000,000.

The buildings erected consisted of: two main buildings, each 265 by 75 feet, and one annex 145 by 46 feet; lime-kiln building, containing ten kilns, 202 by 68 feet; boiler house, 175 by 46 feet; stack, 150 feet high, 10 inches diameter of flue; salt store house, 96 by 54 feet; one soda store house, 100 by 84 feet; one soda store house, 100 by 120 feet; machine shop, 100 by 50 feet; and other buildings, such as carpenter's shop, cooper's shop, barn, store for general supplies, office, gas works, locomotive house, pump house, sheds, and other small buildings. Altogether the ground actually covered by buildings is not far from 3 acres.

The materials handled every day require the nearly constant service of two locomotives, and consist approximately of:

Limestone	Long tons	300
Coal	do	250
Coke	do	30
Salt	do	300
Ammonia	do	10
The product	do	140
Barrels required		700
Bags required		700
Hands employed		500

Shipments can be made either by rail or canal, in bags or barrels, and a considerable quantity is shipped in bulk, but by rail only.

The consumers of the Solvay Process Company's alkali are found in every branch where soda ash can be employed. In glass making some of the most important houses use this ash exclusively. One firm has recently disposed of 50 tons of Tennant's ash in order to adopt the Solvay 58 per cent. alkali. Sales to glass makers are constantly increasing, and universal satisfaction is expressed by those who have used this ash.

For window glass the mixture of batch which has given most excellent results wherever tried is as follows:

	Pounds.
Sand	100
Solvay 58 per cent. ash	26 to 30
Pulverized limestone	30 to 40

Attention is particularly called to the use of limestone instead of lime. This has entirely obviated some of the most serious difficulties encountered in the use of Solvay process 58 per cent. alkali. The stone should be reduced so as to pass through a sieve of eight or ten meshes to the inch. It can, in most localities, be brought to the glass works during the summer, and after grinding can be stored for use just as the sand is.

The advantages of limestone are: it is cheaper than lime; it is ready for use immediately on grinding; no shaking is required.

The troubles which some glass makers experience, with white knots or stones, with seeds or "lousy" glass, and with cordy or streaked glass, seem all to disappear in the use of this mixture. The reason for this is easily found. Limestone, which is mainly carbonate of lime, contains from 40 to 44 per cent., by weight, of carbonic acid. When fusion takes place this gas, together with that from the carbonate of soda or soda ash, is released, and the mechanical action of this doubled volume of gas, in bubbling up through the liquid mass, mixes the contents of the pot most thoroughly, and insures a good melt. The glass made from this mixture has a greater and more permanent luster than that made with lime.

The mixture above can be varied within the limits given, without much apparent effect on the glass, and should be changed by each maker according to the quality of the sand and stone used. More limestone makes the glass harder. More alkali makes it softer.

In soap making, the Solvay Process Company's 58 per cent. alkali gives entire satisfaction. Many large houses are using it for the greater part of their alkali, and some use no other whatever.

In paper making, from the first, this alkali has been received with caution; but the success, where experiments have been made, is flattering and convincing. New buyers in this business are constantly coming forward.

In dyeing and bleaching, in cotton and woolen mills, the Solvay 58 per cent. has largely replaced caustic and crystals of soda, and wherever once introduced has always been retained, both on account of the better results obtained and the economy effected in its use.

For machinists' use, a quality of ash which contains a little dirt and is discolored, made up of the sweepings of the works, is just as serviceable as the best crystals, and 1 pound of it has the same effect as 3 of crystals. For cleaning boilers, and keeping them free from scale, or softening the scale when once formed, provided the scale arises in part or in whole from sulphate of lime contained in the feed water, this dirty discolored soda ash is as good as 58 per cent. alkali, and is sold at lower price. It has been in use at many works in and near Syracuse for more than a year, and has given most satisfactory results.

Among the industries in which the soda is used, in addition to those already noted, are starch, sugar, glucose, oil refining, candles, aniline dyes, wood pulp, pyroligneous products, citrate and sulphite of soda, acetates, etc., earthenware and pottery, salt purification, silicate of soda, dynamite, and many others.

The Solvay Process Company intends soon to prepare a purified supercarbonate of soda, and to place it on the market. The manufacture of a portion of its product into caustic soda is also contemplated in the near future.

The following table, which shows the imports of alkali from England for the past sixteen years contrasted with the production at Syracuse, may be of interest:

Imports of soda ash compared with domestic production at Syracuse.

Years ending June 30—	Imported.	Made at Syracuse.	Total.
	Long tons.	*Long tons.*	*Long tons.*
1870	95,182		
1871	96,225		
1872	109,491		
1873	107,466		
1874	104,553		
1875	101,878		
1876	116,994		
1877	117,551		
1878	121,975		
1879	150,029		
1880	164,609		
1881	155,655		
1882	175,939		
1883	172,071		
1884	156,158	11,000	167,158
1885	167,083	15,000	182,083

From the above it will be seen that only a small percentage of the consumption of the country is supplied by home manufacture.

The selling price of the Syracuse soda ash for 1885 was from $1.10 to $1.15 per 100 pounds, 48 per cent. alkali, equal to $29.77 to $31.12 per 2,240 pounds 58 per cent.

In addition to the works especially erected for the manufacture of soda ash under the Solvay process at Syracuse, the Eureka Chemical Company, of Watertown, New York, is building a new works at Syracuse for the manufacture of fine sulphate of soda, especially adapted to glass-makers' use. This works will employ, essentially, the Le Blanc process, but with greatly improved and more economical apparatus. The by-products will all be utilized, and by the methods adopted it is claimed that a perfectly pure sulphate of soda can be produced at a very moderate cost, and as it is the high price at which sulphate of soda has been sold that has interfered with its use, this company believes that the reduced cost will lead to a return to the use of soda ash at many works that have recently employed salt cake and the cheaper substitutes for soda ash.

THE NATURAL SODAS OF THE WEST.

During the past year, for the first time, a systematic effort has been made to work the soda deposits of Wyoming, and to establish a market for the product in the growing and prosperous towns of the West. No attempt has been made to manufacture anything but the commercial caustic soda, for which quite a ready sale can be had. Lack of railway facilities has held back the development of any beds but those near Laramie.

The soda property generally known as the "Union Pacific lakes" lies about 13 miles nearly due south of Laramie, and is reached by a branch of the Union Pacific railway. The property embraces some 2,000 acres, including five "lakes," in all but one of which the soda is solid. These lakes are connected, and seem to drain one into another. All of the soil near Laramie is more or less impregnated with the sulphate of soda, and the common sources, it is believed, are springs, water from which bears large percentages of soda salts.

The physical condition of the soda in the lakes varies much with the season. In wet years the soda is almost fluid, while in dry years in all but one of the lakes it is solid, and in this one it occurs as a saturated solution. In the solid lakes the soda contains many thin layers of mixed clay and soda. Analysis of a sample of this mixture shows:

Analysis of deposits of soda salts at Laramie, Wyoming.

	Per cent.
Iron, lime, magnesia	22.33
Alumina, soda, hydrochloric and sulphuric acids	40.82
Silica	36.85
Organic matter	Traces.
Total	100.00

The soda when taken pure contains large quantities of water, which fact interferes seriously with its employment in the manufacture of sodium hydrate.

Its composition varies only slightly, and the following may be taken as typical analyses:

Average analyses of soda deposits near Laramie, Wyoming.

	1.	2.	3.
	Per cent.	*Per cent.*	*Per cent.*
Sulphate of soda	44.55	41.41	39.78
Water	54.98	54.79	59.66
Insoluble matter	.47	3.8	.56
Total	100.00	100.00	100.00

These lakes are the only ones from which soda is being taken for use.

The soda works near Laramie were built by the Union Pacific Railway, and leased to Mr. Howard Hinckley. The process used is the old "black ash," with stationary furnace. The capacity of the works is about 2 tons of sodium hydrate per day. The capacity of the furnace is 3½ tons of sodium sulphate per day. Re-screened coal from the Rock Spring mine is used, and the limestone necessary is obtained near Laramie. The "black balls" formed of the fused soda, coal, and lime, are broken up and washed in four lixiviating pans, and the liquor is then taken to two settling vats. Thence it is drawn to the "causticizer," which is a large circular tank, in which are two perforated vessels containing caustic lime, around which the solution of sodium carbonate is agitated. After the causticizing, the liquor is passed through three long circular iron settlers. The clear liquor is then drawn to the "V pan," where waste heat is used to aid the evaporation of the solution. The slightly concentrated liquor is then drawn to the "boat pan," which is set upon the reverberatory furnace. The evaporation is continued as long as possible, and the new concentrated solution is then drawn to another room, into the "finishing pot." This is a large cast-iron pot, set directly over a furnace. Here all remaining traces of water are driven off at a low red heat. The hydrate at this stage is generally nearly black. Small quantities of niter are added to the fused mass to whiten it. The hydrate is then ladled into sheet-iron vessels and shipped. Some of the Laramie caustic soda has been used by the Denver Soap Company, which reports favorable results from its use. The works at Laramie are not well adapted to the most economical handling of the soda. Improvements are now being made by which the number of men employed will be greatly reduced and the composition of the "black balls" made more uniform.

When the soda works were first begun it was supposed that the natural occurrence of the material as a sulphate, rendering unnecessary the reduction of the chloride to the form of a sulphate, would greatly decrease the ultimate cost of the caustic soda; but it was found that the very large quantity of water present in the soda as it comes from the lakes more than offset, by the trouble and delay it caused in the furnaces, the gain in the natural form of the soda.

The Laramie works produced from July to January, 1885, about 30 tons of caustic soda. Defects in the plant have caused great delay and loss of some of the caustic soda, and it has been decided to close the works until alterations now being made can be completed. The lessee of the works states that good reports of the caustic soda have been made by users of it.

The "Donney" soda lakes are situated about 18 miles southwest of Laramie, and are three in number, covering, approximately, with the land included, 520 acres. In one lake the deposit is 11 feet thick; in the others it is 5 to 6 feet. The soda from these lakes is similar to that from the Union Pacific lakes, and there seems to be an underground connection between the two groups. In boring an artesian well near these lakes to prospect the underlying strata a brine was obtained, which, upon analysis, showed—

Analysis of brine from near the Donney soda lakes.

	Grains per gallon.	Per cent.
Sodium chloride	2,002	2.86
Sodium sulphate	770.2	1.10

The large percentage of salt is very curious, as only traces of it are found in these lakes.

The soda deposits in Carbon county are situated in the Sweetwater valley, near Independence Rock, and nearly 50 miles due north of Rawlins. These deposits contain both carbonate and sulphate of soda, and are generally known as the "Dupont Lakes." The lakes are four in number, and vary from 6 to 2,000 acres in area, and are held by United States patents in the name of L. Dupont. There are five claims known as—

	Acres.
New York soda mine	160
Philadelphia soda mine	80
Omaha Soda mine	20
Wilmington soda mine	160
Wilkes Barre soda mine	20

The Omaha soda mine includes 20 acres, of which about 5 are covered with carbonate and sulphate of soda, mixed with a little chloride of sodium and sand blown in from the surrounding soil. Several bore holes were put down, and show an average thickness of about 6 feet.

Amount of carbonate of soda contained in the different samples.

No. 1, 3½ feet from surface ....per cent..	24.62
No. 2, surface ....do....	41.55
No. 3, surface near shore ....do....	32.42
No. 4, water ....pounds per gallon..	1½

A fused sample showed 52.23 per cent. of carbonate of soda. A fuller analysis of a sample taken from the surface showed:

Analysis of surface soda from Carbon county, Wyoming.

	Per cent.
Moisture	9.01
Insoluble	2.61
Sulphate of soda	25.75
Chloride of sodium	2.13
Carbonate of soda	30.62
Bicarbonate of soda	30.09
Total	100.21

Another sample from near the surface contained 56.3 per cent. of water.

Analysis of dry salt.

	Per cent.
Chloride of sodium	0.65
Sulphate of soda	69.29
Carbonate of soda	27.60
Insoluble matter	1.20

The variations and the proportion of sulphate and carbonate of soda are shown by the following table, the samples having been dried:

Samples.	Chloride of sodium.	Sulphate of sodium.	Carbonate of sodium.
	Per cent.	*Per cent.*	*Per cent.*
Five feet below surface	0.979	64.05	15.60
Five feet below surface	.32	65.08	16.70
Surface	.81	17.02	80.60

The Wilkes Barre claim is about one mile west of the Omaha, and the soda is in solution.

Samples of this solution showed by analysis:

	Carbonate of soda.
No. 1 ......grains per gallon	8,728
No. 2 ......do	4,905

The Wilmington claim is located one-quarter of a mile west of the Wilkes Barre, and covers 160 acres. The soda here is also in solution. Its depth has never been determined. It has been sounded with a 40-foot rope without finding bottom in the center. A sample of the solution contained 2,343 grains of carbonate of soda per gallon.

A sample which had crystallized out by cold, when dried, showed:

	Per cent.
Chloride of sodium	1.83
Sulphate of soda	39.04
Carbonate of soda	59.00
Insoluble matter	9.23

The New York and Philadelphia claims are both upon one lake, which is solid, and is 4 miles west of the Wilmington. Two bore holes have been put down in this lake. One, at a distance of 50 feet from the shore, showed 4 feet of soda; the other, at a distance of 230 feet from the shore, passed through 14 feet of solid soda without touching bottom.

Three samples taken from this lake showed as follows:

	No. 1.		No. 2.
	Per cent.	*Per cent.*	*Per cent.*
Chloride of sodium	1.83	2.04	2.52
Sulphate of soda	71.37	44.77	72.40
Carbonate of soda	3.10	5.00	5.10
Insoluble matter	22.82	47.50	19.03

Fifteen miles from these soda deposits, in the Seminoe mountains, good limestone occurs, containing 2 per cent. of magnesia. Near the limestone is a good 8-foot vein of coal.

A comparison of the analyses from the Donney and Union Pacific lakes, and those from the Dupont lakes, show how much greater the percentage of carbonate of soda in the latter is. The Sweetwater country is still out of the reach of transportation, and until a railway is built in this direction, these soda deposits must remain undeveloped. Great aid, in the way of analyses and reports, has been given by Mr. Howard Hinckley, of Laramie, Wyoming, and by Mr. Irving A. Stevans, of Wilkes Barre, Pennsylvania.

LIME.

The lime used in the glass works of the United States, in 1885, amounted to a total of 43,168 long tons, of which 10,594 tons were used as caustic lime, and 32,574 as limestone. Here again, as in the case of soda ash and salt cake, and, as a result of the change from ash to cake, the consumption of the cruder material, limestone, has largely increased since the census year.

The average value of the caustic lime used at the works was $5.94 a ton, the range of value from $3.11 to $18.66⅔; the average value of the limestone $4.31 a ton; the range of value from $1.21 to $7 a ton.

MANGANESE.

During the year 1885, there was considerable activity in searching for manganese deposits in the United States, and the output was largely increased over that of the preceding year. The statistics of this production are given in the article on manganese. But little manganese suitable for the use of the glass-makers has as yet been found in the United States. The supplies are imported chiefly from New Brunswick and Nova Scotia, and from Europe. Considerable manganese is produced in Chili and Russia, some of which is suitable for glass making.

OTHER MATERIALS.

The other materials for glass works do not call for special remarks.

The amounts used, the total average value per cent., and range of value per cent. are given in the table accompanying this report.

CONSUMPTION OF MATERIALS IN THE MANUFACTURE OF GLASS IN 1885.

In the following table will be found consolidated the statements received of the total amounts of the chief materials consumed in the manufacture of glass in the year 1885. The ton used is uniformly 2,240 pounds.

Under the previous headings most of these figures have been discussed. It is only necessary to say here that, with the exception of the writer's census report, this, so far as has been learned, is the first attempt to compile a statement regarding the materials used in the glass industry of the United States. It may be also proper to say here that the variations in the prices of these materials, the bulk of which is imported, is owing to the distance from the sea-board. The price of materials produced in this country varies with the nearness of the works to the source of supply and the cost of labor at the place at which they are produced.

Amounts and value of the chief materials used in glass making in the United States in the year 1885.

Materials.	Amounts.	Total value.	Average value, per unit.	Range of value, per unit.
Mixing sand ... long tons ..	221,543	$507,178	$2.28 +	$0.60 to $10.25
Grinding sand ... do ...	61,284	31,610	.51 +	.50 to 10.00
Soda ash ... do ...	60,050	2,052,758	34.18 +	27.00 to 45.33
Salt cake ... do ...	23,419	396,963	16.95 +	8 00 to 40.00
Nitrate of soda ... do ...	2,987	146,900	49.18	25.00 to 120.00
Common salt ... do ...	2,323	14,684	6.32 +	5.00 to 20.00
Lime, caustic ... do ...	10,594	62,993	5.94 +	3.11 to 18 66
Limestone ... do ...	32,574	140,497	4.31 +	1.21 to 7.00
Potash ... do ...	443½	50,480	113.82 +	110.00 to 140.00
Pearl ash ... do ..	15	1,750	116.66⅔	110.00 to 135.60
Red lead ... pounds ..	696,000	37,118	.05⅓ −	.05 to .06
Litharge ... do ...	2,081,240	112,794	.054 +	.05 to .05½
Arsenic ... do ...	1,105,973	35.772	.032 +	.02½ to .09½
Manganese ... do ...	293,850	16,589	.056 +	.03½ to .08¾
Fireclay ... long tons ..	17,794½	319,056	17.93 +	2.00 to 35.00
Clay pots ... number ..	5,085	200,631	39.45 +	25.75 to 50.00

IMPORTS AND EXPORTS OF GLASS.

In the two following tables will be found a statement of the imports and exports of glass and glassware into and from the United States. The exports cover the period since 1791. The imports date back to 1867. The variety of these exports is such that it is almost impossible to give the contents. The exports are what is chiefly known as glassware, that is, table-ware and similar articles. The imports of all grades, from the coarsest black bottle to the finest artistic ware, including tableware, looking-glasses, bottles, and colored glass, were:

Glass and glassware of domestic production exported from the United States.

Fiscal years ending September 30, until 1842, and June 30 since—	Value.	Fiscal years ending June 30—	Value.
1791	$10	1856	$216, 439
1826	44, 557	1857	179, 900
1827	59, 307	1858	214, 608
1828	51, 452	1859	252, 316
1829	49, 900	1860	277, 948
1830	60, 280	1861	394, 731
1831	102, 736	1862	523, 906
1832	106, 855	1863	998, 569
1833	93, 494	1864	793, 650
1834	79, 229	1865	1, 268, 533
1835	79, 808	1866	621, 391
1836	46, 877	1867	654, 689
1837	44, 950	1868	609, 708
1838	37, 881	1869	580, 718
1839	43, 448	1870	530, 654
1840	56, 688	1871	466, 447
1841	43, 095	1872	547, 112
1842	36, 748	1873	627, 562
1843 (a)	25, 348	1874	731, 827
1844	77, 860	1875	691, 310
1845	98, 760	1876	628, 121
1846	90, 860	1877	658, 061
1847	71, 155	1878	869, 682
1848	76, 007	1879	768, 644
1849	101, 419	1880	749, 866
1850	136, 682	1881	756, 022
1851	185, 436	1882	864, 235
1852	194, 634	1883	996, 857
1853	170, 561	1884	839, 756
1854	229, 382	1885	783, 915
1855	204, 679		

a Nine months.

Glass, and manufactures of, imported and entered for consumption in the United States, 1867 to 1885, inclusive.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1867	$3, 744, 557	1877	$3, 952, 751
1868	3, 111, 232	1878	3, 331, 980
1869	3, 985, 686	1879	3, 281, 453
1870	4, 086, 329	1880	5, 133, 285
1871	4, 450, 725	1881	5, 862, 270
1872	6, 776, 951	1882	6, 753, 537
1873	6, 945, 982	1883	7, 597, 897
1874	5, 447, 355	1884	7, 553, 185
1875	5, 756, 706	1885	6, 340, 721
1876	4, 804, 544		

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* For entire list of mineral springs see Bulletin No 32.

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