

DEPARTMENT OF THE INTERIOR,
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Appointed November 4, 1881. Office of Superintendent
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REPORT

ON THE

MINING INDUSTRIES OF THE UNITED STATES

(EXCLUSIVE OF THE PRECIOUS METALS),

WITH SPECIAL INVESTIGATIONS

INTO THE

IRON RESOURCES OF THE REPUBLIC

AND INTO THE

CRETACEOUS COALS OF THE NORTHWEST.

BY

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SPECIAL AGENT.



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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, July 13, 1886.

Hon. L. Q. C. LAMAR,
Secretary of the Interior.

SIR: I have the honor to transmit herewith the report on the mining industries of the United States (exclusive of the precious metals) by Professor Raphael Pumpelly, of Newport, Rhode Island, chief special agent. This report forms the fifteenth volume of the series constituting the final report on the Tenth Census.

I have the honor to be, very respectfully, your obedient servant,

JAMES H. WARDLE,
Chief of Census Division.

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Notes on the samples of iron ore collected in Virginia—Continued.

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Notes on the samples of iron ore collected in East Tennessee—Continued.

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Notes on the samples of iron ore collected in Georgia. By Bailey Willis.....367-378

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DIRECTORY OF BITUMINOUS COAL MINES.—Alabama (866), Arkansas (866), California (867), Colorado (867), Georgia (868), Illinois (868), Indiana (880), Iowa (885), Kansas (890), Kentucky (893), Maryland (895), Michigan (896), Missouri (896), Montana territory (899), Nebraska (899), North Carolina (899), Ohio (899), Oregon (911), Pennsylvania (912), Tennessee (926), Virginia (927), Washington territory (927), West Virginia (927), Wyoming territory (930).	
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DIRECTORY OF COPPER MINES (977).	
DIRECTORY OF LEAD AND ZINC MINES (978).	
DIRECTORY OF SMELTING AND REDUCTION WORKS (981).	
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LETTER OF TRANSMITTAL.

NEWPORT, R. I., *June 15, 1884.*

Hon. CHAS. W. SEATON,

Superintendent of Census.

SIR: I have the honor to submit herewith the result of the statistical and special investigations into the mining industries of the United States (exclusive of the precious metals), with which I was charged.

I have the honor to be, sir, your obedient servant,

RAPHAEL PUMPELLY,

Special Agent.

INTRODUCTORY REMARKS.

In 1879 my division of the United States Geological Survey was detailed by Hon. Clarence King, the Director, to act as special agents of the Census Office. The work intrusted to me—collecting and discussing the statistics of the mining industries of the United States exclusive of the precious metals—promised to be one of unusual interest, and capable of being made of great benefit to the political economy of the country. The act authorizing the Tenth Census provided for special investigations separately of the great factors of the economy of the nation. It was essential to the success of the plan that the fundamental questions, about 30 in number, should be put in a strictly uniform manner, and that the answers should have as nearly as possible a uniform value. It was found to be impossible to accomplish this either through the regular enumerators of the Census Office or by correspondence alone.

In the absence of even the most elementary list of establishments it became necessary, in order to obtain a complete representation, to have each district canvassed by special agents, who were generally more or less acquainted with the region and with the local mining industries. These personal interviews with the managers of the establishments, supplemented by correspondence from the central office, succeeded in obtaining a uniform result. Schedules of questions were prepared, under my direction, adapted to the various branches of mining and metallurgy, and containing a large number of questions capable of being understood by the mining community, and to most of which the answers could be summed up to totals for the whole country.

Although the questions asked varied according to the branch of the industry, the most important of those intended to foot with totals are contained in the following scheme: a

QUESTIONS OF LOCALITY.	
State.	Total employés.
County.	Miners.
Number of mines.	Laborers.
	Administrative force.
	Number of horses, mules, and oxen.
	Number and horse-power of steam-engines.
	Value of all machinery.
	Value of explosives.
	Cords of wood used for fuel.
	Value of wood.
	Timber (linear feet) used.
	Value of timber.
	Sawed lumber (board measure) used.
	Value of lumber.
	QUESTIONS RELATING TO CAPITAL.
	Amount of working capital.
	Value of plant.
	Value of real estate.
	Total capital.

In additions to the above questions, to which answers were required from all establishments, there were asked a large number of other questions, the answers to which, from a considerable number of establishments, would give the necessary data for estimating the totals for the whole industry.

The following gentlemen were appointed special agents of the census to collect these statistics: In the eastern district of Pennsylvania, Mr. Charles Allen, Harrisburg, Pennsylvania. In Huntington, Bedford, Clearfield, and Potter counties, Pennsylvania, Mr. C. B. Finley, Huntington, Pennsylvania. In Cambria, Blair, Indiana, and Somerset counties, Pennsylvania, Mr. Walter Fellows, Johnstown, Pennsylvania. In the western district of Pennsylvania—comprising the rest of the state—Mr. Edward B. Alsop, Pittsburgh, Pennsylvania. In Ohio, President Edward Orton, of the University of Ohio, Columbus, Ohio, assisted by Professors N. W. Lord and A. G. Wetherby, and Messrs. Andrew Roy, Edward Hyatt, and Edward Orton, jr., all of Columbus, Ohio. In northern Illinois and Iowa, Mr. W. L. Fawcett, Chicago, Illinois. In southern Illinois and Missouri—excluding the coal-fields of Missouri—

a Professor W. B. Potter, of Washington University, Saint Louis, Missouri. In Alabama, Professor Eugene A. Smith, of the University of Alabama, Tuscaloosa, Alabama. In Maryland, Dr. L. B. Hall, of Johns Hopkins University, Baltimore, Maryland. In Georgia, Dr. George A. Little, Atlanta, Georgia. In Tennessee, Mr. J. G. Cantrell, Nashville, Tennessee. In Kentucky, Mr. John R. Proctor, Frankfort, Kentucky. In North Carolina, Professor John C. Kerr, Raleigh, North Carolina. In Indiana, Colonel Ensign Bennett, Indianapolis, Indiana. In Maine and Vermont, Professor N. S. Shaler, of Harvard University, Cambridge, Massachusetts, with Messrs. J. B. Wolff and J. M. Wilson, assistants. In New York, New Jersey, Massachusetts, and Connecticut, Professor John C. Smock, of Rutgers College, New Brunswick, New Jersey. In Virginia and West Virginia, Mr. Jed. Hotchkiss, of Staunton, Virginia. In Michigan, Mr. George A. Fay, of Marquette, Michigan. In Wisconsin, Professor T. C. Chamberlin, assisted by Mr. James Wilson, jr., of Beloit, Wisconsin.

b These gentlemen carried out the duty assigned them of visiting the mines in their respective districts, either in person or by deputy, and of filling the schedules from inquiries made on the spot, with zeal and intelligence.

In that part of the mineral-producing field not assigned to any of the above gentlemen, viz, the coal-fields of Missouri, Kansas, Arkansas, and Texas, the mineral statistics were gathered, on the blank prepared by the Census Office, by the regular civil enumerators and forwarded to this office for tabulation. In the part of the country west of the 100th meridian the schedules of the non-precious minerals heretofore enumerated were collected by the western divisions of the United States Geological Survey, and the schedules, when regarded as complete, were sent to this office to be tabulated. It will therefore be seen that the duties of this office with regard to the statistics of mining were very different in different parts of the country, and, further, that the statistics were collected on blanks of different form. The lack of uniformity in this respect added greatly to the labor of tabulation.

c When the work as originally commissioned was well under way, this office undertook the additional duty of gathering the statistics of the minor mineral production. As many of the special agents had canvassed their respective districts before it was understood that the work was to be thus extended, there was no alternative but to attempt to gather the additional material through the very unsatisfactory medium of correspondence. Many of these substances are produced in out-of-the-way localities and in small quantities. Their importance is rapidly increasing, and an effort has been made to gather the statistics of them as fully as possible, if for no other purpose than to make a basis for subsequent censuses.

The "minor minerals" were supposed to include asbestos, asphaltum, barytes, chromic iron ore, cobalt, corundum, garnet, graphite, glass-sand, hydraulic cement and hydraulic lime, infusorial earth, kaolin, manganese, magnesian limestone, mica, nickel, ocher, oil-stones, pyrite, quartz, feldspar, scythestone, whetstone, and soapstone.

d It was understood that the production of the following minerals was excluded from the consideration of this office: The precious metals and quicksilver, petroleum, potter's clay, fire clay, building stone, paving stone, brick clay, molding sand, salt, gypsum, phosphates, and all fertilizing material. The production of grindstones was also necessarily excluded, since they are made in quarries whose chief product is building and flag stones.

In accordance with the broad, general plan of the census it was decided, with the sanction of the Superintendent of the Census, that in addition to the general statistical canvass of the mining industries, especial attention should be devoted to the iron-ore industry. And this special investigation was accorded to the iron-ore industry because of the varied composition of the ores, and the relation of this variation to the several special processes of manufacture of iron and steel; because of the commercial relation existing between the quality of the ores and their position with reference to distance and means of transportation to consuming centers; because the capacity of the different ore-fields is unknown, and, finally, because of the bearing of all these factors, considering the entire country, upon the relation of a great fundamental industry to foreign competition and to numerous questions in political economy.

The investigation of the iron ores was directed to determining—

1. Their classification.
2. The distribution, geographically and geologically, of the different varieties.
3. The manner of occurrence of the different varieties.
4. The chemical character of the different varieties down to the products of each mine.

This special study required an expert survey in detail of all the mining districts and known undeveloped iron-ore deposits of the country. The experts, Messrs. Bailey Willis, Bayard T. Putnam, William Chauvenet, Edward R. Benton, visited every mining district and, excepting the carbonate districts of Pennsylvania, Ohio, and West Virginia, almost every mine and known deposit in the United States and territories. After the necessary study of the mode of occurrence of the ore and of the extent of selection in mining in each mine, careful differential samples were taken of each variety of the ore in order to determine the influence of the separate varieties in each mine upon the metallurgical character of the whole output. These were commercial samples, from the mines and from the stock-piles, each sample consisting of ten to twenty pounds of small chippings.^(a) These samples accompanied by hand-specimens of the different varieties making up each sample, were forwarded to the Newport office. Altogether there were collected nearly fourteen hundred samples.

^a This method, which has been found by numerous control tests to give in careful hands excellent results, was, I believe, first proposed and used by Major T. B. Brooks in the geological survey of the iron-ore districts of Michigan, and subsequently by the writer in the geological survey of Missouri.

The original intention was to extend the chemical study of each sample to the determination of all points of a metallurgical importance, making complete analyses of the soluble and insoluble constituents in all cases where it seemed desirable to do so. But early exhaustion of the census appropriations necessitated an extensive curtailment of the plan, and the complete analyses were confined chiefly to the more important ores of the Archæan, and the partial analyses largely to the determination of iron, phosphorus, and sulphur, and generally to noting incidentally the presence of titanium and manganese. One departure from the usual custom needs perhaps to be explained here. It is usual to give the amount of phosphorus, as of all other constituents, only in percentage of the ore; but since a knowledge of the amount of this element present in an ore is of vital importance in regard to steel manufacture, and since it becomes practically all concentrated in the pig, it was thought desirable to give also the phosphorus (phosphorus-iron) ratio (*i. e.* per cent. of phosphorus divided by per cent. of iron). This has been calculated throughout and given with each analysis. It shows the amount of phosphorus in 100 parts of the iron contained in the ore; and as this impurity is practically wholly concentrated in the pig the phosphorus ratio shows the per cent. of phosphorus that would be contained in the pure iron (*i. e.*, the pig free from carbon, silica, etc.) were the ore smelted with pure fluxes without intermixture with other ores. As a matter of fact, since the pig contains only about 95 per cent. iron, the ratios given multiplied by 0.95 will give a closer approximation to the amount of phosphorus in the pig.

In all there were made 93 complete and 1,157 partial analyses, embracing over 4,400 determinations. Although the work was thus curtailed the complete set of the powdered samples and the full collection of the hand-specimens are preserved in the National Museum.

To partially cover the incompleated part of our own work, I am able, through the courtesy of Professor Lesley, to give a large number of analyses, by Mr. Andrew S. McCreath, of those ores of Pennsylvania not analyzed by ourselves. Mr. McCreath very kindly selected the analyses representing samples taken to express averages.

The following table will show the number of samples collected in each state:

Total number of samples, 1,377, apportioned as follows:

Alabama	77	New York	156
British Columbia	1	North Carolina	67
California	4	Ohio	93
Colorado	32	Oregon	3
Connecticut	18	Pennsylvania	133
Delaware	4	Rhode Island	1
Georgia	61	South Carolina	5
Kentucky	34	Tennessee	148
Maine	3	Utah	28
Maryland	48	Vermont	10
Massachusetts	11	Virginia	100
Michigan	136	Washington territory	1
Minnesota	8	West Virginia	19
Missouri	49	Wisconsin	12
Nevada	1	Wyoming territory	2
New Hampshire	1		
New Jersey	109	Total	1,377
New Mexico	2		

Of these samples there were analyzed the aggregate numbers set down opposite the names of the respective districts in the following table:

	Par- tials.	Com- plete.	Total.		Par- tials.	Com- plete.	Total.		Par- tials.	Com- plete.	Total.
Alabama	71	6	77	Minnesota	8		8	South Carolina	5		5
British Columbia	1		1	Missouri	44	5	49	Tennessee	133	15	148
California	4		4	Nevada	1		1	Utah	28		28
Colorado	32		32	New Hampshire	1		1	Vermont	9	1	10
Connecticut	17	1	18	New Jersey	104	5	109	Virginia	88	12	100
Delaware	4		4	New Mexico	2		2	Washington territory	1		1
Georgia	43	4	47	New York	151	5	156	West Virginia	15		15
Kentucky	33	1	34	North Carolina	58	9	67	Wisconsin	10	2	12
Maine	2	1	3	Ohio	93		93	Wyoming territory	2		2
Maryland	48		48	Oregon	3		3				
Massachusetts	11		11	Pennsylvania	24		24	Total	1,157	93	1,250
Michigan	110	26	136	Rhode Island	1		1				

This special survey presents undoubtedly a very truthful picture of the iron resources of the country, and the tables and graphic plates, respectively, which are the combined result of the investigation of the ores and of the statistical canvass, show how perfectly the two methods supplement each other. The chemical work was carried out by Mr. A. A. Blair, assisted by Mr. F. A. Gooch, Captain John Pitman, United States Ordnance, Mr. J. F. White, Mr. Edward Whitfield, Mr. W. T. Richmond, and Mr. Charles F. King.

a The statistical work of my department was begun with an absence of definite instruction, and of special knowledge or experience in the art of gathering statistics, and was therefore necessarily tentative throughout its entire course. Much ground had to be gone over twice at an increase of time and labor, and no one can appreciate more fully than I do the incompleteness of the result. The following suggestions are made in the hope that they may save our successors in 1890 some of the annoyances to which our lack of experience subjected us.

GENERAL SCOPE OF THE INQUIRY.

b Taking it for granted that the primary object of the United States Census is economic information, and that the technical investigation of the mining industries is to be strictly subordinated to that object, the following points would seem to be the ones which should be regarded as essential. The schedule should be so framed as to make the leading question under each head prominent and distinct, and answers to them should be insisted on in all cases:

1. The number of mines, or separate "industrial establishments".
2. The location of each and name of manager.
3. The product for the census year.
4. The value of the product at the mine when ready for delivery.
5. The average number of hands employed.
6. The amount paid yearly in wages.
7. The number of months run.
8. The value of the material or mine supplies consumed annually.
9. The number and horse-power of steam-engines in use.
10. The value of the machines used.
11. The value of the fixed and floating capital.

Each of these heads can be so subdivided that the answers will furnish all the economic features of the industry. The subdivisions could be carried so far as to furnish full technical information in addition, but it must be remembered that the schedule must be adapted to mines under many different conditions, and that it must be framed with regard to ready and accurate tabulation. The danger in a multiplicity of questions—as our experience plainly showed—lies in the fact that many will be unanswered, and the important ones will probably be among them. If special information is desired, either geological, mechanical, technical, or social, it can be best obtained from well-developed and established mines. It should form the subject of a special report, and its value will depend on the zeal and sagacity of the agent. It may be observed in passing that no schedule can be framed containing more than ten questions which will not be erroneously filled up in a majority of cases if left to the manager of the mine; not so much from reluctance or carelessness as from the fact that the scope and meaning of questions will be interpreted differently by different persons. The value of the statistics following depends upon the fact not only that the industries have been more thoroughly canvassed than ever before, but that the questions have been asked and the answers written down by agents who comprehended the general bearing of the inquiry.

Our experience suggests the following remarks on the schedule of questions best adapted to gather the statistics of the mining industries, and applicable to all mines.

c

MEANING OF THE TERM "ESTABLISHMENT OF INDUSTRY".

The census tabulation is limited to mines which have been productive during the census year; for, though mines which have been abandoned and which would have a value if reopened, and mines which have been recently opened but have not marketed their product during the census year, are both part of the sum total of our mineral property, an attempt to include them would involve the danger of dealing with speculative and unreal values, a danger which can not be too carefully avoided. It is evident that the enumeration of producing mines at any given time must include some which have been recently opened and some which are about to die, and must therefore bring in as much of the growth and decay of the individual units of the industry as is necessary to a true presentation of its condition.

The question what constitutes a mine or "establishment of industry"—the unit of the Census—is not always easily settled. The definition of the mine engineer, of the mining company, and of the political economist would be very likely to be based on different discriminations. No one would think of calling the Calumet and Hecla openings two mines, although they are in reality two separate industrial establishments under one general head, nor of calling the sixty-five collieries of the Reading Coal and Iron Company one industrial establishment, although they are united in ownership and under the same supervision. The gatherer of statistics is obliged to accept the mercantile definition of the place. The term "establishment of industry", as used in these tables, may be taken to mean a mining operation the accounts of which are separate and the product of which is not mingled with that of any other before it is shipped, though at the same time it may consist of numerous distinct mine openings. We

are obliged to accept the statistics as they are kept by the operators, although so doing may disguise the extent to which the ownership of our mineral resources is becoming concentrated in a few hands. That fact could of course be shown by an analysis of the returns. The "establishments" number 4,520, and their individual annual product varies from \$200 to over \$4,000,000.

THE LOCATION OF THE ESTABLISHMENTS.

If a complete and exhaustive list of mines could have been obtained in advance, the labor of collecting statistics would have been very much simplified. No such list existed in any state at the beginning of the census work, except, perhaps, in the iron and copper district of Michigan. The agents were obliged to supplement their own knowledge by inquiries of those best informed. The difficulty of obtaining a list of the producers of minor minerals in so large a country as the United States was increased by the fact that they are generally mined in remote localities and in small quantities. It is possible that the system of state inspection of coal mines may hereafter be so perfected as to supply all that may be desired for that industry in this respect. We have included in our publications a list of the names and addresses of all mine operators that we have reached, believing that such a list, though necessarily growing more imperfect each year, would be valuable in many ways, and especially so in furnishing a starting point for compiling a preliminary list for the next census. It will also serve to test the thoroughness of the present canvass.

THE TONNAGE OF THE PRODUCT.

c

The yearly product is taken from the books of the producers in by far the greater number of cases. The following comparisons with independent sources will substantiate the claim to as great accuracy and completeness as the nature of the work admits. Mr. Swank, in his report on the iron and steel industries, returns 7,709,706 tons as the amount of iron ore reduced in furnaces, etc., in the United States during the census year. If we add to the total amount mined the amount imported—439,451 tons—we have a grand total of 8,414,257 tons as the available ore "brought into sight" in the country during the same period. The difference—704,551 tons—is explained by the loss on handling, estimated at not far from 2 per cent., and by the fact that in consequence of the scarcity and high price of ore in the spring of 1879 the stocks on hand were brought down to the lowest point. The year was marked by great activity in iron mining, many new mines were opened, and the stock on hand in the spring of 1880 was much greater than that on hand at mines and furnaces a year earlier.

The total of the production of anthracite given in the following tables for Pennsylvania reaches 28,640,819 net tons. The reports of the *Inspectors of Mines* of Pennsylvania for 1879 give 26,142,689 gross (=29,279,801 net) tons, and for 1880, 23,437,242 gross (=26,249,711 net) tons as the annual production of anthracite coal. Although a large proportion of these last is apparently estimate, it affords confirmation of their accuracy that our total for a period which covers part of both years falls between them. The same reports afford confirmation of the fullness of our returns of the tonnage of bituminous coal, the two figures being 18,837,962 net tons, as given by the inspectors and, including the irregular product, 18,425,163 net tons for the year terminating seven months earlier, as given by the census. No more perfect agreement could be desired in view of the fact that the annual increase of production in that state is 6 per cent., nor would a more perfect agreement afford more convincing proof of substantial accuracy.

There is a class of small producers, principally of bituminous coal and iron ore, which from the strict economic standpoint should be kept distinct. It consists of farmers who having an outcrop of coal or a bed of soft ore on their land, do a little irregular surface-work during the fine weather of the winter or in the interval between seed-time and harvest. The coal produced in this manner is used for a local domestic fuel, and does not find its way into the general market. There are over 5,000 of these small producers, principally in the states of Pennsylvania, Ohio, Kentucky, and West Virginia, and their entire product amounts to less than three-quarters of a million of tons. As no capital is employed and but very little labor hired, this mining cannot be said to have any influence on the industry at large. The arbitrary rule to exclude from consideration any establishment not producing yearly as much as \$500 worth for sale would cause this local gathering of fuel to be overlooked entirely. Iron ore raised in this small way is sold to some neighboring blast-furnace, and goes to swell the general product of manufactured iron. It amounted during the census year to 909,977 tons, but involved the employment of very little capital or hired labor. The product is cheap and low-grade ore, and the industry is entirely distinct from underground mining by a well-organized establishment.

A great part of the lead mining of the northwestern district—Iowa, Illinois, and Wisconsin—is of this same irregular and desultory character, so much so that it proved impossible to obtain returns of all the lead ore produced there from the miners themselves. Mining there consists of prospecting. The ore is found in irregular deposits and sold to smelters. As soon as the deposit is exhausted, which may occur a few days after it is found, the pit is abandoned, and the two or three miners working on a royalty in partnership go elsewhere. The ore-

a smelters' accounts of purchases are, therefore, in these states, the only source from which the total product of lead and zinc can be obtained. They were very thoroughly and energetically canvassed by Mr. George H. Eldridge, from this office, and in estimating the lead- and zinc-ore product are to be taken in preference to the miners' returns.

The copper returned in the mining tables should be slightly increased in order to arrive at the entire production of that metal, as a small quantity reaches the market as a by-product in the mining of the precious metals. Lead, also, is very generally associated with silver and shipped in the form of base bullion. This portion of the product does not appear in our returns of lead mines.

In some cases the mining industry is restricted to mining, pure and simple; in others, a certain amount of labor is expended in preparation for market. Thus the anthracite mines are invariably connected with a "breaker" or building in which the coal is reduced to uniform size. The Lake Superior copper mines crush and wash the rock they mine, in order to send to the smelting establishments material containing as high a percentage of metal as possible, and some producers of iron ore roast or calcine it before delivery. Where these operations are so interwoven with the business of mining as to be inseparable, they are taken to constitute a part of the mining industry; where they are separable or conducted at a distance, they are regarded as a part of the business of reduction or manufacturing, the statistics of which were compiled by other hands. Our aim has been to draw the line rigidly at mining statistics, lest we might duplicate items of capital or labor which appeared in the summation of other branches of industry. The statistics of smelting establishments given in this report are independent of mining operations.

VALUE PER TON OF THE PRODUCT.

c It follows, therefore, that the value of the mining product is taken at the pit's mouth, or rather at the point where the labor reported ceases to act on it, where it is delivered for transportation to a new owner. This accounts for the low average price returned, at least in the case of coal and iron ore, which are more than doubled in price before they reach the consumer.

LABOR AND WAGES.

The accurate determination of the number of men supported by any industry furnishes the most trustworthy criterion of its relative importance. The number of boys under sixteen years of age employed has always been made the basis of a question on the schedule, which should contain also a general inquiry into the system of labor. In most branches of non-precious mineral production the underground force is paid by the ton of product, and not by the day, and furnishes at its own cost a considerable amount of material, as powder, fuze, etc., which on the pay-roll may appear as wages instead of mine supplies. Care has been taken to guard against this error, and to include under the head of wages remuneration for labor only. Steadiness of employment is also an important factor in the labor question, and we have, therefore, endeavored to ascertain the number of days of enforced and voluntary idleness as well as the net pay received. How irregular the periods of employment are in the mining industry may be seen from the following comparative table for the census year of 1880:

Kind of mining industry.	Average per cent. of year worked.	Average per cent. of year lost in strikes.	Average per cent. of year lost from other causes.
Anthracite coal.....	70.68	0.72	28.00
Bituminous coal.....	75.70	6.68	17.62
Iron ore.....	77.55	0.02	22.43
Copper.....	100.00	0.00	0.00

e

The column headed "Average per cent. of year lost from other causes" does not include the time lost by reason of holidays, temporary inability on the part of the individual, etc., but only the time lost by the suspension of mining operations from overproduction, lack of means of transportation, etc.

MATERIALS CONSUMED.

f This is of course not as important a question in the mining industry as it is in those which operate on raw material. Mine supplies consist of powder, fuze, timber, lumber, fuel, feed for animals, machine extras, wire cables, rails, etc. The inquiry under this head should be itemized as far as possible.

CAPITAL EMPLOYED.

This is the subject on which questions are most likely to be resented and the answers misleading or based on erroneous conceptions. If the question is simply, How much capital is employed in your business? it may be considered an inquiry into a strictly private matter; the answer may refer to what would remain after the debts were paid; or some such unsubstantial thing as "the good will of the business" may be included. In case the

producer is an incorporated company, the answer will be the amount of share capital at par, which is carried as an **a** indebtedness on the books. In nearly every case it will be an estimate in round numbers of something which may or may not be the subject-matter of the inquiry. What the present investigation has sought to ascertain is, the value of the mineral property of the country as a producer of actual values, that it might be ranked with the other great divisions of productive energy with regard to its real importance. From this point of view the question of ownership and indebtedness, which occupies the most important place in the mind of the operator, may be disregarded. If the mine is worked on a royalty the operator would naturally omit the real estate in estimating his assets, whereas it is in reality the most important part of mining capital. The questions should therefore be framed with a view to ascertaining the value of the entire mining establishment, and not merely the mercantile capital of the lessee. They were: What is the value of the mineral real estate attached to the mine? What is the value of the plant? and how much is usually employed as working capital? The second question should perhaps **b** have been divided into: What is the value of the fixed plant; and what is the value of the movable plant and equipment? The third question covers an item of mineral property which might be overlooked; that is, the product on hand or in transit which has been paid for out of the floating capital, and the receipts for which are deferred in the ordinary course of business.

The result of this form of inquiry has been to increase very greatly the amount returned as "capital of the mining establishments", without including anything of a speculative or artificial value, nor the great body of mineral-producing land which is not productive at present, and is in reality the property of the next generation.

POWER AND MACHINERY.

c

The question of labor is closely connected with that of labor-saving machinery, and no intelligent analysis of the one can be made which does not take into account the increasing effect of the other. At the same time, to complicate the schedule, which must be applicable to all classes of mines, with technical questions on machinery, will not result in any definite information, and is very likely to weaken it as a register of economic statistics. Such information can be gathered only by a special study of typical mines, and can be conveyed only through the medium of detailed descriptions and drawings. The number, value, and horse-power of the engines, and the value of the machinery, can be gathered on the statistical blank and entered in the final tables. The agent can, of course, enter on a separate note-book matter for a report on any technical features.

The question of movement of mineral product, final destination, freight-rates, etc., can be investigated through the returns of transportation companies. Such information is not generally to be obtained from the managers of **d** mines who have nothing to do with the product after it is shipped.

In conclusion, we wish to express our obligations to mine managers and owners. We have received returns from 4,520 regular establishments and more than 6,000 small producers. Information has been rudely refused in two cases only, and withheld from narrow views of the utility of statistics in two or three more. In such cases we have made no attempt at legal coercion, but have obtained the information as best we could from other sources. Had the census year coincided with the calendar year ending December 31, the labor of gathering the statistics would have been very much simplified.

The manuscript of this volume, excepting the portion relating to the Cretaceous coals of the northwest, and some discussions left to be added to the proof, was forwarded to the Superintendent of the Census in 1882. The lateness of its publication is due to the limited means at the disposal of the Bureau. Since the completion of the main **e** body of the volume there was carried out, under the direction of the writer, and for the Northern Transcontinental Survey, an extensive and systematic exploration of the Cretaceous coal-fields of the territories of Montana and Washington, as well as of part of the lignite-bearing fields of Dakota. At the time of the suspension of this survey the results of this exploration were undigested and unplatted. To avoid the loss of results that had cost over \$100,000, the writer had the topographical work platted and the coals analyzed largely at his own cost, but partly also through the generous co-operation of the members of the survey in whose provinces the work naturally belonged. It seemed, therefore, eminently proper that these results should be contributed to the census. It remains to be added, that, with the exception of the topography, this work on the Cretaceous coals was executed by gentlemen who were special agents under me in the census work proper—Messrs. Eldridge, Willis, Putnam, and Wolff in the field work, and Dr. F. A. Gooch in the laboratory. To Mr., now Professor, Charles F. Johnson, jr., much of the **f** success is due, both in planning and executing the statistical canvass; and many of the tables of analyses and of comparison with the Census of 1870, as well as the discussions of those tables, were planned and calculated by him. The tabulation of the returns and the very voluminous correspondence needed to perfect the schedules was done by Mr. T. Nelson Dale, to whose care and tact much more of the successful result than appears on the surface is due. In addition to the large and valuable portion of the samplers' notes, in the part relating to iron ores, contributed by Mr. Bayard T. Putnam, nearly the whole work of editing has been executed by him.

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a TABLE 1.—Condensed statement of mineral production of regular mining establishments for the United States, by substances.

1880.	Number of states and territories.	Number of countries.	Number of establishments.	Tons of 2,000 pounds produced during census year 1880.	Value of product.	Value of materials consumed.	Men employed.	Boys employed.	Total hands employed.	Wages paid.	Number of steam-engines.	Horse-power of steam-engines.	Value of all machinery, including engines.	Capital employed and invested.
Bituminous coal and lignite (a).	24	385	2,089	41,850,054	\$52,427,868	\$4,860,493	93,817	6,269	100,116	\$32,601,500	855	26,168	\$2,668,801	\$103,109,867
Anthracite coal.....	3	11	277	28,021,371	42,130,740	6,732,502	54,616	16,132	70,748	22,693,407	1,667	105,897	13,908,415	154,504,330
Iron ore.....	23	160	805	7,064,829	20,470,756	2,894,011	30,080	1,588	31,668	9,538,117	821	24,838	3,211,548	61,782,287
Copper ore.....	10	10	28	603,101	8,832,886	1,381,334	5,745	270	6,015	3,077,403	129	13,276	2,022,800	31,570,056
Lead and zinc ore.....	10	29	206	177,003	3,837,761	331,070	7,323	160	7,483	2,640,205	167	6,739	476,295	7,442,983
Minor minerals.....	21	83	180	.....	3,387,444	625,347	4,026	176	4,202	1,305,222	86	5,058	.....	6,262,315
Total.....	.....	628	4,404	.....	131,006,405	16,825,747	105,607	24,625	220,232	71,855,014	3,725	181,880	22,887,910	304,672,684

a Inclusive of semi-anthracite from Pennsylvania but exclusive of Utah lignite, as the statistics from this territory did not reach office until after table was made.

c TABLE 2.—Averages applicable to mineral products, from regular establishments, from Census of 1870 and 1880, in the United States.

Kind of mineral product.	Value of machinery per ton raised, 1880.	Value of machinery per dollar of product, 1880.	Tons raised per horse-power of engines, 1880.	Tons raised per horse-power of engines, 1870.	Value produced per horse-power of engines, 1880.	Value produced per horse-power of engines, 1870.	Materials used per ton, 1880.	Materials used per ton, 1870.	Wages paid per ton, 1880.	Wages paid per ton, 1870.	Value produced per hand per year, 1880.	Value produced per hand per year, 1870.	Tons raised per hand per year, 1880.	Tons raised per hand per year, 1870.	Wages paid per hand per year, 1880.	Wages paid per hand per year, 1870.	Per cent. of value of product paid for labor, 1880.	Per cent. of value of product paid for labor, 1870.	Per cent. of value of product paid for materials, 1880.	Per cent. of value of product paid for materials, 1870.	Capital necessary for dollar of product, 1880.	Capital necessary for dollar of product, 1870.	Value of product per ton, 1880.	Value of product per ton, 1870.	Number of boys to 100 men, 1880.	Number of boys to 100 men, 1870.
Anthracite coal.....	\$0 40	\$0 33	271	357	\$398	\$370	\$0 24	\$0 23	\$0 70	\$1 47	\$072	\$703	450	323	\$362	\$474	54.0	60.0	16.0	9.0	\$3 06	\$1 93	\$1 47	\$2 46	30.0	20.0
Bituminous coal.....	00	05	1,590	920	2,003	1,894	12	19	80	1 24	541	852	431	418	336	510	62.0	61.0	9.3	9.4	1 90	1 08	1 25	2 04	6.7	12.8
Iron ore.....	45	16	284	306	824	1,542	41	38	1 85	2 01	663	880	220	229	300	400	46.6	51.7	14.0	9.7	3 01	1 34	2 00	3 89	5.3	12.3
Copper ore.....	2 64	30	74	111	665	823	1 39	84	3 09	3 88	1,592	978	169	139	523	509	30.6	52.0	15.6	11.2	3 58	1 50	8 89	7 87	4.7	3.3
Lead and zinc ore.....	2 00	1 20	20	.....	569	215	1 87	.....	14 91	.....	518	904	24	.....	356	356	68.8	59.4	8.6	5.2	1 93	1 08	21 08	.....	2 2	3.2

TABLE 3.—Percentages of gain in the factors of the mining industries (regular establishments) since the Census of 1870, in the United States.

Kind of product.	Increase in number of men employed.	Increase in number of boys employed.	Increase in total employes.	Increase in value of entire product.	Increase in tonnage of product.	Increase in value of materials used.	Decrease in yearly wages paid per hand.	Increase in total wages paid.	Increase in total capital.	Increase in horse-power of engines.	Change in value of yearly product per hand.	Increase in tonnage raised yearly per hand.	Change in per cent. of value of product paid for labor.	Change in per cent. of value of product paid for materials.	Change in price per ton of product.
Anthracite coal.....	24.0	77.0	33.2	9.4	82.7	86.0	23.6	b 1.4	202.8	116.6	b 15.2	41.1	b 10.00	a 77.77	b 40.24
Bituminous coal.....	131.3	408.5	116.3	49.6	143.3	134.0	35.2	53.0	74.7	95.8	b 36.5	3.1	a 1.80	b 1.06	b 38.72
Iron ore.....	105.0	343.5	110.8	55.0	103.0	126.1	32.8	39.4	247.6	189.4	b 25.4	0.07	a 44.33	a 43.83	b 25.45
Copper ore.....	9.7	57.8	11.3	69.8	.....	135.5	a 2.7	13.4	305.3	110.1	a 53.5	27.0	b 4.11	a 39.28	a 20.61
Lead and zinc ore.	340.8	201.8	297.1	151.6	.....	321.8	00.0	339.5	145.7	607.1	b 42.6	.....	a 74.61	a 65.36	.....

a Increase.

b Decrease.

REMARKS ON TABLE 1.

This table was compiled with a view to the comparison of the economic features of the industries in 1880 and 1870. Consequently, it covers the production of the regular mining establishments only, excluding the "farmer-miner". From these last 5,363 returns were received, aggregating 909,977 tons of iron ore and 916,569 tons of bituminous coal.

The statistics of the copper-mining industry, as given in table No. 1, are restricted to the production of the country east of the 100th meridian. The copper mining in Arizona, California, etc., results not in the production of copper alone, but in that of "copper matte", an alloy or mixture of copper and other metals, which is sold in

the East to be refined. The copper ore east of the 100th meridian is, however, valuable for the copper alone, with a few exceptions. The amount of copper produced from both sources, as taken from the statistics of smelting-establishments, is—

	Pounds metallic copper.
Refined in eastern works.....	9, 041, 884
Smelted in western works (all lake Superior).....	45, 130, 133
Total.....	54, 172, 017

The statistics of lead and zinc, which are given together for the reason that in the northwestern district—Illinois, Iowa, and Wisconsin—they are generally produced from the same mine, covers all the mining returns where either of those metals was the main product.

The mining returns of the northwestern district, when it was out of the question to gather the full statistics from the miners themselves, for the reasons already alluded to, have been increased to make them correspond to the amounts of lead and zinc ore which the smelters returns showed were produced there during the census year. In the county tables, however, they are given as they were received, though much below the truth. The total annual yield of these metals, taken from the statistics of the smelting-establishments, is as follows:

Lead.	Pounds.	Zinc.	Pounds.
Smelted from ores.....	66, 970, 836	Metallie zinc or spelter.....	46, 477, 000
Refined from base bullion, the principal value of which was silver.....	95, 067, 207	Zinc oxide produced in chemical works from ore, 20, 213, 631 pounds, equivalent to metallie zinc.....	10, 203, 460
Total yield of metallie lead, census year.....	162, 038, 105	Total metallie zinc, census year.....	62, 681, 459

RECAPITULATION.

The grand total of the production of coal, iron ore, and the non-precious metals embraced in this report would therefore be, bringing together the regular and the irregular production of coal and iron ore, and the actual production of copper, lead, and zinc as returned by the smelters, including that obtained as a by-product in precious-metal smelting, as follows:

	Amount.	Value.
Anthracite coal..... tons..	28, 021, 371	\$42, 139, 740
Bituminous coal: (α)		
Regular product..... tons..	41, 864, 802	52, 461, 513
Irregular product..... do..	916, 560	1, 002, 305
Total coal..... do..	71, 402, 742	95, 003, 558
Iron ore:		
Regular product..... tons..	7, 004, 820	20, 470, 750
Irregular product..... do..	900, 977	2, 086, 201
Total iron ore..... do..	7, 974, 800	23, 150, 957
Metallie copper..... pounds..	54, 172, 017	9, 402, 253
Metallie lead..... do..	162, 038, 105	7, 936, 140
Metallie zinc..... do..	46, 477, 000	2, 802, 712
Zinc oxide..... do..	20, 213, 631	763, 738
Minor minerals..... do..		3, 387, 444
Total value of all non-precious mineral product.....		143, 201, 802

α Includes the coal and lignite mined west of the 100th meridian.

REMARKS ON TABLES 2 AND 3.

The averages in Tables 2 and 3 are based on Table 1, and a corresponding table compiled from the Census of 1870. The values of 1870 were of course reckoned in the debased currency of the period. As remarked before, the industries considered are the mining industries proper, which are limited to the work of extracting the mineral from the ground and such preparation or dressing on the spot as is necessary to fit it for transportation. When an industry is compound—embracing both mining and manufacturing—as, for instance, when a furnace company mines ore and reduces it to the state of pig-iron, that part of the return which relates to manufacturing has been carefully eliminated.

The “irregular production” by persons whose chief business was not mining does not enter into the totals in Table 1, and it was probably not included in the returns of 1870, at least in the case of the bituminous coal industry, since it is made up of very small individual contributions, much less in value than the limit of \$500 annual product, which was then (and should hereafter) be taken to be necessary in order to constitute an “establishment of industry”. The object of the census is, ultimately, the investigation of economic relations, or rather the furnishing the results by which such relations can be investigated, and not an endeavor to swell the arithmetical total of production by collecting items insignificant in themselves and unimportant in their aggregate effect on the industries of the country at large.

a The production of anthracite coal is so completely in the hands of large establishments that the small, irregular production has not been separated.

For the purposes of comparison, the irregular product of iron ore in 1880 is also rightly excluded from Table 1. The Superintendent states, page 749, volume 3, United States Census industrial statistics, 1870, that the iron ore raised in 1870 was then understated by an amount corresponding closely to the "irregular product".

The copper, lead, and zinc statistics, as compiled from the Census of 1870, correspond very closely in extent and scope to the statistics of those industries as given in Table 1 for 1880.

Therefore, Tables 2 and 3 present as nearly as possible a correct general view of the advance in the mining industries during the past decade.

The amounts of copper ore and rock mined was not specified in the Census of 1870, only the value of the product. b For the purpose of comparison, the weight of the ore and rock has been obtained from independent sources. It will be observed that this is the only mineral product which has increased in value per unit since 1870. This is owing to the increase in the per cent. of metal contained in the rock raised in the Lake Superior region, the leading mine being exceptionally fortunate in this respect.

The weight of lead and zinc ore was not specified in the Census of 1870, and no sufficient data have been obtained to estimate it. It is therefore necessarily omitted in the comparison tables.

No computations have been made in the returns of the minor minerals, as they embrace so many materials of different natures. The minor mineral production is, however, included in the totals, though not large enough to affect the percentages.

c TABLE 4.—Product of the non-precious mineral industries (regular establishments only), by substances and by states.

State or territory.	Anthracite coal.	Value.	Bituminous coal and lignite.	Value.	Iron ore.	Value.	Lead ore.	Value.
	Tons.		Tons.		Tons.		Tons.	
Alabama.....			322,034	\$175,550	184,110	\$183,108		
Alaska.....								
Arizona.....								
Arkansas.....			14,778	33,535				
California.....			236,950	663,013				
Colorado.....			462,747	1,041,350				
d Connecticut.....					35,018	147,739		
Delaware.....					2,723	6,553		
Georgia.....			154,644	231,605	72,705	120,692		
Idaho.....								
Illinois.....			6,089,514	8,739,755			772	\$30,200
Indiana.....			1,440,496	2,143,093				
Iowa.....			1,442,333	2,473,155			384	10,172
Kansas.....			763,597	1,408,168			10,081	460,980
Kentucky.....			935,857	1,123,040	33,522	88,090		
Maine.....					6,000	9,009		
Maryland.....			2,227,844	2,584,465	57,040	118,050		
Massachusetts.....					62,617	226,130		
Michigan.....			100,800	224,500	1,837,712	6,094,618		
e Missouri.....			543,990	1,037,100	386,197	1,074,875	28,315	1,478,571
Montana.....			224	800				
Nebraska.....			200	750				
Nevada.....								
New Hampshire.....								
New Jersey.....					754,872	2,300,442		
New Mexico.....								
New York.....					1,230,769	3,400,132		
North Carolina.....			350	400	3,276	5,102		
Ohio.....			5,932,853	7,029,488	198,835	448,000		
Oregon.....			43,205	97,810	6,972	4,060		
Pennsylvania.....	28,640,810	\$42,172,048	518,075,548	18,207,151	1,820,561	4,318,999		
Rhode Island.....	6,176	15,440						
f South Carolina.....								
Tennessee.....			494,491	628,954	89,993	120,951	50	2,500
Texas.....								
Utah.....			14,748	33,045				
Vermont.....					500	2,750		
Virginia.....	2,817	8,290	40,520	92,897	169,623	384,331	11,200	33,000
Washington.....			145,015	389,046				
West Virginia.....			1,782,569	1,971,847	60,371	83,595		
Wisconsin.....					41,440	73,000	1,728	78,525
Wyoming.....								
Total.....	28,640,812	42,196,078	41,864,802	53,461,513	7,064,820	20,470,756	53,140	2,102,948

a Includes 23,441 tons irregular production.

b Includes 70,560 tons of semi-anthracite, valued at \$110,000.

TABLE 4.—Product of the non-precious mineral industries, etc.—Continued.

State or territory.	Zinc ore.	Value.	Copper ingots.	Value.	Minor minerals.	Value.	Total value, excluding copper in states and territories indicated.
	<i>Tons.</i>		<i>Pounds.</i>		<i>Tons.</i>		
Alabama.....							\$664,607
Alaska.....			3,933	(a)			
Arizona.....			3,183,750	(a)			
Arkansas.....							33,535 ^b
California.....			720,000	(a)	2,597	\$19,948	682,061
Colorado.....			1,578	(a)			1,041,350
Connecticut.....							147,700
Delaware.....					14,510	163,310	163,863
Georgia.....			923	(a)		120,135	472,432
Idaho.....			150,000	(a)			
Illinois.....	3,000	\$30,000				102,324	8,011,279
Indiana.....					7,500	22,291	2,165,334
Iowa.....							2,402,327
Kansas.....	7,248	131,169					2,090,317
Kentucky.....							1,211,976
Maine.....			(c)		1	2,000	11,000
Maryland.....	672	7,300	67,056		1,200	159,303	2,870,208 ^d
Massachusetts.....						101,970	328,100
Michigan.....			45,830,262	7,079,292		41,057	14,279,437
Missouri.....	34,344	599,373	230,717	25,730		13,106	4,828,845
Montana.....			1,212,500	(a)			800
Nebraska.....							750
Nevada.....			134,730	(a)	50		
New Hampshire.....			(e)				
New Jersey.....	39,381	461,070			33,823	40,278	3,391,782
New Mexico.....			4,055	(a)			
New York.....						1,623,011	5,122,143
North Carolina.....			1,610,000	350,000		79,855	435,957
Ohio.....							8,077,488
Oregon.....							102,479 ^d
Pennsylvania.....	29,469	394,568	214,736	35,259		420,102	65,015,024
Rhode Island.....							15,440
South Carolina.....					7,427	27,700	27,700
Tennessee.....	3,009	23,145	(e)				783,550
Texas.....			5,084	(a)			
Utah.....							36,045
Vermont.....			2,647,894	409,495		48,788	521,039
Virginia.....	10,448	24,120	678	(a)		179,125	721,709
Washington.....							380,046
West Virginia.....						4,500	2,064,942
Wisconsin.....	4,617	64,562	18,087	1,549		100,000	317,636
Wyoming.....							1,089,451 ^e
Total.....	123,868	1,784,219	56,005,084			3,387,444	131,218,014

a Value of copper ingot not returned in these states and territories, and not estimated, because in some cases the copper occurs only as an accessory metallurgical product from the smelting of mixed ores, and also because its value depends partly on the cost of its transportation to market.

b Excluding 1,275 pounds returned by smelters, value not estimated.

c Copper ore was mined in this state, but not smelted; estimated to produce 34,050 pounds of ingot.

d Copper ore was mined in this state, but not smelted; estimated to produce 102,500 pounds of ingot.

e Copper ore was mined in this state, but not smelted; estimated to produce 163,880 pounds of ingot.

a TABLE 5.—Coal and iron ore product by industrial fields east of the 100th meridian.

ANTHRACITE COAL.

INDUSTRIAL FIELDS.	Product.	Value.	Horse-power.	Wages.	Materials.	Value per ton.	Horse-power of engines per ton of product.	Wages paid per ton of product.	Materials consumed per ton of product.
	<i>Tons.</i>								
Pennsylvania.....	28,612,595	\$42,116,509	105,752	\$22,064,055	\$6,729,477	\$1.47	.0087	\$0.70	\$0.24

b

BITUMINOUS COAL.

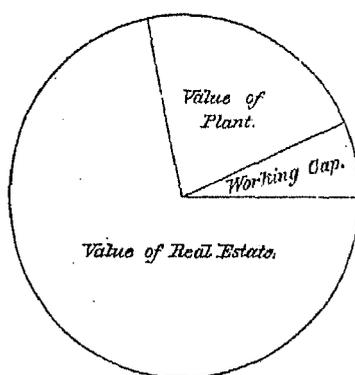
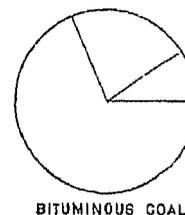
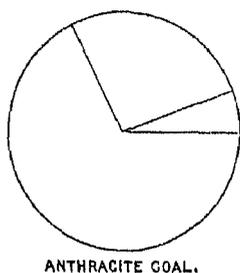
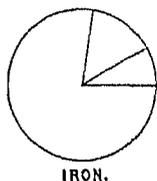
Pennsylvania, Tioga, Clearfield, and Bradford counties.....	8,162,108	\$3,886,335	205	\$1,830,444	\$310,471	\$1.21	.000065	\$0.58	\$0.10
Pennsylvania, exclusive of the above counties.....	14,842,795	14,320,816	5,186	9,027,189	1,438,131	.96	.000349	.608	.097
Ohio, West Virginia, and Kentucky.....	8,651,279	10,724,381	4,701	7,089,877	1,278,339	1.24	.000550	.819	.148
Maryland.....	2,227,844	2,584,455	840	1,370,079	194,942	1.16	.000386	.01	.09
Virginia and North Carolina.....	40,879	68,237	703	71,747	11,064	2.28	.018668	1.755	.285
Tennessee, Alabama, and Georgia.....	972,069	1,830,118	557	750,791	105,406	1.37	.000573	.77	.108
Missouri, Kansas, Iowa, and Nebraska.....	2,750,120	5,009,173	2,088	2,956,648	353,071	1.82	.000757	1.075	.128
Arkansas.....	14,778	33,535	35	20,850	1,185	2.27	.002368	1.410	.077
Michigan.....	100,809	224,500	235	140,000	7,750	2.23	.002391	1.448	.077
Illinois.....	6,089,514	8,739,755	8,294	6,035,919	790,140	1.43	.001362	.99	.13
Indiana.....	1,449,496	2,143,393	1,717	1,405,164	158,604	1.48	.001184	.97	.11
United States east of 100th Meridian.....	40,301,758	40,045,398	24,696	30,707,099	4,601,662	1.217	.000624	.762	.1157

IRON ORE.

Michigan.....	1,837,712	\$6,034,648	6,574	\$2,573,857	\$930,711	\$3.28	.00358	\$1.40	\$0.51
New York.....	1,239,759	3,409,132	8,039	1,507,395	584,895	2.82	.00245	1.21	.43
New Jersey.....	754,872	2,000,442	4,480	1,606,267	584,229	8.84	.00594	2.13	.77
All others.....	8,232,496	8,080,534	10,739	8,850,608	885,076	2.48	.00322	1.10	.20
United States.....	7,064,829	20,470,756	24,853	9,538,117	2,894,011	2.90	.00351	1.85	.41

PLATE I.—REPRESENTATION OF THE PROPORTIONAL AMOUNTS OF CAPITAL INVESTED IN “WORKING CAPITAL”,
IN “PLANT”, AND IN LAND.

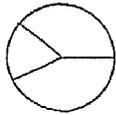
The areas of the circles represent the amounts of capital employed and invested in the various mining industries. The areas of the segments, measuring from end of horizontal diameter on the right towards the left, represent the proportional amounts of capital invested and employed as working capital; the areas of the next represent the values of the plant, machinery, buildings, fixtures, etc.; and the remainder, in each case, the value of the land. The circle representing the minor minerals is not divided, as the data were not complete for that purpose.



Working capital.	\$24,544,000
Plant,	81,848,800
Real estate,	259,010,524
Total capital,	\$365,403,324

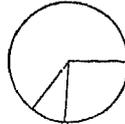
PLATE II.—REPRESENTATION OF THE DISTRIBUTION OF THE VALUE OF THE VARIOUS MINERAL PRODUCTS.

The areas of the various circles are proportional to the values of the products. The first segment in each, measuring from the right end of horizontal diameter to the left, represents the part of the value of the product paid for wages; the next segment the part paid for material consumed; the remainder represents royalty, profits, etc.



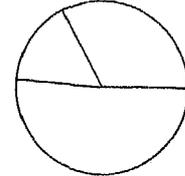
MINOR MINERALS.

Value of product,	\$3,387,444
Wages paid,	1,305,222
Material used,	225,348



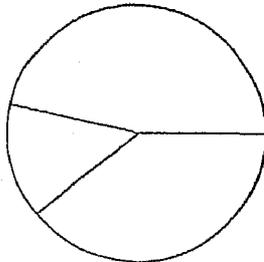
LEAD & ZINC.

Value of product,	\$3,897,761
Wages paid,	2,640,285
Material used,	331,970



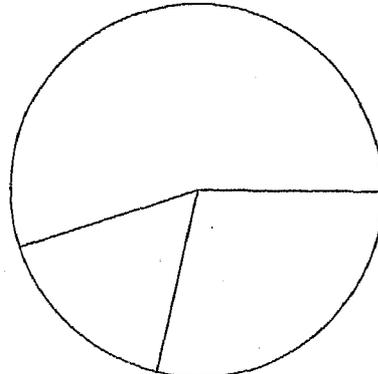
COPPER.

(b) Value of product,	\$8,832,836
(b) Wages paid,	3,077,403
(b) Material used,	1,381,834



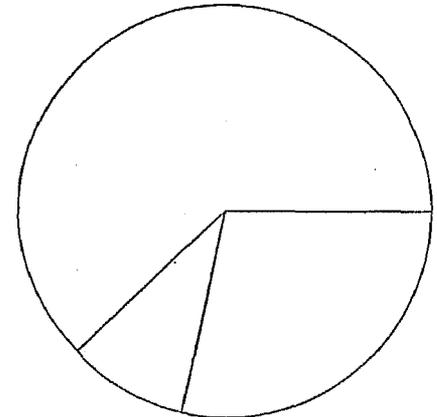
IRON ORE.

(a) Value of product,	\$23,156,957
(a) Wages paid,	10,074,728
Material used,	2,894,011



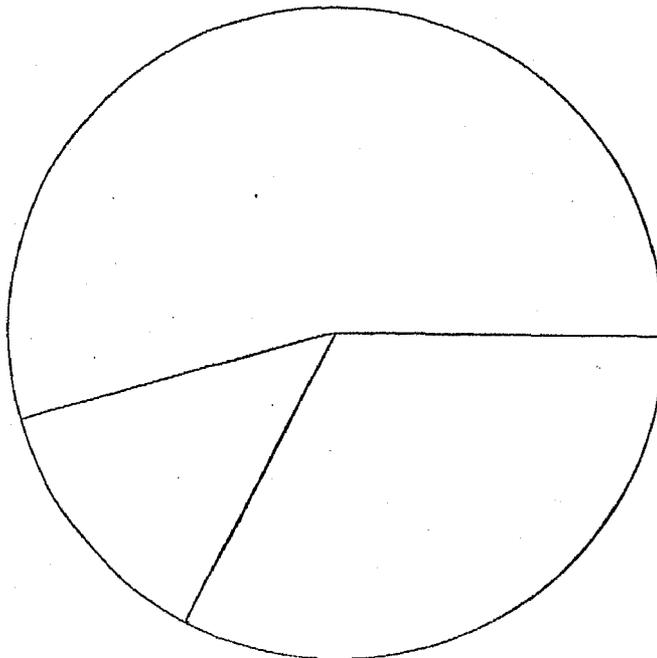
ANTHRACITE COAL.

Value of product,	\$42,180,748
Wages paid,	22,693,407
Material used,	6,732,592



BITUMINOUS COAL.

Value of product,	\$52,351,518
Wages paid,	32,561,175
Material used,	4,853,676



TOTAL MINERAL PRODUCT.

Value of product,	\$193,747,259
Wages paid,	72,352,200
Material used,	16,818,930
Royalty, profits, etc.,	44,576,129

(a) Includes irregular product.

(b) Includes only copper east of 100th Meridian. See Table 49, p. 798.

PLATE III.—REPRESENTATION OF THE PROPORTION OF ADULT HANDS TO BOYS UNDER 16 EMPLOYED IN EACH INDUSTRY.

The areas of the circles represent the total number of hands employed. The smaller segment represents the number of boys, and the larger the number of men.

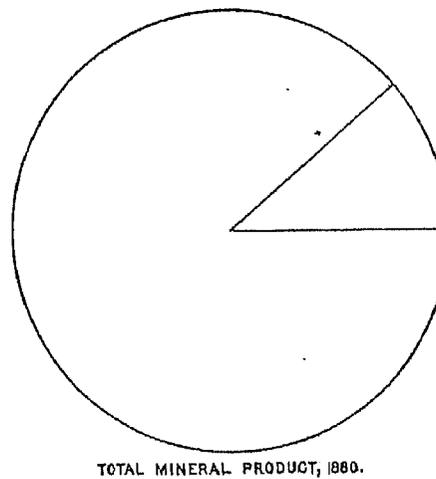
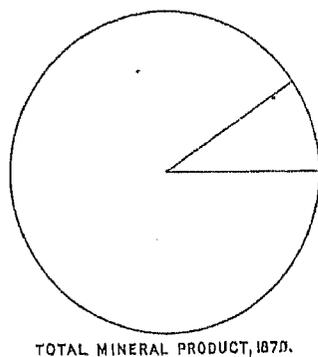
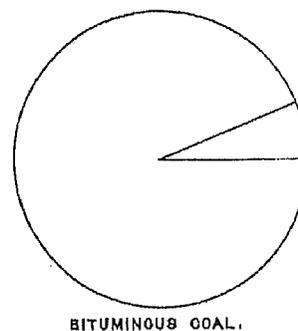
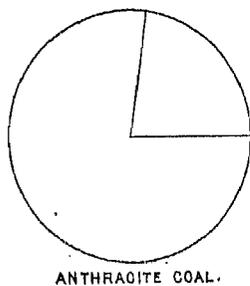
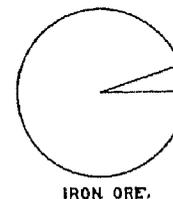


PLATE IV.—REPRESENTATION OF THE WEIGHT OF THE VARIOUS MINERALS TAKEN FROM THE EARTH DURING THE CENSUS YEARS OF 1880 AND 1870.

The areas of the circles represent the relative weights of the material taken from the earth, in the eastern district of the United States, in mining for the non-precious minerals. The copper rock contains about 2.8 per cent. of metal. The iron ore contains about 50 per cent. of iron, the coal is all merchantable product, the lead and zinc ores represent 30 per cent. of metal. No account is taken of the waste rock or culm removed in mining. When an inner circle is drawn it represents the corresponding tonnage as reported in 1870.

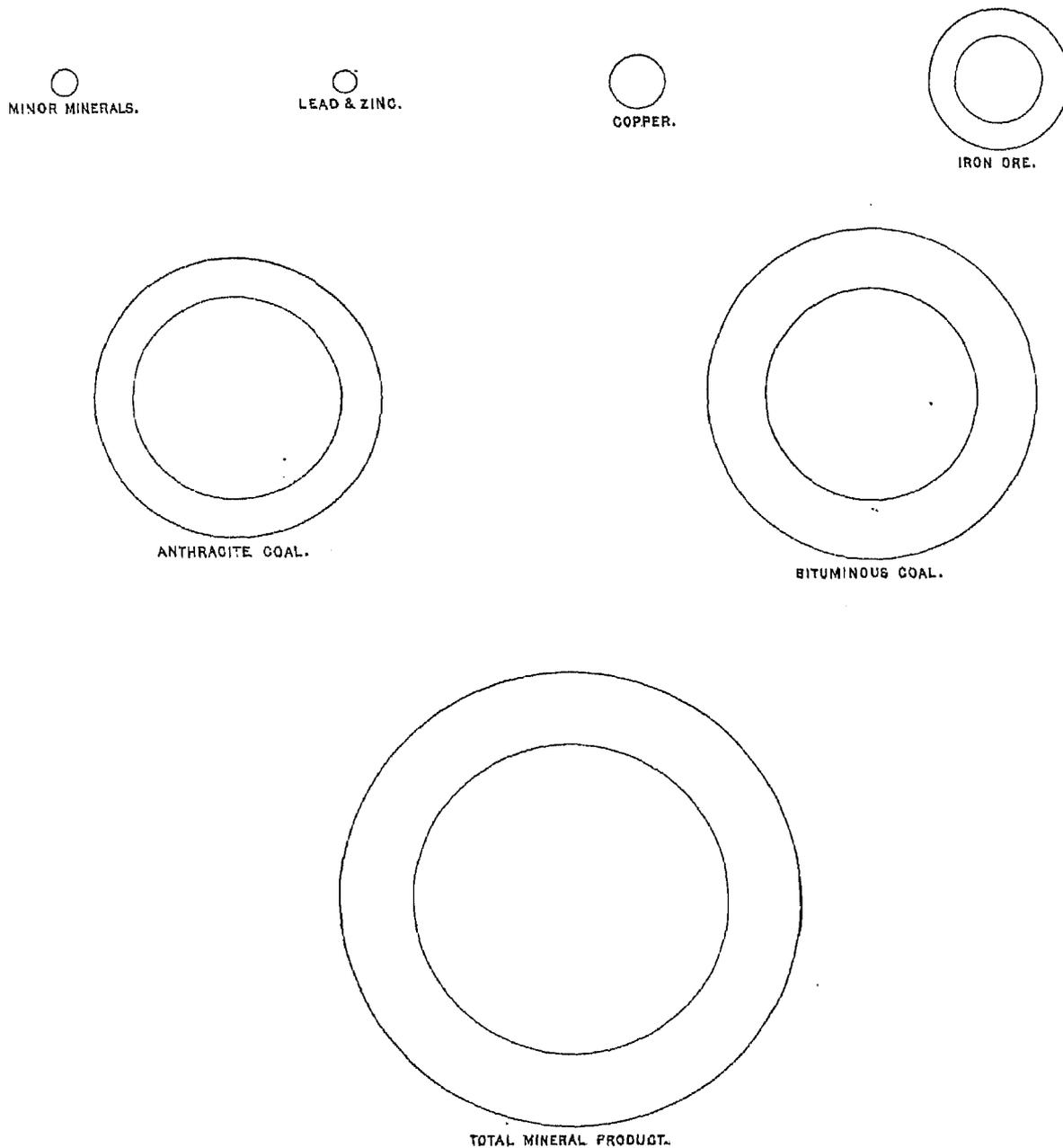
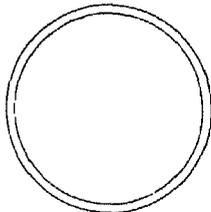
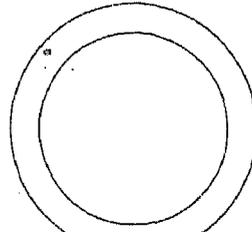


PLATE V.—REPRESENTATION OF CHANGES IN PRICES, WAGES, ETC., SINCE 1870 IN THE MINING INDUSTRIES.

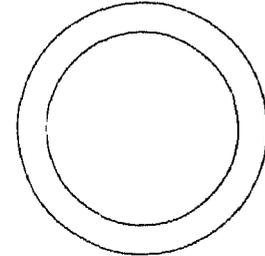
The outer circles represent the prices in 1870, and the inner circles the corresponding prices in 1880. The annular space represents the shrinkage during the included decade.



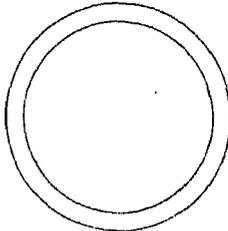
GOLD.
Shrinkage 13%
from 115 to 100



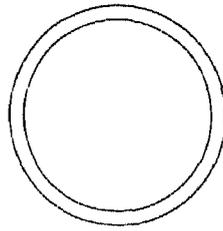
BITUMINOUS COAL.
Shrinkage 39%



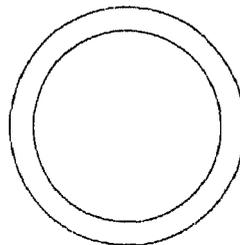
ANTHRACITE COAL.
Shrinkage 40.5%



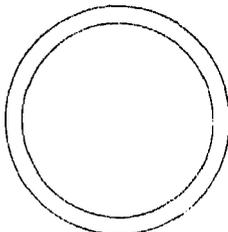
IRON ORE.
Shrinkage 26.5%



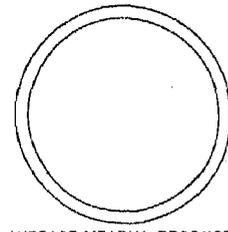
INGOT COPPER.
Shrinkage 24%



ALL NON-PRECIOUS MINERALS.
Average shrinkage of price 32.5%



AVERAGE YEARLY WAGES PER HAND.
Shrinkage 29.3%



PRICE OF AVERAGE YEARLY PRODUCT PER HAND.
Shrinkage 24.3%

PLATE VI.—REPRESENTATION OF THE RELATION OF MECHANICAL POWER TO PRODUCT IN THE MINING INDUSTRIES.

The areas of the left-hand circles represent the engine horse-power employed. The areas of the right-hand circles represent the number of thousand tons raised yearly from the earth per horse-power. In the copper and anthracite-coal mining, however, the power is employed in preparing for market as well as in raising to the surface.

