Annual report of the state mineralogist for the year ending ...

California State Mining Bureau

GENERAL VIEW OF THE NEW ORLEANS EXPOSITION.

CALIFORNIA STATE MINING BUREAU.

HENRY G. HANKS, STATE MINERALOGIST.

FIFTH ANNUAL REPORT

OF THE

STATE MINERALOGIST,

FOR THE YEAR ENDING MAY 15, 1885.

SACRAMENTO:
STATE OFFICE ..... JAMES J. AYERS, SUPT. STATE PRINTING.
1885.

To his Excellency GEORGE STONEMAN, *Governor of California:*

SIR: I have the honor herewith to submit to you the fifth annual report of the State Mineralogist of California, in compliance with section three of an Act of the Legislature, entitled "An Act to provide for the establishment and maintenance of a Mining Bureau," approved April 16, 1880.

I have the honor to be, very respectfully,

HENRY G. HANKS,
State Mineralogist.

SAN FRANCISCO, June 15, 1885.

REPORT.

The original Act creating the CALIFORNIA STATE MINING BUREAU, approved April 16, 1880, provides for an annual report by the State Mineralogist, in the following words: "At the close of each year he shall make a report in detail to the Governor, showing the amount of disbursements of the Bureau under his charge, the number of specimens collected, and giving such statistical information in reference to mines and mining as shall be deemed important." In obedience to these commands, this, the Fifth Annual Report of the State Mineralogist, has been prepared.

The prosperity of the Mining Bureau, and the growth and progress of the State Museum, since the publication of the last report, have been as remarkable as they are satisfactory. The usefulness of the institution is now more generally admitted, and the unexampled and rapid growth of the Museum is proof that the Bureau was needed and is receiving the coöperation of the people. Otherwise it would have been impossible to make so large and valuable a collection with the amount of money placed at the disposal of the State Mineralogist.

Soon after the institution of the State Mining Bureau, it became evident to the State Mineralogist that the plan upon which it was founded was radically defective, and the responsibility of the rapidly growing Bureau too much for one individual to assume. With this view, he applied repeatedly to the Legislature, asking for the appointment of a Board of Trustees who should be vested with the financial and general management, leaving him free to pursue the work for which he is best fitted. The last Legislature gave this matter their attention, and passed the following Act, which places the institution on a proper basis, and insures to the people its perpetuity and better management:

[Assembly Bill No. 78—Passed the Assembly February 11, 1885; passed the Senate March 5, 1885.]

An Act supplementary to an Act entitled "An Act to provide for the establishment and maintenance of a Mining Bureau," approved April 16, 1880.

The People of the State of California, represented in Senate and Assembly, do enact as follows:

SECTION 1. All property of this State pertaining to said Mining Bureau, and the money and financial affairs thereof, shall be vested in and be under the direction and control of a Board of Trustees of said Bureau.

SEC. 2. It shall be the duty of the Governor of the State to appoint five (5) citizens and residents of this State to be such Trustees.

SEC. 3. The appointees herein mentioned, when assembled, shall constitute the Board of Trustees of the State Mining Bureau, three of whom shall constitute a quorum. The Board shall have power, by said name, to sue and defend. They shall keep a record of all their proceedings, and they shall elect one of those so appointed to be President of the Board, and shall have the right to appoint a custodian of the Museum and other employés. The State Mineralogist shall be the director of the Museum, and shall have the right to appoint a custodian of the Museum, and other employés, subject to the approval of the Board of Trustees, and it shall be his duty to consult the Board in all matters of importance.

SEC. 4. Said Board shall make rules for its own government, for regulating the custody and disbursement of funds, and the mode of drawing the same from the State Treasury.

SEC. 5. The Board of Trustees shall, annually, report to the Governor of the State the condition of the Bureau, with a statement of the receipts and expenditures in detail, which report shall be published in the annual report of the State Mineralogist, provided for in the Act to which this is supplementary.

SEC. 6. The Trustees are hereby empowered to pay out of any moneys coming into their hands, the amount advanced by Wells, Fargo & Company, shown in the financial statement of the State Mineralogist, and published in his reports.

SEC. 7. The Board of Trustees shall be empowered to receive, on behalf of the State, bequests or gifts, legacies and devises, real estate and other property, and to use the same in accordance with the wishes of the donors; and if no instructions are given, to use their discretion for the best interests of the State Museum.

SEC. 8. The Board of Trustees may, with the assistance of the State Mineralogist, prepare a special collection of ores and minerals of California, to be sent to any World's Fair or Exposition, at which they may deem it desirable to display the mineral wealth of the State.

SEC. 9. All Acts or laws in conflict with this Act are hereby repealed.

SEC. 10. This Act shall take effect immediately.

In accordance with the provisions of the Act, the Governor appointed the following gentlemen Trustees: William Irelan, Jr., Chairman; S. Heydenfeldt, Jr., Vice-Chairman; J. Z. Davis, Walter E. Dean, and George Hearst, who accepted the office and organized April 18, 1885. Hereafter all financial matters will be managed by them, and they will report yearly to the Governor.

During the past year the State Mineralogist was informed of the intention of the owners of the building now occupied by the State Mining Bureau to reconstruct or rebuild it, necessitating, during the operation, the removal of tenants. On making inquiry and finding that such was really the intention, he felt it his duty to seek some more suitable location for the Museum and offices, in a better and more permanent building, one in which the institution would be allowed to remain for an unlimited time. Provisional arrangements were made with THE SOCIETY OF CALIFORNIA PIONEERS for the rental of a portion of their new and very elegant as well as fire-proof building, now being erected on Fourth Street, near Market, on the property donated to that society by JAMES LICK. Since the appointment of the Board of Trustees, a satisfactory and final arrangement has been made with the society, and the Museum will be removed as soon as the building is finished, which will be about the first of November. In view of the magnitude of the undertaking of moving so large an accumulation of articles demanding so much care in handling, and the time required for the rearrangement of the specimens, the Museum must remain closed for several months.

The Museum will be placed in the upper story, occupying the entire floor. This principal room will be accessible both by spacious staircases and by elevator. Of the floor below the Museum the Bureau will occupy the entire southern half. The space will be divided into five rooms: the front room will be devoted to the growing library, and the rear one will be set aside for the exclusive use of the State Mineralogist, and will serve as a private study and laboratory. The remainder of the space will be divided into three rooms: one will be used as a receiving room for boxes and new specimens, in which they will be unpacked, cleaned, and prepared; another will be used exclusively for duplicates for exchange or other disposition, and the third will be devoted to the preparation and classification of specimens for the Museum cases. It is believed that this building will provide suitable quarters for the Mining Bureau for many years to come.

VISITORS.

Daily attendance at the Museum has gradually increased; the entries on the register now number 17,841, and will probably be increased to 20,000 before removal. A new register will be commenced in the new building. The number of names entered does not fully indicate the total attendance, for many persons do not register without being invited to do

so, and in many instances decline to enter their names on a second visit. A plan will be pursued in the new rooms to indicate the actual number of persons who visit the Museum, independent of the entry of names.

CHEMICAL WORK.

Owing to the want of a suitable laboratory, and of the means to employ an assistant chemist, the State Mineralogist has been compelled to decline for the present making analyses of new minerals, ores, etc., to do which would afford him great satisfaction. Such laboratory work has long been contemplated by him. There could scarcely be a more important work than this. The results would not only be of the greatest interest to those applying for information, but on being published in the reports of this office, the results would not alone be valuable to the miners of California, but interesting and instructive to others, in other States and countries.

This department is so important that it should be duly considered by the Legislature, and a sufficient appropriation made to equip a suitable chemical and metallurgical laboratory, and to employ an assistant chemist.

An attempt was made by the last Legislature to transfer this work to the State University, which has an admirable and well appointed laboratory, a professor in charge, and advanced students to whom the work could be intrusted. A bill was passed creating the office of State Analyst in which the following section was inserted: "Sec. 6. It shall be competent for the Mineralogist of the State of California to submit to the State Analyst any minerals of which he desires an analysis to be made, provided that the cost of the same shall be defrayed by the Mining Bureau." But as no provision was made to pay the special chemist whom it was proposed to employ to superintend the work of the Mining Bureau, and as the condition of the funds of that institution would not admit of such disbursement, the Act, as far as the State Mining Bureau is concerned, remains inoperative.

Many minerals and mineral products are daily sent to the State Mineralogist for examination. This work is done as expeditiously as possible, and the required information sent. But this class of work has increased to such an extent that it would require the whole time of one person to do it properly. For this reason it is impossible for the State Mineralogist to do it all without neglecting his other duties. This unavoidable delay very naturally causes dissatisfaction, and letters of complaint are frequently received. Still, until more assistance can be employed, it cannot be avoided, much as it may be regretted.

CORRESPONDENCE.

This department, also, is growing daily in magnitude, and is now quite sufficient to employ the entire time of one individual during the business hours of the institution. Like the chemical work, and for the same reason, it sometimes so accumulates that letters remain too long unanswered. It would be a source of satisfaction to the State Mineralogist if all letters could be replied to immediately on receipt, but this cannot always be. To explain and to offer an apology to writers, the following circulars have been prepared and are inclosed with replies, which are sometimes necessarily brief:

CIRCULAR.

CALIFORNIA STATE MINING BUREAU, OFFICE OF STATE MINERALOGIST,
SAN FRANCISCO,....., 188...

The Act creating the State Mining Bureau, for the advancement of legitimate mining in California, provides for the collection and display, in a State Museum at San Francisco, of the varied mineral products of California—the collection to include not only the precious metals, but all minerals which have an economic value and can be used in the arts, in manufactures, in agriculture, or in commerce.

It is the province of the State Mining Bureau to give general information relating to the mineral interests of the State, to aid in which correspondence is solicited; information, however obtained, will be placed on record in the office of the Mining Bureau for the use and benefit of all interested. It will be the aim of the Bureau, through the agency of the State Museum and by its publications, to call the attention of the world to the natural advantages of California as a desirable place of residence, and as a field for the profitable investment of capital. To secure this end, the coöperation of all those who have the interest of the State at heart, is much to be desired. Information, therefore, bearing on the general interest of the commonwealth, will be thankfully received.

This circular is specially prepared to assist in answering certain questions frequently asked in letters received by the Mining Bureau, and to avoid the constant repetition in replies. Certain information is so frequently asked, that it can be better given in a carefully prepared circular than by the pen.

The correspondence of the Bureau has increased to such an extent that it is impossible to answer all letters in detail without some plan to save labor, and it is often impossible to answer immediately, for the following reasons:

First—All letters must take their turn.

Second—The information asked cannot always be obtained without delay, and specimens sent with letters do not in every case reach the Bureau at the same time. Frequently, specimens require careful examination, in which they must take their turn.

Third—Sometimes the State Mineralogist is out of the city, and all specimens requiring his special attention must await his return.

For the above reasons, neither delay nor extreme brevity in correspondence should be mistaken for neglect.

Ores are frequently sent to the State Mining Bureau to be assayed for gold, silver, lead, copper, tin, etc.; the Bureau does not make commercial assays, for the reason that such a course would interfere with the business of assayers, which was not the intention of the framers of the Act.

While the Mining Bureau cannot, for the above reason, agree to furnish assays, it will determine minerals, and will make analyses of any new mineral discovery, the publication of which would be of interest to the citizens of the State generally.

All iron ores, mineral waters, building stones, marbles, limestones, coal, coal oil, asphaltum, and other useful minerals, will be analyzed or examined, and the result published. This will be done for a double purpose: first, to give the world a reliable account of what the State produces; and to encourage others to search for valuable minerals. All information given by the Bureau, and all work done, will be free.

The State Mining Bureau does not take any interest in mining property, in the sense of negotiating sales or furnishing capital.

When specimens of valuable minerals are received they are carefully labeled and placed in cases in the Museum, where they can be seen and examined by all. When inquiry is made for certain minerals found in the State, the persons making such inquiry are shown the case containing minerals of that class, and all information given.

The Mining Bureau does not deal in mining stocks, nor will it give any quotations or advice as to their purchase or sale, but will at all times give such information as it may possess concerning the mines themselves.

It is desired to make the ethnology of the Pacific Coast a feature of the Museum. All Indian relics, recent or prehistoric, will find a place, and their collection will no doubt throw much light on the ancient history of the State.

Every article sent to the Bureau will become the property of the State, for the use and benefit of the public, and will be carefully preserved in the State Museum.

All packages should be addressed to the California State Mining Bureau, San Francisco, and sent by Wells, Fargo & Co.'s Express, or by railroad or steamship lines as slow freight.

HENRY G. HANKS, State Mineralogist.

CALIFORNIA STATE MINING BUREAU, OFFICE OF STATE MINERALOGIST,
SAN FRANCISCO....., 188...

Mr. —— ——, ——:

DEAR SIR: The specimens mentioned in your letter dated ——, were not received, or were not marked in such a manner that they could be recognized as those described in your letter.

This frequently occurs, and causes disappointment to those sending to the State Mining

Bureau for information. No appropriate answer can be returned until the specimens are received and examined, for which reason letters of this character are laid aside for an indefinite period, as in this case.

All packages should be plainly marked, *on the inside,* with the name of sender, locality, etc., as no dependence can be placed on post-marks, which are generally illegible.

Asking you to excuse delay, I remain very truly,

____ ____,
State Mineralogist.

LIBRARY.

The library so far has been comparatively so insignificant that no special attention has been given to it beyond that required for the care of the books, but in the new quarters a special room will be devoted to this very important branch of the State Mining Bureau.

While the number of books is not as yet very large, they are specially valuable, and already the library is an important one of reference. Every effort in the future will be made to increase the number of books, and it is to be hoped that public spirited citizens, of whom there are many in the State, will aid this department by gifts of books, as miners have almost wholly created the Museum by their donations. This is a matter for the consideration of our best citizens.

By the order of the Board of Trustees, the State Mineralogist purchased in New Orleans a number of rare and valuable works on mining and kindred subjects, which constitute an important addition to the library.

The following newspapers continue to be sent to the Mining Bureau gratuitously:

1. Engineering and Mining Journal, New York.
2. Mining Record, New York.
3. Mining Review, Chicago, Illinois.
4. Economist, Boston, Massachusetts.
5. Daily Report, San Francisco, California.
6. Daily Grass Valley Union, Nevada County, California.
7. Daily Evening Gazette, Reno, Nevada.
8. Sierra County Tribune, California.
9. Humboldt Standard, Eureka, Humboldt County, California.
10. Inyo Independent, Inyo County, California.
11. Arizona Gazette, Phœnix, Arizona Territory.
12. Ventura Free Press, San Buenaventura, California.

PUBLICATIONS.

All the publications of the Mining Bureau have been distributed. There has been an unusual demand for them. No partiality has been shown in their distribution. As long as any remained, all applications were honored, if the person asking had not already received a copy. Many applications from the State, from the East, and from foreign countries, have been received since the reports were exhausted. There is no law providing for the reprinting of the publications of the State Mining Bureau, but it would seem that reports made in the interest of the State should be supplied as long as the demand continues.

CATALOGUES.

A second volume of the Museum Catalogue has been printed during the last year. This brings the number of entered specimens to 6,000. A third volume has been commenced, of which 488 numbers have been sent to the State Printer. There are a large number of valuable specimens in the rooms which have never been entered in the catalogue or prepared for the Museum. When they are so prepared and placed in cases, they will aug-

ment very considerably the already extensive State collection, and add materially to the exhibit.

A catalogue of the books in the library has also been printed, which was alluded to in the last report. There were at the date of the catalogue, May 15, 1884, of printed books, 247; of maps, lithographs, etc., 156; total, 403. Besides these, there were a very large number of pamphlets and publications of scientific societies sent to the Mining Bureau as donations or in exchange for the reports of the Mining Bureau. Since the publication of the library catalogue many more books and pamphlets have been received.

GENERAL MUSEUM.

It is to be hoped that citizens will now more generally avail themselves of the opportunity afforded by the State Museum to gain a knowledge of the resources of their State, and will not only visit the Museum themselves but will encourage their children to do so. Strangers do not need this invitation, as they constitute the most frequent visitors. It is a severe reflection on our citizens to state the truth—that but few in proportion know of the existence of the State Museum, much less do they visit it.

DONATIONS AND ACCESSIONS TO THE MUSEUM

Have been large during the last year, and some of them are very valuable. It has been the custom in former reports to give the names of donors. This is omitted in this, owing to delay in preparation, caused by the absence of the State Mineralogist from his office, during the New Orleans Exposition. Due credit will, however, be given in the next.

RECEIPTS AND DISBURSEMENTS, STATE MINING BUREAU, FROM MAY 15, 1884, TO MAY 15, 1885.

RECEIPTS.

Cash on hand as per last report	$81 22
Bureau Fund	4,737 60
Warrants for State Mineralogist's salary	3,000 00
	$7,818 82

DISBURSEMENTS.

General expenses		$576 96	
Rent		2,400 00	
		$2,976 96	
Salaries—Janitor	$820 00		
Compilers and writers	148 00		
Museum attendance	268 00		
Accountant	170 00		
State Mineralogist	3,000 00		
		4,406 00	
Postage		82 60	
Museum		181 60	
Maps		10 00	
Library		18 25	
Traveling expenses		130 60	
Cash on hand		12 81	
			$7,818 82

THE NEW ORLEANS EXPOSITION.

During the past year an International Exposition was held in the City of New Orleans. Commissioners were appointed by the respective State Governments, including California. When it was proposed to send the State collection of minerals, the same controversy arose as before the Denver

Exposition of 1882, and with the same result. It was decided that the State Mineralogist had no authority to remove the minerals from the City of San Francisco. In this dilemma, it being the popular wish that the mineral as well as the agricultural, commercial, and manufacturing interests of the State should be represented, an appeal was made to the Legislature (then in session) which resulted in the passage of the following concurrent resolution:

Assembly Concurrent Resolution No. 11, relative to sending the mineral collection of the State Mining Bureau to the World's Fair and Cotton Centennial Exposition at New Orleans:

Resolved by the Assembly, the Senate concurring, That the State Mineralogist be and is hereby authorized and directed to carefully pack and ship to New Orleans, so much of the cabinet of minerals now in the State Mining Bureau, at San Francisco, as will secure a proper representation of the mineral wealth and resources of California in the WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXPOSITION, now open in New Orleans; said exhibit to be under the charge and control of the State Mineralogist; and at the close of the Exposition, or sooner if by him deemed expedient or proper, to be returned to its present quarters in the STATE MINING BUREAU. The expense attending this exhibit shall be paid out of any appropriation made by this Legislature for the better display of the resources of the State of California, at such Exposition.

Immediately on receiving a certified copy of the resolution from the Secretary of State, the Museum was temporarily closed, and all the California minerals and ores packed with the greatest expedition and care, all of which was completed and the cases were ready on February twenty-fifth, but shipment was delayed until March third. On that day the State Mineralogist left San Francisco for New Orleans, where he arrived Sunday, March eighth. On March fourteenth the minerals arrived in New Orleans, but it was not until the eighteenth of the month that they were delivered at the Government Building of the Exposition. On the twentieth day of March the beautiful onyx marble mantel, which was loaned to the Mining Bureau by Mr. J. Z. Davis of San Francisco, was set up in the California headquarters. April first all the cases were in order and the arrangement of the entire collection complete.

There were twenty-five plate-glass cases brought from the State Museum; the rough boxes in which they were packed were piled in such a way as to furnish improvised tables, which were neatly covered with dark colored cloth. On these, large piles of rough ores, petroleum, borax, salt, asphaltum, silicified wood, manufactured iron, quicksilver, etc., were placed, the whole presenting an attractive appearance. The collection remained undisturbed until the end of the Exposition, when it was repacked, and on the sixth of June was placed in a car and delivered to the railroad company, to be returned to San Francisco. The State Mineralogist arrived on the thirteenth of June, but the minerals and cases were not returned to the State Museum until July second. A number of the cases were damaged, and several of the glass plates broken. As the Museum is about to be removed, as elsewhere stated, it was thought best not to unpack the minerals until possession was taken of the new quarters; until which time the damage to the minerals, if any, cannot be known. The injury to the cases cannot be repaired without an outlay of one hundred and six dollars, as estimated by the cabinet-maker.

On consultation with the Governor, he granted permission to make a full and detailed report on the mineral exhibit of California, to be supplemented by a more general one of the mineral exhibits of all the States and Territories shown in the Government Building. To carry out this plan, and in accordance with a previous understanding with prominent citizens, the State Mineralogist left New Orleans some time after the minerals were

arranged, and spent seventeen days in visiting gold mines in Georgia and North Carolina, and some of the iron and coal mines in Alabama and Tennessee, an account of which will appear in the general report to follow this.

In making the proposed report, all exhibits other than mineral must of necessity be ignored. While some States do not appear to advantage as mineral producers, it must not for that reason be thought that they were not well represented otherwise. In many instances States showing but few even of the minerals to be found within their boundaries, made magnificent displays of agricultural and other resources. In the vastness of the building, some mineral exhibits may have been overlooked. The report will describe those actually seen and examined.

California was well represented in every department. It was the only time the State has ever asserted herself at a World's Fair, and there can be no doubt that the effect of the Exposition will long operate to her advantage. One of the most remarkable and striking features of the Exposition was the gathering under one roof in the Government Building, from all parts of the American Union, not only the natural resources of the various States and Territories, but also many representative men and women. Not only were mechanics of the highest order numbered among the visitors, but also scientific and literary men, whose writings have made their names widely known to the world, and men of rare business ability, skilled in the employment of large sums of money.

Contrary to expectation, the Exposition failed to be in a general sense international, but became more a display of American inventions and native wealth. While the Main Building was a marvel of size, and was no doubt the largest collection of manufactures and resources ever gathered together in one building, the chief interest of the Exposition was centered in the Government Building, in praise of which too much cannot be said or written. Under this single roof were placed side by side the natural resources of the several States and Territories, so abundant and so varied in character as to cause a feeling of pride in the breast of every American citizen who saw them; while to the foreigner it was a lesson he was quick to observe. It was clearly shown on the one hand that the United States have within their borders vast stores of raw material, vegetable, animal, and mineral; and on the other that American citizens and mechanics have the ability and the energy to manufacture them to an extent far beyond the requirements of the nation; so that if cut off for any reason from intercourse with other countries, the people have ample material and the ability and the inclination to supply their wants from their own resources.

It was interesting to note the composite character of the National and State exhibits; what one is deficient in, another supplies in the greatest abundance. The contributions from the several States were so large, so comprehensive, and so generous, that no general comparison can be made between them. All were beyond what could be expected of them, when all the difficulties attending their collection are considered.

The collective exhibit afforded a rare opportunity for study and consideration on the part of the political economist, the technologist, the capitalist, the student, and the lover of pure science. Here men of science and intelligence met to exchange ideas, to give and to receive information, and presumably to prepare for publication the results of their observations.

One feature of the Exposition should be mentioned here, although not to the credit of all the States, a number of which were represented by individuals, some of whom could but ill afford to bear the expense, while the States they so well represented were benefited and tacitly accepted the honor. These self-denying persons were in too many instances compelled

to sell goods to pay their expenses, or to endure actual want. Many were placed in this position, and inconvenience if not actual suffering was quite too common. Some States were wholly, others in part, represented by railroad companies, which expended large sums of money to assist the Exposition, receiving back only a portion of the disbursement in fares and transportation. No instance came to my knowledge in which a railroad company, in advancing its own interest, attempted to eclipse or ignore actual State exhibits. Every State and Territory in the Union was represented except *Utah* and *Alaska*, yet only a portion made appropriations or officially recognized the Exposition beyond the appointment of a Commissioner. Still the World's Fair was a great national success in every sense except financially.

Outside of the direct and practical benefit resulting from the Exposition, it did much to create a good feeling between the North and the South, in which sense it was worth more to the nation than the entire cost. Thrown together for months, people from both sections came to know more of each other. Northern and Western visitors were met with a cordiality, both in the City of New Orleans and throughout the entire South, as gratifying as it was in many cases unexpected.

HISTORY OF FORMER WORLD'S FAIRS OR INTERNATIONAL EXPOSITIONS, COMPILED FROM VARIOUS SOURCES.

The first International Exposition or World's Fair was held in Hyde Park, in London, England, in the year 1851. The Society of Arts of England had been accustomed to hold annual fairs for many years. In 1849 the Council of that society recommended that the exhibition of 1851 should be the first of a series "which should culminate every fifth year in a great National Fair, or Exposition, embracing all manufactures." Application was made by the society to the British Government, asking the Government to provide a permanent building for such exhibits. His Royal Highness, Prince Albert, was at that time President of the society, and suggested that the proposed national display should be made *international*. The reply from the Home Secretary to a letter from the Prince being favorable, the society commenced active operations. In 1850, the Queen issued a royal commission providing for an inquiry as to the best methods to insure success. It was thought best at first to provide funds by private subscription, but it was found to be impossible to collect sufficient money by this plan, and in June a guarantee fund of $1,000,000 was proposed. A royal charter was obtained, and the Commission borrowed money from the Bank of England to make up the deficit.

In 1850 architects were asked to send in plans, to which request two hundred and thirty-three responses were received. The plan drawn by Sir Joseph Paxton was accepted, which proposed a building wholly of iron and glass. The building was commenced in September, 1850, and finished at the opening, May 1, 1851. The working time was about one hundred and ninety days. The building was three stories high, and had the following dimensions: Length, 1,840 feet; width, 408 feet; area of ground floor, 772,784 square feet; area of galleries, 217,100 square feet; total area, 989,884 square feet—about $28\frac{6}{10}$ acres. The central dome was 104 feet high. The contract price was $388,350, with the understanding that the proceeds of the sale of the building after the Exposition should be paid to

the contractors. But there was so much extra work ordered by the management that the price finally awarded was $694,810; the building sold for $365,018, so that the total amount received by the contractors was $1,059,828. The Exposition opened May 1, 1851, and closed October fifteenth. Her Majesty the Queen presided in person at the opening.

Days open		141
Total daily paid admissions		5,265,429
Total admissions		6,039,195
Season tickets issued		773,766
Average daily attendance		42,831
Largest attendance (October 7)		109,915
Largest number in the building at one time (October 7)		93,224
Smallest daily admissions		9,327
Exhibitors (foreign)	6,556	
Exhibitors (Great Britain)	7,382	
Total number of exhibitors		13,938
Total receipts		£506,100 06 11
Total expenditures		292,794 11 03
Surplus		£213,305 15 08
About		$1,032,400 00

The building was sold in 1852 to the Crystal Palace Company, by whom it was taken down and rebuilt at Sydenham, a London suburb, where it was surrounded with gardens and transformed into a public pleasure resort.

DUBLIN—1853.

The Royal Society of Dublin, Ireland, had made triennial exhibitions since the year 1835. When in 1852 it was proposed to hold the usual fair in 1853, the society received from a contractor, Mr. William Dargan, an offer to furnish a building under the following conditions: The contractor proposed to advance $97,000 for the construction of an Exposition building which should revert to him at the close. He was to receive all the net proceeds under the specified sum, with five per cent interest added; the valuation of the building to be taken as part of the money to be paid him. The offer was accepted and plans for the building solicited. The award was made to Sir John Benson of Cork, and the building erected under his supervision. The edifice was two stories high, and constructed principally of timber; the skylights were of corrugated glass; superficial area about 265,000 square feet, or over six acres. The building was commenced August, 1852. The Exposition opened May 12, 1853. The building consisted of five parallel arched and dome-roofed halls. The central hall was 425 feet long, and 100 feet wide, and 105 feet high. The northern and southern halls each 375 feet long, 50 feet wide, and 65 feet high. Hall for fine arts 325 feet long, 40 feet wide, and 38 feet high. Machinery hall 450 feet long, 40 feet wide, and 46 feet high. The building cost more than was anticipated—$290,000, and when sold at the termination of the Exposition, brought only $77,000. While it was being erected, the Executive Committee decided to make the Exposition international. There were no premiums or awards offered.

The receipts for admission were about $229,000, and the attendance was about 1,000,000.

EXPOSITION OF THE INDUSTRY OF ALL NATIONS, NEW YORK—1853-4.

An association of prominent citizens of the United States was formed in the latter part of 1851 for the purpose of planning an American Interna-

tional Exposition of the Industry of all Nations. In 1852 the City Government of New York gave the association free use for five years of Reservoir Square, bounded by Fortieth Street, Sixth Avenue, Forty-second Street, and the Croton Reservoir, on condition that a building of iron and glass should be erected, and the price of a single admission should not exceed fifty cents.

The Association for the Exhibition of the Industries of all Nations was incorporated March 11, 1852, with a capital stock of $500,000, and a term of five years. The admittance to the Exposition was set at fifty cents. It was provided that on one day all children of charitable institutions and public schools should be admitted free. It was provided, also, in the charter granted by the Legislature of New York, that the net proceeds of one day's exhibition should be devoted to the relief fund of the Fire Department of the City of New York. The United States Government did not officially indorse the association, but made the building a bonded warehouse for the convenience of foreign exhibitors. The Exposition was, in reality, a private business enterprise, although patronized and assisted by the General Government.

The association invited architects to send in plans for an Exposition building; a number were presented, and those of Carstensen & Gildmeister were selected as the most suitable. The building was commenced in October, 1852, and was only partially finished, after several postponements, at the opening, which took place on July 14, 1853. Its form was that of a Greek cross surmounted by a central dome one hundred feet in diameter. The dimensions were:

Length of naves	149 feet.
Width of naves	41½ feet.
Width of aisles	54 feet.
The length of each diameter of the building along the main aisles was	365 feet 5 inches.
Area of principal floor	157,195 sq. feet.
Area of second floor	92,496 sq. feet.
Total area of building	249,691 sq. feet.
Or about	5¾ acres.

The square space, nearly all of which was occupied by the building, was 445 by 455 feet. The framework was of iron, with a large area of glass. The whole quantity of iron used in the construction of the building was 1,800 tons, of which 1,500 tons were cast iron and 300 tons wrought iron. Of glass, the quantity was 15,000 panes, or 55,000 square feet. 750,000 feet, board measure, of boards and timbers were also used. The general effect of the building, externally and internally, was graceful, light, striking, and beautiful. There was an octagonal space in the gallery or upper floor under the dome, and an arched cross reaching to the roof and extending from each of the four main entrances to the center. The staircases were of iron, and beautifully curved. The roof and dome were painted and decorated, and the whole exterior and interior painted in oil colors. The outside was finished in light bronze color, and the ornamental portions partly gilded. The general color of the interior was buff or cream color, relieved by red, blue, and yellow, applied skillfully and only in quantities sufficient to produce an artistic effect. A portion of the ornamental work was gilded.

The Exposition was opened July 14, 1853, by President Pierce in person, and thrown open to the public on the following day.

PARIS—1855.

France began holding exhibitions or fairs in 1798. On the occasion of the eleventh, in 1849, Napoleon, then President, proposed an international exhibit, in which all countries should be invited to participate, but the proposal did not meet the approval of the French people. When the first English Exposition based on the same idea met with such marked success, the French were ready to do likewise, and it was decided that the next Exposition to be held in France, in 1855, should be made international, and in 1852 the Emperor directed the building of a permanent structure in the *Champs Elysées*, the principal avenue in the City of Paris, "to receive national exhibitions and to serve for great public ceremonies and for civil and military fêtes."

A company was organized to construct an Exposition building, for which they were to be repaid by a thirty-five years' lease of the site and the profit from the exhibition. The accepted plans for the building were made by Viel and Desjardins. The contract was awarded to York et Cie, with the privilege to make changes in the plan, provided they neither altered the dimensions, the solidity, nor the artistic aspect of the building, which was to be considered as a national monument.

The building was 827 feet long by 354 feet wide, in form a parallelogram. To this principal building was added an Annex, a Palace of Fine Arts, a building containing a panorama of the Champs Elysées, connected with the main building by an arched passage. The area of the several parts of the Exposition was as follows:

Industrial Palace (square feet)	545,934
Annexes	446,955
Panorama and passage	97,116
Palace of Fine Arts	173,768
Gardens and inclosed grounds	237,648
Total area (square feet)	1,501,421

Or over 34 acres. Of this more than one million and a quarter square feet were covered.

There were exhibitors	20,780
Total admissions	5,162,330
Average daily admissions	25,811
Largest attendance one day	123,017
Total expenses, about	$2,201,000 00
Receipts, about	574,000 00
Cost of Industrial Palace	2,524,000 00
Cost of Annexes	777,000 00
Cost of Panorama	194,000 00
	$3,495,000 00

This Exposition opened May 15, 1855, and closed on November fifteenth of the same year. The French Government was wise enough to consider the advantage such an exhibit would be to the nation in many ways, without considering or expecting a direct return from the proceeds of the admission fees. And so satisfactory were the results that the Government, with the approval and sanction of the people, has thrice repeated the Exposition, each time on a grander scale, and is now planning one which is expected to far excel those of the past.

LONDON EXPOSITION—1862.

The success of the first international exposition in London, in 1851, was a source of great satisfaction to the people of England, so much so that

there was strong inclination manifested to repeat it on a grander scale. This desire culminated in 1862.

As at the first Exposition the first active steps were taken by the Society of Arts. The first Commission had used the surplus derived from the Exposition of 1851 to purchase a considerable tract of land in Kensington, a suburb of London, a portion of which they had leased to the Royal Horticultural Society.

In March, 1860, the Society of Arts applied to the Commission, asking for the use of these grounds for an international Exposition, to be held in 1862, provided the society could obtain sufficient funds, by subscription, to meet the expenses. A favorable decision being returned, the society made a public call for subscriptions to the amount of $1,120,000 as a guarantee fund. In June, the required sum having been subscribed, it was thought best to increase it to $2,174,595.

The terms of the agreement made with the Commission were as follows: They engaged to lease the required ground free of rent for the Exposition, at the termination of which all temporary buildings were to be removed. If the profits of the Exposition would allow of the erection of a permanent building at a cost not to exceed $243,000, they would on the receipt of $48,665 lease the lands to the society for ninety-nine years without further cost.

The Queen appointed five Commissioners, at the request of the society, and the Bank of England agreed to advance the necessary funds when all the signatures to the guarantee deed were obtained.

The plans of Captain Francis Fowkes, of the Royal Engineers, being accepted, contracts for the building were let at an estimated cost of $2,092,595. The contractors agreed to complete the building by February 12, 1862, to remove the same after the Exposition was ended, and to receive $973,300 if the profits were less than $1,946,600. If the profits reached that sum, or were in excess, they were to receive $1,459,950, and the Commissioners were privileged to purchase the building for $2,092,595 in lieu of rent or other payment.

The building was commenced March 7, 1861, and finished in April, 1862. It was built principally of brick and iron; the main portion 1,150¾ feet long by 500 wide, and two stories high. The two wings were each 750 feet long by 250 wide. There were towers at the ends of the main building and wings. 7,000,000 bricks, 12,000 tons of wrought iron, and 4,000 tons of cast iron were used in the construction. There were 820 columns of iron, 25 feet long, equal to four miles in length; and 1,266 iron girders, the combined length of which equaled six miles. 1,000,000 superficial feet of lumber was required and used for floors; and 486,380 square feet of felt was used on the roof, equal to eleven acres. 353,000 superficial feet of glass was used, equal to over eight acres, the weight of which was 247 tons. The building was substantial and ornamental, both outside and inside. There were two twelve-sided domes of glass, with an outer and inner gallery to each. They were 160 feet in diameter, and 250 feet high. The interior of the building was beautifully painted and decorated, and the remarkable feat of finishing twenty acres of surface in eight weeks was performed. The principal color was a warm pale gray, with panels of blue and red, relieved by colored lines and circles of black, with stars or rosettes of gold. The iron columns were painted bronze color, relieved with gold color. The capitals were gilt, and ornamental parts picked in with rich red and blue, alternately. The center blocks of the columns were colored red, with bands of blue, or *vice versa*, and gilt moldings. The interior of

the dome was also richly decorated in gold, blue, red, green, and maroon. The colors were selected with taste and applied with skill, by an artist of well known ability and judgment. In suitable positions there were inscriptions and quotations in letters of gold.

The Exposition was opened May 1, 1862. The Duke of Cambridge, representing the Queen, was assisted by Earl Granville in the ceremonies. The exhibition remained open one hundred and seventy-one days.

The total admissions were	6,211,130
Average daily admissions	36,328
Largest admissions for a single day	67,891
Smallest admissions for a single day	5,615
Total receipts from admissions	$1,977,285

At this Exposition, minerals in the crude state and manufactured were made a special feature. The success was not equal to that of 1851. It was almost a failure financially, and its general failure was attributed partly to the war in the United States, partly to mismanagement, and especially to the great frequency of such exhibits elsewhere. It was judged, from the experience on this occasion, that at least twenty-five years should intervene in any one country between international expositions.

PARIS UNIVERSAL EXPOSITION OF 1867.

This Exposition was created by a decree of the French Emperor. The site chosen was the *Champ de Mars*, the parade ground of the *Ecole Militaire*. The grounds were rectangular, and had an area of 119 acres. The building was circular, or rather was in form that of a rectangle with rounded ends, and was in effect seven concentric galleries inclosing a central pavilion surmounted by a dome. The area of the building was thirty-nine acres. Through the center of the grounds and building, from *Pont d' Jena* to the *Ecole Militaire*, ran the wide *Avenue de Europe*. The whole space not occupied by the building was laid out into a beautiful garden with serpentine walks. M. Le Play was appointed general manager. The building was commenced April 3, 1866, and finished by the end of the year. It was formally opened by the Emperor on April first and closed October thirty-first of the same year. Funds for this Exposition were obtained as follows:

From the Imperial Government	$1,165,020
Appropriation—City of Paris	1,165,020
Public subscription, about	2,000,000
Guarantee fund	1,553,360
Total	$5,883,400

Number of days open	214
Total admissions	8,706,037
Average daily attendance	43,561
Largest number of visitors in one day	184,405
Smallest number of visitors in one day	1,002

The total receipts for admissions were 10,765,000 francs; sale of tickets, 8,407,209 francs. When a settlement was made a deficiency was announced of 10,000,000 francs, as shown in the published reports of the Government.

Each gallery was devoted to a special class of exhibits. This I believe was the first instance in which California was officially represented at any international Exposition. Professor William P. Blake was appointed State Commissioner to represent California, which he did to the credit of him-

self and the State. He made a collection of ores, minerals, and characteristic products, in all about 300 specimens. Gold, silver, copper, lead, iron, quicksilver, borax, salt, petroleum, and building materials were shown. A full list of the specimens was published in the *Mining and Scientific Press*, March 23, 1867, vol. 16, folio 178.

Dr. J. B. Pigné, of San Francisco, exhibited a special collection of ores and minerals from the Pacific Coast, including California. These specimens were selected for their beauty and richness in the minerals they represented. At the termination, they were donated to the *Ecole Imperiale des Mines* of Paris. Besides the mineral display, the following names of California exhibitors appear in the reports:

BOOKS.—State Agricultural Society, by reports and transactions.

CEREALS.—A collective exhibit of California cereals was made by J. W. H. Campbell of San Francisco, J. D. Peters of Stockton, and L. D. Perkins of Oakland.

A special sack of high mixed white wheat, weighing one hundred and twenty pounds, was shown by Mr. Campbell, which attracted much attention and was solicited for seed. At the close, what remained was donated to the Royal Agricultural Society of England. A special collection of seeds of cereals and vegetables, one hundred and twenty varieties in all, was exhibited by Mr. Perkins, all of which were donated at the close to the Imperial *Societé de Acclimation* of France.

GLASSWARE, by the Pacific Glass Works, of San Francisco, a large variety.

HOPS.—T. Scheer, of San Francisco, exhibited a bale of hops of excellent quality, which was distributed to those interested, in small samples.

LIFE BOAT MODEL, by J. Reed, of San Francisco.

PAPER.—San Lorenzo Paper Mills.

PUMP—Steam Wrecking—by Harrison & Co., of San Francisco. This, discharging, as it did constantly, a large volume of water, was a conspicuous object in the Exposition.

PHOTOGRAPHS.—C. E. Watkins made a fine exhibit of California views, consisting of a complete set (30) of Yosemite views, and views of the big trees of the Mariposa Grove. These views were mounted in frames of the wood they represented.

Lawrence & Houseworth exhibited photographic and stereoscopic views, twenty-two large views of the Yosemite Valley, four of the Big Trees, twenty-one stereoscopic views of the Yosemite Valley, thirty-three of the Mammoth Trees, forty of San Francisco, seventeen illustrating hydraulic mining, forty-three of placer mining, and one hundred and fifty-eight of California scenes.

Edward Vischer, of San Francisco, sent six photographic albums of California and Nevada, which did not reach the Exposition.

SAW TEETH, adjustable for circular saws. Exhibited by W. P. Miller, of San Francisco.

SOAP AND WASHING POWDERS.—Exhibited by the Standard Soap Company. The following absurd statement appears in the official reports: "The alkali is said to be made from the ashes of the ice plant, which grows in Santa Barbara County."

WINES.—Buena Vista Vinicultural Society of San Francisco exhibited sparkling Sonoma wines.

C. H. Le Franc, of New Almaden, Santa Clara County, red and white wines.

M. Keller, Rising Sun and Los Angeles vineyards, brandy, wine, and bitters.

Kohler & Frohling, San Francisco, Los Angeles red and white wines.

Sansevain Brothers, Los Angeles, wines.

WIRE ROPE.—A. S. Hallidie exhibited round and flat wire rope. The entire exhibit was donated to the *Conservatoire des Arts et Metiers*, at the close of the Exposition.

WOODS.—John D. Boyd, of San Francisco, made a fine display of California woods and veneers, and two doors varnished and highly polished—one of redwood and one of laurel.

WOOLEN GOODS.—Mission Woolen Mills, San Francisco, showed a large assortment of blankets, traveling shawls, cassimeres, and flannels. They were mixed, plaid, and plain, and the blankets were both colored and plain. The peculiar blanket used to collect gold and sulphurets in the sluices was shown and attracted the attention of mining men.

The following Californian exhibitors received awards:

W. P. BLAKE, Commissioner, silver medal, for exhibit of California minerals. This is equivalent to an award to the State.

STATE OF CALIFORNIA, for cereals, also a silver medal.

DR. J. B. PIGNÉ. Silver medal.

MISSION WOOLEN MILLS, for woolen fabrics, bronze medal.

C. E. WATKINS, photographs, bronze medal.

BUENA VISTA AGRICULTURAL SOCIETY. Honorable mention.

The following States and Territories were represented by mineral exhibits, some by large State exhibits, others by a few specimens, sometimes shown by private individuals:

Alabama,	Iowa,	New Mexico,
Arizona,	Kansas,	Nevada,
Arkansas,	Louisiana,	Ohio,
California,	Maryland,	Oregon,
Colorado,	Massachusetts,	Pennsylvania,
Connecticut,	Michigan,	Utah,
Dakota,	Minnesota,	Vermont,
Georgia,	Missouri,	Washington,
Idaho,	Montana,	West Virginia,
Illinois,	New Jersey,	Wisconsin.

VIENNA INTERNATIONAL EXHIBITION—1873.

The Austro-Hungarian Government announced to the Government of the United States its intention to hold an international exhibition in the City of Vienna in the year 1873, by an official letter from Baron Lederer, then Austrian Minister to the United States, to the Secretary of State. This letter was dated June 29, 1870. Baron Lederer asked that the facts be brought to the notice of the proper authorities of the United States.

In due time, by an Act of Congress, passed in June, 1872, the President was authorized to appoint one or more persons to represent the United States at the Exposition, and by joint resolution an appropriation was made of $300,000 to carry out that purpose.

The Exposition was held in the Prater, the great public park of Vienna. It was opened on the first of May, 1873, and closed October thirty-first, of the same year—one hundred and eighty-six days. The park is convenient to the central part of the city and can be reached by walking within thirty minutes.

The main exhibition was held in a single building of great size and of peculiar construction, besides which there were, as usual, a series of annexes, consisting mainly of a large machinery hall, detached from the great building to avoid noise, and smell of oil and smoke.

The main building, the "Industrial Palace," consisted of a central nave

2,953 feet long by 84 feet wide and 74 feet high, with a grand central rotunda 358 feet in diameter and 80 feet high—the largest ever built in the world. Along the line of the building there were sixteen cross transepts, each 572 feet long by 51 feet wide, forming an immense "gridiron," as the building was whimsically called. The buildings were principally wood and quite temporary in character. Brick, iron, and stucco of cement and sand were also largely used in part in the construction. Considerable taste was shown in painting the interior, the principal colors being creamy gray and bronze colors relieved with gilding. The total area of the main building was 1,833,000 square feet, and the machinery hall had an area of 429,000 square feet.

Thirty-one foreign countries made exhibits. The United States was not well represented, and there was much dissatisfaction expressed. The United States Government appointed seven scientific Commissioners, eighty-eight honorary, and eight skilled and practical citizens. The Commissioner-General was H. Garretson. The total number of United States exhibits were six hundred and forty-three, of which California made nine. Total awards to the United States were four hundred and fifty-seven. The total space occupied by the United States in main building, Machinery Hall, and a special Agricultural Hall, was 2,703 square meters=29,084 square feet.

The price of admission to the Exposition was as follows: Sundays, 50 kreutzers=39½ cents; other days, one florin=47 cents. Total admissions, 7,254,687.

The Exposition was so long being arranged that great dissatisfaction was expressed, and it was first considered a failure; but when, toward the close, everything was put in order, it was admitted to be, in a general sense, a fair success. Even the United States managed to gain considerable credit for the practical character of its exhibits. At first the prices of everything rose to an exorbitant rate, but after the first month they were greatly reduced. There was a strike of cabmen and mechanics, which has generally happened at all great Expositions, which caused much inconvenience, but which lasted only a short time. The attendance was large. On June first there were 28,000 visitors, and on the following day 97,108. The average daily attendance for May was 10,200; for June, 40,537. Days open, 186.

Total admissions	7,254,687
Total receipts for admissions	$964,217
Total average daily admissions	39,003
Largest daily admissions	139,000

California was represented by Guido Kustel, a noted local metallurgist, who did the best in his power to advance the interests of the State. No subscriptions could be collected, and the usual apathy prevailed. Booth & Co. intended to send a ten-stamp quartz mill, but the idea was abandoned.

The following names of California exhibitors appear in the United States catalogue:

Buena Vista Vinicultural Society, of San Francisco, California wines. Nonpareil wine and Buena Vista wines, first and third quality, and Pearl of California. This company received a medal.

Eberhardt & Lachman, San Francisco, California wines. Medal awarded.

Houseworth, Thomas, photographs of California scenery, also received a medal.

Harris, Michael, San Francisco, California marble.

Kimball Carriage Company, San Francisco, light road wagon. Gold medal.

Kustel, Guido, San Francisco, minerals from Utah and California. Medal. Fruit with galvanized metallic coating. Honorable mention.

Muybridge, E. J., San Francisco, photographs and landscapes. Medal awarded.

Neumann, J., San Francisco, raw and spun silk. Medal awarded. This exhibit was placed in the Alabama department, and credited to that State until discovered and restored by Mr. Kustel.

Watkins, C. E., San Francisco, landscape photographs of California scenery. Awarded a medal.

Rather an insignificant showing for the great State of California, but remarkable for the number of awards. It will be seen that there were but nine exhibitors and nine awards. Michael Harris failed, but Mr. Kustel received two.

CHILIAN EXPOSITION, SANTIAGO—1875.

This Exposition was created by a decree of the Chilian Government and was under its protection. The site selected was the Quinita Normal (model farm). The building was architectural, rectangular, two stories high. At each corner were square tower-like buildings with pediment, and at each of the four central entrances arches surmounted by statues. The Exposition was inaugurated September 16, 1875, with imposing ceremonies. Italy, England, and the United States were of all foreign countries the best represented. California was well represented, especially by machinery. An engraving representing the exhibition buildings may be found in the *Mining and Scientific Press*, vol. 29, October 24, 1874, folio 265. The California Commissioner was William C. Quimby, of San Francisco.

UNITED STATES INTERNATIONAL EXPOSITION, PHILADELPHIA—1876; GENERALLY KNOWN AS THE "CENTENNIAL."

This was *par excellence the* great American International Exposition. Whatever may be done in the future, it will be difficult to excel this grand national exhibition, which was admitted by foreigners to be in many respects superior to any before held.

History.

On March 3, 1871, the Congress of the United States appointed the United States Centennial Commission, and June 1, 1872, the Commission was instructed "*to conduct an international exposition of arts and manufactures and products of soil and mine, in the year 1876, in commemoration of the anniversary of American Independence.*" The committee was to consist of one representative of each State and Territory in the Union. The State of California was represented by J. Dunbar Creigh, of San Francisco.

The United States made no appropriation and advanced no funds beyond what was required to engrave certificates of stock and to strike the medals awarded to exhibitors; but the Forty-fourth Congress appropriated $1,500,000 for the use of the Exposition as a loan, which sum was afterwards fully repaid. This was after an unsuccessful attempt had been made to raise funds by subscription. Congress also appropriated $649,250 to make a display of the executive departments of the Government. The Exposition was open for six months, from May 10, 1876, to November 10, 1876.

The opening ceremonies were conducted by Rutherford B. Hayes, President of the United States, in person. After a brief but appropriate speech,

he said: "I declare the international exhibition now open," upon which the great American flag was unfurled, followed by the hoisting of the flags of other nations, ringing of chimes, singing of the hallelujah chorus with organ and orchestral accompaniment, and the firing of one hundred guns. The President of the United States, conducted by the Director-General, then made a tour of the main building. As the procession passed the Foreign Commissioners at their respective departments, they were presented to the President and joined in the procession. In the machinery hall the President and the Emperor of Brazil, assisted by George H. Corliss, started the great engine and set the machinery in motion.

Buildings.

There were two hundred and forty-nine buildings, as follows:

Official Exposition buildings	45	Area,	57.531 acres.
Concessions	41	Area,	4.624 acres.
United States Government	7	Area,	2.634 acres.
Foreign Governments	15	Area,	0.855 acres.
Private exhibits	56	Area,	2.765 acres.
Private exhibits (outside)	41	Area,	0.977 acres.
State buildings	24	Area,	1.991 acres.
Public comfort	20	Area,	0.089 acres.
Totals	249	Area,	71.466 acres.

Total cost of buildings	$5,242,295 83
Which sold for	294,245 75
Loss	$4,948,050 08

Main Building.

This building was 1,880 feet long by 464 wide. It was built of wrought iron, brick, and glass. The roof was of boards covered with tin. It was painted inside and out at a cost of $60,483. The area covered by the building was 20.2 acres.

Total cost	$1,763,600 00
Sold for	250,000 00
Loss	$1,513,600 00

Machinery Hall.

Covered 14 acres. It was built at the expense of the City of Philadelphia. It was 1,402 feet long by 360 feet wide. The foundation, five feet high, was of brown stone on a base of granite. The superstructure was of wood. Cost, $634,863 48.

Agricultural Hall

Covered 8.72 acres. Dimensions, 820x540 feet. It was principally wood. 1,111,560 feet of lumber, 211,300 pounds of iron, 243,100 square feet of tin roofing, and 410,000 square feet of felt roofing, and 113,500 square feet of glass were used in the construction.

Total cost	$299,426 62
Sold for	13,100 00
Loss	$286,326 62

Mineral Annex.

This building covered 2.71 acres. It cost $22,007 83, and sold for $1,000.

United States Government Building.

Built principally of wood in the form of a Greek cross. Central nave and aisles, 480x100 feet; cross transept, 340x100; area, 2.33 acres; total floor area, 102,840 square feet. At crossing of nave and transept there was an octagonal dome, above which a large American flag floated. The interior was rough, but was decorated with flags and signals. It was lighted by gas. $578,500 were appropriated for the construction of this building.

Carriage Annex.

Area, 1.95 acres; cost, $60,171 08, and sold for $4,100.

Memorial Hall.

This fine building was 365 feet long by 210 feet wide, and 59 feet high. But little wood was used in its construction. The principal materials used were granite, iron, and glass. It covered an area of 1.5 acres, and cost $1,564,398 56. The art annex covered 1.4 acres, dimensions 395x222 feet; cost $109,045 67, and sold for $3,050.

Horticultural Hall

Was built by the City of Philadelphia, at a cost of $367,073 47. It was 235x80 feet superficial area, and 55 feet high. The materials used in its construction were principally iron and glass.

Grounds.

The total area of the grounds, which were highly ornamental and well kept, was 284.48 acres.

The Exposition was open one hundred and fifty-nine days.

Total admissions	9,910,966
Average daily attendance	62,333
Largest number in one day	274,919
Smallest	12,720

The idea of appointing a special day for each State—known as State days—during which it was expected that citizens should do their best to bring their State into prominence, and to advocate the advantages possessed by it, originated at this Exposition. The same was observed by the representatives of many States at the New Orleans Exposition, and greatly to their credit. At Philadelphia there were ten State days, and twenty-seven addresses were delivered by representatives of other States, but there was no California day nor was there any official address.

Another peculiarity of this Exposition was the institution of a woman's department, which I believe was the first introduction of that feature at any Exposition.

This was in every sense an international Exposition. Twenty-seven foreign countries and seventeen British Colonies were represented.

It will be impossible here to give an elaborate description of this, perhaps the greatest and most successful of all international Expositions, and I regret to say that California did not take sufficient advantage of that golden opportunity, but disappointed her citizens and the world at large.

In the report of the Mineral Annex, the name of California does not appear. The State erected a building jointly with Nevada, and there were a few creditable exhibits, but insignificant when compared with what our State could and should have made. The Commissioners for California were J. Dunbar Creigh and John Middleton, both of San Francisco. The following report on the collective exhibit of California appears in the official reports of the Exposition:

State of California, United States, Collective Exhibit Report.
Commended for a spacious State building containing specimens of the woods of the State, also a very fine exhibit of the natural resources of the State, animal, vegetable, and mineral, made for the citizens of California by the Land Department of the Central Pacific Railroad Company; including a very beautiful shield of the State, about three feet in diameter, carved entirely of the native woods of California; also an exceedingly valuable collection of marine shells of the Pacific Coast, and many interesting specimens of petrifaction.

Cost of the Exposition.

Total expenses		$10,997,980 59
Total income, not including stock account or assets:		
Income account	$4,821,325 78	
Appropriation State of Pennsylvania	1,000,000 00	
Appropriation City of Philadelphia	1,500,000 00	
		$7,321,325 78

PARIS EXPOSITION—1878.

The Paris Exposition—"*Exposition Universelle de 1878*"—was created by decree of the President of the French Republic, which is sufficiently explained by the following extracts from an official letter from M. Bartholdi to Hamilton Fish, Secretary of State of the United States:

LEGATION OF FRANCE IN THE UNITED STATES,
WASHINGTON, May 20, 1876.

Mr. Secretary of State: By two decrees dated respectively the fourth and thirteenth of April last, the President of the Republic decided that a universal exhibition of productions of agriculture, industry, and the fine arts, should be opened at Paris on the first day of May, 1878, and close on the thirty-first of October of the same year. * * * As soon as the regulations and the programme, which the Commission is now preparing, shall have been issued, I shall transmit copies thereof to your Excellency; but I hereby notify your Excellency, by order of my Government, of the opening of this new international exhibition, and through your mediation officially invite the Government of the United States to be pleased to lend its valuable coöperation.

My Government feels confident that the appeal which it addresses to all Governments will be heard; it is convinced that all will respond with sympathy, realizing as they do the advantages of these great enterprises through which nations form new bonds and learn mutually useful lessons, thus insuring the development of their prosperity by labor and peace.

President Hayes, in his message, October 16, 1877, recommended the cordial participation of the American nation in the proposed Exposition.

The Committee on Foreign Affairs reported in favor of an appropriation. Congress, by joint resolution, approved December 15, 1877, accepted the invitation of the French Government to be represented at the Exposition, and authorizing the President to appoint a Commission, to report to the United States under the general direction of the Secretary of State, and appropriating $150,000 to defray expenses. A minority report of Committee on Foreign Affairs reported adversely as to the appropriation. By a subsequent Act of Congress $40,000 more was appropriated.

By the resolution Hon. R. C. McCormick was appointed Commissioner-General by the President and confirmed by the Senate. It was also provided that the Governors of the several States might nominate and the

President appoint two honorary Commissioners. All the States and Territories of the Union accepted this permission. The Governor of California proposed the names of William C. Quimby and Henry G. Hanks, both of whom were commissioned by the President. Mr. Quimby did not go to Paris, and California was wholly represented by Mr. Hanks, who was also appointed Superintendent of the mineral section of the United States, placed on the staff of the Commissioner-General, and made a report on the mineral exhibit of the United States, which was published in Volume I of Reports of the United States Commissioners.

The Exposition was held in the center of the City of Paris; mainly in the *Champ de Mars*, the locality of the Exposition of 1867, and an additional space lying between the river and "*Place du Trocadero.*" The principal buildings of the exposition were the "*Palais du Trocadero*" and the "*Palais du Champ de Mars*," erected on opposite sides of the River Seine, but connected by a magnificent bridge of stone—"*Pont d'Jéna.*" The Trocadero was crescent-shaped, with a central building containing a grand hall, capable of seating five thousand persons. This grand and beautiful building was constructed in the most substantial manner, and has become one of the national monuments of the City of Paris.

The cost of the Trocadero greatly exceeded the original estimates—5,200,000 francs. It was originally intended to be of perishable material, like the building on the *Champ de Mars*, and to be removed at the termination of the Exposition, but it was considered afterwards that it would be better to construct it of durable materials, and in a style elegant enough to place it in a suitable rank with the monuments of the capital, consequently iron and stone were substituted throughout for wood and plaster. The foundations had to be dug very deep, at a heavy cost; and the quarry work required very considerable labor. To sum up all, the Trocadero palace cost 10,000,000 of francs. The superficial area covered was 16,000 square meters. With its additions it amounted to 620 francs per superficial meter, very much more than the first estimates, but a very moderate cost, when the nature and importance of the construction is taken into account, as well as the rapidity of the execution.

This palace, under decision dated May 1, 1879, became public property; and since then has been assigned to the Minister of Public Instruction. In the agreement with the City of Paris, dated May 14, 1877, the Trocadero (without the grounds) was valued at 3,000,000 francs. The cession made to the Minister includes the palace and 22,000 square meters of land.

The Palace of the Champ de Mars, or, as it was frequently called, the Industrial Palace, was more temporary in its character, and has since been wholly removed, leaving the grounds to their former use: a parade ground for troops in front of the military school "*Ecole Militaire.*" The building was 706 meters (2,316 feet) long by 350 meters (1,148 feet) wide. In the center of this mammoth edifice was the municipal exhibition of the City of Paris. This central building was about 500 feet by 150 feet. Through the center of the Industrial Palace ran the "*Rue des Nations*," along which special and characteristic buildings were erected by foreign nations. On the sides of the parade ground and in the gardens, all within the inclosures, were a multitude of annexes, both great and small, some national, some private.

The expenses estimated for the construction of the palace of the *Champ de Mars* were 18,000,000 francs; the actual expenses were 23,000,000 francs in round numbers, say an excess of about 28 per cent.

This result was owing to: First—The construction of a basement of more

than 110,000 square meters, which placed the palace on a general level, and furnished abundant resources for ventilation. Second—By making a change in the machinery galleries, which originally projected upon the Polonceau system, they were constructed in a form entirely new, and made much more elegant. Third—The requirements for decoration (awnings, painting, hangings, sculpture, etc.), which are always difficult to estimate in advance. Fourth—In the establishment of the palace entrance on the Seine. Fifth—In projecting the industrial museum which occasioned an additional expense of more than 460,000 francs in the purchase of materials for its location. Finally, the surface covered was about 226,602 square meters. Its cost for construction and maintenance amounts to about 102 francs per square meter.

From the facade of the industrial palace to the Trocadero, a space of about 2,300x1,500 feet through which the river ran, was laid out in most beautiful ornamental grounds and gardens, superior to any I have ever seen elsewhere in the world. The cost of the gardens of the Champ de Mars was estimated at 1,000,000 francs; the expenses amounted to 1,900,000 francs in round numbers. This increase was owing: First—To the work neglected to be done by the foreign exhibitors upon which the management had counted, and which they were obliged to execute instead. Second—To the rainy weather which made the care of the alleys and gardens very expensive. The space maintained for the garden was about 16 hectares. The cost for both was about 12 francs 60 centimes per meter.

In front of the Trocadero a large body of water fell first in a miniature cataract, then in a succession of lesser cascades into a basin. The width of the stream was about 80 feet, and the length, including the basin, about 400 feet. There were four large gilded statues or figures of animals representing the continents. The cost of the gardens of the Trocadero was estimated at 2,260,000 francs—the actual cost was 2,800,000 francs. The excess was explained by the importance given to the central cascade, and the central fountain, and the increase of the aquarium, which cost nearly 360,000 francs.

The French people are proverbially noted for their taste and love of the beautiful, and no stronger proof could be given of this natural trait than the buildings and grounds of the Exposition of 1878. The French exhibits were profuse in works of art, such as statuary, paintings, architectural designs, carvings, modeling, tapestries, laces, terra cottas, mosaics, and a multitude of minor forms of art and design. Besides the exhibits in the Exposition buildings, visitors had access to the grand museums and art galleries of the City of Paris, and at Versailles. No other country can, in my opinion, for many years to come, hope to vie with France in this particular.

The Exposition was formally opened May 1, 1878, at the Trocadero, by the President of the Republic, Marshal MacMahon, Duc de Magenta, who declared the opening in the following words: "In the name of the Republic, I declare the Universal Exposition of 1878 to be opened," after which, in company with the Prince of Wales, the Crown Prince of Denmark, and other distinguished individuals, he made a tour of the buildings and grounds. Nearly all night the city streets were thronged with people. All churches, public buildings, and monuments were festooned with colored lights and Chinese lanterns.

The Exposition was extended from the first to the tenth of November. There were no official closing ceremonies. The steam engines of the United States section were stopped on Saturday night, the ninth, instead

of Sunday the tenth, the official day, after loud and continued blasts by the steam whistles. The closing of the valves which shut off the steam for the last time was performed by M. Birgen, Director of the foreign sections, who, as he slowly turned the throttle, aptly said: "Although France now cuts off the steam by which the United States has proved the greatness of her inventions, I trust nothing will ever sever the friendship between the two countries."

The Exposition was open one hundred and ninety-four days. The total admissions were 16,156,626; daily average, 83,281. The expenses of the Exposition were vastly greater than the estimates. The total expenses of the Exposition actually paid were 55,271,650 francs, equal to $11,054,330, counting the franc at twenty cents, which is a little over the actual value in American money. Besides this, there were large expenses unpaid, which were afterwards specially provided for by the Government.

The following extract from the official reports shows that the excess in expenses did not cause any regret on the part of the French people:

> The essential cause of this enlargement of expenses is, as has been seen, the very success of the exhibition. If the original plan had been maintained, many of the expenses would have been avoided; but would it have been truly wise to diminish the success by exercising economy? Such a course was never thought of.

The receipts also fell below the estimates:

Total sale of tickets	$12,283,888 69
Season tickets	115,400 00
Entrances, June 3	29,479 70
National lottery, allowed	950,870 00
	$13,379,638 39
Anticipated returns by estimate, $14,000,000; deficit	620,361 61
	$14,000,000 00

The following, from the official reports, explains the cause of this deficiency:

> The principal causes of this deficiency appear to be: first, the donation made to the representatives and agents of exhibitors, to the pupils of the primary schools, etc.; second, the facilities given the foreign Commissioners; third, the persistent rains during the months of June and July, 1878, which detained at home many farmers whose crops were threatened.
>
> In 1867 the total receipts from entrances were 10,765,000 francs.

Resumé of receipts and expenditures as given in official government reports, with concluding remarks:

> Deficiency—To resume: The actual expenses were 55,775,000 francs, and the receipts 24,350,000 francs, making a deficit of 31,425,000 francs. The deficiency estimated in 1876 was but ten millions. This deficit is greatly reduced by taking into account the value of the buildings turned over to the various Ministerial Departments, but it is nevertheless important, and surpasses greatly the first estimate.
>
> Managed as a private enterprise, the Exposition would have cost less perhaps, but it would also have brought less honor to our country.
>
> The Government must, on an occasion like this, seek for moral and political results, and these results were obtained beyond measure. Who dares to say they have cost too dear?

Deficiency in American dollars, nearly 6,000,000. The sale of materials amounted to 3,434,226 francs.

France was greatly benefited by the Exposition, and the City of Paris specially so. During the Exposition the five great railroads brought to Paris 12,145,905 passengers, while within the same period in 1877 the number was only 9,552,414. The difference in favor of 1878 was 2,602,491.

On consulting the registers of the Prefecture of the Police, it was found that from the first of May to the thirty-first of October, 571,792 furnished rooms received tenants, of which 353,170 were French, and 218,622 were strangers. In 1877 (ordinary year), during the same period, the number was 263,018, of which only 78,804 were strangers. The receipts at the theaters of Paris in 1878 was (francs) 18,573,009; in 1877, 8,255,931; in favor of 1878, 10,317,078; figures showing that all branches of trade and commerce were benefited, for the patronage of places of amusement is always an index of a condition of prosperity, or otherwise.

CALIFORNIA AT THE EXPOSITION.

In October, 1877, an effort was made to prepare a collection of the products of California, to be sent to the Paris Exposition, held the following year. The Directors and honorary members of the California Immigrant Union named the following gentlemen as a committee to procure and take charge of the California exhibits: R. P. Hammond, J. R. Scupham, W. C. Quimby, J. H. Culver, and Wm. H. Martin; their action being indorsed by the Governor of the State.

At a meeting of this committee, held October 9, 1877, the following gentlemen were named as a special committee on the mineral collection: A. B. Paul, H. G. Hanks, M. Attwood, A. Derre, E. J. Fraser, and J. P. Jackson, of San Francisco; Wm. Watt, of Nevada County; O. C. Hewitt, Amador County; Wm. Fraser, El Dorado County; Wm. Gwinn, Calaveras County; Charles A. Waldeyer, Butte County; John Townsend, Placer County; H. Bellows, Inyo County; E. Burke, Kern County; H. B. Callahan, Lake County; Wm. Streeter, Mariposa County; C. Aaron, Mono County; N. B. Past, Monterey County; J. M. Redway, Los Angeles County; J. B. Randol, Santa Clara County; Charles Nickerman, Santa Cruz County; H. A. More, Siskiyou County; J. Redman, Tuolumne County; C. E. Chubbuck, Colton, California. Nevada—Jas. G. Fair, R. P. Keating, J. W. Grear, H. G. Blaisdell. Arizona—C. C. Bean, A. P. K. Safford, E. P. Voisard, and Jas. Holden.

Several other names were afterwards added to this committee, and a circular was issued by them addressed to the "Miners of the Pacific Coast," soliciting specimens of ores and all useful mineral productions of the coast, and the loan of such as the owners might not wish to part with, and for which the committee agreed to become responsible. Wells, Fargo & Co., and the railroad and steamship companies, generously agreed to transport all contributions free of charge. The Executive Committee, consisting of Messrs. Paul, Attwood, Derre, Jackson, Fraser, and Heydenfeldt, made the following report, which is condensed from the daily papers of the time:

They commenced their labors after being solicited to do so by a general committee, and after assurance of the necessary pecuniary aid to make a display which would do justice to the mineral resources of the Pacific Coast. They worked actively, having faith founded not only on the assurances of those who were the accredited agents of the Commission, but placing further reliance in the men of wealth and position whose names figured so conspicuously in print as promoters of a most commendable undertaking. They incurred obligations amounting to $800, when it became clear that the general committee was without funds. The Legislature was next appealed to, but without avail. A crisis was reached and the effort would have failed, but at this moment Mr. John W. Mackay, of Virginia City, Nevada, touched the wires, notifying the committee of his donation of $5,500 to carry out the work. The public must not forget to award the credit of the Pacific Coast mineral display first to John W. Mackay for his munificent gift, and also to Wells, Fargo & Co., the Central Pacific Railroad Company, Edward Bosqui, and Wm. T. Coleman & Co. To these alone are thanks due, save to the donators of specimens whose names appear on the catalogue, and to your committee whose labors end with this statement of solid facts. Signed by

ALMARIN B. PAUL, Chairman.

This substantial assistance from Mr. J. W. Mackay enabled the committee to forward and exhibit a creditable collection of Pacific Coast minerals in charge of the Commissioner from California.

This exhibition at Paris, which required for the smaller and rarer specimens ten large showcases, besides tables for the larger samples, was a credit to the State, and did a good work in making the riches and extent of California mineral resources known to the world. There were represented 137 gold mines, 92 silver mines, 23 quicksilver, 18 copper, and 287 specimens of various other minerals, shown in groups of 6, 8, 10, and 20 specimens each. The Pacific Coast collection of minerals won a gold medal; attracted much attention, and was visited by scientific men and capitalists from every land.

On the return of the Commissioner to San Francisco, a meeting of the committee on the Pacific Coast mineral exhibit was held to receive his report, after the reading of which the following resolutions were passed:

Resolved, That in view of the great and material benefit which the State of California will derive from the mineral exhibit at the Paris Exposition of 1878, it is the sense of this committee that the State of California is in honor bound to refund to John W. Mackay the sum which he advanced to this committee for the purpose of enabling it to display the minerals of this State.

Resolved, That the thanks of this committee are due to the Commissioner for his able management, and that congratulations be extended to him for his successful carrying out of the aims of the committee.

A joint resolution of the Legislature of California (approved April 7, 1880) acknowledged Mr. Mackay's liberal action in the following terms:

Resolved by the Assembly, the Senate concurring, That the thanks of the people of California are due, and are hereby extended to Mr. John W. Mackay, of Nevada, for the generous and patriotic aid rendered by him to the Commissioners of California appointed by the Governor to represent the State at the Paris Exposition of 1878, by his donation of $5,500 to defray the cost of transmitting a large and valuable collection of specimens from the mineral resources of California to the French capital.

Resolved, That the Governor be requested to forward to Mr. Mackay a certified copy of this resolution, under the seal of the State.

The Commissioner left San Francisco April 21, 1878, and returned October twenty-eighth of the same year.

As there was at that time no State Museum, and as the specimens were specially collected for that Exposition, it was thought best to donate the whole collection to the French Government, which was accordingly done, and the specimens, in which the entire Pacific Coast is represented, are now in the *Ecole des Mines* at Paris. The following letters, relating to the transfer, were sent and received:

EXPOSITION UNIVERSELLE DE PARIS, ETATS-UNIS D' AMERIQUE,
COMMISSARIAT-GENERAL, PARIS, October 2, 1878.

Honorable R. C. McCormick, Commissioner-General:

SIR: I have the honor to transfer to you, on behalf of the State of California, United States of America, duplicate ores, minerals, and type specimens of noted mines of the Pacific Coast; in the name of Mr. John W. Mackay, of Nevada, specimens of rich ores from the silver mines of the Comstock ledge, Nevada, and from Mr. T. Parrott, of California, specimens of cinnabar and sulphur, from the quicksilver mines, known as the "Sulphur Bank," in Lake County, California. These specimens are for the French Government, and were selected and arranged at the request of Senator Krantz, Commissioner-General.

The specimens are all numbered to correspond with the accompanying printed catalogue of the mineral exhibits of the Pacific Coast.

I have the honor to be, very respectfully,

HENRY G. HANKS,
Commissioner for California.

The following letter was received from the Minister of Public Works of France:

[Translation.]

VERSAILLES, February 4, 1879.

Henry G. Hanks, Superintendent of minerals, etc.:

SIR: The Director of the School of Mines has informed me that the State of California has very generously disposed, by gift, in favor of this school, of the very valuable and rare collection of ores, rocks, and minerals, from the Pacific States, which was on exhibition at the Exposition Universelle of 1878.

I desire you, sir, to express my sincere acknowledgment to the government of the State of California for this act of liberality. I also wish at the same time to return you my thanks for the obliging assiduity with which you have represented your Government in this affair.

Receive, sir, the assurance of my highest consideration.

DE FREYCINET.

Aside from the mineral exhibit, California was but poorly represented at the Exposition. The following names only appear on the official catalogues:

Bidwell, John, Chico—Wheat, 63 to 68 pounds per bushel.

Blowers, R. B., Woodland—Raisins.

California—State mineral exhibit.

Cook, Mrs. M. A., San Francisco—Flowers naturally preserved.

Curtis, J. M., San Francisco—Wine heater.

Dietz, Geo. A., Sacramento—Raisins.

Durban, Charles L., Messilla Valley—Raisins.

Hooper, G. F., Sonoma—Native wines.

Muybridge, E. J., San Francisco—Pneumatic clock.

Sutherland, Mrs. M. A., San Francisco, represented by Thomas B. Oakley, Paris—Jewel boxes in California gold and gold quartz.

Tisch, David, Oakland—Pampas grasses.

Weston, U., San Francisco—Photographs.

University of California, Berkeley—College register.

The following prizes were awarded to California exhibitors:

State of California—Pacific Coast mineral exhibit. Gold medal and diploma.

Curtis, J. M., San Francisco—Wine heater. Silver medal.

Hanks, H. G., San Francisco. Silver medal.

Sutherland, Mrs. M. A.—Jewel boxes in California gold and gold quartz. Bronze medal.

INTERNATIONAL EXHIBITION, MELBOURNE, AUSTRALIA—1880.

The locality of this exhibition was so far from Europe and North America that it did not attract the attention it deserved. As far as I can learn, England and the Colonies made the principal exhibits.

Thomas R. Pickering was appointed executive manager on the part of the United States. No State Commissioners were appointed. If California was represented at all, I have no particulars, not having been able to procure any published reports of the Exposition.

DENVER MINERAL EXHIBIT—1882.

This was a somewhat local mineral Exposition, held in Denver, Colorado, in 1882. It was planned to raise the needed funds by the issue of bonds to the amount of $200,000, drawing eight per cent interest. The Exposition was located four miles from the city, to which street cars ran, conveying passengers for ten cents each way. It was early decided that there should be no rewards or premiums. A very stylish architectural building, constructed principally of brick, iron, and glass, was erected, which was ready

to receive exhibits July fifteenth. The building was in the form of a Grecian cross, with towers at the corners, surmounted at the two main entrances by shapely domes. The building was three stories high. The long arm of the cross was 500 feet long, by 120 feet wide. The short arm was 310 feet long, and the same width. The floor space or area, including galleries, contained 120,000 square feet, or less than three acres. An engraving of this building was published in the *Mining and Scientific Press*, vol. 45, folio 129, and the ground plan on folio 185. The Exposition opened August 1, 1882, and closed September thirtieth of the same year.

The duration of the Exposition was sixty-one days. The Legislature of California made no appropriation, and although considerable attention was called to the importance of making a State exhibit by the press of California, no success resulted from the attempts made by private citizens. It was proposed to send the minerals in the State Mining Bureau, but it was found that this could not be done without a special Act of the Legislature. As there was a general opinion expressed that the State Mineralogist could and should take the responsibility, that official addressed a letter to the Attorney-General for information, to which the following reply was received:

Henry G. Hanks, State Mineralogist, San Francisco:

DEAR SIR: After considering the contents of your letter of the third instant, and upon examining the "Act" to provide for the establishment and maintenance of a Mining Bureau, passed April 16, 1880, I am of opinion that the Governor has no control over the specimens and ores in the Mineralogical Bureau, and that, therefore, permission received from him to remove the specimens, for the purpose of placing them on exhibition at the Denver Exposition, would not add anything to the authority of the State Mineralogist.

The geological and mineralogical specimens which have been collected by or under the direction of the State Mineralogist, are in his charge, and if he causes them to be removed from the State, he will be responsible for their safe return.

I regret that I am unable to find any statute authorizing the removal of these specimens. The State Mineralogist, being a statutory officer, has no authority in excess of that conferred upon him by the statute creating the office and prescribing his duties.

The benefits to the State from a proper exhibition of her minerals at the Denver Exposition would be so great that it will be a matter much to be regretted if we are not represented there.

I have the honor to remain, your obedient servant,

A. L. HART, Attorney-General.

SACRAMENTO, California, August 17, 1882.

In his second annual report, 1882, the State Mineralogist alluded to this subject in the following words:

Much was said on the occasion of the recent mineral Exposition at Denver, as to the State being represented. The same controversy will arise from time to time, and it would be well to come to some understanding on this very important subject, and to decide if it is worth while to take advantage of such opportunities, to the credit of the State. If it is proper and politic to do so, some decided action should be taken in time, and appropriations made to carry out that end. This is clearly a matter which interests the whole State, and not only a few extra public-spirited citizens, who are generally called on for funds at the last moment and unfairly criticised if they fail to respond. This is a mild form of blackmail which is not worthy of our citizens. If it is considered proper to have the State represented at future world or domestic Expositions, it is proper for the expense to be borne by the State, which is benefited as a whole. If this matter is considered in time, there would be no difficulty in making a creditable exhibit; but if left until the last moment, collections are made too hastily and sent forward in an unfinished condition. Yet, in the popular enthusiasm it is too often expected that energy will take the place of painstaking detail, which only can effect the purpose.

Mr. Warren B. Ewer, of the *San Francisco Mining and Scientific Press*, was appointed State Commissioner, by which he was invested with the right to represent the State at his own expense, and as no collections had been made of the resources of California, he went to the Exposition empty

handed, to learn that a large space had been reserved for our State in the most conspicuous part of the building.

Mr. Ewer was in Denver at the opening. He sent a series of very valuable and important communications to his paper, and doing the only other thing in his power, made an eloquent address, in which he apologized for the conspicuous absence of a California exhibit, and gave many facts and statistics as to the natural wealth of the State. From his letters we learn the following facts concerning the Exposition:

It was a mistake to place the building so far from the city. The attendance was not so large as was expected. The Exposition, instead of being international or interstate, as was hoped, was local in its character, being the offerings chiefly of the Western States. Colorado made the largest exhibit. The other principal Territories represented were Utah, New Mexico, Arizona, Idaho, Montana, Dakota, and Wyoming. Nevada made a very creditable exhibit. The mineral exhibits were magnificent and imposing; they are described in detail in the Commissioner's letters. An attempt was made to continue the Exposition permanently. The only California exhibitor mentioned was Edward Denniston, of San Francisco, who had silver-plated copper plates for quartz mills, and his stand was made California headquarters. No financial statement of the Exposition was given, although it was regarded as a successful showing of the natural mineral wealth of the great West, which did much to give confidence in the value and permanency of the mines.

NEW ORLEANS WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXPOSITION—1884-5.

The following general description and history of this Exposition has been taken mainly from the *New Orleans Times-Democrat Almanac for 1885*, and partly from other sources. Much of it is quoted *verbatim*.

HISTORY.

Origin of the Exposition.

The subject of Expositions had been before the people of the South for several years. It was brought notably to the front in a letter of Mr. Edward Atkinson, the well known scientist and expert, which was widely published in August, 1880, and attracted considerable interest. The Expositions of Atlanta and of Louisville were virtually the culminations of this discussion. The idea of making a specialty of a cotton exhibit in an Exposition was suggested by the approach of the centennial of its first export.

The first record of cotton as an industrial product for export from this country is the account of the shipment of six bags (about one bale) from the port of Charleston, South Carolina, in 1784, to England. In one century the export has increased 4,000,000 fold, and the production grown to 7,000,000 bales, and to a value as an export in excess of any known product.

When the scheme was first agitated by the Southern press, it found a host of friends, some of whom allowed their interest to quietly subside before any lasting action was taken.

After a time the design of holding a cotton exhibition simply was abandoned, and the plan enlarged so as to embrace an industrial Exposition of the first order. The highest authority in the land was invoked to give the

proposed Exposition an official existence and recognition among the nations of the earth, and the following Act of Congress was passed:

The Act of Congress.

WHEREAS, it is desirable to encourage the celebration of the one hundredth anniversary of the production, manufacture, and commerce of cotton, by holding, in the year 1884, in some city of the Union, to be selected by the Executive Committee of the National Cotton Planters' Association of America, an institution for the public welfare, incorporated under the laws of Mississippi, a World's Industrial and Cotton Centennial Exposition, to be held under the joint auspices of the United States, the said National Cotton Planters' Association of America, and of the city in which it may be located, and in which cotton, in all its conditions of culture and manufacture, will be the chief exhibit, but which is designed also to include all arts, manufactures, and products of the soil and mine; and whereas, such an exhibition should be national and international in its character, in which the people of this country and other parts of the world who are interested in this subject should participate, it should have the sanction of the Congress of the United States; therefore,

Be it enacted by the Senate and House of Representatives of the United States in Congress assembled, That a World's Industrial and Cotton Centennial Exposition be held in the year 1884, under the joint auspices of the United States Government, the National Cotton Planters' Association of America, and the city where it may be located.

SEC. 2. That the President of the United States may, upon the recommendation of the Executive Committee of the National Cotton Planters' Association of America, appoint six United States Commissioners, and, upon the recommendation of the majority of subscribers to the enterprise in the city where it may be located, appoint seven United States Commissioners, who, together, shall constitute a Board of Management of said World's Industrial and Cotton Centennial Exposition.

SEC. 3. That the President of the United States may, on the recommendation of the Governors of the various States and Territories of the Union, appoint one Commissioner and one Alternate Commissioner for each State and Territory, whose functions shall be defined by the said Board of Management.

* * * * * * * * * * *

SEC. 8. That whenever the President shall be informed by the said Board of Management that provision has been made for suitable buildings, or the erection of the same, for the purpose of said Exposition, the President shall, through the Department of State, make proclamation of the same, setting forth the time at which the exhibition will open, and the place at which it will be held, and such Board of Management shall communicate to the diplomatic representatives of all nations copies of the same, and a copy of this Act, together with such regulations as may be adopted by said Board of Management, for publication in their respective countries.

SEC. 9. That the President be requested to send, in the name of the United States, invitations to the Governments of other nations to be represented and take part in said World's Industrial and Cotton Centennial Exposition, to be held in some city of the United States to be hereafter selected as aforesaid.

SEC. 10. That medals with appropriate devices, emblems, and inscriptions, commemorative of said World's Industrial and Cotton Centennial Exposition, and of the awards to be made to exhibitors thereat, be prepared at some mint of the United States, for the said Board of Management, subject to the provisions of the fifty-second section of the Coinage Act of 1873, upon payment of a sum not less than the cost thereof; and all the provisions, whether penal or otherwise, of said Coinage Act against the counterfeiting or imitating of coin of the United States, shall apply to the medals struck and issued under this Act.

SEC. 11. That all articles which shall be imported for the sole purpose of exhibition at said World's Industrial and Cotton Centennial Exposition, to be held in the year 1884, shall be admitted without payment of duty, or of customs fees or charges, under such regulations as the Secretary of the Treasury shall prescribe; *provided*, that all such articles as shall be sold in the United States or shall be withdrawn for consumption therein at any time after such importations, shall be subject to the duties, if any are imposed on like articles by the revenue laws at the time of importation; *and, provided further*, that in case any articles imported under the provisions of this Act, shall be withdrawn for consumption or shall be sold, without payment of duty as required by law, all penalties prescribed by the revenue laws shall be applied and enforced against such articles and against the persons who may be guilty of such withdrawal or sale.

Location.

The Exposition thus organized, the next thing was the selection of the proper spot for it. This matter was discussed for some time by the Cotton Planters' Association. It was at first proposed to leave it open to bids, the city making the highest bid to have the Exposition. This project, however, did not promise well, and public opinion generally settled down on New

Orleans as the proper location, it being the largest city in the South, centrally located, and the greatest cotton port in the world. It was accordingly proposed that, if New Orleans would guarantee the amount necessary to assure the success of the Exposition, it would be fixed there. This being done, New Orleans was officially chosen as the seat for the World's Industrial and Cotton Centennial Exposition.

ORGANIZATION.

The organization provided for under the Act of Congress, incorporating the Exposition, was finally completed, with the following officers:

Edmund Richardson, President; Albert Baldwin, First Vice-President; William B. Schmidt, Second Vice-President; Samuel Mullen, *Secretary; Thomas H. Hunt, †Treasurer; E. A. Burke, Director-General; F. C. Morehead, Commissioner-General.

Board of Management—Edmund Richardson, Albert Baldwin, William B. Schmidt, F. C. Morehead, Governor R. M. Patton, Thomas Hardeman, Jr., Duncan F. Kenner, E. M. Hudson, Jules C. Denis, Simon Hernsheim, Samuel H. Buck, John V. Moore, G. A. Breaux.

Advisory Finance Committee—Hon. W. J. Behan, Chairman; Robert S. Howard, Jos. H. Oglesby, A. J. Gomila, C. M. Soria.

General Finance Committee—Hon. W. J. Behan, Chairman; Clement L. Walker, Secretary; Jules Aldigé, Bertrand Beer, A. S. Badger, A. Brittin, Jesse K. Bell, Charles A. Butler, E. L. Carriere, John Chaffe, H. Dudley Coleman, E. P. Cottraux, E. F. Del Bondio, James D. Edwards, B. F. Eshelman, John W. Fairfax, R. F. Gray, A. J. Gomila, Robert S. Howard, Andrew Hero, Jr., Frank T. Howard, Sigmund Katz, Carl Kohn, Victor Latour, E. T. Manning, A. A. Maginnis, P. R. Middlemiss, Adolphe Meyer, B. J. Montgomery, A. J. Michaelis, E. Miltenberger, Joseph H. Oglesby, J. G. Schriever, C. M. Soria, Adam Thomson, E. A. Weeks, Joseph A. Walker, E. B. Wheelock, E. D. Willett, B. D. Wood.

*Samuel Mullen resigned his office July twenty-second, and Richard Nixon was elected Secretary.
†Thomas H. Hunt died May 7, 1884, and John B. Lafitte was elected Treasurer May twenty-seventh.

Subscriptions.

This was the preliminary organization of the Exposition, the foundation from which it afterwards arose. It gave it, however, only an organization, nothing more, and the Board of Management began at once active operations to secure popular subscriptions. Appeals were made to the citizens of New Orleans to subscribe to the Exposition stock and a thorough canvass of the city begun for this purpose. These efforts were crowned with success. The citizens, corporations, street and trunk railroad companies, subscribed liberally, raising the needed $500,000. An appeal made to the City of New Orleans brought a donation of $100,000, to be devoted specially to the erection of a horticultural building, that should remain after the Exposition was over and become the property of the city. The State of Louisiana contributed $100,000, and various other States from $5,000 to $30,000 each. When a sufficient amount had thus been realized to assure the success of the Exposition, an appeal was made to the Federal Government to grant similar aid to that given the Philadelphia Centennial in the form of a loan, the Government to advance $1,000,000 to the Exposition, to be paid back out of the first earnings. Such a loan was warmly recommended by President Arthur, and when the bill making it came before Congress, it was adopted with wonderful unanimity. This made the total direct subscription to the Exposition $1,608,000.

Thus recognized by the Federal Government, the Exposition suddenly acquired new force and promise, and its aims and designs were greatly enlarged. In the meanwhile, our Ministers and Consuls abroad had notified foreign Governments that a grand international exhibition was going to be held here, and these foreign Powers were invited to send their representatives and exhibits.

This invitation was accepted by nearly all the invited Powers, and a majority of these countries began at once to make preparations for their displays, making appropriations to this end. Of these the most generous was Mexico, which, through the Federal Government of that republic and the several individual Mexican States, appropriated nearly $250,000 for a complete and thorough Mexican exhibit, including the erection of two handsome buildings for headquarters and for exhibits on the grounds, and the sending of two regiments of Mexican troops, one cavalry, the other infantry, to remain in New Orleans during the Exposition. The various Central American republics made similar handsome appropriations. Throughout the world the same interest was shown in the Exposition, and such far distant countries as Siam and Liberia set aside considerable sums for national displays. The cities followed the examples of the States, nearly all the leading towns having raised funds for the purpose of securing exhibits of their manufactures, industries, etc.

Thus provided with ample funds, the managers set about the task of erecting the necessary buildings, making the scope and general characteristics of the Exposition better known, and issuing invitations to possible exhibitors, so as to secure a full display.

Work in all these branches was continued simultaneously. The Commissioner-General, as well as the European and other Commissioners, traveled from point to point, arousing popular interest in the Exposition, and securing appropriations for it. The supervising architect, with a large force of men, continued the work of erecting the necessary buildings, while from the central office, documents and papers were sent over the world to make known the aims and purposes of the Exposition.

Officers.

The following officers were appointed to carry out this work of erecting the buildings, attending to and adorning the ground, collecting exhibits, etc.:

E. A. Burke, Director-General and Chief Executive Officer.
F. C. Morehead, Commissioner-General.
G. M. Torgerson, Supervising Architcct.
F. N. Ogden, Chief Superintendent.
S. H. Gilman, Consulting Engineer.
Parke Earle, Chief of Department of Horticulture.
George B. Loring, Chief of Department of Agriculture.
B. K. Bruce, Chief of Department of Colored Exhibits.
Samuel Mullen, Chief of Department of Installation.
Charles L. Fitch, Chief of Department of Transportation.
B. T. Walshe, Chief of Department of Information and Accommodation.
Thomas Donaldson, Chief of Department of Ores, Minerals, and Woods.
John Eaton, Chief of Department of Education.
Wm. H. H. Judson, Chief of Department of Printing and Publishing.
Charles W. Dabney, Jr., Chief of Department of Government and State Exhibits.
Mrs. Julia Ward Howe, Chief of Department of Women's Work.

Exposition Park.

While these various officers were being chosen, the Board of Management had finally selected suitable grounds for the Exposition in the Upper City Park, belonging to the City of New Orleans. The park boasts of many advantages. It is a level tract of land, containing two hundred and forty-nine acres, naturally adorned with groves of live oak, with a splendid view of the river, and within easy reach of New Orleans, either by a number of horse car lines or by way of the river, as it faces directly on the Mississippi. The use of this ground was given the Exposition by the city, and work was begun at once on the buildings to be erected there.

Commissioners.

Under the Act creating the Exposition it was provided that the President should, upon the recommendation of the Governors of the several States and Territories, appoint one Commissioner and one alternate for each of them. These appointments were accordingly made by him as follows:

Alabama—E. S. Pratt, Commissioner, Mobile; H. L. Stoutz, alternate, Selma.
Arkansas—C. M. Taylor, Commissioner, South Bend; Sterling R. Cockrill, alternate.
California—Col. A. Andrews, Commissioner, San Francisco; John H. Carroll, alternate, Sacramento.
Colorado—H. T. Sickles, Commissioner, Alamosa; Noel May, alternate, Denver.
Connecticut—Thomas F. Plunkett, Commissioner, Hartford; Benjamin E. Mallory, alternate, Mystic Bridge.
Delaware—William Dean, Commissioner, Newark; Chas. H. Preat, alternate, Georgetown.
Florida—W. H. Sebring, Commissioner, Bronson; W. D. Chipley, alternate, Pensacola.
Georgia—Dewitt C. Bacon, Commissioner, Savannah; Chas. N. Smith, alternate, Castroville.
Illinois—Hon. Frank J. Gilbert, Commissioner, 85 Madison Street, Chicago; Lewis B. Hibbard, alternate.
Indiana—J. R. Carnahan, Commissioner, Indianapolis; W. F. Nisbet, alternate, Evansville.
Iowa—H. S. Fairall, Commissioner, Iowa City; John S. Ely, alternate, Cedar Rapids.
Kansas—Hon. Frank Bacon, Commissioner, Chanute; Hon. G. Y. Johnson, alternate, Topeka.
Kentucky—Judge G. T. Perkins, Commissioner, Covington; E. Polk Johnson, alternate, Louisville.
Louisiana—C. J. Barrow, Commissioner, Port Allen; W. I. Hodgson, alternate, New Orleans.
Maine—J. D. Ham, Commissioner, Lewiston; M. S. Howe, alternate, Biddeford.
Maryland—George W. Bishop, Commissioner, Barnum's, Baltimore; J. Thomas Sharf, alternate, Baltimore.
Massachusetts—J. Howard Nichols, Commissioner, Boston; Edward S. Bradford, alternate, Springfield.
Michigan—A. P. Swineford, Commissioner, Marquette; F. M. Carroll, alternate, Grand Rapids.
Minnesota—Oliver Gibbs, Jr., Commissioner, Lake City; Samuel E. Adams, alternate, Monticello.
Mississippi—S. A. Jonas, Commissioner, Aberdeen; A. B. Hurt, alternate, Winona.
Missouri—F. F. Hilder, Commissioner, 620 Chestnut Street, St. Louis.
Nebraska—Ex-Governor R. W. Furnas, Commissioner, Brownsville; A. Vance, alternate, Osceola.
Nevada—Col. C. C. Thomas, Commissioner, Sutro; George Russell, alternate, Elko.
New Hampshire—George W. Riddle, Commissioner, Manchester; D. W. Johnson, alternate, Claremont.
New York—D. J. Johnson, Commissioner, Cohoes; Eph. Chamberlain, alternate, Utica.
North Carolina—Hon. George Howard, Commissioner, Tarboro; J. Turner Morehead, alternate, Leaksville.
New Jersey—Hon. C. H. Barney, Commissioner, 259 Washington Street, Jersey City; Joseph H. Reynolds, alternate, Camden.
Ohio—Homer Hamilton, Commissioner, Cleveland; J. W. McDymonds, alternate, Massillon.
Oregon—J. Mayer, Commissioner, Portland; T. B. White, alternate, Albany.
Pennsylvania—A. E. Lewis, Commissioner, Milford; R. H. Thomas, alternate, Mechanicsburg.
Rhode Island—Arnold B. Chace, Commissioner, Valley Falls; Hezekiah Conant, alternate, Pawtucket.
South Carolina—A. P. Butler, Commissioner, Columbia; W. S. Mauldin, alternate, Greenville.
Tennessee—A. J. McWhirter, Commissioner, Nashville; John Stack, alternate, Bristol.
Texas—T. T. Gammage, Commissioner, Palestine; H. C. Cook, alternate, Meridian.
Vermont—I. P. Mead, Commissioner, Montpelier; Henry G. Root, alternate, Bennington.
Virginia—Dr. J. M. Blanton, Commissioner, Richmond; James B. Pace, alternate, Richmond.
West Virginia—Philip Pendleton, Commissioner, Berkeley Springs; Alexander Campbell, alternate, Bethany.
Wisconsin—Hon. E. D. Holton, Commissioner, 613 Grand Avenue, Milwaukee; J. M. Smith, alternate, Green Bay.

Territories.

Arizona—Frank M. Murphy, Commissioner, Prescott; Douglas Gray, alternate, Prescott.
Dakota—Alex. McKenzie, Commissioner, Bismarck; John A. Gaston, alternate, Deadwood.
Idaho—George L. Sharpe, Commissioner, Salmon City.
Montana—John S. Harris, Commissioner, Helena; Hon. W. A. Clark, alternate, Butte.
New Mexico—Prof. P. Langhammer, Commissioner, Cerillos; Col. F. A. Blake, alternate, Socorro.
Utah—Jacob Laurence, Commissioner, Salt Lake City; Wm. G. Galligher, alternate, Salt Lake City.
Washington—A. P. Sharpstein, Commissioner, Walla Walla; Hon. C. E. Ferguson, alternate, Walla Walla.
Wyoming—Hon. Homer Morrell, Commissioner, Rawlins; Rev. Geo. C. Rafter, alternate, Cheyenne.

Department of Agriculture.

The Chief of the Agricultural Department was the Hon. George B. Loring, of Massachusetts, United States Commissioner of Agriculture. The executive management was under the superintendence of the Hon. George Y. Johnson, Secretary of the Kansas State Fair, Topeka, who divided the department into the following parts, and assigned them dates and premiums as here given:

Division A—Fat stock, December to January, Edward Hannon, Kansas City, Missouri, Superintendent.
Division B—Horses, mules, and donkeys. Commenced to receive stock December 20; opened formally December 25; closed January 25. Dexter Curtis, Madison, Wisconsin, Superintendent.
Division C—Dogs. January 10 to January 20. Charles Lincoln, Detroit, Michigan, Superintendent.
Division D—Poultry and pet stock. January 15 to February 15. B. N. Pierce, Indianapolis, Indiana, Superintendent.
Division E—Cattle. January 25 to March 1. Samuel Dysart, Franklin Grove, Illinois, Superintendent.
Division F—Dairy products. December 10 to May 31. Dairy tests from February 10 to February 20. Charles E. Marvin, Rochester, Minnesota, Superintendent.
Division G—Sheep and goats. January 25 to March 1. John A. Cross, Cleveland, Ohio, Superintendent.
Division H—Swine. January 25 to March 1. W. Scott Baker, Franklinville, New York, Superintendent.
Division I—Farm and garden products. December 10 to May 31. George C. Brackett, Lawrence, Kansas, Superintendent.
Division J—Farm machinery and utensils. December 10 to May 31. Thomas H. Glenn, Chicago, Illinois, Superintendent.
Division K—Machinery for production of agricultural products. December 10 to May 31. Sylvanus Burtis, Superintendent.
Division L—Humane inventions. George T. Angell, Boston, Massachusetts, Superintendent.
Division M—Buildings department of agriculture. M. Updike, Superintendent.

Dairy Products.

The following committee constituted the Executive Committee of the Dairy Division:

D. W. Curtis, Fort Atkinson, Wisconsin.
W. D. Hoard, Fort Atkinson, Wisconsin.
Hon. Hiram Smith, Sheboygan Falls, Wisconsin.
Col. R. M. Littler, Secretary Produce Exchange, Chicago, Illinois.
Col. R. P. McGlincy, Secretary Elgin Dairy Board of Trade, Elgin, Illinois.
C. C. Buel, Rock Falls, Illinois.
C. A. Huston, Cedar Rapids, Iowa.
Jos. Sampson, Storm Lake, Iowa.
John Moody, Perry, Iowa.
J. W. Sheppard, St. Louis, Missouri.
C. A. Lawrence, New Orleans, Louisiana.
G. W. Simpson, Boston, Massachusetts.
Joseph Real, New York City.

Department of Colored Exhibits.

Hon. B. K. Bruce, Chief Department Colored Exhibits. The following were the honorary State Commissioners:

Hon. Henry Demas, New Orleans, La.
A. Dejoie, New Orleans, La.
Peter W. Ray, Brooklyn, N. Y.
John S. Leary, Fayetteville, N. C.
Rev. James Poindexter, Columbus, O.
Alexander Ferguson, Portland, Or.
Rev. B .T. Tanner, Philadelphia, Pa.
Rev. M. Van Horn, Newport, R. I.
Hon. J. C. Clausen, Charleston, S. C.
Hon. J. C. Napier, Nashville, Tenn.
Joseph Cuney, Galveston, Texas.
Frank Harris, St. Albans, Vt.
Ed. A. Randolph, Richmond, Va.
Chas. Ankrum, Clarkesburg, W. Va.
J. W. Birney, La Crosse, Wis.
J. W. Cromwell, Washington, D. C.
D. P. Hamilton, Wilmington, Del.
Hon. E. C. Smith, Bloomington, Ill.
James T. Bradford, Baltimore, Md.
P. Joseph, Mobile, Ala.
Hon. N. W. Gibbs, Little Rock, Ark.
P. A. Bell, San Francisco, Cal.
Hy. O. Wagoner, Denver, Col
St. John Appo, Hartford, Conn.
Rev. J. E. Lee, Jacksonville, Fla.
Hon. W. A. Pledger, Atlanta, Ga.
W. H. Russell, Indianapolis, Ind.
Alex. Clark, Muscatine, Iowa.
J. L. Waller, Atchison, Kan.
W. J. Simmons, Louisville, Ky.
A. H. Grimke, Boston, Mass.
S. C. Watson, Detroit, Mich.
E. P. Wade, St. Paul, Minn.
M. M. McLeod, Jackson, Miss.
J. J. Bruce, Brunswick, Mo.
E. R. Overall, Omaha, Neb.
John G. Cutler, Hampton, N. H.
R. Henri Herbert, Trenton, N. J.

James Lewis, Esq., Chief of Department of Information and Accommodation (colored), with office at 16 Union Street, New Orleans.

Scope of the Exposition.

The following is an enumeration of the different groupings of exhibits:

1. Agriculture.
2. Horticulture.
3. Pisciculture.
4. Ores and minerals.
5. Raw and manufactured products.
6. Furniture and accessories.
7. Textile fabrics, clothing, and accessories.
8. The industrial arts.
9. Alimentary products.
10. Education and instruction.
11. Works of art.
12. Natural history.

These include everything that can possibly be shown at an Exposition, fair, or other similar display.

GENERAL DESCRIPTION.

The Grounds.

The ornamentation of the grounds was made a matter of special consideration, the general idea being to give effect to the tropical and semi-tropical plants flourishing in Louisiana. For this purpose the general design of ornamentation included Mexican, Central American, Californian, and Floridian gardens, showing the flora of those respective countries and States, particularly the evergreens and those plants flourishing and blooming in the Winter. Groves of orange, banana, lemon, mesquite, and maguey were laid out. Through these ran winding paths, while around the grounds were scattered mounds of flowers, under the shady shelter of the grand guardian oaks adorned with long graceful pendants of Spanish gray moss. Fountains and lakes, all things, in fact, that could delight the eye, were provided, presenting a grand view when lit up at night by the electric light. In the center of the grand lake, lying between the main and the United States Government buildings, named Lake Rubio, in honor of the wife of

President Diaz, of Mexico, 100 feet of fountain stand-pipe rose, throwing out three jets at intervals of twenty-five feet.

Electric Lights.

On the top of a spire rising fifteen feet above this column, an electric light of 100,000 candle power threw its radiance over the falling jets of the fountain and across the waters of the lake. In front of the five principal entrances, a 36,000 candle power electric light was placed, and in five different sections of the grounds, towers 125 feet high were lighted by ten standard arc lamps. Fifty additional standard arc lamps were arranged around the grounds and steamboat landing on the river front.

The Art Hall, Music Hall, and the offices of the management, were lighted by 4,800 Edison incandescent lights, the largest incandescent plant in the world, requiring twelve machines and forty miles of wire, enough to completely light a city of 25,000 inhabitants.

The main building was illuminated by the Louisiana Electric Light Company, requiring a plant of 800 arc lights of 2,000 candle power each.

The Government Building was lighted by the Brush electric light, which furnished 300 arc lights for this purpose. It also gave the Exposition the largest single electric light in the world—one of 100,000 candle power.

Chimes.

The chime of fifteen bells was located in the principal tower of the Main Building, and was played regularly daily from 12 to 1, and from 4 to 5 o'clock. Evening concerts were given.

Professor Widdows, of Washington, of Philadelphia Centennial fame, was the performer, and the bells were from the well known foundry of McShane, Baltimore. By a telephonic connection with the organ in Music Hall, the chimes could be played with the organ, and later with the Mexican band. The chimes were accessible to all visitors, and Professor Widdows welcomed all who visited his tower, to which no fee was charged.

Distribution of Exhibits.

On entering the main portals of the Main Building, the first division or section of exhibits, twenty-four feet in width, with an aisle on either side and extending along the whole front and the larger portion of the river side, was devoted to raw and manufactured products, ore, minerals, and woods.

Just inside of this and running parallel with it, was the next division, for textile fabrics, clothing, and accessories. This was forty-eight feet in width and extended along the whole front of the building.

Along the whole front, just inside the above and forty-eight feet in width, was the section devoted to alimentary products. The next section nearest the center, and twenty-four feet in width, was that for educational exhibits. At right angles with this was the spaces for the various nations of the earth. To the right of Music Hall were Russia, Belgium, Germany, Japan, Siam, China, Turkey, and Asia Minor, and beyond these, agricultural implements. To the left were Austria and Hungary, Italy, Portugal, Spain, France, Great Britain, Denmark, Sweden and Norway, South America and Central American countries, and last and nearest the river, the large space for Mexico.

The entire upper side was devoted to machinery and engines. The Director General's office was just left of the main entrance, and the railroad

ticket office just to the right, attached to which were the transportation and telegraph offices.

The United States exhibits and those of the several States were located in the Government Building.

Horticultural exhibits were confined to Horticultural Hall, and similarly, the lumber products were seen in the sawmill building, the cotton machinery in the cotton building, and so on.

The Machinery Department.

The machinery was erected under the direction of Mr. S. H. Gilman, Chief Consulting Engineer. The department possessed a motive power of twenty batteries of steam boilers, aggregating 5,200 horse power. The largest engine was a Corliss of 650 horse power. The work to be done by the twenty-four engines comprised the driving of 11,000 feet of shafting, the furnishing of power to exhibitors, and to the forty or more dynamos of the Edison, Brush, and Louisiana Electric Light Companies. These alone required about 2,000 horse power.

Samuel Smith, Esq., of the firm of Smith, Myers & Scheur, Cincinnati, Ohio, was Superintendent of Machinery Hall, and Samuel Webber, Esq., of New Hampshire, Mechanical Engineer and Aid to the Chief of Installation in locating machinery.

The Water Supply

Consisted of two compounding duplex Worthington pumps, having a capacity of 4,000,000 gallons in twenty-four hours. They were located in a special pumphouse at the southwest corner of the park, next to the river.

This plant distributed the water through upwards of five miles of pipe, and furnished it to every building in the park, besides supplying the numerous fountains on the grounds. The Main Building alone contained over 10,000 feet of water pipe, with fifty-six fire hydrants, so distributed that five streams of water could be turned on to any point at fifteen seconds notice. The Government Building was equally well protected, besides which there were large pumping engines arranged to throw water at call, both on the Exposition buildings and many of those outside the grounds.

This entire water system was under a constant pressure from a standpipe 100 feet high and forty-two inches in diameter, in which the water was kept continuously at a height of ninety-five feet.

Special Features.

The World's Industrial Exposition presented several special and striking features, as compared with all previous ones.

What were termed "Tropical Displays" were peculiar to it, and so extensive as to be almost a leading feature. In fruits, flowers, plants, and forestry, in cultivated products, in export woods, in mineralogical samples, in native manufactured products, in rich archæological stores, the exhibits of Mexico, the countries of Central and South America, and the West Indies, were complete and comprehensive, unitedly composing an extraordinary display. China, Japan, Persia, Siam, and Australia, also contributed largely to the splendor of the occasion. The exhibits from Great Britain, France, Belgium, Russia, Italy, Germany, and other European countries were large and varied.

The exhibits of the General Government, in magnitude and variety, far exceeded any previous display made by it, not excepting even the magnificent display at the Philadelphia Centennial.

The cotton exhibit, showing cotton from the seed to the textile fabric, through the numerous processes it has to pass, was unique, attractive, and interesting.

The sugar and rice exhibits, displaying the processes of cultivating, harvesting, and manufacturing these crops, all practically demonstrated, have never been seen before at any Exposition.

The live stock display was an interesting feature, including not only cattle, horses, mules, sheep, and hogs, but that useful animal, the dog. A very liberal premium list was offered in this department.

The electrical display was complete; the grounds and buildings being illuminated by the different electric light companies of the world, enabling all to compare their advantages.

The machinery exhibit was enormous, including nearly every variety of machinery used, and especially all those of recent invention.

The exposition of woman's work was an important feature, the desire being to show what woman is doing in all branches of taste, skill, and industry. To this department the Board of Management appropriated $50,000 to assist in making their exhibit complete and interesting.

Another special feature was a department devoted especially to an exposition of the work and progress made by the colored race. The Board of Management assigned the sum of $50,000 to this department also, and the entire galleries of the Government Building were given up to it.

Accommodation Bureau.

A special feature of the Exposition, extremely agreeable and advantageous to visitors, was the Department of Accommodation and Information, organized for the purpose of providing for the visitors to the Exposition, and seeing that they were properly housed and cared for. This department made a thorough canvass of New Orleans during the Summer and Fall, and listed and classified accommodations, covering provision for 50,000 persons, the rates of board ranging from $1 to $3 per day. The main office was in direct communication by telephone and messenger service with the different district offices, by which prompt information was at all times available to the visitor.

The Exposition grounds were reached directly by five lines of street cars and two of steam; by the river, water craft of every character could land at the gates.

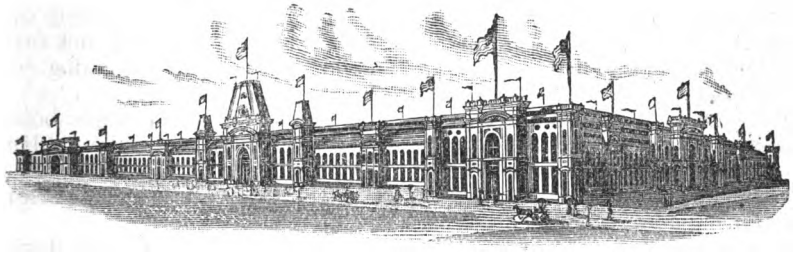
Premiums.

Premiums were provided for the agricultural and stock departments, for the dairy department, and for agricultural and other machinery, a large amount having been set aside by the managers for this purpose. The Exposition itself awarded premiums for oxen, milch cows, horses, mules, sheep, dogs, etc.; for the largest yield of milk, butter, and cheese; for the best displays of certain grain and other agricultural products. The New Orleans Cotton Exchange also offered a handsome list of premiums for cotton exhibits, and other organizations did the same for other articles and displays. In addition to these money premiums, handsome medals were awarded the best exhibits in every department and bureau of the Exposition.

BUILDINGS.

The architect of the Exposition buildings, Mr. G. M. Torgerson, is a Swede, who came to this country in 1867, and settled in the South. His

first success was at Water Valley, Mississippi. When bids were advertised for he sent in plans which were accepted. He has furnished plans required for this report, to be found at the end of this volume, which, I believe, are now for the first time published.



The Main Building.

Plans of this building were open for general competition.

The Main Building was the largest ever erected, and covered thirty-three acres of ground. It was 1,378 feet long by 905 feet wide, without courts, and had a continuous roof composed largely of glass so arranged as to afford an abundance of light without subjecting the interior to the direct rays of the sun. Within, the view was unobstructed. From one side or corner of the building to its opposite, the interior showed all the phases of the exhibit at a glance. There were no partitions, and the lofty pillars, wide apart, supporting the roof structure, presented no impediment to one's vision, but only served to assist the eye in measuring the vast expanse. Wide and spacious galleries, twenty-three feet high, were reached by twenty elevators supplied with the most approved safety appliances, and convenient stairways. The view from them at any and every point was simply superb.

The machinery department occupied a space of 1,378 feet long by 300 feet wide, within the Main Building, and had an iron extension 570 feet long by 120 feet wide, for factories and mills in operation. From the galleries overlooking it, over two miles of shafting could be seen rapidly revolving, driving every known character of machinery.

Music Hall, with a seating capacity, in commodious chairs, for eleven thousand people, a platform capacity for six hundred musicians, and a mammoth organ built to order for the Exposition, occupied the center of the interior.

The Main Building contained the general exhibits, and was situated about in the center of the grounds, a fine view of it being presented from the river, from the city, or from St. Charles Avenue, and showing its resemblance to the palace of the Louvre in Paris.

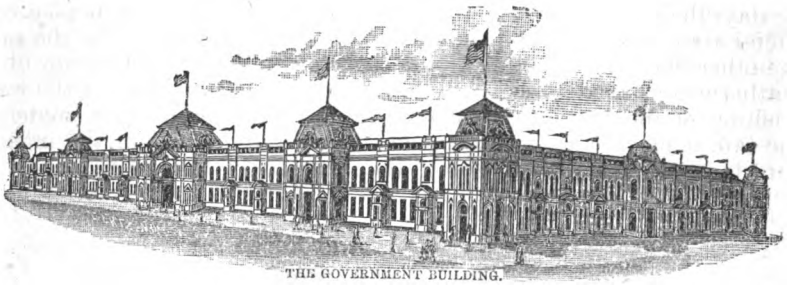
The following figures, showing the total cost of this building, were furnished by Mr. Torgerson:

The net total cost of labor for the construction of the main building amounts to $203,646, representing 94,823 working days, of ten hours. Work was commenced on the main building on the fourteenth day of March, 1884, and it was ready for occupation in time for opening, on the first of December. 9,000,000 feet of lumber were required for the main building. The contract to deliver it in one hundred and five days was awarded to Poitevent & Farre, lumber dealers and producers of New Orleans, who have extensive sawmills at Pearlington, a town on Pearl River, Hancock

County, Mississippi, on the margin of a magnificent growth of timber. The capacity of their mills is 50,000 feet per day. These gentlemen were called on to overcome many difficulties in fulfilling their contract. All the lumber had to be hauled six miles by teams, over muddy roads, during violent rain storms.

The roof of this immense building was so vast that the question of its proper covering was one of cost as well as quality and usefulness. The contract was taken by the Cincinnati Roofing Company, and the materials were shipped from that city all ready to put in place. The material was first covered with asphaltum, and sanded over with some white material to resist the softening effect of the sun's rays. It was claimed that this roof was fireproof, but upon what grounds I did not learn. The area of this roof was about 1,300,000 square feet. Materials used in the construction of the main building:

Timber	9,809,500 feet.
Glass	312,200 square feet.
Nails	301,600 pounds.
Wrought iron	222,356 pounds.
Cast iron	36,920 pounds.



United States and State Exhibits, generally known as the Government Building.

The second building in size was that erected for the United States Government and State exhibits. This was 885 feet long by 565 feet wide. At the time of the adoption of the plans it was supposed that the main building, having the largest capacity of any building heretofore erected, in conjunction with the horticultural hall and such minor outside buildings as were necessary, would afford ample space and accommodation for all exhibits; but the interest in the World's Exposition had become so widespread, and the applications and inquiries for space so numerous, that the necessity for additional accommodation became imperative, and the management determined upon the erection of this magnificent structure, especially for the General Government. In addition to the Government exhibits, the collective State exhibits and the general educational display were located there.

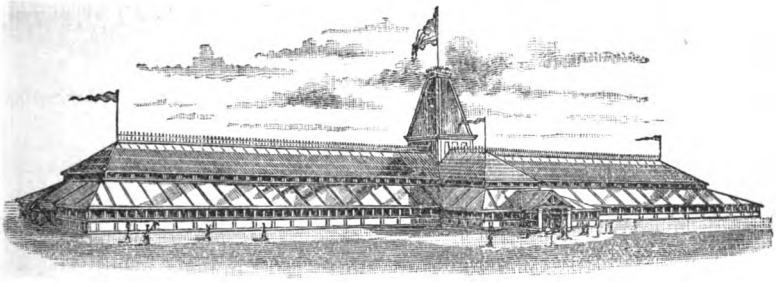
The building was in the renaissance style of architecture. Although it was only forty-three feet high, the altitude was heightened by a series of towers that give to the structure a fine and imposing effect. The roof, or rather series of truss roofs, were managed by the architect in the same ingenious way that was found so effective in the construction of the main building. The interior was a vast open space, being free from partitions or objects calculated to obstruct the general view. The center of the building was devoted to the Government exhibits. The Departments of State, Army, Navy, Post Office, Interior, etc., here found room for the largest and most

complete exhibits that have yet been known. Around these were congregated the exhibits of the several States and of the railroad companies, such as the Union Pacific, Louisville and Nashville, and others. In the galleries were the exhibits of the special department designed to show the industry and progress of the colored race. There were forty pavilions one story high let into the sides of the building, and they served the double purpose of lending architectural adornment and increasing the space allotted to exhibits. The gallery was twenty-one feet from the lower floor and forty feet wide. Numerous skylights and windows served to light the interior.

The most conspicuous and effective structural features were four towers, one in the center of each facade, reaching the height of ninety-six feet. At the base of each was one of the main entrances.

The following cost figures are furnished by the architect: The construction of the Government building, for labor, $108,740, and contains as follows: 5,275,000 feet of lumber, 175,000 square feet of glass, 160,000 pounds nails, 61,722 pounds wrought iron.

On the fifteenth day of August, 1884, the Board of Management gave orders for the construction of the Government Building, and in sixty working days the roof was on. In the beginning of November a Nebraska State official arrived with exhibits and commenced the installation of the same. The other States soon followed suit. At this time the inclemency of the weather commenced to seriously interfere with the progress of the inside finishing of the building, especially in the transportation of materials. The rain made the roads impassable, hence the decision of the management to postpone the opening until the sixteenth of December.

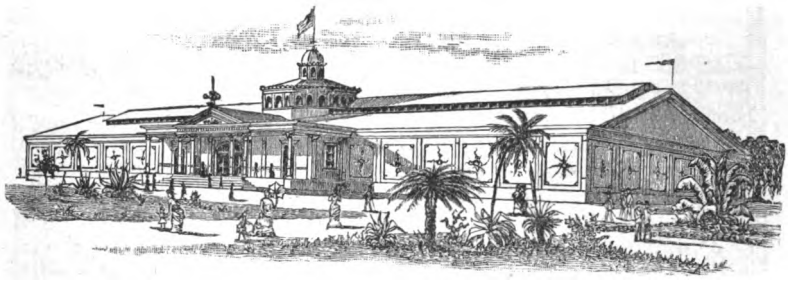


The Horticultural Hall.

The third building in size, and a conspicuous feature of the group, was the Horticultural Hall, which was 600 feet in length and 194 feet wide through the center. It was the largest conservatory in the world. It was substantially built as a durable structure, becoming, by arrangement with the city, a permanent feature of the Park. It was located on high ground in the midst of magnificent live oak groves. Surmounting the center was a tower 90 feet high, roofed with glass. Beneath this tower, in constant play, was a grand fountain. Extending through the center of the hall 25,000 plates of fruit, double the amount ever before displayed at any Exposition, were exhibited. Around the hall were arranged an infinite variety of rare tropical and semi-tropical plants, flowers, and shrubbery, gathered from every available source. Above this display, on a fair decline, the roof appeared almost like a solid plate of glass. In the central

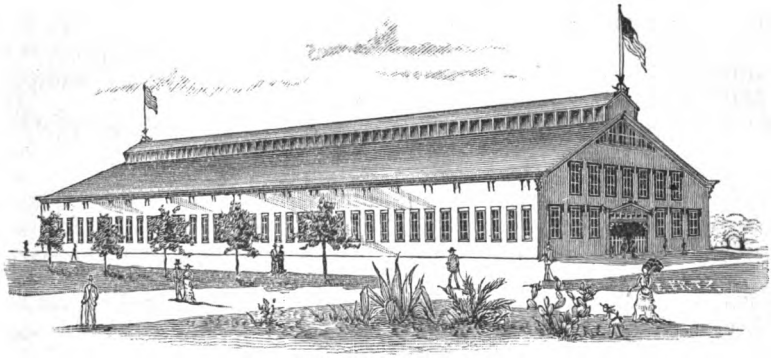
hall, with a much higher roof, only partially of glass, was located a tropical hothouse, 250 feet long by 25 feet wide, in which the most delicate flowers from the far south were nurtured and made to bloom in their most brilliant perfection. Tropical fruits in the various stages of growth were also exhibited. By arrangements for stated supplies and through processes of preservation and cold storage, fruits of every section and the production of all seasons were available for exhibit.

The most eminent horticulturists of the United States arranged and perfected the display. Cash premiums to the amount of $32,000 were offered in this department, and contributions to its exhibits from Mexico, Central America, the West Indies, and the different States of the Union, were unprecedently large and varied.



The Art Gallery.

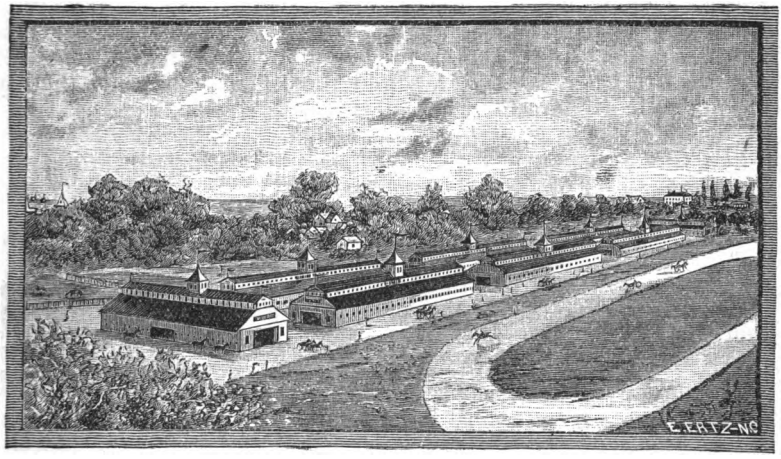
The Art Gallery was 250 feet long by 100 feet wide. It was a structure built of iron. The building was elegant and artistic, so arranged for hanging, accessibility, and light, as to present the best effects, and with ample accommodation for as large a collection as was ever exhibited on this hemisphere. It was fireproof, even the partitions being of iron.



The Factories and Mills Building.

Despite the enormous, and at first apparently extravagant size of the main building, it was found necessary to extend the machinery department. This extension, under the title of the Factories and Mills Building, was at first planned to be 350 by 120 feet, but was finally extended to 570 feet. It was made of iron, to contain the heavier machinery, and in it was especially shown cotton in all its processes of manufacture, and all the

newest appliances. Sugar cane and rice were also shown in all their stages of treatment and manufacture. Here was exhibited cotton from the boll to the bale, and the newly invented cotton pickers, openers, and lappers, as well as the various and complex machinery for ginning, cleaning, baling, and compressing, all in constant operation, a large supply of field cotton being provided for this purpose.



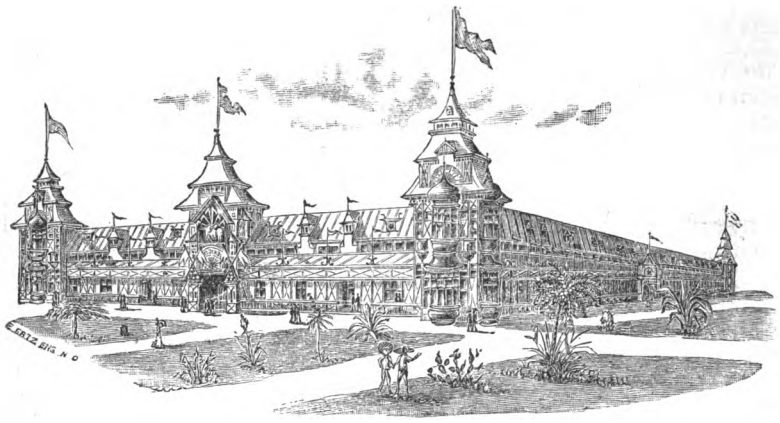
Live Stock Quarters, Stables, and Stock Arena.

The live stock quarters were unusually ample, situated in the northwestern portion of the park, towards St. Charles Avenue, and covered many acres of ground. There were six distinct buildings for horses and two for cattle. The buildings for horses were in two parallel rows, each 386 feet long, 60 feet wide, and 24 feet high. The stalls were arranged on either side—the heads of the animals to the outside, leaving a broad passage through the middle of the building. The buildings for the cattle stand at either end of the parallel rows, and at right angles with them. They were 378 feet long, 72 feet wide, and 24 feet high.

In addition to these live stock structures, a regulation half-mile track was laid out adjoining the line of buildings. The track and space inclosed was also used as an arena for the stock display.

The space devoted to the stock department was 2,080 by 780 feet, covering thirty-seven acres of ground.

Over $125,000 was appropriated by the management in encouraging, making provision for, and promoting the live stock display, a sum unequaled at any prior Exposition or industrial affair, the prime object having been to secure the most comprehensive, varied, and exhaustive representation of the stock interest of this continent that it was possible to do.



The Mexican National Headquarters.

The Mexican National Headquarters was built by the Mexican Government, from the design and under the supervision of their architect, Señor de Ybarrola, and brought to New Orleans for immediate erection. It was located in the southeast portion of the park. It was a triumph of taste and architectural achievement. A quadrangle 192 feet front by 288 feet deep, inclosed an open courtyard 115 feet by 184 feet, according to the general plan of a Mexican gentleman's residence, except that it had more entrances. Graceful towers at each corner and in the center of each side saved it from any accusation of straight line sameness, and gave ample chance for a wealth of florid ornamentation in the most Oriental style. The coloring, too, was ravishing, with its cunning conspiracies of gold and green and maroon, with touches of intense red here and there.

The interior gallery running round the courtyard was terraced, and here was placed a marvelous museum of the brilliant birds and fantastic flowers of Mexico, making a kind of hanging garden, enchanting to all beholders.

Altogether the most attractive feature of the Mexican representation was the octagon building, designed by Señor de Ybarrola, for the mineral display. This was located near the main building, in the most conspicuous part of the grounds, and was a specimen of the purest Saracenic architecture of the third epoch. Each face of the octagon was thirty-two feet wide, thus making an area of seventy-eight feet diameter, the whole supporting a wonderfully exquisite dome thirty feet high. It was built entirely of iron, a combination of columns and arches, with details of the most elaborate and delicate tracery. Viewed at a distance it gave the impression of being made of the finest and rarest point lace, and the dome, owing to a skillful arrangement of tints beneath the iron filagree, was made so light, so buoyant, so intangible, that it seemed not to rest upon but to be poised above the substructure. The spaces between the supporting columns were closed with panels of hard wood elaborately carved in Moorish designs, thus enabling the building to be closed or converted into an open air pavilion at will.

The troops sent over by the Mexican Government to take part in the Exposition were stationed in the headquarters' building.

Other Buildings.

Scattered over the grounds were a number of other buildings. That of the Grand Rapids furniture manufacturers was graceful and attractive. Several of the States had buildings of their own. North Carolina had two—one an office for its Commissioners, made of forty varieties of handsome native woods; the other a Chinese pagoda of mica, devoted specially to the exhibit of precious stones collected by the State. Similarly, other States had offices either for their Commissioners or for special exhibits; so, also, had the Territories, and a number of the towns and cities.

Sawmill Building.

The Sawmill Building stretched from the rear of "The Factories and Mills Building" towards the Mississippi. This was at first designated to be only 600 feet long, but its length was afterwards doubled. A wharf extended from this point into the river, where a boom of logs was provided for use in the fifty sawmills located here.

In addition to these were the several restaurants, lunch houses, and other edifices devoted to public comfort.

The following estimates of the cost of certain buildings were furnished to the State Mineralogist by the architect: The grand total cost for the construction of all the buildings erected by day's work, including plank roads and drainage of the park, amounted to $432,572. To this amount must be added the cost of material, probably amounting to about $400,000. The horticultural hall, art gallery, and machinery hall extension, were put up by contract, and cost together about $100,000; making a gross total of about $950,000.

There was no finish, strictly speaking, to any of the buildings at this Exposition, and no attempt at decoration beyond what was produced by the introduction of flags of all nations, large and small, and special devices of State or railroad headquarters. The woodwork was generally not even planed. In this feature the artistic effect of the Exposition fell far below those of other countries; but this defect was amply made up by the exhibits. The attendance was not large and fell below the number which had been reasonably expected. This was owing to several reasons, which may be briefly summed up as follows: The too recent exhibits of Atlanta, Louisville, and other American localities, and the international exhibits at Amsterdam and elsewhere in Europe; the unexpected difficulties which the management was called upon to overcome, which consumed valuable time and caused the impression to go abroad that the Exposition was a failure, while on the contrary it was a marked success, reflecting the greatest credit on the management. When this was at last admitted, the season was advanced and the weather too warm for comfort to Northern people. This, coupled with the idea that New Orleans was unhealthy after a certain season, prevented many Northern people from visiting the Exposition who otherwise would have been glad to do so.

The Exposition was opened December 16, 1884, with appropriate ceremonies.

At two o'clock on that day there were two hundred persons in the White House at Washington. In the center of the East Parlor a telegraph instrument was placed on a small table; an operator, Mr. Marean, sat at the table—below which stood the President of the United States, surrounded by members of his Cabinet, members of Congress, and promi-

nent men of the country. A telegram was received from President Richardson, of the Exposition, announcing the opening, and presenting the Exposition, through the President of the United States, to the people. The President's reply, declaring the Exposition open, was then returned to New Orleans. After this was read in the Main Building, the President, in Washington, with his own hand, gave the signal, by telegraph, upon which steam was turned on the great engine, and all the machinery was set in motion.

CALIFORNIA.

GEOGRAPHY.

California lies between 32 degrees 45 minutes and 42 degrees north latitude, and between the 38th and 48th meridian of longitude west of Washington. It is bounded on the north by Oregon, on the east by Nevada and Arizona, on the south by the Mexican State or Province of Lower California, and on the west by the Pacific Ocean. It has a seacoast 1,097 miles in length, and an average width of 200 miles. The area of the State approximates 156,000 square miles, or in round numbers, 100,000,000 of acres. Of this area 36,000,000 acres are specially suited to agriculture, 30,000,000 are grazing lands, also adapted to fruit raising; 20,000,000 are mountainous, but contain minerals of great value and timber; 5,000,000 acres are swamp or tule lands, which can, to a certain extent, be reclaimed; and 5,000,000 acres consist of alkaline lands or deserts, a portion only of which can be utilized. There are three principal chains of mountains in the State, nearly parallel to each other, and having the general trend of the coast. The Sierra Nevada is the backbone, so to speak. The rains falling on these mountains divide their waters at the summit, one portion flowing to the Pacific Ocean, the other finding its way eastward into the Great Basin, where it either sinks into the loose, sandy soil, or spreads out into alkaline lakes of considerable magnitude. These bodies of water are kept in a state of equilibrium by evaporation.

The Coast Range is rather a low range of mountains lying near the seacoast, as indicated by the name. In the southeastern part of the State there is another elevation which has been called the Inyo Mountains. This range differs from others mentioned in being highly argentiferous. Owens Valley, which separates it from the Sierra Nevada, is remarkable for its uniform width and great length, extending as it does for one hundred miles in a direction somewhat west of north. The mountain ridges lying both east and west of Owens Valley are the highest in the State, and some of the peaks or summits are the highest in the United States, if not in North America. Mount Whitney rises to an altitude of over 15,000 feet, and the summit may be reached without great difficulty. This celebrated mountain is surrounded by at least a hundred peaks, all of which are over 13,000 feet in height above the sea level. In the more southern portion of the State the mountains are broken into spurs, short ranges, and isolated buttes. It is to this portion of California that we look for a large output of silver in the near future. Other minerals and metals also abound in the irregular mountains mentioned.

The valleys of California vary from alpine meadows, surrounded by snow-clad inclines lying high up in the mountains, to widespread plains, between distant parallel mountain chains. All are fertile. Some require irrigation, others do not, while still others are improved by artificial watering.

There are several large lakes in the State and numerous lakes of lesser magnitude. Some contain pure and fresh water, while others are alkaline or salt.

FORESTS.

While some portions of California are well wooded, others are but sparsely covered with timber, while others still are entirely bare.

The Sierra, to an altitude of 8,000 feet, and some portions of the Coast Range, are clothed with magnificent forests of pine, fir, spruce, and cedar. Oaks do not appear at an altitude above 5,000 feet. The so called "big trees" of California—the Washington Cedar, or *Sequoia Gigantea* of the botanist—live only at a great altitude (from 5,000 to 8,000 feet), and not, as generally supposed, in two or three isolated spots, but in great abundance, extending for many miles along the line of altitude mentioned. They are too large to be conveniently handled, but the lumber and timber would be useful if it were accessible, which it practically is not. These trees seldom fall from natural causes, and when they do they lie from 800 to 1,000 years without material decay, like the granite or syenite obelisks left unfinished in ancient Egyptian quarries. These vegetable columns sometimes rise to an altitude of 400 feet, and in some cases measure forty feet in diameter at the base, although generally not more than thirty feet. Along the northern coasts grow the redwoods, from which a large portion of the lumber and timber in general use is obtained. These trees are also very large, some of them yielding from thirty to forty thousand feet of lumber. The wood is durable, easily worked, and has a straight grain and rich color. It is extensively used in California for building and other purposes, and is largely exported, latterly to London, where it is in great demand and commands fancy prices for ornamental purposes. Other useful and durable woods are found in abundance in the State.

SCENERY.

Our State is noted for its magnificent scenery. In the California Alps, the region surrounding Mt. Whitney, may possibly be found as superb landscapes and commanding views as at any locality on the face of the earth. This region of the State surpasses even the Yosemite and Hetch-Hetchy Valleys, celebrated the world over for their exceptional beauty and grandeur. Since visiting Mt. Whitney and the picturesque country in its vicinity, it has remained a mystery to me why tourists and lovers of nature in her grandest and wildest moods, do not flock to the locality and revel in its beauties.

Rugged mountain peaks of granite, partly covered with perpetual snow, mountain streams filled with trout, splendid cañons, wild rocky gorges, mountain meadows, lakes of purest water, cascades, cataracts, waters that "fall and pause and fall," mural cliffs rising to a dizzy height, dense and almost impenetrable forests, an atmosphere bracing and smelling of ozone, or redolent with the odor of fir balsam and pine needles, are a few of the attractions of the higher altitudes. Lower down are boiling springs, volcanic cones surrounded by extensive beds of ancient lava, and even a miniature Sahara with accompaniment of shifting hot sands and moving whirlwinds, alkaline lakes, and scattered sage-brush. Silver and gold mines may also be visited in the vicinity, the mountains are ribbed with undiscovered mineral wealth, and all of these attractions are within thirty miles or so of a well appointed narrow gauge railroad. Why all these natural beauties should go begging for appreciative observers, and not be eagerly sought by ubiquitous tourists, can only be accounted for by their ignorance of the facts I have here stated.

CLIMATE.

So much has been said and written of the climate of our State, that it is quite unnecessary to dwell upon the subject. As to temperature, almost any degree may be selected from a large assortment. It is only necessary to consider well what would be most agreeable, and then to seek it in the varying climes of Death Valley, the arenaceous plains of the Colorado or Mohave Deserts, among the snows and pines of the high Sierras, in the mountain valleys, in the fogs among the redwoods of the northern coast, or in the streets of Crescent City, San Francisco, Monterey, Los Angeles, or San Diego.

AGRICULTURAL RESOURCES AND PRODUCTS.

Thirty-five years ago agriculture was almost unknown in California. Now it is the mainstay of State industries, both present and prospective. The adverse opinion I have formed as to the policy of raising enormous crops of cereals in California, to send abroad, discounting the future, so to speak, by extracting from our fertile soil the elements of that fertility and sending it out of the country, may be erroneous, but I fear not. The facts, however, remain.

The average annual production of cereals for the last five years, may be seen by the following estimate:

Wheat, 45,000,000 bushels, value	$50,000,000
Barley, 10,000,000 bushels	7,000,000
Oats, 3,000,000 bushels	2,000,000
Rye, 300,000 bushels	200,000
Buckwheat, 5,000 bushels	5,000

The annual shipment of wheat and flour from San Francisco amounts to about 1,250,000 tons, of the aggregate value of nearly $40,000,000. 1,250,000 barrels of flour are made from the wheat crop by 200 flouring mills in the State, of which 120 are steam, while 80 are driven by water. The yield of the cereal crop is from 20 to 30 per cent higher in California than in States east of the Mississippi River, and there has never been a general failure of this crop in this State.

Almost every kind of vegetable can be grown in California, in some localities without, and in nearly all parts of the State with irrigation. Under favorable circumstances they grow luxuriantly, some of the vegetables raised in our State having been noted for their large size. Thus we have produced squashes of good quality weighing 260 pounds each, 800 pounds, in one instance, having been raised on a single vine. We have grown cabbages weighing 50 pounds; beets weighing 118 pounds; watermelons weighing 110 pounds; and carrots, turnips, and other vegetables of corresponding size.

The number of fruit trees in the State is roughly estimated at 8,000,000, divided as follows: Apple, 2,700,000; peach, 1,200,000; pear, 500,000; plum and prune, 600,000; cherry, 400,000; apricot, 500,000; orange, 1,600,000; lime and lemon, 500,000. Aside from this estimate there are several hundred thousand fig trees, olive, quince, and other fruit-bearing trees, not to mention a vast number of currant and berry bushes of every description. The fruit crop is never wholly gathered, large quantities going to waste every year. Some of the surplus is dried and canned, and thus saved from loss.

The horned cattle of California now number 800,000 head—one third of the number in the State thirty years ago; but those remaining are of im-

proved breeds, a considerable portion being kept for dairy purposes, whereas formerly cattle were only valued for their hides and tallow.

Dairying is extensively conducted in California. For a number of years the production of butter alone has been estimated at 11,000,000 pounds, and of cheese at 4,000,000 pounds.

It is estimated that there are 5,000,000 sheep in the State. The wool clip is approximately 40,000,000 pounds, of an estimated value of $8,000,000.

Grapes and Wine.—Certain extensive areas in California are specially adapted to the culture of the grape. The wines are not only good, but the product is generous. Mr. Wetmore, a California authority on the subject, estimates that in 1885, 70,000 acres of vines were in bearing. The vintage for 1881 was 12,000,000 gallons; in 1882 it was 9,000,000 gallons; in 1883, 9,500,000 gallons. I have not convenient data for more recent production.

Honey.—There are 1,000 bee-keepers in the State, and 100,000 colonies of bees. Each colony produces 200 pounds of honey annually, or 20,000,000 pounds in all. Of wax, each colony yields five pounds, or an aggregate of 500,000 pounds. The value of the wax, at 25 cents per pound, amounts to $125,000. The honey is of the best quality, and is largely exported to Germany, Glasgow, Paris, and Liverpool, the bulk of the export going to the latter port. Most of the honey so exported is first extracted from the comb.

All of the agricultural products of California were well represented at the Exposition, the effect of which must and will be felt, and will in all probability cause immigration of the better classes to our State.

San Francisco, our principal city, is destined to become one of the largest and most important in the world. From Acapulco, in Mexico, to the Straits of Fuca, there is no other perfect harbor. Here a ship can be sailed in without a pilot. San Francisco is as well situated for a manufacturing as for a commercial port. The climate is such that laborers and mechanics, artisans, etc., can work every day in the year without discomfort, there being no extremes of heat and cold. A noble, navigable bay, without impediments, extends east and south many miles from San Francisco. The shores of the bay are already settled, and villages and garden grounds extend on every side. To the east lie the western and middle States and Territories; to the south, Mexico, Central and South America; to the north, Oregon, Washington Territory, British Columbia, and Alaska; to the west, and beyond the Golden Gate, is the broad Pacific, a roadway to China, Japan, the Indies, and Australia, and to the Islands of the South Seas.

HISTORY.

Events resulting from the advance of civilization, within the historic period, have operated slowly but continuously toward the settlement of the American continent. What may have happened before the birth of history is unknown to us, or we can only glean traces of the past from geological study, and contemplation of silent ruins left by unknown races. To the thoughtful student of prehistoric relics a singular line of inquiry is suggested. The remains of the ancient civilizations of Chili and Peru appear to antedate other American ethnological records, and have a curious correspondence to the earliest traces of human life in Europe and Asia. It is even possible, and perhaps probable, that this continent was the birthplace of civilization, and that Asia and Europe were peopled from America by way of Behring's Straits, in the north, or, still more likely, that boatloads of people drifted across the Pacific before the trade winds from the coast of Peru, as ably argued by Charles Wolcott Brooks, of San

Francisco, in a valuable paper read before the California Academy of Sciences. Be this as it may, in compiling a brief history of California we must confine our investigations within the bounds of written history.

It is curious to consider the influence of nature's laws in shaping the acts and destiny of man. The revolution of the earth on its axis produces the trade winds, and causes the phenomena of the tides. The trade winds, blowing always from the east, make it easier to sail westward than to return. Hence, "Westward the star of empire takes its way." The inclination of the axis of the earth to the plane of its orbit causes the change of seasons, and renders one part of the earth more desirable than another as a place of residence. Not only do the trade winds make it possible to sail safely for long distances westward, but in many cases vessels have been forced to sail before them when blown from an eastern shore. Posidonious, as quoted by Strabo, writes: "Starting from the west, one might, aided by a continual east wind, reach India in so many stadia."

The Chinese are supposed to have been the earliest sailors, and are accredited with the discovery of the magnetic needle, which was first a bit of loadstone, floated on a chip in a vessel of water. The Chinese had large ships before the birth of Christ, and so also had the Carthagenians and Phœnicians.

The first ventures made by men living near the shores of the sea were fishing voyages in canoes, or on logs, rafts, or catamarans. From this the next step was to canoes, cut from logs of great size, capable of carrying many men, such as are now used by the South Sea Islanders. When these were not long enough, composite vessels were built in which pieces of timber were fastened together, but which were still impelled by oars. Sails were first used to assist the oars in propelling the primitive ships. As the art of building ships improved, longer voyages were undertaken, and sailors became more venturesome, but still followed the coast from cape to cape or from island to island. Pytheas, a native of Masilia, explored the Baltic and sailed to the north, passing Great Britain and Scotland and reaching Thule. The island to which this name was given may have been Iceland or the Shetland Islands. As explorers extended their navigation to the south, by the way of the Red Sea, and west in the Mediterranean, they came at last to the Pillars of Hercules, now the Straits of Gibraltar, or to Bab El Mandeb, the gate to the Red Sea, face to face in each case with a great unknown ocean. Coasting north in the former instance they reached Britain, and sailing south in the latter they entered the Indian Ocean, and discovered and fully explored Madagascar and the eastern coast of Africa, now thought to be the Ophir of Solomon. Sailing east, they found ports in Arabia and India. They doubled the Cape of Good Hope and probably visited Central and South America and the West India Islands. The ancients knew that the earth was a sphere. Pythagoras showed his pupils that our planet cast a circular shadow on the moon in the time of an eclipse. The Greek philosophers taught that the earth was a sphere and mentioned antipodes.

In an old book (*American Antiquities and Discoveries in the West*, by Josiah Priest, Albany, 1835), I find a quotation, showing that in 1821 a planter living near Montevideo, in Uraguay, South America, found in a field a tombstone upon which Greek characters were inscribed. This stone was raised, and a shield, helmet, and swords were found beneath, and an earthern vessel or amphora. The Greek inscription, with the exception of a portion, which was nearly obliterated, translated thus: "During the dominion of Alexander, son of Philip, King of Macedonia, in the sixty-third Olympiad Ptolemais * * *." On the helmet was a design representing

Achilles dragging the corpse of Hector around the walls of Troy. In the private collection of President Soto, of Honduras, exhibited in the California State Museum in 1883, a sculptured sphynx was shown. This would indicate that the ancient people of Copan were at least in communication with those of Europe. The universal custom of erecting tumuli must have had a common origin with a similar practice in ancient Europe and Asia.

The Greeks thought that in the north, ice and snow would put a bar to navigation, and in the south the heat would become so great as to melt and burn any ship or people, and to the west the sea would grow shallow or change to a morass, where Atlantis sank. Plató believed that mariners could sail east or west, and either return to the same point or meet with unknown continents. He asserted that the fabled Continent of Atlantis was greater than Europe and Africa combined. Virgil had heard of a western land; Tibullus of another world in the great ocean, and declared that it would be possible to sail from Spain to India, were not the Atlantic Ocean so wide. The fable of Atlantis was probably based on the stories of returned voyagers from America. The "Islands of the Blessed," lying to the west, mentioned by Strabo, historian and writer, are thought to be the Canary Islands, but possibly were the West Indies. The Romans sailed to Britain in the time of Cæsar. Agricola, Governor of Britain, in the time of the Emperor Vespasian, sent a fleet westward through the Pillars of Hercules, which sailed around Britain, and "saw Thule from afar."

California, although one of the younger States of the American Union, is old in history. Seventy-eight years before the Mayflower landed her load of pilgrims in Massachusetts, and forty-three years before Sir Walter Raleigh attempted a settlement on Roanoke Island, Upper California had been discovered, and it was settled and missions established within its borders before the Revolutionary War.

The word California first appears in the writings of Bernal Dias Costello, companion and historian of Cortez. Its origin is unknown. Michael Venegos, in his *Natural and Civil History of California*, published in 1758, expresses the opinion that the name was derived from an accidental word or misunderstood Indian name.

The following chronological events led ultimately to the discovery of California:

982. Eric the Red, a Norman, visits Greenland.
985. Bjorn Heriulfsson, also a Norman, sighted the coast of Labrador.
1000. Leif, also a Norman, visited Vinland.
1035. Frisians sail from the Weser to the north.
1147. Arabs sail from Lisbon into the great ocean.
1170. Madoc sails westward from Wales.
1284. Vivaldi and Dorea sail from Genoa into the ocean.
1280.–1295. Marco Polo travels in China and Japan.
1326. Spaniards visit the Canary Islands.
1420. Island of Madeira discovered by the Portuguese.
1432. Azores Islands visited by the Portuguese.
1446. Cape De Verde Islands discovered by the Portuguese.
1486. Bartholoma Diaz reaches the southern cape of Africa.
1492. August third, Columbus sails from Palos, Spain, westward to discover the Indies.
1513. The Pacific Ocean was discovered by Balboa.
1523. Charles V assisted Cortez to search for a strait to the Spice Islands.
1534. Lower or Old California was discovered by Fortun Ximenez, a commander or pilot under Cortez, or by Hernando de Grixalva, in the month of February of that year.
1535. Cortez coasted both sides of the Gulf of California with four hundred Spaniards and three hundred negro slaves.
1541. California was known as a peninsula, but this discovery was forgotten for over a hundred years, during which period it was thought to be an island, and was called "Islas Carolinas."

1542. Juan Rodriguez Cabrillo sailed along the northwest coast of America. He discovered Upper or New California, and sailed as far north as Cape Mendocino.
1553. New Mexico was discovered. The Spaniards introduced agriculture, and worked some rich mines near Santa Fe.
1579. Sir Francis Drake discovered the coast of Upper California, which he named New Albion.
1587. Captain Thomas Cavendish fell in with Cape St. Lucas, and soon after captured the annual Spanish galleon.
1596. Gaspar de Zunega, Count de Monte Rey, was ordered to make explorations of the coast of California.
1683. Expedition ordered by Court of Spain. Command given to Don Isodoro Otondo. Father Kuhn or Kino was made spiritual commander. He rediscovered the fact that California was not an island.
1697. The Jesuits asked permission of the Crown to make spiritual conquests in California.
1708-9. Captain Woodes Rogers sailed from England and touched at some uncertain port in California.
1741. The Russians advanced seven hundred and twenty miles southward from Cape Mendocino.
1743. Spanish galleon touched for the first time at the Port of Cape St. Lucas.
1746. The Jesuit, Fernando Consag, explored the Gulf of California.
1747. The Jesuits had established forty-three missions in California.
1767. The Jesuits were expelled from California.
1769. The Mission of San Diego was founded by Junipero Serra.
1769-70. The missionaries, in extending their spiritual explorations, journeyed northward, and in December, 1769, or January, 1770, discovered a great bay, which they named San Francisco, from their patron saint.
1776. The Mission of San Francisco was founded. A supply ship, which arrived August eighteenth, was probably the first vessel to enter the Golden Gate.
1812. The Russians took possession of Bodega Bay, and subsequently of Fort Ross.
1841. During this year the Russians abandoned Fort Ross and sold the property to Captain John A. Sutter.
1846. In January of this year, Colonel John C. Fremont arrived at Monterey. In May, General Taylor crossed the Rio Grande, and war was commenced in Mexico. July fourth, Fremont called a meeting of citizens of Sonora, who asserted California's independence, and declared war against Mexico. On the tenth of July the American flag was hoisted at Monterey and San Francisco.
1847. California was ceded to the United States on payment of $15,000,000. On the sixth of March, the ship "Thomas H. Perkins" arrived with a portion of Stevenson's regiment. The war with Mexico was already ended.
1848. January nineteenth Marshall discovered gold at Sutter's Mill. The treaty of Guadalupe Hidalgo was signed at this time.
1849. February twenty-eighth, the first steamer that ever entered the Golden Gate, the "California," arrived at San Francisco.
1850. California was admitted to the Union, and became a State.

Californians have been unjustly accused of making exaggerated statements when speaking of the varied resources and the climate of their State. We were, ourselves, surprised when we became aware of the value and importance of the land we had selected for our abode. We came to the New El Dorado to dig in the placers for gold. We remained to make homes and to develop resources little suspected by the peaceful invaders who swarmed like locusts on the golden shores. We thought the country fit only for mining, until, almost by accident, was discovered fertility in the soil, and its fitness for agriculture proved. As a reward for their industry and foresight, the pioneer farmers were soon enabled to sell to the miners, at exorbitant prices in yellow gold, the finest vegetables and fruit. They imported bees and set them to work gathering sweets from the beautiful wild flowers of California, and the stores of honey these industrious insects laid up was a new surprise. Fields were sown with wheat and other cereals, which yielded handsome returns. Fruit trees, experimentally set out, rewarded the planters with abundant crops in the course of a few years. In the meantime we made salt, burned lime, made bricks, erected sawmills, tried our hand at wool manufacture, built a few miles of railroad, and, in a word, as far as we were able, or could spare time from mining, endeavored to supply our growing wants from the native resources of the State.

During the first few years, the yield of gold did not materially diminish, but farming greatly increased, and the agricultural districts gradually rose in importance, until our noble bay was crowded with ships from foreign lands, which bore away to hungry Europe our enormous surplus crops of wheat. Wool and wine became, also, important factors in the general prosperity of the State.

CALIFORNIA MINERAL EXHIBIT IN THE GOVERNMENT BUILDING.

The total area occupied by the collective exhibits of California was 14,450 square feet of ground-floor, and a portion of the gallery with an additional space of 2,550 square feet. The space set aside for our State was larger than for any other except Texas. It is a pleasure to state that all the space was filled, and creditably filled, with the varied resources of California. The space devoted to the State mineral collection was near the State headquarters, on both sides of the entrance. It was so arranged that persons having business or visiting the official department passed between rows of plate-glass museum cases, the number of and the general arrangement of which have been mentioned before. The collection was classified into four groups—ores, minerals, rocks, and manufactures.

Many persons are under the impression that gold, silver, copper, and quicksilver, make up the sum total of the mineral products of California; this is a mistake; other valuable and useful minerals are abundant.

In the last report of this office (Fourth Annual Report of the State Mineralogist for the year ending May 15, 1884), a catalogue of all the distinct mineral species known to exist in California, was published; the number described was one hundred and sixty-one. Varieties were described but not numbered. The following is a classified list of the species. The numbers are those of the fourth annual report:

Arseniates.

57. ERYTHRITE. Etym. *Red* (Greek). Arseniate of Cobalt.
83. LEUCOPYRITE. Etym. *White* (Greek), and *Pyrite;* Arsenical Iron.

Antimoniate.

18. BINDHEIMITE. Etym. "*Bindheim,*" the chemist who first analyzed it. Hydrous antimoniate of lead, or a compound of the oxides of the two metals; the antimony oxide acting as an acid, the lead as a base.

Borates.

21. BORATE OF STRONTIA. Mentioned in letter written by Dr. John A. Veatch to the California Borax Company, quoted in full in the Third Annual Report, Part 2, Fol. 15.
22. BORAX. Etym. *Boorak,* or *Baurach* (Arabic), Bi-borate of Soda, Tincal, Native Borax, etc.
112. PRICEITE. Etym. *Price,* San Francisco chemist. Pandermite is a variety of priceite. Colemanite is also a variety of priceite.
154. ULEXITE. Borate of Lime, Tiza, Boronatrocalcite, Natroborocalcite, Tinkalzit, Cotton Balls, Sheet Cotton, etc. Named from Ulex, a noted chemist.

Carbonates.

9. ARAGONITE. Etym. *Aragon,* a province in Spain. Carbonate of Lime.
15. AZURITE. Etym. *Azure, a blue color.* Mountain Blue, Blue Malachite, Chessy Copper, Azure Copper Ore, etc. Hydrous Carbonate of Copper.
20. BISMUTITE. Etym. *Metal Bismuth.* Hydrous Carbonate of Bismuth, Stream Bismuth.
26. CALCITE. Etym. "*Calx*"—lime (Latin). Carbonate of Lime, Calcareous Spar, Calc Spar, Dogtooth Spar, Iceland Spar, Limestone, Lithographic Stone, Marble, Stalactite, Stalagmite, Travertine, Tufa, Thinolite, Anthraconite, etc.
30. CERUSITE. Etym. *Cerussa* (Latin). White Lead, Carbonate of Lead, White Lead Ore, etc.
47. DIALLOGITE. Etym. *doubtful* (Greek). Rhodochrosite, Carbonate of Manganese.

50. DOLOMITE. Named from the French geologist Dolomieu. Carbonate of Lime and Magnesia.
62. GAY-LUSSITE. Etym. *Gay-Lussac*, French chemist. Carbonate of Lime and Soda.
73. HYDROMAGNESITE. Hydrous Carbonate of Magnesia.
87. MAGNESITE. Etym. *Magnesia* (Greek). Carbonate of Magnesia.
89. MALACHITE. Etym. "*Mallow.*" Green Carbonate of Copper, Mountain Green.
134. SIDERITE. Named from the Latin word for Loadstone, or Magnet. Spathic Iron, Carbonate of Iron.
136. SMITHSONITE. Carbonate of Zinc.
152. TRONA. Etym. Egyptian name. Sesquicarbonate of Soda.
158. ZARATITE. Named from a Spaniard. Emerald Nickel, Hydrate of Nickel, Hydrated Carbonate of Nickel.

Chlorides.

14. ATACAMITE. Etym. "*Atacama,*" a province in Bolivia. Chloride of Copper.
29. CERARGYRITE. Etym. "*Horn Silver*" (Greek). Chloride of Silver.
70. HALITE. Etym. *Salt* (Greek). Common Salt, Chloride of Sodium.

Chloro-bromide.

52. EMBOLITE. From a Greek word, meaning intermediate. Chloro-bromide of Silver.

Chloro-carbonate.

108. PHOSGENITE. Etym. *Phosgene*, Light Producer. Chloro-carbonate of Lead.

Elements.

11. ARSENIC. Etym. *Arsenicum* (Latin). See also Arsenolite.
40. COPPER. Etym. *Cuprum* (Lat.).
48. DIAMOND. Crystallized Carbon. The name diamond is a corruption of "adamas" or "adamant," derived from two Greek words, meaning "I conquer."
36. GOLD.
67. GRAPHITE. Etym. "*I Write*" (Greek). Plumbago, Black Lead, etc. Graphite, when pure, consists of carbon.
74. IODINE. Etym. *Violet* (Greek).
75. IRIDIUM. Etym. *Rainbow* (Latin).
95. IRON, METEORIC.
102. NICKEL. In meteoric iron.
110. PLATINUM. Etym. *Plata*, Silver.
122. QUICKSILVER. Etym. "*Living Silver.*" Mercury.
135. SILVER.
143. SULPHUR. The term sulphur is derived from the Latin word *sal* (salt), and the Greek for fire.
146. TELLURIUM—See also Altaite, Calaverite, Hessite, Petzite, and Tetradymite.

Fluoride.

59. FLUORITE. Etym. *To Flow* (Latin). Fluorspar, Fluoride of Calcium.

Iodide.

39. COCCINITE. Iodide of Mercury.

Molybdate.

157. WULFENITE. Molybdate of Lead.

Nitrate.

137. SODA NITER.

Oxides.

12. ARSENOLITE. Etym. "*Arsenicum*" (Latin). Oxide of Arsenic.
27. CASSITERITE. Etym. "*Tin*" (Greek). Binoxide of Tin.
31. CERVANTITE. Etym. "*Cervantes*" (Span). Antimony Ochre.
35. CHROMITE. Etym. "*Color*" (Greek) impure oxide of chromium. Chromic Iron, Chrome Ore, etc.
42. CORUNDUM. Etym. *Kurand* (Hindoo). Oxide of Aluminum.
44. CUPRITE. Etym. *Cuprum*, copper (Latin). Red Oxide of Copper.
71. HEMATITE. Etym. *Blood* (Greek). Hæmatitis, Specular Iron, Micaceous Iron, Red Hematite, Susquioxide of Iron.
84. LIMONITE. Etym. *Meadow* (Greek). Hydrous Sesquioxide of Iron.
85. LITHARGE. Etym. *Silver Stone* (Greek). Oxide of Lead.
88. MAGNETITE. Etym. *Magnesia Stone* (Greek). Magnetic Iron Ore.
92. MELACONITE. Etym. *Black* (Greek). Black Oxide of Copper.

93. MENACCANITE. Etym. *Menaccan*, in Cornwall, England. Ilmenite, Titaniferous Iron.
101. MOLYBDITE. Molybdic Acid, Molybdic Ochre.
103. OPAL. Etym. *Opalus* (Latin). Hyalite, Wood Opal. Silicic Acid, Oxide of Silicon.
109. PICOTITE. Etym. *Picot de la Peyrouse*, French chemist. Chrome Spinel.
114. PSILOMELANE. Etym. *Bare* and *Black* (Greek). Oxide of Manganese.
116. PYROLUSITE. Etym. *Fire-wash* (Greek). Binoxide of Manganese.
121. QUARTZ. Oxide of Silicon, Silicic Acid, Silica.
128. RUTILE. *Rutilus*, Red (Latin). Titanic Acid.
130. SASSOLITE. Native Boracic Acid.
140. STIBICONITE. Partzite, Antimony Ochre, Hydrous Oxide of Antimony.

Organic.

17. BERNARDINITE. (?) Etym. *San Bernardino County, California.*
98. MINERAL COAL. Lignite, Anthracite, Ionite, etc.
106. PETROLEUM.
124. RESIN. Fossil.

Phosphate.

156. VIVIANITE. Etym. Vivian, an English mineralogist. Phosphate of Iron.

Silicates.

1. AGALMAMOLITE. Etym. "*An Image*" (Greek). PAGODITE—from *Pagoda* (Chinese). Chinese figure stone, a variety of pinite, hydrous silicate of alumina, magnesia, iron, lime, soda, and potash.
2. ALBITE. Soda Feldspar. Etym. *Albus* (white), from its color. Silicate of alumina and soda.
5. AMPHIBOLE. Etym. "*Doubtful*" (Greek). Actinolite, Anthophyllite, Amianthus, Asbestus, Hornblende, Mountain Cork, Mountain Leather, Tremolite, etc.
6. ANDALUSITE. Named from Andalusia, a province in Spain, where it was first found, is a silicate of alumina, containing sometimes sesquioxide of iron, magnesia, lime, soda, potash, and manganese in varying proportions.
19. BIOLITE. Etym. *Biot*, French physicist, who first studied its crystallography. Hexagonal Mica. See, also, Mica.
36. CHRYSOCOLLA. "*Gold Glue*" (Greek). A hydrous Silicate of Copper.
37. CHRYSOTILE. This is a magnesian mineral, a variety of serpentine.
38. CLAY. Hydrated silicate of alumina, contaminated, more or less, by various impurities, mechanically intermixed.
46. DATOLITE, OR DATHOLITE. Etym. "*To Divide*" (Greek). Silicate of lime, containing from eighteen to twenty-two per cent of boracic acid.
54. ENSTATITE. Etym. *An Opponent* (Greek). Bronzite, Silicate of Magnesia, Alumina, Iron, Lime, Manganese, etc.
55. EPIDOTE. Etym. *Increase* (Greek). Silicate of Alumina, Lime, Iron, etc.
58. FELDSPAR—See also Albite, Labradorite, and Orthoclase. The name Feldspar generally applies to *Orthoclase*, but it also indicates a group of minerals, called the feldspar group.
61. GARNET. Etym. *Pomegranate Seeds* (Latin). Andradite.
65. GLAUCOPHANE. Etym. *Glaucus*, sea-green color (Latin). Wichtisite. This mineral occurs in a rock matrix, widely distributed in California, and associated with serpentine.
68. GROSSULARITE. Etym. *Gooseberry* (Latin). Lime Garnet.
78. JEFFERISITE. Named from *Jefferis*, mineralogist, of Pennsylvania.
79. LABRADORITE. Etym. *Labrador*. Feldspar.
81. LENZINITE. Hydrous Silicate of Alumina.
82. LEPIDOLITE. Etym. *Scale Stone* (Greek). Lithium Mica.
86. LITHOMARGE. Etym. *Marl Stone* (Greek and Latin). Fine grained Hydrous Silicate of Alumina.
90. MARIPOSITE. *Spanish*, a butterfly. *Mariposa County.* (Provisional name.)
96. MICA. Etym. "*A Crumb* or *Grain*" (Latin). Isinglass, Muscovy Glass, etc. This name is not confined to a single mineral, but is applied to a group, the members of which are silicates of a variety of bases; all having a cleavage parallel with the base of the crystal.
104. ORTHOCLASE—See also Feldspar—Common Feldspar, Potash Feldspar. This mineral derives its name from the Greek, meaning "*straight break*," because it cleaves at right angles. It is a silicate of alumina and potash.
105. PECTOLITE. Etym. *Combstone* (Greek).
119. PYROPHYLLITE. Etym. *Fire Leaf* (Greek).
120. PYROXENE. Etym. *Stranger to Fire* (Greek). A silicate of different bases, the varieties of which are known under different names, as augite, diopside, sahlite, omphazite, hypersthene, diallage, smaragdite, etc.
125. RHODONITE. Silicate of Manganese. Named from its red color, from a Greek word, "the rose."
126. ROCK SOAP. This is a mineral resembling halloysite and mordenite, but believed to be a mechanical mixture of two or more minerals. It has the remarkable property of removing impurity from the skin, like soap.

132. SEPIOLITE. Meerschaum, Hydrous Silicate of Magnesia.
133. SERPENTINE. Chryotile, Picrolite, Retinalite. So called from its resemblance to the skin of a serpent, is found in such large masses or beds that it is also classed with the rocks.
145. TALC. Steatite, Soapstone, French Chalk.
150. TITANITE. Sphene, Titaniferous Iron. Named from Titanium, one of the elements. Sphene is from the Greek for a wedge, from the shape of its crystals.
151. TOURMALINE. Is a mineral almost invariably found crystallized, of all colors, from opaque black to nearly or quite transparent colorless. The usual colors are: *black* (schorl), *red* (rubellite), *blue* (indicolite), *green* (crysolite), *honey-yellow* (peridot), *colorless* (achroite).
155. VESUVIANITE. Etym. *Vesuvius*. Idocrase. Silicate of alumina, lime, iron, etc., first found in the ancient lavas of Vesuvius, whence the name.
159. ZEOLITE. Etym. *Boil* and *Stone* (Greek). The name zeolite applies to a group of minerals which includes at least twenty species; the name is therefore indefinite. They are all hydrous silicates of alumina, and generally are found in lavas and amygdaloids.
161. ZIRCON. Jargon, Silicate of Zirconia.

Sulphates.

4. ALUM. Etym. "*Alumen*" (Latin), as generally understood, is a hydrous sulphate of alumina and potash.
7. ANGLESITE. Etym. "*Anglesea*," an island on the coast of Wales. Is a natural sulphate of lead, called also "lead vitriol."
8. ANHYDRITE. Etym. "*Without Water*" (Greek). Anhydrous Sulphate of Lime, Anhydrous Gypsum.
16. BARITE. Etym. "*Heavy*" (Greek), Barytes, Sulphate of Baryta, Heavy Spar, Terra Ponderosa, Cawk, and many other names. The element Barium is named from this mineral. The term *Terra Ponderosa* was applied by the earlier chemists and mineralogists.
32. CHALCANTHITE. Etym. "*Flowers of Copper*" (Greek). Native Sulphate of Copper, Blue Vitriol.
41. COPPERAS. Etym. *Cuprosa* (Lat.), Coquimbite, in part Hydrous Sulphate of Iron.
56. EPSOMITE. Epsom Salt, Hair Salt, Sulphate of Magnesia.
64. GLAUBERITE. Etym. *Glauber*, German chemist. Sulphate of lime and soda.
69. GYPSUM. Ancient name—Alabaster, Selenite, Satin Spar, Plaster of Paris.
153. TURBITH MINERAL. Yellow Sulphate of Mercury. Is not found in nature. Specimens taken from the interior of the furnaces at the Sulphur Bank quicksilver mine, Lake County.

Sulphides.

10. ARGENTITE. Etym. "*Argentum*" (Latin name for silver). Silver Glance, Vitreous Silver, Sulphuret of Silver.
13. ARSENOPYRITE. Etym. *Arsenic and Pyrite*. Mispickel.
23. BORNITE. Etym. *Born*, a chemist of the last century. Purple Copper Ore, Variegated Copper, Horseflesh Ore, Erubescite, etc. Is a double sulphide of copper and iron.
33. CHALCOPYRITE. Etym. "*Copper Pyrite*" (Greek). (See, also, Copper.) Copper Pyrites. This mineral is also a double sulphide of copper and iron.
34. CHALCOSITE. Etym. *Copper* (Greek). Vitreous Copper, Copper Glance. Sulphide of Copper.
43. CUBAN. Etym. *Cuba*. Sulphide of Copper and Iron.
51. DUFRENOYSITE. Etym. *Dufrenoy*, French mineralogist. Composed of Sulphur, Arsenic, and Lead.
60. GALENA. Etym. *Lead Ore, or Lead Dross* (Latin). Galenite. See, also, Lead. Sulphide of Lead.
63. GEOCRONITE. Etym. *Earth* and *Saturn*, the alchemistic name for Lead (Greek). Sulphide of Lead and Antimony.
77. JAMESONITE. Named from *Jameson*, Scotch geologist. Sulphide of Antimony, Lead, Iron, Copper, and Zinc.
91. MARCASITE. Etym. ancient name for *Pyrite* (Arabic, or Moorish origin). Sulphide of Iron, White Pyrites.
94. METACINNABARITE. Etym. *Beyond* (Greek) and *Cinnabar*). Black Sulphide of Mercury.
97. MILLERITE. Sulphide of Nickel.
100. MOLYBDENITE. Etym. *Lead* (Greek). Sulphide of Molybdenum.
117. PHYRRHOTITE. Etym. *Reddish* (Greek). Magnetic Pyrites.
111. POLYBASITE. Named from the Greek—*Many Bases*—it being a sulphide of many bases, viz.: antimony, arsenic, copper, iron, silver, and zinc.
113. PROUSTITE. Etym. *Proust*, French chemist. Light Ruby Silver Ore. Arsenical Sulphide of Silver.
115. PYRARGYRITE. Etym. *Fire Silver* (Greek). Dark Ruby Silver, Antimonial Sulphide of Silver.
118. PYRITES. Etym. *Fire* (Greek). Pyrite, Sulphuret of Iron, the "Sulphurets" of the gold miner, Mundic, Martial Pyrites. See, also, Marcasite.
123. REALGAR. Name used by the alchemists. Sulphide of Arsenic.
138. SPHALERITE. Blende, Zinc Blende, Black Jack, Sulphuret of Zinc. The name

"sphalerite" is from the Greek, meaning treacherous. The original name "blende" is from the German, meaning blind, deceiving, because blende while resembling galena produced no lead.

139. STEPHANITE. Etym. *Stephan*, Mining Director of Austria. Brittle Silver Ore, Brittle Sulphuret of Silver. This is a double sulphide of silver and antimony.

141. STIBNITE. Etym. *Stibium* (antimony). Sulphide of Antimony, Antimony Glance.

142. STROMEYRITE. Etym. *Stromeyer*, chemist who first analyzed it. Silver Copper Glance.

148. TETRAHEDRITE. Name for tetrahedron. Gray Copper, Fahlerz, Sulphide of Copper and Antimony.

Sulpho-Arsenide.

53. ENARGITE. Etym. *Obvious* (Greek), sulpho-arsenide of copper, sometimes containing antimony, iron, silver, or zinc.

Tellurides.

3. ALTAITE. Etym. *Altai Mountains of Asia.* Telluride of Lead.
25. CALAVERITE. Etym. *Calaveras County*, where first found.
72. HESSITE. Etym. *Hess*, Russian chemist. Telluride of Silver.
107. PETZITE. Etym. *Petz*, the chemist who first analyzed it.
A variety of Hessite, being a telluride of silver and gold—the latter metal replacing part of the silver.
144. SYLVANITE. Etym. *Transylvania.* Telluride of Gold.
147. TETRADYMITE. Etym. *Quadruple* (Greek). Bismuth, with Tellurium.

Tungstates.

45. CUPROSCHEELITE. Tungstate of Lime and Copper.
131. SCHEELITE. This mineral is named after the Swedish chemist Scheele. It is a Tungstate of Lime.

Vanadate.

127. ROSCOELITE. Named from Prof. Roscoe of Manchester, England; contains 28.6 per cent of vanadic acid.

Sundries.

24. BUILDING STONES.
28. CEMENT.
49. DIATOMACEOUS EARTH.
76. IRON ORES. See, also, Hematite, Limonite, and Magnetite.
80. LEAD ORES. See, also, Galena, Anglesite, and Cerusite.
99. MINERAL WATERS.

Since the publication of the last annual report, a new California mineral has been discovered. The following papers, which are given in full, contain all at present known of this interesting mineral:

ON HANKSITE.

A New Anhydrous Sulphato-Carbonate, from San Bernardino County, California.

By William Earl Hidden.

[From the Annals of the New York Academy of Sciences, Vol. III, No. 7. Read May 25, 1885.]

In the very complete and attractive exhibit of California minerals brought to the World's Industrial and Cotton Centennial Exposition at New Orleans, by Henry G. Hanks, State Mineralogist of California, were several species of unusual interest.

Among these, was the new borate, Colemanite, with its large and lustrous crystals so much resembling the finest of the Bergen Hill datolites; the new vanadium mica, Roscoelite, mixed as it is mechanically with much native gold between its folia; borax crystals, clear and bright, of unusual size; stibnite in superb crystals almost equaling the late discoveries in this species in Japan, and many others equally noteworthy, and to which I may refer in a separate paper later.

Of particular interest to the writer was a small lot of *apparently hexag-*

onal crystals to which had been given the name of "Thenardite." Now as Thenardite is asserted in the text-books to be orthorhombic, I was prompted to measure the angles of these crystals. Their seeming non-conformity in shape pointed to the possibility of their being new—in angle, or type of form, especially. The results confirmed my first suspicions of their true hexagonal character, though my measurements were only approximate, being made with a hand goniometer.

Since the hexagonal character of the mineral, which seemed so evident, might possibly be due to complex twinning of orthorhombic individuals, it seemed advisable to have this question decided on the basis of an optical examination; and for this purpose three of the best crystals were kindly given by Mr. Hanks, and sent by me to Dr. Edward S. Dana for that exact crystallographic definition needed in this case, and which he always so ably and generously gives to science. The crystals sent being quite clear, Dr. Dana was, in a few days, enabled to report them "as uniaxial (double refraction negative) and that normally," and thus their positive difference from Thenardite was proven beyond question. They were true *hexagonal* crystals. Believing now the mineral to be either a dimorphous form of sodium sulphate, or possibly an entirely new species, an analysis seemed necessary. Accordingly I placed sufficient material in the hands of Mr. James B. Mackintosh, E.M., for that purpose, and he has very kindly done the work. His results showed the mineral to contain the following substances:

SO_3	45.89
CO_2	5.42
Cl.	2.36
*Na_2O	46.34

Corresponding to:

Na_2SO_4	81.45
Na_2CO_3	13.06
NaCl	3.89
Na_2O (excess)	1.08
	99.48

These results give the following molecular ratios for:

Na_2SO_4	57.3		3.95
Na_2CO_3	14.5	or	1.00
NaCl	6.65		.46
Na_2O	1.74		.12

Or closely in the ratio of $4 : 1 : \frac{1}{2} : \frac{1}{8}$. This all points to the formula:

$$4\,(Na_2SO_4) + 1\,(Na_2CO_3) + \tfrac{1}{2}\,(NaCl)$$

As representing the composition of the crystals under examination. Or, neglecting the sodium chloride as non-essential, the formula could be given thus:

$$4\,Na_2SO_4 + Na_2CO_3$$

Which is probably the true one.

The observed excess of soda is either due to errors of analysis, as only a small quantity was used, or it may have been combined with boracic acid, as borax is very abundant at the locality.

The interesting anomaly of a sulphate and carbonate being in chemical combination, reminds us of the rare sulphato-carbonate of lead, Leadhillite, to which this alone bears relation as a natural species.

*All bases calculated as soda. Lime and magnesia were not present.

The angles I obtained were as follows:

O on I = 90°.	O on 1 = 130° 30′
I on I = 120°.	O on 2 = 113° 30′

Accordingly the value of the vertical axis is 1.01399. Cleavage parallel to O nearly perfect, but difficult to obtain.

Crystals striated horizontally. They are commonly terminated at both ends of the prism and are very symmetrical in shape. They average, as thus far seen, about one centimeter in length and thickness, with O and I as predominating planes (see fig. 1).

Fig. 1.

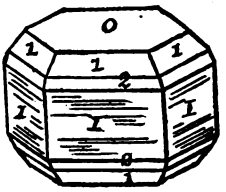


Fig. 2.

Sometimes the crystals are confusedly grouped (see fig. 2), as from a common center, much like the Aragonite from a noted European locality. For some late years mineralogists have received from several localities in the far west, groups of crystals that were hexagonal (tabular) in appearance, very impure in composition, and to which the name of Aragonite has been attached. For the most part they are simply calcium carbonate mixed with sand and mud, and are without cleavage. It is very probable that they are pseudomorphs after the sodium sulphato-carbonate here described. In particular I refer to crystals which I have seen credited to Colorado and to Nevada.

The crystals here analyzed were found with salt, thenardite, tincal, etc., at the works of the San Bernardino Borax Company, in San Bernardino County, California.

The density of this new California mineral is 2.562: its hardness, 3.–3.5: it is readily soluble in water; effervesces with acids. It affords, when dissolved in water, an abundant precipitate of barium sulphate when barium chloride is added to the solution. On addition of silver nitrate, to a fresh solution, chloride of silver is precipitated, showing that chlorine is also present. Gentle ignition developes no appreciable loss in the weight of the mineral.

The crystals are transparent to semi-opaque, with a white, waxy color, inclining to yellow; surfaces never highly polished or very smooth.

The definite formula deduced from Mr. Mackintosh's analysis, taken together with the form, warrants me in announcing these crystals as a new mineral species. I therefore propose for it the name of Hanksite, after Henry G. Hanks, of California.

NEWARK, N. J., May 23, 1885.

[From the American Journal of Science, Vol. XXX, August, 1885.]

Art. XX.—Mineralogical Notes; by Edward S. Dana and Samuel L. Penfield.

1. A Large Crystal of Hanksite.

Some two years since, Professor G. J. Brush placed in our hands for examination, a large crystal, or rather group of crystals, of anhydrous sulphate related to thenardite. The specimen had been received by him from Professor J. S. Newberry, who stated that he had purchased it in California, but was unable to learn the exact locality from which it came. The examination proved it to be probably hexagonal in crystalline form, and in composition to consist of sodium sulphate and carbonate in the ratio of 4:1. Feeling reluctant to attach a new name to a mineral of which only one specimen was in hand, and that from an unknown locality, we postponed the publication of our results until some further facts should come to light. The same mineral has now been rediscovered, and in specimens so satisfactory as to justify their receiving the name Hanksite, given by Mr. Hidden.

The specimen examined by us consisted of a low hexagonal prism, measuring transversely 75^{mm}, and in a vertical direction 20^{mm}; this prism is penetrated by several other similar tabular crystals, but in varying positions, so that no general law of twinning can be given. The basal edges were irregularly replaced by pyramidal planes. Apparently the form is hexagonal, the prism and pyramid both being present, and the measured angles of the former showing very little variation from the required 60°. The analogy of the artificial sulphates of sodium and potassium suggested, however, that the form might be really orthorhombic, and the hexagonal aspect due to twinning. The optical examination made to settle the question was not satisfactory, because the crystal contained so much mud as impurity as to be transparent only in spots. Some points were found, however, which gave an obscure uniaxial figure with negative double refraction; but this question might not be regarded as satisfactorily settled were it not for the excellent results which Mr. Hidden's crystals have afforded. The pyramidal plane spoken of was rough and rounded, and was only distinctly seen on part of the edges. The approximate angle (supplement) measured on the basal plane is 43°, which, referred to the vertical axis assumed by Mr. Hidden, gives a symbol $\frac{4}{5}(40\bar{4}5)$; required 43° 8′.

An analysis of the mineral gave (Penfield) the following results, which are almost identical with those of Mr. McIntosh:

		Ratio.				
SO_3	43.59	.545	and	.545	=	43.59 SO_3
Na_2O	40.86	.659		.536		33.23 Na_2O
				.123		7.63 Na_2O
CO_2	5.42	.123		.123		5.42 CO_2
K	2.33	.060				2.33 K
Cl	2.13	.060				2.13 Cl
Insol.	4.41					
Ign.	1.32					
	100.06					

This corresponds then to:

Na_2SO_4	76.82
Na_2CO_3	13.05
KCl	4.46
Insol.	4.41
Ign.	1.32
	100.06

The insoluble portion is apparently clay; a section examined in the microscope showed the impurity densely distributed in bands parallel to the prismatic faces. The fact that in the analysis the potassium and chlorine are present in exactly the amounts required to form potassium chloride may be only a coincidence, and the chlorine may in fact be combined with sodium, and the potassium may in part replace the sodium in the sulphate. It is immaterial which explanation is adopted, but in any case it is quite certain that the potassium (or sodium) chloride is present as an impurity, for in the thin section numerous rectangular crystals, some of them apparently cubes, were visible. It seems proper, therefore, to deduct these elements from the analysis, leaving only the sodium sulphate and sodium carbonate. The result, calculated to 100 per cent, is:

Na_2SO_4	85.48
Na_2CO_3	14.52

This corresponds, though approximately only, to the formula

$$4Na_2SO_4 + Na_2CO_3$$

which requires

Na_2SO_4	84.27
Na_2CO_3	15.73
	100.00

The minerals of California may be classified into two groups—economical minerals, that is those which can be practically used by man—which supply his necessities or contribute to his comfort and convenience—and those which are interesting only for the connection they bear to science. The following is a catalogue of the special California minerals shown at the Exposition. The numbers refer to the museum catalogue:

1430. ACTINOLITE. Contra Costa County.
470. ACTINOLITE. Mariposa estate, Mariposa County.
3443. ACTINOLITE. Twelve miles east of Gilroy, Santa Clara County.
4213. ACTINOLITE. Eureka, Humboldt County.
4335. ACTINOLITE. Santa Rosa, Sonoma County.
4339. ACTINOLITE. Spanish Ranch, Plumas County.
5946. ALKALI (?). Forming a layer in the sandstone deposit, Temple Street Cut, Los Angeles.
4249. ALUM SLATES. Near Auburn, Placer County.
4250. ALUM. Crystallized from No. 4249, near Auburn, Placer County.
4404. ALUM. Near Newhall, Los Angeles County.
4468. ALUM INCRUSTATION. Found ten miles north of Santa Rosa, Sonoma County.
5799. ALUM. This mineral sweats out of bedrock at mouth of tunnel, Bonanza Mine, Gold Run, Placer County.
1795. ANDALUSITE CRYSTALS. Near Ne Plus Ultra Mine, Fresno County.
3700. ANDALUSITE. Moore's Hill, twelve miles south of Mariposa, Mariposa County.
4450. ANDALUSITE CRYSTALS. Imbedded in clay slate (See No. 1795), Fresno County.
2328. ANDRADITE GARNET. Diamond Mountain, Lassen County.
2. ARAGONITE, RED. Suisun, Solano County.
261. ARAGONITE. Suisun, Solano County.
556. ARAGONITE. (Polished.) Suisun, Solano County.
755. ARAGONITE. San Luis Obispo County.

1194. ARAGONITE. Gold Run, Placer County.
1872. ARAGONITE. Soda Springs Hotel, Siskiyou County. Deposited by a spring near the Falls and near the Sacramento River.
2006. ARAGONITE (Onyx Marble). Southeast quarter section nine, township thirty-two south, range fifteen east, Mount Diablo meridian, San Luis Obispo County. Mr. Jacob Z. Davis exhibited a magnificent mantlepiece of this mineral, which attracted much attention. It was set up in the headquarters or reception room, to which it was a great ornament.
2327. ARAGONITE (Onyx Marble). Mineral Spring, six miles above Kernville, Kern County.
2383. ARAGONITE. Twelve miles north of San Luis Obispo.
2740. ARAGONITE CRYSTALS. Candace Copper Mine, Colusa County.
3602. ARAGONITE, white and pure. Johnsonville, Plumas County. This mineral has the property of being easily reduced to a powder, and will no doubt be used as a substitute for chalk in chemical manufacture. Occurs in large quantities nine miles from Jamisons, in Little Long Valley. Four hundred feet wide. Lime has been burned said to be of good quality.
3733. ARAGONITE. Cerro Gordo, Inyo County.
4758. ARAGONITE. Ranch of J. M. Pugh, near Smithville, Colusa County.
5220. ARAGONITE (so called Onyx Marble). From near Yreka, Siskiyou County.
5343. ARAGONITE (slab polished, so called Onyx Marble). Suisun, Solano County. See Nos. 2, 261, 386, 556, 670, all from the same locality, but different varieties.
5345. ARAGONITE (so called Onyx Marble). Found in considerable quantity near Vacaville, Solano County. Takes a high polish, and is suitable for use as an ornamental stone.
1293. ASBESTUS. Shasta County.
1678. ASBESTUS. Eighteen miles northeast of Oroville, Butte County.
2419. ASBESTUS. White River, Tulare County.
2437. ASBESTUS. Lower part of Mount Bullion, one third of a mile east of Bear Valley, Mariposa County. Occurs in a clay formation and is four inches wide (?).
4464. ASBESTUS. Bear Valley, Mariposa County.
1803. AZURITE. New York District, San Bernardino County.
4085. BARITE (Sulphate of Baryta). Found in cleaning up at the Malakoff Hydraulic Mine, North Bloomfield, Nevada County.
4167. BARITE (Sulphate of Baryta). Found as a gangue with silver ore, Calico District, San Bernardino County.
5991. BARITE. Found ten miles above Georgetown, El Dorado County.
2318. BASALT WITH ZEOLITE. Siskiyou County.
4641. BISMUTITE (Stream Bismuth). Found in sluicing for gold, Big Pine Creek, Inyo County.
4237. BRONZITE. Berkeley Hills, Alameda County.
1676. CALCITE WITH BITUMEN. New Almaden Mine, Santa Clara County.
2173. CALCITE. Modoc Mine, Inyo County.
3394. CALCITE WITH PYRITE. Malakoff Mine, North Bloomfield, Nevada County.
3406. CALCITE GEODE. Sweetwater, Nevada County.
3580. CALCITE CRYSTALS. Argus Mountains, Inyo County.
4452. CALCITE (Iceland Spar). Santa Clara County.
5009. CALCITE. Bed of the Klamath River, Yreka, Siskiyou County.
1949. CALCAREOUS TUFA. Mahoney Mine, San Luis Obispo County.
1195. CARBONATE OF MAGNESIA (Magnesite). Gold Run, Placer County.
3025. CARBONATE OF MAGNESIA WITH SILICA. Under the microscrope, cryptocrystalline. Arroyo Seco, Monterey County. Occurs in a vein two feet wide.
4675. CARBONATE OF MAGNESIA. Obtained in the tanks in working the mother liquors in the manufacture of salt by the Union Pacific Salt Company, Alameda County.
1807. CARBONATE OF SODA (Trona). Sink of the Mojave, Death Valley, Inyo County.
1265. CAT'S EYE. Calaveras County.
657. CALCAREOUS SPAR. Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
64. CHALCEDONY. Volcano, Amador County.
546. CHALCEDONY. Murphy's, Calaveras County.
574. CHALCEDONY. Near St. Helena, Napa County.
962. CHALCEDONY. Big Tank, Colorado Desert, San Diego County.
1206. CHALCEDONIC QUARTZ. Vallecito, Calaveras County.
1249. CHALCEDONY. Douglassville, Tuolumne County.
1397. CHALCEDONY. Soledad Cañon, S. P. R. R., San Bernardino County.
4283. CHALCEDONY. Los Angeles County.
4901. CHALCEDONIC QUARTZ. Dry Creek, six miles northeast of Ione City, Amador County.
234. CHALCOCITE, VITREOUS COPPER. San Diego County.
4474. CHALCOPYRITE. Sections 12 and 13, Township 15 north, Range 6 east, Placer County.
4119. CHALCOPYRITE. (Yellow Copper Ore), Beveridge District, Inyo County.
230. CHRYSOCOLLA. San Diego County.
2192. CHRYSOLITE WITH CALCITE. Near Independence, Inyo County.

924. CINNABAR IN SERPENTINE. Tuolumne County.
5952. COLEMANITE. In magnificent crystals. Colemanite is a new variety of Priceite (see No. 157), borate of lime. For description of Colemanite see Third Annual Report of the State Mineralogist, part 2, fol. 86. The specimen is from near Calico, San Bernardino County.
2176. CRYSTALS. Found in furnace slag, Modoc Mine, Inyo County.
3666. CUPROSCHEELITE. (With Tourmaline), Kern County.
1266. DENDRITES. Shasta County.
2122. DENDRITES. Called by the miners "Picture Quartz," Standard Mine, Bodie, Mono County.
2165. DENDRITIC OXIDE OF MANGANESE. Near Volcano, Amador County.
3584. DIALLOGITE CRYSTALS (very fine). Colorado Mine No. 2, Monitor District, Alpine County.
4033. DIAMOND (rough). Spring Valley Hydraulic Mines, Cherokee Flat, Butte County. Weight 180 milligrams. Found in cleaning up sluices, associated with zircons, gold, platinum, iridium, etc. A number of diamonds have been found at this locality, but none of large size or first water.
5063. ENARGITE. Tarshish Mine, Monitor District, Alpine County.
639. ENARGITE with PYRITE. Morning Star Mine, Alpine County.
2805. ERYTHRITE (Cobalt Bloom). Kelsey Mine, Compton, Los Angeles County.
439. FELDSPAR (Orthoclase). Yosemite Valley, Mariposa County.
445. FELDSPAR (Orthoclase) with MOLYBDENITE. Yosemite Valley, Mariposa County.
457. FELDSPAR (Orthoclase). Yosemite Valley, Mariposa County.
4062. FOSSIL RESIN. Hydraulic Mines at North Bloomfield, Nevada County, two hundred and eighty feet below the surface.
687. GALENA (Argentiferous). Searsville, Santa Clara County.
243. GARNETS IN MICA SCHIST. Thirty miles northeast of San José.
2365. GARNETS. Piru Mountains, Ventura County.
96. GOLD IN PYRITES. Drytown, Amador County.
2792. GOLD AND PLATINUM. Concentrated from twenty miners' pans of dirt, Calpella, Mendocino County.
1369. GOLD. From the Bodie mines, Mono County. An alloy of gold and silver, known in mineralogy as Electrum.
4198. GOLD WASHED FROM SANDS (see No. 4197). Upper Gold Bluff, Humboldt County.
4169. GOLD IN MISPICKEL (Arsenical Pyrites). Near Georgetown, El Dorado County.
929. GRAPHITE. Tuolumne County.
1895. GRAPHITE. Guerneville, Sonoma County.
3746. GRAPHITE. Near Pine Flat, Sonoma County.
2190. GROSSULARITE AND DATHOLITE. San Carlos, Inyo County.
354. GYPSUM AND SELENITE. Lockwood Creek, Ventura County, sixty miles south of Bakersfield.
362. GYPSUM. Lockwood Creek, Los Angeles County.
667. GYPSUM. Monterey County.
1721. GYPSUM (Selenite). Near Susanville, Lassen County.
2268. GYPSUM. Near Breckenridge, Kern County.
3726. GYPSUM. Near Hill's Ferry, Stanislaus County.
4647. GYPSUM. Crystallized, near Calico District, San Bernardino County.
5018. GYPSUM. Posa Creek, foothills of the Sierra Nevada, Kern County.
5415. GYPSUM. Of good quality, Bitterwater Ranch, San Benito County.
1721. GYPSUM (Selenite). Near Susanville, Lassen County.
1347. HYALITE ON PYRITES. Kelseyville, Lake County.
1514. HYALITE—A VARIETY OF OPAL. Found plentifully in cavities in basaltic lava, township ten north, and ranges five and six east, Lake County.
1320. HYDROMAGNESITE. Market Street Cut, near Guerrero Street, San Francisco.
3709. ICELAND SPAR, CALCITE. Darwin, Inyo County. This spar is nearly as fine as the true Iceland spar, and could be used for optical purposes.
3731. ILMENITE (in Quartz). Twenty miles south of Mariposa, near Buchanan, Mariposa County.
4044. IRIDIUM FROM CALIFORNIA GOLD. It is found in varying quantities in the crucibles in which the gold is melted.
2262. JAMESONITE. Mokelumne Hill, Calaveras County.
2126. JEFFERISITE. Susanville, Lassen County.
4911. JEFFRIESITE. Tulare County.
813. LENZINITE. Chance Mine, Copper Hill, Shasta County.
2773 LEPIDOLITE. Twenty miles southwest of Colton, San Bernardino County.
4262. LEPIDOLITE, PINK AND WHITE, WITH AZURITE. Vein matter of the Half Dollar Mine, Inyo County; shaft seventy-five feet deep.
5296. LIMONITE CRYSTALS, AFTER PYRITE. Containing gold. Butte County.
130. LITHARGE. San Bernardino County. Probably from ancient furnaces.
423. LITHOMARGE. Alph Mine, Tuolumne County.
1325. LITHOMARGE, WITH FOSSIL LEAVES. Alpha Mine, Table Mountain, Tuolumne County.

2515. LITHOMARGE. Near Big Trees, Calaveras County.
4498. LITHOMARGE. Lassen County.
1175. MAGNESIA (?). Port Harford, San Luis Obispo County.
2322. MAGNESITE (Carbonate of Magnesia). Tulare County.
4238. MAGNETIC SANDS. Mouth of Russian River, Sonoma County.
4139. MAGNETITE CRYSTALS (perfect octahedrons). Shasta County.
1295. MARIPOSITE. Josephine Mine, "Las Mariposas."
159. MICA. El Dorado County.
4064. MICA. Near Lang, Los Angeles County.
4084. MICA. Near Ravenna, Los Angeles County.
3985. MILLERITE (with Cobalt?). Half a mile from Cisco, Placer County.
3748. MOLYBDENITE. Minnie Mine, Sweetwater Range, Mono County.
4102. MOLYBDENITE (Sulphide of Molybdenum). White Mountains, Inyo County.
4126. MOLYBDENITE (Sulphide of Molybdenum). Fresno Flat, Fresno County.
4365. MOLYBDENITE (Sulphide of Molydenum, mistaken for Graphite). Inyo County.
4454. MOLYBDENITE. South Fork of the King's River, Fresno County, fifty-five miles northeast of Visalia.
4336. MOUNTAIN LEATHER (Amphibole). Little Grass Valley Mine, Pine Grove District, Amador County.
4727. MOUNTAIN LEATHER. A variety of Amphibole, found eighteen feet below the surface, near Pine Grove, Amador County. (See No. 4336.)
4970. NITRATE OF SODA. Cave in Calico District, San Bernardino County.
2745. OCHER, IMPURE RED. McPherson's Claim, Sheep Ranch District, Calaveras County.
4010. OCHER, YELLOW. (Limonite), found in considerable quantities adjoining an iron mine (see No. 3765), Campo Seco Township, near Campo Seco, Calaveras County; valuable as a pigment.
4011. OCHER, BURNT. (Same as No. 4010), near Campo Seco, Calaveras County.
5301. OCHER, YELLOW. Of good color and quality; found in large quantity on Section 32, Township 12 north, and Range 11 east, four miles east of Georgetown, El Dorado County.
1251. OPALIZED WOOD. Calaveras County.
4395. OPALS. Stockton Hill. Mokelumne Hill, Calaveras County. When this locality was first discovered, many years ago, the opals were thought to be of great value, and considerable capital and labor were expended to prove them worthless.
4759. PARTZITE. With Native Silver, Galena, etc. Tower Mine, near Benton, Mono County.
2919. PARTZITE. Comanche Mine, Blind Springs, Mono County.
1521. PLATINIRIDIUM. Cinnabar, Mercury, Zircons, etc. Black sand concentration. Hopland, Mendocino County.
1522. PLATINIRIDIUM. Concentrated from No. 1519. Black sand concentration. Hopland, Mendocino County.
1892. PLATINIRIDIUM. Enright Claim, three miles above Trinity Center, Trinity County.
4199. PLATINIRIDIUM. Washed from beach sands (see No. 4197), Upper Gold Bluff, Humboldt County.
4224. PLATINUM, IRIDIUM, ETC. Concentrations from the Spring Valley Hydraulic Mine, Cherokee, Butte County.
512. PICROLITE. Bear Valley, Mariposa County.
555. PICROLITE. Fort Point, San Francisco.
693. PICROLITE. Amador County.
1318. PICROLITE. Market Street Cut, near Guerrero Street, San Francisco.
1439. PICROLITE. Maryland Mine, Grass Valley, Nevada County.
2121. PICROLITE IN SERPENTINE. Yuba River, Nevada County.
4087. PICROLITE. From the Serpentine Rocks, Goleta, Santa Barbara County.
4960. PICROLITE. Near Red Hill, Butte County.
5106. PRICEITE (Borate of Lime). Calico, San Bernardino County.
5646. PRICEITE (variety Pandermite after Ulexite, showing the change from a "cotton ball"). Death Valley, Inyo County. This specimen is referred to in the Third Annual Report of the State Mineralogist, part 2, folio 85.
1671. PSILOMELAIN (in quartz). Santa Ana River, Los Angeles County. Mistaken for tin ore.
351. PYRITES. Morning Star Mine, Alpine County.
3671. PYRITES, GLOBULAR, IN CALCITE. Near Auburn, Placer County.
653. PYRITES. Jackson, Amador County.
981. PYRITES WITH COAL. Spinks Coal Mine, Lincoln, Placer County.
1505. PYRITES (SULPHIDE OF IRON). Redington Mine, Lake County.
1649. PYRITE. Modoc Mine, Inyo County.
1710. PYRITE, RICH IN SILVER, WITH QUARTZ. Iron Mountain Mine, seven miles from Shasta.
2027. PYRITE CRYSTAL. Patterson Mine, Tuttletown, Tuolumne County.
2128. PYRITE. Mono County.
2348. PYRITE. From a cavity in the Sunderland Quicksilver Mine, San Luis Obispo County.

3411. PYRITE, FOUND IN LIGNITE (LARGE TREE). Malakoff Mine, North Bloomfield, Nevada County.
4140. PYRITE, NODULE OF. Found with silver ore, Iron Mountain, Shasta County.
4338. PYRITE, CUBICAL. Knox & Osborn Mine, Calaveras County.
4386. PYRITE (containing also Sulphide of Copper in small quantities, called "white ore"). San Francisco Copper Mine, Spenceville, Nevada County.
4905. PYRITE. Clipper Coal Mine, Lincoln, Placer County.
5428. PYRITE NODULES. Gold Gravel Hydraulic Mine, La Porte, Plumas County.
1811. PYROPHYLLITE. El Dorado County.
3723. PYROPHYLLITE. Greaser Gulch, Mariposa County.
13. QUARTZ GROUP OF CRYSTALS. Wyoming Mine, Panamint, Inyo County.
18. QUARTZ CUT AND POLISHED.
34. QUARTZ CRYSTALS. Placer County.
49. QUARTZ DRUSY. Alpine County.
823. QUARTZ CRYSTALS, GROUP OF. Mariposa Mine, Mariposa County.
828. QUARTZ CRYSTALS. Mariposa Mine, Mariposa County.
1276. QUARTZ PEBBLE. Vallecito Mine, Calaveras County.
1451. QUARTZ CRYSTALS. Calaveras County.
1416. QUARTZ CRYSTALS. Placer County.
138. QUARTZ (HACKED), WITH GOLD. Shasta County.
1449. QUARTZ CRYSTALS COATED WITH MALACHITE. Panamint, Inyo County.
1792. QUARTZ CRYSTALS ON SILVER ORE. From the incline of the Bodie Mine below the four hundred and thirty-three-foot level, Bodie, Mono County.
2164. QUARTZ. (Chalcedony), Volcano, Amador County.
2170. QUARTZ CRYSTAL. Modoc Mine, Inyo County.
2316. QUARTZ, SMOKY. Siskiyou County.
2446. QUARTZ CRYSTAL, SMOKY. North Fork of Feather River, Butte County (?).
2043. QUARTZ, SEMI-OPAL. Referred to as Aragonite in No. 1832. Eighteen miles southeast of Santa Rosa, Sonoma County.
3701. QUARTZ, WITH PYRITE. Both crystallized, El Dorado County.
3710. QUARTZ CRYSTALS (Doubly Terminated). Beveridge District, Inyo County.
3782. QUARTZ CRYSTALS. Standard Mine, Bodie, Mono County.
4143. QUARTZ CRYSTAL (smoky). Beveridge, Inyo County.
4149. QUARTZ (wood opal). Placer County.
4802. QUARTZ (bloodstone). In gravel near Windsor, Sonoma County.
5357. QUARTZ CRYSTALLIZED. Near West Point, Calaveras County.
5163. QUARTZ, TRIANGULAR PRISM (edges modified by planes, see 3782), Standard Mine, Bodie, Mono County.
5538. QUARTZ CRYSTAL. Very large and very fine; one end white, the other smoky. Total length, 13 inches; girth, 15 inches; width of widest face, 2¾ inches; weight, 14.5 pounds. Twenty miles north of Placerville, El Dorado County.
5953. QUARTZ TAILINGS. Oregon Ravine, near Placerville, El Dorado County, 1,000 feet below the Pacific Mine.
1827. ROSCOELITE. Granite Hill, El Dorado County. Roscoelite is a vanadium mineral, one of the rarest known, and is always rich in gold.
5768. ROSCOELITE, WITH GOLD. Section 7, Township 11 north, range 10 east, El Dorado County (see Second Annual Report of State Mineralogist, folio 262). Pilot Hill, El Dorado County.
979. SAND, WHITE. Spinks Coal Mine, Lincoln, Placer County. Cook & Spinks. Description of Nos. 979 to 987, inclusive. The formation is nearly as follows: Four feet soil, sixteen feet clay, one foot sand, five feet clay, four feet sand, twenty feet clay; twelve feet alternate layers of coal and clay, varying in thickness from one inch to two feet, eight feet coal—in all, seventy feet.
1145. SAND. From ocean beach, Port Harford, San Luis Obispo County.
1211. SAND, BEACH. Monterey, Monterey County.
1406. SAND, QUARTZ. Spinks' Coal Mine, two miles from Lincoln, Placer County.
1520. (A.) COARSE PORTION (Separated from No. 1519). Black Sand Concentration, Hopland, Mendocino County.
1520. (B.) HEAVY NON-MAGNETIC PORTION BLACK SAND CONCENTRATION. Hopland, Mendocino County.
1520. (C.) MAGNETIC PORTION BLACK SAND CONCENTRATION. Hopland, Mendocino County.
1520. (D.) LIGHT SAND—BLACK SAND CONCENTRATION. Hopland, Mendocino County.
1519. SAND, BLACK. Concentration from hydraulic washing, Hopland, Mendocino County. Mechanical analysis, heavy non-magnetic portion (No. 1520 B), 88.3210 per cent; magnetic portion (No. 1520 C), 8.2420; light sand (No. 1520 D), 2.8740; platiniridium (No. 1522), 0.5505; gold (No. 1523), 0.0125.
1526. SAND CONTAINING GOLD, PLATINUM, ZIRCONS, DIAMONDS (?), AND MAGNETITE. Pine Grove, Amador County.
1588. SAND, COARSE. From the beach at Pescadero, San Mateo.
1673. SAND, MAGNETIC, WITH PYRITES. Hydraulic washings, two miles northeast of Jackson, Amador County.
1675. SAND. From hydraulic washings, two miles northeast of Jackson, Amador County.

2277. SAND CONTAINING GARNETS. Ravine in Soapstone Mountain, twenty-four miles east of Bakersfield, Kern County.
4804. SAND, WHITE. Thirty-two feet from the surface, near Lincoln, Placer County, in its natural state. (See No. 979.)
4286. SAND IMPREGNATED WITH ASPHALTUM, Santa Cruz County.
4864. SAND. Santa Monica, Los Angeles County.
4868. SAND. Seven Palms, 108 miles from Los Angeles.
4865. SAND, RED. Line of the Southern Pacific Railroad, near Rock Creek.
4870. SAND, WITH SHELLS. Colorado Desert, San Diego County.
4881. SAND. Colorado Desert, San Diego County.
4892. SAND CONTAINING ZIRCONS. Hydraulic Mine, Irish Hill, three miles north of Ione, Amador County.
4986. SAND. From a well in the Colorado Desert, San Diego County.
5776. SAND. From beach at Lobitas, San Mateo County.
5781. SAND. Overlying 5780, American River, Sacramento.
5783. SAND, COARSE. Used for building purposes, American River, Twelfth-Street Bridge, Sacramento.
5793. SAND. North Bloomfield Mine, Nevada County.
5795. SAND, COARSE. From bank opposite Marysville, Yuba County.
5796. SAND, FINE. From bank opposite Marysville, Yuba County.
5800. SAND, STRATIFIED. Sixty feet above bedrock, Indiana Hill, Gold Run, Placer County.
5934. SAND, BLACK MAGNETIC. Found between sandstone strata, near Watsonville, Santa Cruz County.
5909. SAND, BLACK MAGNETIC. Alameda.
5910. SAND. From below layer of sandstone, Temple Street Cut, Los Angeles.
5940. SAND, MAGNETIC. French Corral, Nevada County.
5942. SAND. In natural state, sedimentary deposit intercalated with sandstone, Temple Street Cut, Los Angeles.
5945. SAND. Wash of the Los Angeles River, Los Angeles County.
5949. SANDS, HYDRAULIC. Gold Run Mine, Placer County; on bedrock; analysis published in Second Annual Report of State Mineralogist, folio 100, marked No. 1.
5950. SANDS, HYDRAULIC. One hundred and fifty feet above bedrock, Gold Run Mine, Placer County; analysis published in Second Annual Report of State Mineralogist, folio 100, marked No. 2.
5951. SANDS, HYDRAULIC. Three hundred feet above junction of north and middle forks of the American River, Placer County; analysis published in Second Annual Report of State Mineralogist, folio 100, marked No. 3.
5952. SAND. From the American River, 200 feet above junction with Sacramento River, Sacramento County; analysis published in Second Annual Report of State Mineralogist, folio 100, marked No. 4.
4153. SAND INDURATED STRATUM. Four feet above the beach, Pescadero, San Mateo County.
4361. SATIN SPAR (Gypsum). San Bernardino County.
1214. SAPONITE. Santa Barbara.
4055. SCHEELITE. From a quartz ledge on Howard Hill, Grass Valley, Nevada County.
799. SELENITE. Santa Barbara.
957. SELENITE. Near Dos Palmos Station, Southern Pacific Railroad, San Diego County.
1260. SELENITE. Robinson's Ranch, Lake County.
1847. SELENITE (Satin Spar). White River, Tulare County.
2727. SELENITE (Gypsum). Susanville. Lassen County.
2890. SELENITE (Gypsum). Buena Vista, Kern County.
4699. SELENITE. Colorado Desert, five miles west of Volcano Station, Southern Pacific Railroad, San Diego County.
4089. SELENITE. San Emidio Antimony Mine, Kern County.
4465. SELENITE (Gypsum). Bear Valley, Mariposa County. Deposit two feet thick.
4664. SELENITE (Gypsum). Near Modesto, Stanislaus County.
4672. SELENITE (Gypsum). Calico, San Bernardino County.
4765. SELENITE (Gypsum). Near Gilroy, Santa Clara County.
4954. SELENITE (Gypsum). Calico District, San Bernardino County.
5908. SEMI-OPAL. Occurs in a vein four or five feet wide in granite, Tehachipi Summit, Kern County.
1501. SEMI-OPAL. Portersville, Tulare County.
4263. SEPIOLITE. Half Dollar Mine, Inyo County.
449. SERPENTINE. Key's Tunnel, California Mine, Yolo County.
11. SILICIFIED WOOD. Nevada City.
90. SILICIFIED WOOD. Downieville, Sierra County.
304. SILICIFIED WOOD. Columbia, Tuolumne County, sixty feet from surface, between lava and clay.
424. SILICIFIED WOOD. Columbia, Tuolumne County.
486. SILICIFIED WOOD. Eclipse Mine, seven miles west of Lower Lake, Lake County.
1171. SILICIFIED WOOD. Near Angel's Camp, Calaveras County.

1772. SILICIFIED WOOD. Dutch Flat, Placer County.
1855. SILICIFIED WOOD. Near Roseville, Placer County.
1856. SILICIFIED WOOD. Near Calistoga, Napa County.
2167. SILICIFIED WOOD. Near Volcano, Amador County.
2387. SILICIFIED WOOD. Burnell Valley, Sonoma County.
2433. SILICIFIED WOOD AND LIGNITE. Mount Diablo Coal Mines, Contra Costa County.
3423. SILICIFIED WOOD. Omega, Nevada County.
3434. SILICIFIED WOOD. Nevada County.
3444. SILICIFIED WOOD. Chalk Bluffs, Nevada County, South Yuba Mining and Milling Company. A large quantity and great variety of specimens.
3781. SILICIFIED WOOD. Duryea Hydraulic Mine, Chili Gulch, Calaveras County, one mile from Mokelumne Hill.
4113. SILICIFIED WOOD. Twenty feet below the surface, San Luis Obispo County.
4152. SILICIFIED WOOD. Large and remarkably fine specimen. Placer County.
5610. SILICIFIED PALM WOOD (with microscopic section). From North Bloomfield Hydraulic Mine, Nevada County. The silicified woods found in the auriferous gravels of the State are generally conifers, and under the microscope show characteristic dotted ducts. This is the first instance where a palm has been found silicified.
2177. SMITHSONITE WITH CERUSSITE. Modoc Mine, Inyo County.
2918. SILVER NATIVE IN PARTZITE. Comanche Mine, Blind Springs, Mono County.
1632. SPALERITE (ZINC BLENDE). White Chief Mine, Mineral King District, Tulare County.
1633. SPHALERITE (ZINC BLENDE) IN CALCITE. White Chief Mine, Mineral King District, Tulare County.
1891. SPHALERITE (Zinc Blende.) Mineral King, Tulare County.
2154. SPHALERITE (Zinc Blende). Dennis Martin's Ranch, four miles west of Menlo Park, San Mateo County.
4070. SPHALERITE (Zinc Blende), with Calcite. Small Hill Mine, Santa Catalina Island.
1130. STALACTITE. Bass' Cave, Shasta County.
2404. STALACTITES (?). Deposited by jets of steam at the Mud Volcanoes, San Diego County. Qualitative analysis shows Carbonate of Lime, with Silica, Iron, Alumina, Magnesia, and Sulphuric Acid, in small quantities, and considerable common Salt.
3722. STALACTITE. Cave near Volcano, Amador County.
4791. STALACTITES. From Crystal Cave, Cave City, Calaveras County. (See No. 133.)
4792. STALAGMITE. Cave of the Catacombs, near Cave City, Calaveras County, rediscovered July 1, 1881. In this cave there were found great quantities of human bones, of which there is no history, and from which the cave was named.
133. STALAGMITE. Calaveras County.
1129. STALAGMITE. Bass' Cave, Shasta County.
2817. STALAGMITE. Morro, San Luis Obispo County.
3012. STALAGMITE. Cave City, Calaveras County.
4790. STALAGMITE. Found isolated at the foot of a tree, near Crescent City, Del Norte County.
1473. SULPHUR, NATIVE. Sulphur bank, Lake County.
5933. SULPHURETS. Washed from earth taken from a tunnel in the Amador Gravel Mine, near Jackson, Amador County.
438. SYLVANITE—TELLURIC GOLD. Malone's Mine, Stanislaus County.
352. TALC. Seven miles from Mount Hamilton, Santa Clara County.
4247. TALC, FOLIATED, WITH CHALCOPYRITE. San Diego County.
2276. TALC IN QUARTZ. Yosemite Gold Mine, Mariposa County.
3433. TALC, FOLIATED. Altaville, Calaveras County.
2736. THENARDITE. (Anhydrous Sulphate of Soda.) Borax Marsh, Inyo County.
1595. THINOLITE. Largely used for lime. Mono Lake, Mono County.
3697. THINOLITE. Desert, near Volcano Station, Southern Pacific Railroad, San Diego County.
1200. TINCAL. Slate Range, San Bernardino County.
4998. TRAVERTINE. Major's Creek, Santa Cruz County.
2129. TREMOLITE (variety of Amphibole). Santa Cruz Mountains.
1310. TRIPOLITE. Santa Barbara.
1807. TRONA (Carbonate of Soda). Sink of the Mohave, Death Valley, Inyo County.
1108. TSCHERMIGITE. Sulphur Bank Mine, Lake County.
188. TUFA. Santa Cruz, California.
814. TUFA (Ferruginous). Peck Mine, Shasta County.
5427. TUFA (?). Very interesting formation. Gold Gravel Hydraulic Mine, La Porte, Plumas County.
1806. ULEXITE (Borate of Lime). Borax Lake, near Grapevine Cañon, Kern County.
4956. ULEXITE (variety technically called "Sheet Cotton," containing free boracic acid). Death Valley, Inyo County.
3588. VIVIANITE. Brea Ranch, Los Angeles County.
5351. WULFENITE (Molybdate of Lead in small crystals). Found six miles northeast of Cane Springs, Kern County.
4155. ZEOLITE (undetermined, in Lava). North Fork Mining District, Fresno County.
4265. ZEOLITE (in Lava). Eureka, Humboldt County.

A special private collection of minerals, ores, etc., the property of A. Dohrman, of San Francisco, was exhibited by Professor C. D. Voy, also of San Francisco. This really fine and valuable collection was displayed in eight table cases, which were quite crowded. Many of the specimens were from California, and were not only valuable and beautiful, but rare, and in some cases typical. The collection was especially rich in crystallized gold specimens. Most of this fine collection was collected by Professor Voy in years past. He worked under many disadvantages in New Orleans, and deserves great credit for overcoming them, and for the great taste displayed in the arrangement. He promised to prepare a catalogue of the California minerals for this report, but for some reason it was not received in time for publication. Among other exhibits under charge of Professor Voy was a hydraulic nozzle, by Hoskins, of Marysville.

A collection of economic minerals is not of necessity a beautiful one. The ores from which the greater portion of mineral wealth is extracted are generally dull and unattractive to the eye, and are low grade; that is to say, they contain the desirable metal in minute specks or crystals, or mixed with worthless minerals, and disseminated through a large quantity of rock or vein matter; such ores must be crushed, assorted, concentrated, and amalgamated, or smelted, according to their condition, or the nature of the valuable minerals contained in them. A collection of rich specimens only would be a deception, and would mislead those to whom we desire to give information. If all ores extracted from mines were as rich as some exceptional specimens, they would have no more value than granite or sand.

GOLD.

Gold differs from all other metals known to man in having but little intrinsic value beyond what it derives from its scarcity, and from the excessive labor required to obtain it. Why it should be so much desired and valued by the human race is a question that has puzzled philosophers and thinkers from the days of Crœsus to the present time, and no satisfactory solution has been found. Gold is the best known medium in which labor can be stored. Silver, platinum, copper, and a few other metals share this property with gold, but not nearly to the same extent.

Gold is one of the products of a country that cannot, under ordinary circumstances, be over produced. Generally its worth increases with the difficulties of production. It is only when it is discovered in unusual quantities that it decreases temporarily in value. It is to the discovery of gold in unusual quantities in California that we owe the brilliant, almost meteoric flight of our State from a dreamy, slow-going Mexican dependency, to its present advanced condition.

Mankind, when crowded together, become restive, which leads to dissensions and wars; when in that condition the people become unhealthy, and sickness and pestilence follow. By these effects the surplus population is removed, otherwise they could not obtain food enough for their support. When gold is discovered in a new locality, colonists follow the gold seekers, and the pressure is thus relieved. The area of fertile lands on the earth's surface is ample for the support of more than all the inhabitants of the world that have lived upon it at any one time, if the population had been evenly distributed, but there must be some strong incentive to overcome the indolence of an overcrowded community and the natural love of home inherent in man.

Before the golden era of the present century there was an uneasy condition arising from the causes mentioned, the symptoms of which were rather

alarming. The artisan and laborer were poorly paid, and there was no special inducement to cause human progress. The wheels of commerce and manufacture were clogged. There was need of a change, and that change commenced with the discovery of gold in California. Prices went up, as they have always done from the earliest historical period during which gold was largely produced; laborers were better able to support their families in comfort; capitalists, who had for many years accumulated and hoarded gold, were no longer able to dictate prices for wages to the laboring classes. When the California golden discovery was repeated in Australia, an era of prosperity, general intelligence, happiness of the masses, equality, and enterprise commenced which has never been equaled in the history of the world; and should gold from any cause cease to be produced from this time forward, the world would have been greatly bettered and advanced by its discovery and use during the last thirty-four years.

Having shown that the discovery of gold in California was the direct cause of universal prosperity in the United States, I do not hesitate to express the opinion that a sudden and total check to the gold supply would be a national calamity. My reasons for so thinking may be best expressed by an example: Suppose a flour merchant has a large stock of goods, purchased with gold, or its equivalent, when a barrel of flour could only be bought for ten dollars. Assume that the gold mines failing, and the purchasing power of gold for that reason increasing, millers and producers combined would be glad to sell wheat and flour at the rate of five dollars per barrel, in the same gold. The loss to the merchant holding a large stock would certainly be great; yet the intrinsic value of the flour would remain the same. A barrel would make the same number of loaves, and feed the same number of individuals.

Let us show further the influence that gold has on the price of labor as proved by experience in California. If an able-bodied laborer, educated or otherwise, can dig from the ground in a day an ounce of gold, valued at $20, he will not work as a baker at $1 50 per day, which he was willing to do before gold was discovered in California. As a consequence, the price of bread rises. When the conditions are changed, as at present, being no longer independent, the laborer is compelled to accept such wages as the master baker offers. The price of bread not only falls again, but the price of labor also declines, and with it the prices of all the products of labor, and the artisan can only provide his family with the necessities of life, and less of the comforts and luxuries than he was able to furnish them when labor demanded and obtained higher wages. What has been said regarding the rise and fall in the price of bread is true also of all other products of labor.

It is true that when gold is practically retired from trade and commerce, prices will regulate themselves, and the artisan, or common laborer, will be able to do better with the smaller sum he receives as wages; but low wages and low prices are always an index to a correspondingly low state of prosperity. It is my opinion that the present uneasy feeling among the working classes, and fall of prices generally, which is causing so much distress among the merchants and manufacturers, as well as the laborers, is due directly or indirectly to the diminishing production of gold.

This idea is not new or original, for history shows that in every instance a sudden augmentation of the precious metals, and specially of gold, has led to a condition of unusual prosperity, followed by a stage of extravagance, speculation, over production and folly, ending in a fall in prices, stagnation, general distress, and return to the normal condition. We are only repeating history.

The evils of stock gambling we have brought upon ourselves and have none other to blame, but since we have in our wisdom, or otherwise, discouraged the production of gold, we must put up with the consequences. The possession of gold made it possible to live in what seemed to be open violation of the laws of commerce and trade. We could, and did, pay our laboring classes higher wages than could be afforded in other States.

Gold can be produced in California for many years to come, but its extraction is annually becoming more difficult. There are causes in operation which will surely lead to a total suspension of its production in the State, but the supply will not then be exhausted. On the other hand, labor in proportion will become cheaper, and the value, or rather the purchasing power of the gold, will increase. For these reasons mines which years ago would not pay to work, are now being opened and wrought with profit. These remarks apply equally to the gold fields of other States and foreign countries.

Unless some new and productive gold field is discovered, the value of gold will continue to increase, and the reaction already commenced, with its train of evils, will continue until the old condition of low prices, poorly paid labor, and general stagnation returns. There are those who believe that such a change would be an improvement on the present feverish high pressure condition of the world. But the argument of these important questions is foreign to the purpose of this report. In view of the fact that the diminution in the production of gold is the direct cause of the present depression of business and the fall of prices, it would be a wise policy on the part of our people to encourage the production of that metal so abundant in our State, that the inevitable return to the former condition may be as gradual as possible, and not partake of the nature of a crisis. This can be done without the sacrifice of any rights of the agricultural interests, if legislation can be effected in the proper spirit, and the general interest of the whole people be considered.

The two important questions, an increased production of gold, and the impartial distribution of the surplus waters of the rivers of the State for irrigation purposes, should engage the attention of our legislators until an equitable adjustment is effected.

For many years California enjoyed a golden era in more senses than one, during which time our people thought themselves better business men than their neighbors. While the gold lasted they cared but little to compete in manufacturing, because they were to a great extent independent of the rest of the world; but the golden fruit will no longer fall into our hands without the trouble of picking, and while it is a disagreeable fact to admit, we are becoming yearly more and more dependent on the other States and Territories, and can no longer defy the law of supply and demand. If we decide to abandon the gold mines we must encourage agriculture and manufactures. We cannot manufacture successfully unless we can compete with prices of other countries, including that of labor. Otherwise goods can be sold in our market cheaper than we can make them.

We should have a larger and a more industrious population to purchase and use our manufactures. Too many idle men crowd to the cities when they should be in the country working small farms or utilizing the water powers. In adapting ourselves to the new order of things our condition *may* be better in the end, but the transition from our former independence will bring with it a share of bitterness.

It is not fair to open an account with the gold mines of California *per se*. At least, not with the bullion produced, for other and external benefits

have been realized. California gold made it possible to farm on a large scale in a new country. It has planted a great empire on the western slope of the American continent; has made a new market for the world; it has swarmed the bees in the city hives of the East and transferred them to a new and fertile field. The precious metal gathered by them in California and other western States and Territories made it possible for the General Government to resume specie payments at the end of the civil war, and aided materially in carrying that war to a successful ending.

The American citizen may proudly boast that all this metallic wealth has been won by free labor, never before known in the history of the precious metals. One of the most serious mistakes we have made in California, has been the attempt to work all the mines discovered immediately, and to leave nothing for posterity and the future. Were this possible, the resulting over-production would defeat the plan, and the metals extracted would have no value. On the other hand, it can be shown that prospecting, and even the fury of speculation, while often a direct injury to those engaged in it, has been a benefit to the State and to the world. It has made us acquainted with mineral localities that would otherwise have remained for a long time unknown. These localities will furnish, when required, and when they are properly worked, raw material for manufactures and arts. The water-courses have all been studied, and numerous ditches been surveyed. When the placer gold is either practically exhausted, or the mines abandoned, the mining ditches will be repaired and will serve to convey to the agriculturists the water so needful for irrigation.

Suppose we have made some mistakes, cannot we in the future rectify them? Is the experience dearly bought, when the present and coming greatness of our glorious State is considered?

Gold in California is obtained by two distinct and separate methods. One is called *placer mining*, which is simply collecting free gold from natural deposits in which it has been concentrated by forces acting slowly but continuously through many geological ages. The other method is known as *quartz or vein mining*. The material worked is quartz, the natural matrix for gold. It is assumed that the gold in the quartz has been concentrated also by natural causes from the wall rocks or the rock formations in which the veins have been formed. Nature, to produce placer gold, first concentrated that metal in the veins, and subsequently changed the solid rocks, including the quartz, into sediments and finely divided particles. Having practically exhausted the surface placers, man with a vast expenditure of capital and labor attacks the quartz, from which he gathers a small quantity of gold. Tupper had this in mind when he aptly said, "In a mountain of quartz we find a grain of gold."

Placer mining is practiced by various methods, but all of them based on the same general principle—taking advantage of the great specific gravity of gold (19.258) and using water not only to remove the foreign matter, but also to allow the precious metal to settle below worthless material. The first placer mining in the State was simple; it consisted in washing the rich auriferous sediments in a miner's pan, rocker, sluice, or long tom. When the cream was skimmed, and the most accessible placers exhausted, more force and more water were required to collect the disseminated gold. This led to ground-sluicing, in which large and powerful streams were conducted through the claims, while the auriferous earth from the sides was picked down or shoveled into the torrent. The richer sediments gathered by this crude process were further concentrated in sluices and the operation finished in the miner's pan. This mode of mining is

not new. In the old work of Agricola, *De Re Metallica*, published in Latin in the year 1621, on folio 270, a quaint engraving may be found in which ground sluicing is represented, and upon which our modern method is no improvement. The sluices, rockers, pans, and riffles figured in that ancient volume go far to show the truth of the saying, "There is nothing new under the sun."

The next step in advance was "booming." In this operation a large quantity of water was gathered in a reservoir, and at the proper moment a floodgate was opened suddenly and the whole body of water precipitated on the gold field, thus imitating the torrent that nature employed to do similar work, but on a grander scale: this method, too, is old. The process is minutely described in *Pliny's Natural History* (Bohn's edition, vol. 6, fol. 99)and quoted in full in the second annual report of this office, folio 44.

The grand culmination of placer mining is the hydraulic method. "HYDRAULIC MINING," in which water is conveyed for long distances in canals, "*ditches*," to reservoirs, called "pressure boxes," and from them in large iron pipes under great pressure to the auriferous deposits, and projected in powerful streams through nozzles four to nine inches in diameter, against the banks. The operation is assisted by blasts in which hundreds of kegs of powder are employed in a single operation. As far as I can learn this is a modern and a Californian invention. All the details of hydraulic mining, as conducted in California, are described in the second annual report of this office. So powerful is the force used in hydraulic mining that vast quantities of earthy matter are transferred from the banks to the beds of the rivers, causing inconvenience and loss to the agriculturists below, for which reason hydraulic mining has been practically suspended in the State, to the great loss of the community and distress of the miners formerly employed; besides destruction of capital, actual and prospective, which in the end will amount to many millions of dollars. Until some method of placer mining is devised which will admit of the working of the great auriferous beds of the State without injury to other interests, hydraulic mining in California must remain suspended.

DRIFT MINING is another form of placer mining, but in some features resembling vein mining. This is the gathering of gold from the bedrocks on which the auriferous gravel banks lie—generally considered as ancient river channels. The rich deposits are made accessible by tunnels driven into the banks nearly horizontally and parallel to the bedrocks. From these tunnels (drifts) this mode of mining takes its name. There being but little objection made to drift mining, it is likely to be continued as long as it is remunerative. A modified form of hydraulic mining is conducted in Georgia and North Carolina, described under the proper head, but on a small scale indeed when compared with the California operation. All the work done near Dahlonega does not equal in extent one of our smallest hydraulic workings in Nevada County.

Quartz is almost invariably crushed in mills under heavy stamps; here, too, we find that we are but adopting a plan of working in common practice in the time of Agricola. In his work we find figured quartz mills with square stamps almost exactly similar to those first introduced into California. We have made great improvements, but the idea is not new. Even washing the blankets, sluices, riffles, aprons, and other familiar mill appliances, are figured in this remarkable book. It is curious to note the small proportion of gold which can be extracted from quartz with profit in California, which is however rich as compared with that successfully wrought in the Southern States. Quartz which contains $60 worth of gold

to the ton of 2,000 pounds, which is about the highest milled in the State, is in the proportion of one part of gold to 10,049 parts of quartz, while $6 to the ton is equal only to one part of gold to 100,489 parts of quartz.

We are now working gold quartz in California which yields less than the last example, while in Georgia the yield, as shown elsewhere, is still very much less.

The total yield of gold in the State of California has been variously estimated. The actual yield will never be known. The estimate accepted by the State Mining Bureau, including 1884, is $1,078,685,169. The weight of such a mass would be about 3,578,203 pounds, or 1,789 tons, nearly. This enormous quantity of gold, if melted together, would make a cube of about fourteen feet face. A model of such an ideal cube was exhibited in the California department of the Exposition, and small as it seemed, it represented the result of thirty-four years mining, millions of days' labor, and the loss of many lives. On the other hand, the gold represented has been an important and powerful factor in causing the present prosperity and greatness of the American Union. The largest yearly production of gold occurred in 1854, when the yield was about $65,000,000; the smallest was in 1883, when the production had diminished to $13,841,297. The total sum of California gold and silver deposited in the United States Mints to January 30, 1883, was:

Gold	$723,044,046 07
Silver	3,055,850 29
Total	$726,099,896 36

Melville Attwood, F.G.S., of San Francisco, who has been actively engaged in practical gold mining since the year 1835, first in Brazil, and afterwards in California, and one of the first who made a success of quartz milling, in Grass Valley in 1852, has prepared a special paper for this report, given below. It will be of great benefit to the prospectors of California—that useful but unappreciated class to whom we are so much indebted for our knowledge of mineral districts in the State, by them brought to public notice.

MR. ATTWOOD'S PAPER.

A Simple Working Test for Determining the Quantity of Gold mechanically combined with Auriferous Vein-matter.

To Henry G. Hanks, F.G.S., State Mineralogist:

DEAR SIR: We have long felt and experienced the want of some practical and correct way of estimating the value of auriferous vein-matter, or gold quartz, which would demonstrate what could be obtained by careful milling—a test that could be applied at the mine, of so simple a character, that those witnessing the trial, though not conversant with mining or milling, would be able to judge of the result, and, if necessary, satisfy themselves of the safety of their money, in case they wished to invest for the futher development, or even the purchase of the mine.

For the greater part of the past fifty years I have been more or less practically engaged in gold mining, and the great importance of some simple and reliable working test has constantly presented itself to my notice, so much so, that I at last determined to try and devise some plan to meet the requirements, and after exhaustive experiments I think that I have, in a great measure, succeeded, and therefore trust I am not out of place in bring-

ing the matter before you and describing as briefly as possible what I recommend, as our science may be said to have grown out of our practice. At the same time I hope that my suggestions, if acted upon, may be the means of preventing in future the erection of costly machinery on worthless mines.

At the present time a renewed interest is beginning to be felt in our California gold mines, so very many of which were abandoned years ago, on which scarcely any work had been done to prove their value, and even such insignificant trials as were made were made at a time when the mining and milling of gold quartz may be said to have been in its infancy; when the proper machinery, water power, and necessary supplies were hardly obtainable, and the use of the improved "hurdy gurdy" wheel unknown. I am of the opinion that in California there is yet, with its unsurpassed climate and facilities for working, a better field for profitable gold mining than in any other part of the world; that is, for medium and low grade quartz.

By "medium grade" I mean rock yielding, say at the rate of from 5 to 12 dollars per ton, and by "low grade" rock yielding from 3 to 5 dollars per ton.

In Tuolumne, Calaveras, Placer, Amador, and Nevada Counties, there are now idle numerous, valuable, and comparatively virgin mines, well worthy of the attention of capitalists, and which offer safe investments to those who will work them, and which are not, like too many of the Mexican mines offered on this market, for the most part worked out or mere holes in the ground. The experienced Mexican miners will not part with their mines so long as they can be made to pay, and as a rule it is only when in a profitless condition that they ask to have them taken off their hands.

In the early days of gold mining in Australia and California, it was thought that the auriferous veinstone would only be found in paying quantities at or near the surface of the ground. One of the most gratifying features of the present time, however, is the fact that rock of a payable nature is now met with in the deep workings of our California gold mines; nearly all our best dividend-paying mines are getting their rock from depths varying between one thousand and fifteen hundred feet; now every increased foot in depth at which payable quartz is found, means the adding of years to the permanency of the gold production of the district.

The discovery of rich rock in depth is of much greater importance than is generally credited. The Idaho mine in Grass Valley is down about 1,500 feet, the Plymouth mine in Amador County 1,400 feet, the Keystone, New York Hill, Empire, Sierra, Buttes, Providence, etc., are all deeper than 1,000 feet.

Through the kindness of W. E. Koch, F.G.S., I am enabled to give you the following particulars of some of the Australian mines:

Name of Mine.	Depth of Reef in feet Producing Gold.	Gold per Ton of 2240 lbs.
Eureka	1200	2 ounces.
New Chum Railway	1100	13 dwts.
New Chum and Victoria	1600	11 dwts.
Lansell's 186 Mine	1760	15 dwts.
Lansell's 186 Mine	2200	14 to 19 dwts.
Londonderry	1200	17 dwts.

I have been told by Australians lately, that Lansell's is down 2,400 feet, and has good pay at that depth.

Many mines in this State have been abandoned when zones of poor quartz have been met with—a fact which is common in lodes. Had the owners sunk a few feet deeper, in all probability they would have come into rich rock again. The unproductive character of that particular portion of the lode may have been caused by a change in the inclosing rock forming its walls. In the Clogan gold mine, Merionethshire, there is a peculiar interstratification of igneous (intruded diabase) and sedimentary rocks, forming the lower silurian deposits of North Wales. In that formation the lodes are only productive when the walls are formed of igneous rocks, little or no gold being met with when the walls are slate, or Cambrean grits.

It is generally conceded by those who have studied the subject, that metalliferous veins owe their productiveness to what the old miners term the "congenial" character of the inclosing, or wall rock, and the Clogan mine proves that even veins yielding the precious metals are not exceptions.

The congenial rocks may be the precipitants of ores from solutions. The ascension theory is that ores found in fissures were only partially derived from the adjoining country rock, and that the greater portion came from a depth, carried into the fissure either by ascending mineral waters, or by sublimation. Some of our best authorities affirm, amongst them Fredolin Sandberger, that the inclosing rocks contain and furnish not only all the constituents of the gangues, but also the ores.

In a work published in 1821, by Westgarth Forster, "A Treatise on a section of the strata from Newcastle upon Tyne to Cross Fell, Cumberland, with remarks on mineral veins," he says of the "Great Limestone;" "This is the most predominate stratum of limestone that we find throughout the whole section, and has been nearly as productive of lead ore *as all the other strata taken together.*"

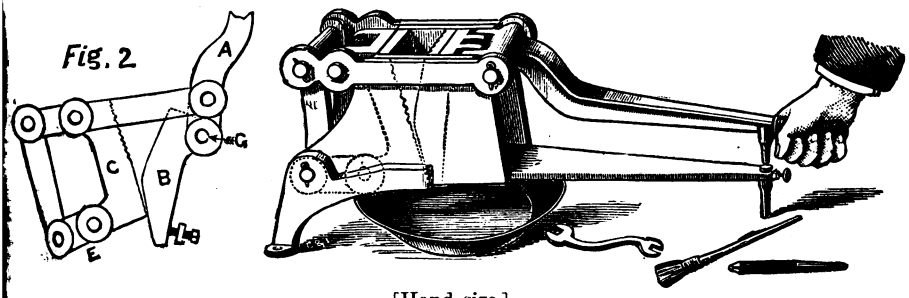
The same may be said of the "Mountain Limestone" of Derbyshire, and the noncongenial toadstone of that district. At the Ecton mine, in North Staffordshire, all the large bodies of copper ore were found where the walls were of the "great gray limestone," the shale and shaly limestone being uncongenial. At Treasure Hill, White Pine, Nevada, most of the silver ore was found where the walls were of gray limestone, so that in well known mining districts it would be the height of folly to make or continue trails where the walls were of noncongenial rocks; and for new districts, it would be well to draw upon information collected elsewhere. The great falling off in the gold supply of the world during the past few years, restricting, in a measure, the currency of the world, coupled with the very large increase in the supply of the commoner metals, has no doubt, to a certain extent, produced the depression in trade now so generally felt in every part of the globe.

On this coast, the partial exhaustion of the Comstock and Bodie mines, and the stoppage of hydraulic mining, have had a very bad effect; also, of late years, a very much larger appropriation of gold has been required for manufactures and ornamentation.

Sampling the Auriferous Quartz.

The gold quartz from which the working test is to be made, should be taken from the lode at the ends or face of the drifts, backs, or croppings, by an experienced, practical miner, in a quantity of not less than thirteen cubic feet, and should be of as true an average of the rock in sight as can possibly be obtained. The broken thirteen cubic feet should then be con-

veyed to the place selected for making the test, and with spalling hammers broken to the size of macadam stuff, of which, after a thorough mixing, two hundred weight, representing as nearly as possible an average of the whole, should be taken and placed on a piece of canvas about two yards square, in the center of which is a stamp die, and then, with cobbing hammers, the two hundred weight should be reduced small enough to pass through a two-inch riddle; the die is then removed, and the canvas raised from each side, so that the broken quartz be well mixed, from which two samples of four pounds each can then be taken. A "heavy bucking hammer," with a large sized "bucking iron," on a piece of canvas so spread or placed that it will collect what flies or is thrown from under the bucking hammer, will reduce the macadam stuff much more rapidly, and is perhaps better than cobbing. (A bucking hammer is formed of a piece of iron six inches square, and one inch thick, adapted to a wooden handle.) The cobbed four pounds samples should then be passed through Taylor's hand rock crusher till it is fine enough to go through a sieve with thirty holes to the linear inch, or even finer, if considered advisable. The following is the description of Taylor's Crusher:



[Hand size.]

The design of this small machine is to enable a person quickly and easily to bring to fine powder the hardest ores, to be assayed, or sampled, or worked. Both jaws are faced with hard white iron, the lower parts of which are plain surfaces, between which the ore is crushed fine. The stationary jaw B has its lower plain surface at an angle to the upper, or corrugated surface. Lower part of this jaw is adjusted by screws, to crush fine or coarse. The movable jaw C is operated by the hand lever A. Jaws, links, and toggles as shown in figure 2. The jaw C has its corrugations horizontal, to facilitate forcing the ore down at each stroke of the lever. This jaw has a vertical and a horizontal motion, the link E forcing plain part of jaw C forward with great force at each downward stroke.

The whole can be quickly taken apart for cleaning, after each lot is worked. To do this, raise the lever A, as in figure 2, and with a tapering drift drive out pin G (upon which lever A turns), then the lever can be thrown over and jaw B removed, and all dusted clean with the brush. To restore parts to position again, replace jaw B, bring back lever and insert pointed drift, and with pin or fulcrum G drive out the drift, and all is ready and clean for next crushing.

The lever has a rubber covering where grasped by the hand, and a rubber cushion where it strikes the bed-piece, to prevent jar and noise. There is a star-shaped piece on top of the lever (not shown), by the turning of which the height to which the lever can be raised is regulated; and when

the lever is raised as in figure 2, this star-shaped piece is turned half around.

Each machine has a cover (not shown) to prevent pieces of ore from flying out, and is furnished with a wrench, drift pin, and dust brush.

Extra jaws and other parts can be had. Weight, complete, eighty-five pounds.

Taylor's hand crusher has many advantages over the common mortar and pestle; first, the rapidity with which it will crush the quartz to the desired fineness, without the stamping and grinding action of the mortar and pestle, by which action so large a proportion of the gold is laminated and floats away when attempts are made to obtain the gold by mechanical assay-washing.

Those conversant with mining and milling, know that there are three modes of reducing gold quartz, copper, silver, lead, and other ores, namely: "crushing," "stamping," and "grinding." The first is effected by horizontal roller rock breakers, the second by stamps, the third by edge mills, pans, arrastras, and millstones.

The great objections to the two latter modes of reduction in the treatment of gold quartz, are the lamination of the gold, and the production, when silver, copper, lead, and other ores are so reduced, of so large a quantity of slimes.

The ore in the condition of slimes, like those from the Comstock mills, is generally in such a state that, so far as I know, all attempts up to this time to profitably recover the metal have failed.

The various simple appliances employed for panning out gold, and the separation of it from pyritic matter and earthy materials, are as follows:

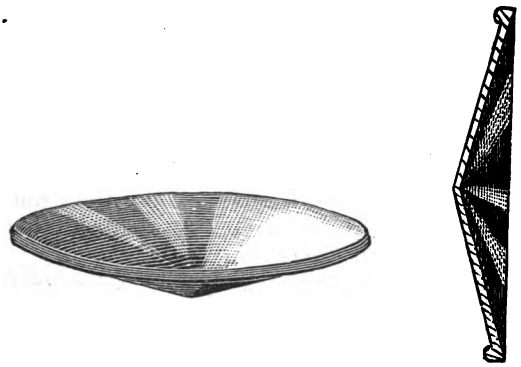
First—The "flat shovel," the use of which is by Cornish ore dressers termed "vanning." The foreman of the different dressing floors where copper, lead, and tin ores are assorted and concentrated for market, necessarily "van" with considerable skill. Vanning is occasionally brought into use in testing for gold. Some of the Cornish and Swansea assayers years ago were perhaps wrongfully accused of "shovel trying," as it was called, instead of making a fire assay of the samples of copper ore sent to them.

Second—The "pan," as used by placer miners and prospectors. It is made out of one piece of sheet iron, and for washing gravel and cleaning up in milling it is vastly superior to any other utensil. A small riddle (piking riddle), similar to those used in assorting lead and other ores, would greatly assist the operation in washing small quantities of gravel. The earthy matter would be more easily removed or cleansed than by rubbing the gravel between the hands. The piking riddle, with about eight holes to the linear inch, has two long handles fixed to it to work it. A large tub partly filled with water is required. The riddle with the gravel in it to be washed is then immersed in the water, and by a sharp quick half-rotary motion the clay or soil is soon removed from the pebbles or gravel. What will not pass through the riddle is then emptied on a table or board so that it can be examined to see if there are any nuggets or cement that require crushing. In estimating the value of "drifting gravel" it is best to do so by the cubic foot, and in the absence of sluices to use the piking riddle and then to wash out the gold with a pan. "In place" the average small gravel will weigh eighteen cubic feet to the ton; on the dump twenty-seven cubic feet.

Third—The "horn spoon," used principally, I believe, by the Mexican miners and millmen to test the mercury in the different stages of the "Patio" and other amalgamation processes. Many of our California

experts use it in prospecting for gold. It is made of various shapes and sizes, but all of them too small to treat a quantity of pulp sufficient for a washing test for gold, besides which the grease from the finger ends in stirring up the pulp in the spoon causes a large proportion of the scale gold to float away on the water, particularly that form of gold generally met with in the cellular portions of the quartz and mostly associated with ferruginous matters. To prove how easily the gold attaches itself to the grease take some sea-beach gold, put into the horn spoon and rub it with the ends of your fingers, then add water to it, and you will find the greater part of it will float away. Nevertheless, with the horn spoon the presence of gold may be detected, but I cannot recommend it for a mechanical or washing assay, the results not being reliable, in fact mere guesswork.

The Batea.



Fourth—The "batea," a wooden bowl or vessel used for washing gold by the Mexican and Brazilian miners, and though these two implements differ very much in size and shape, in skillful hands very good results are obtained from both. My improved form of Brazilian batea, a description of which will be found in your report for 1884, is the result of many years of study. My first attempts were made of zinc, one of which I presented to the Jermyn Street School of Mines, London, in 1851, a cut of which will be found in "Philips' Metallurgy," 1859.

The pattern of my latest improved form I have given to John Taylor & Co., and Mr. Justinian Caire, of this city, who are making them in good form and of suitable wood. The improved batea, if skillfully handled, will give very accurate results, showing nearly every particle of the mechanically combined gold in the veinstone. It is, also, very useful as a concentrator to find the percentage of pyritic matter in the ore.

When the miner is desirous of making a very accurate working test, two bateas should be used, so that the tailings from the first operation can be washed over again. The right hand fingers should also be covered with rubber cots, so that the grease from them may not float the gold: a little washing ammonia should also be added from time to time during the washing or panning out.

In case there is any talcose or greasy matter in the samples of veinstone, it should be soaked in boiling water with a little caustic soda for ten or fifteen minutes before panning out, which can be done in a large glue pot.

When the gold and pyritic matter are brought together in the center of the batea, and well freed from the gangue, allow them to be covered with one

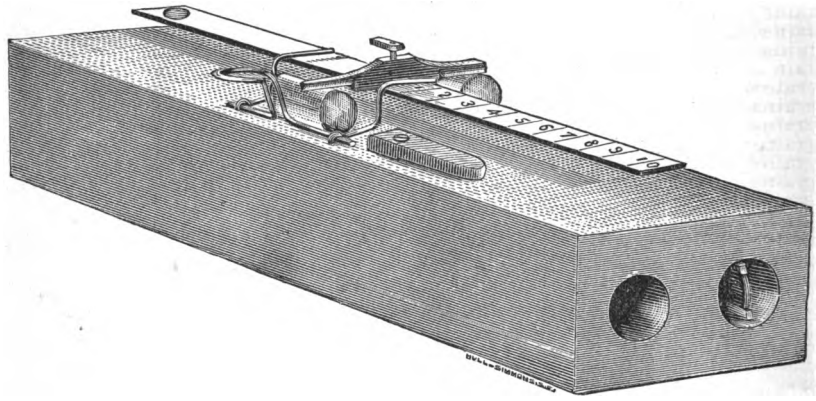
or two inches of water, and then, with a "bar magnet," remove all magnetic iron, which can be easily effected, but care must be taken at the same time, that none of the gold is picked up with the iron; by striking the magnet slightly against the side of the washing tub, the iron will fall from the magnet.

When all the gold is well collected in the center of the batea, a little pure mercury is added sufficient to form a hard amalgam. This mercury being rubbed by the finger covered by a cot, will rapidly take up the gold, the wooden surface of the batea greatly assisting the operation.

The pyritic matter left, if thought to contain any gold, can be ground up fine with water and mercury in an agate mortar, or roasted in a clay dish with a little nitrate of soda, and then amalgamated.

The four-pound samples are then to be treated as directed in using the batea, and the resulting amalgam put in a piece of charcoal, and the mercury volatilized by the aid of a blowpipe, the resulting gold being weighed, the value per ton of rock will be found by the accompany tables. In case the fineness of the gold appears to differ from that of the district, it can easily be determined with sufficient accuracy by the touchstone of testing needles.

The Pocket Balance.



Among the many difficulties I had to encounter in making the working test was first in getting the rock properly and rapidly crushed, and afterward in having the gold washed out of the crushed rock and amalgamated without loss of gold. Messrs. Taylor's hand crusher I found answered very well for the crushing, and the improved form of batea for washing out and amalgamating the gold, but to complete the outfit I required a portable, accurate, and cheap balance. After many attempts, in which I was kindly assisted by M. G. Rockwell and M. Bohn, and taking Dr. Black's invention as a model, I have at last succeeded in making a balance which I think will answer the purpose so well that Messrs. Taylor are now making one something after the same pattern but with improvements.

The balance and frame, as shown by the accompanying drawing, is about seven inches long and one and a half wide and one inch deep. The balance is a German silver beam, six inches long and one fourth of an inch wide; the fulcrum knife-edged and the bearings pieces of round glass.

On the right hand side of the fulcrum ten divisions are marked at equal distances from each other, and on the left hand side a small depression is made to receive the globules of metal or a small pan for gold dust. Above

the fulcrum is a small vane, which being turned to the right or left adjusts the beam to equilibrium. The two small wires resting upon the beam keep it in place while the globules to be weighed are being placed on the beam. By a very slight pressure with the finger the wires are raised and allow the beam to work.

The number of weights required are three, made of flattened wire, viz.: 10 grains, 1 grain, and one tenth of a grain. The weights are moved from one division to another as required to balance the globules, keeping the flat side on the lines of division.

This balance is very sensitive and will weigh to the one thousandth part of a grain.

Holes are made in the wooden block to hold the blowpipe, pincettes, weights, charcoal, etc. The following table is to be used in connection with the balance:

Prospector's and miner's Gold Table, to determine free gold per ton of 2,000 pounds average. Sample for working test, four pounds avoirdupois, 28,000 grains.

Weight of Washed Gold; four-pound sample in grains and tenths.	Fineness, 780; value per oz., $16 12.	Fineness, 830; value per oz., $17 15.	Fineness, 875; value per oz., $18 08.	Fineness, 920; value per oz., $19 01.
5 grains	$83 97	$89 36	$94 20	$99 05
4 grains	67 18	71 49	75 36	79 24
3 grains	50 38	53 61	56 52	59 43
2 grains	33 59	35 74	37 68	39 62
1 grain	16 79	17 87	18 84	19 81
.9 grains	15 11	16 08	16 95	17 82
.8 grains	13 43	14 29	15 07	15 84
.7 grains	11 75	12 51	13 19	13 86
.6 grains	10 07	10 73	11 30	11 88
.5 grains	8 40	8 93	9 42	9 90
.4 grains	6 71	7 14	7 53	7 92
.3 grains	5 03	5 36	5 65	5 94
.2 grains	3 36	3 57	3 76	3 96
.1 grains	1 68	1 78	1 88	1 98

Table

For determining the amount of free gold per ton of 2,000 pounds average. Sample for washing, 29,166⅔ grains, approximately 4 pounds 2¾ ounces.

Each grain of gold obtained after washing will, therefore, equal 1 ounce per ton. If the gold be—

750 fine, each ounce will be worth $15 50
800 fine, each ounce will be worth 16 53
850 fine, each ounce will be worth 17 57
875 fine, each ounce will be worth 18 08
900 fine, each ounce will be worth 18 60
920 fine, each ounce will be worth 19 01
930 fine, each ounce will be worth 19 22
940 fine, each ounce will be worth 19 43
950 fine, each ounce will be worth 19 63

Hence, multiply the value per ounce by the number of grains to give the value per ton. Example: If the washed gold weighs 2 grains, and the fineness be known or estimated at say $16 53 per ounce, the sample shows $16 53 × 2 = $33 06 per ton.

I lately had occasion to make a cursory examination of what at one time was considered a very important mining district—Meadow Lake. A large town was built, then called "Summit City," which "city" might be said to have been built up by high assays, and let down by working results.

It had a reported population of about 5,000, brick hotel, stock board, etc. I am also told that 100 different mining locations were recorded, and seven quartz mills erected. Now the place is quite deserted, and the mills and buildings, with few exceptions, in ruins.

It is impossible to say how many indescribable processes were tried there to save the gold, from numerous high assays they were led to believe the veinstone contained. The samples which gave high assays were supposed to have been taken by parties who thoroughly understood the business. The assay certificates of Meadow Lake rock, if bound up together, would make quite a large volume.

Vast sums of money must have been expended—how much, it is impossible to tell; but I feel assured that had the simple practical test which I have now tried to describe to you been applied at the mines by some experienced hand, the greater part of the money would have been saved; and from the cursory examination I made of the district, I feel satisfied many of the large mines would now be in successful operation. The auriferous veins in Meadow Lake are of low grade, containing considerable pyritic matter and zinc blende; the blende and a large proportion of pyritic matter, however, does not carry gold.

At the croppings a considerable portion of the pyritic matter has undergone decomposition, leaving in the cellular quartz films and scales of gold. Samples taken from such parts might account for some of the high assays.

The wholesale failure in the mining and milling at Meadow Lake was a lesson dearly bought, but at the same time the best evidence I can advance to show the great value of reliable practical working tests, and also the desirability and necessity, when an examination of a gold quartz mine is required, to employ a thoroughly practical man, who has had years of practical experience in the working of that class of mines, and who also understands the way of taking samples to correctly represent the rock in sight.

I trust the day has gone by when breaking small pieces of rock from here and there in the lode for fire assay, or, worse still, pounding in a mortar and afterwards attempting to wash out the gold with greasy fingers in a horn spoon, and then by the aid of a powerful magnifier guessing the gold contents of the rock, will be considered a reliable assay.

Low grade ore, that carries a large proportion of pyritic matter with zinc blende, like the Meadow Lake ores, cannot be milled without considerable loss, and the lower the grade the greater the loss. With such ore, battery amalgamation is out of the question, so that the treatment to be adopted must be the same as that in use at the St. John del Rey mine, in Brazil, namely, concentrations, though, from the published accounts of that company, their mode of concentration is very imperfect, and the *cold* amalgamation, depending on the atmosphere for temperature, sadly behind the age.

At a meeting of the St. John del Rey company, June eighteenth, the proceedings of which were published in the *Mining World and Engineering Record*, the Chairman, Mr. Hocking, gave some interesting particulars regarding the great loss in milling their low grade sulphuretted ore. It appears that when the gold contents by assay were at the rate of $9 33 per ton they only recovered $7, losing $2 33, or about 33 per cent. From their Cinabo mine, a much lower grade of ore, they only recovered $3 from $6 ore, a loss of 50 per cent.

In one of their old reports for 1866 it is stated that during the year they milled 60,685 tons of ore, the average gold contents of which by assay was $23, from which they recovered $19 50, losing $3 50, or about 15 per cent.

Comparative Statement of Assays and Results.

Months. 1866.	Mineral Treated.	Contents Per Assay.		Produce in Reduction.		Loss on Process.,		
	Tons.	Per Ton Oitavas.	Total Oitavas.	Total Oitavas.	Per Ton Oitavas.	Total Oitavas.	Per Ton Oitavas.	Per Cent.
January	5072.8	9.889	50.169	44.487	8.768	5.682	1.121	11.32
February	4663.2	11.388	52.872	44.199	9.478	8.673	1.860	16.40
March	5144.8	11.486	64.243	55.074	10.703	9.169	1.783	14.27
April	5019.2	11.506	57.752	47.416	9.446	10.336	2.060	17.87
May	5373.6	11.520	61.898	57.541	10.707	4.357	0.813	7.03
June	5271.2	10.911	57.517	49.494	9.388	8.023	1.523	13.94
July	5195.2	10.473	54.411	45.737	8.803	8.674	1.670	15.94
August	5033.6	11.673	58.758	49.378	9.809	9.380	1.864	15.96
September	4442.4	11.809	52.461	45.371	10.213	7.090	1.596	13.70
October	4980.2	12.516	62.304	50.973	10.235	11.331	2.275	18.18
November	5170.6	12.437	64.311	54.425	10.524	9.886	1.913	15.37
December	5318.3	11.525	61.296	99.693	9.343	11.603	2.182	18.92
Totals	60685.1	11.501	697.992	593.788	9.780	104.204	1.720	14.92

These mines were purchased by an English company more than half a century ago, and have paid dividends for the greater part of that time. The company have always employed men of great talent to manage the reduction works.

Careful analyses have been made of sulphurets or concentrations of our California mines and those of Brazil; the difference, if any, is very trifling, so that the gold in the raw sulphurets of our California mines may be amalgamated in barrels, the same as in Brazil, provided the operation be properly conducted and pyritic matter reduced fine enough, and free from decomposition.

A very cursory examination of the lead mines in the lower carboniferous rocks of the Alston Moor District (north of England) would in a short time convince any one of the truth of what are called "congenial rocks."

The following is a catalogue of California gold mines represented in the Exposition. For description and names of donors see corresponding numbers in museum catalogue:

5070. Akin or Virginia Mine, near Coulterville, Mariposa County.
2372. Alabama Mine, near Jamestown, Tuolumne County.
1865. Alabama Mine, near Penryn, Placer County.
111. Alaska Mine, Sierra County.
3744. Albion Mine, Meadow Lake, Nevada County, complex ore. This specimen will be carefully analyzed and the results published.
456. Al. Bunnell Mine, Kern County, Slickensides.
462. America Mine, North San Juan, Nevada County.
4362. Baltimore Mine, near Kelsey's, El Dorado County.
465. Bald Mountain, Forest City, Sierra County, cement with gold.
1794. Banghart Mine, Shasta County, sulphurets.
3445. Banghart Mine, ten miles north of Shasta, Shasta County, gold in porphyry.
2346. Banner District, San Diego County.
2812. Basco Mine, San Antonio Creek, Calaveras County.
1908. Basin Slope Mine, Tuolumne County.
4120. Beveridge District, Inyo County, gold in cellular quartz.
3719. Beveridge District, Mono County, gold on quartz crystal. The gold has the appearance of having been formed in the crystal, but close inspection shows that it is cemented on the outside by oxide of iron.
293. Big Blue Lead, Kern County.
909. Black Mine, Tuolumne County.
2429. Blue Lead, Sierra County, gold in cement.
380. Blue Ledge Mine, Kelsey Flat, El Dorado County.
1268. Bodie Mine, Mono County.

4744. Bodie Mine, Mono County, quartz with gold (electrum).
1541. Bodie Mine, Bodie Mining District, Mono County, gold and silver.
3778. Bodie Mine, east drift, Bodie District, Mono County.
677. Boston Mine, Latrobe, El Dorado County.
120. Boynton Mine, near Soledad, Monterey County.
2870. Bright Star Mine, Piute Mountain, Kern County.
1457. Brunswick Gold and Silver Mining Company, Nevada County.
1278. Calaveras Mine, Calaveras County.
344. California Con. Mine, Gold Tunnel, Nevada County.
4156. Carga Muchacho Mine, twelve miles west of Fort Yuma, San Diego County. Up to June 17, 1882, this mine has produced 14,000 tons of quartz, which yielded in the mill at El Rio, $167,000. This statement is made by Mr. Wm. Sublette, by whom the specimen is donated.
100. Cedarburg Mine North, El Dorado County.
1456. Central Mine, three miles north of Haywards, Amador County.
279. Cerro Gordo Mine, Inyo County.
3424. Champion Mine, Yuba River, near Omega, Nevada County.
897. Chaparral Mine, Tuolumne County, gold quartz in slate, sixty feet deep, two feet wide.
2351. Cherokee Mine, Tuolumne County.
2103. Coe Mine, Coulterville, Mariposa County.
388. Confidence Mine, Fresno County.
2823. Conrad Mine, Duncan Hill, one and a half miles west of Auburn, Placer County, one hundred and fifty-foot level.
1881. Corbet's Creek Mine, Mariposa County, gold-bearing sulphurets in quartz.
5314. County Line Mine, Bishop Creek District, Inyo County.
650. Crescent Mine, Plumas County.
1285. Crown Point Mine, Amador County.
——. Crystal Mine, El Dorado County.
2374. Crystalline Mine, near Jamestown, Tuolumne County.
3029. Dahlonega Mine, section twelve, township sixteen north, range eleven east, Placer County.
2885. Deadwood Mine, Nevada City, Nevada County.
2452. Delano Gold and Silver Mine, Deer Creek, Tulare County.
4491. Diadem Quartz Mine, Edman District, Plumas County, gold in quartz, cut and polished specimen.
1878. Doss Mine, two miles from Hornitos, Mariposa County, gold-bearing sulphurets.
5047. Dover Mine, Humbug Cañon, Placer County.
4166. Dudley Mine, Meadow Lake District, Nevada County.
566. Dutch Boy's Mine, near Railroad Flat, Calaveras County.
1502. El Capitan Mine, North Fork District, Fresno County.
2321. El Carmen Mine, Hite's Cove, Mariposa County.
2032. El Dorado County, auriferous pyrites, contains 21.4 ounces of gold to the ton.
2138. Euchre Bar Mine, section five, township fifteen north, range eleven east, Placer County, contact vein.
4375. Excelsior Mine, Meadow Lake District, Nevada County, auriferous pyrites.
3745. Excelsior Mine, Meadow Lake District, Nevada County, complex ore.
974. Fall Creek Mine, near Emigrant Gap, Nevada County, gold quartz with free gold.
1629. Fall Creek Mine, Washington Township, Nevada County, quartz with telluric gold.
572. Farrall Mine, James Bar, Mokelumne River, Calaveras County.
2912. Flag Mine, Brown's Valley, Yuba County.
1398. Fresno Enterprise Mine, five miles from Fresno Flat, Fresno County.
4922. Gagnere Mine, section thirty-two, township two north, range fourteen east, in the town of Tuttletown, Tuolumne County.
1093. German Mine, near Placerville, El Dorado County.
320. Glencoe Mine, Calaveras County.
5061. Godfrey Gravel Mine, Grass Valley, Nevada County, cement with gold.
2769. Gold Blossom Mine, one thousand feet south of St. Patrick Lode, Placer County.
3676. Golden Crown Mine, Coulterville Mining District, Mariposa County, vein matter. This specimen is remarkable, as showing the effect of solfataric action in the vein.
249. Golden Gate Mine, two miles from Sonora, Tuolumne County, gold quartz with mass of sulphurets.
898. Golden Gate Mine, Tuolumne County, gold quartz in slate, one hundred feet deep.
3429. Golden Hero Mine, near Copperopolis, Calaveras County.
2796. Gold King Mine, three miles southeast of Cherokee Flat, Butte County.
5031. Gold Mountain Mine, near Jamestown, Tuolumne County.
5032. Gold Mountain Mine, 400-foot level, near Jamestown, Tuolumne County.
5033. Gold Mountain Mine, 600-foot level, near Jamestown, Tuolumne County.
5034. Gold Mountain Mine, 850-foot level, near Jamestown, Tuolumne County.
5035. Gold Mountain Mine, near Jamestown, Tuolumne County, wall rock (foot wall).
5036. Gold Mountain Mine, near Jamestown, Tuolumne County, wall rock (hanging wall).
4853. Gold Quartz Mining Company, Nevada City, Nevada County.
2091. Gold Run Mine, from the hanging wall, sixty feet from surface. Tunnel cuts the

vein at sixty feet, shaft forty feet, vein sixteen feet wide, section thirty, township ten, range nine, Webber Creek, El Dorado County.

2900. Gold Run Mine, Webber Creek, El Dorado County, croppings.
466. Golden Star Mine, Alleghany, Sierra County, cement with gold.
257. Gold Virgin Mine, Mariposa County.
16. Good Friday Mine, Placer County, gold quartz.
379. Good Hope Mine, Piru District, Ventura County.
2908. Grasshopper Mining Company, Mosquito Gulch, Calaveras County.
3392. Green Valley claim, near Dutch Flat, Placer County, chimney rock.
903. Grizzly Mine, Tuolumne County, one hundred and fifty feet deep.
1094. Gwinn Mine, Calaveras County.
571. Hackendorn Mine, Blue Mountain, Calaveras County.
1597. Hanover Mine, average ore, Fine Gold Gulch, Fresno County.
1598. Hanover Mine, Fine Gold Gulch, Fresno County. This specimen shows electrum in wire form.
2516. Hayden Hill Mine, Lassen County.
919. Heslep Mine, Tuolumne County. One hundred and fifty feet deep.
5037. Hidden Treasure Mine, near Murphy's, Calaveras County.
474. Hite Mine, Mariposa County.
3715. Hite Mine (900 foot level), Hite's Cove, Mariposa County.
1393. Homer Mill and Mining Company, Mono County.
3630. Hoosier Bar, Middle Fork of American River, eight miles from Auburn, Placer County, placer gold.
375. Humming Bird Mine, Piru District, Ventura County.
2754. Hungry Gulch, near Pine Cove, Amador County, gold crystal.
5060. Idaho Mine, Grass Valley, Nevada County, ordinary ore, and rich ore from 1,400-foot level.
2824. Indian Valley Mine, Indian Valley, Placer County.
917. Jackson Tunnel, Mariposa County, gold quartz in granite.
3008. Jenny Lind, Calaveras County, half ounce of placer gold.
4287. Jones' Mine, old Carson Creek Gold and Silver Mining Company, Carson Creek, Calaveras County, ores containing tellurium.
477. Josephine Mine, Bear Valley, Mariposa County, croppings.
5071. Jumper Mine, Hayden Hill, Lassen County.
2054. Kanaka Mine, six miles from Downieville, Sierra County.
239. Kentuck Mine, Long Tom District, Kern County.
3596. Keynote Mine, Beveridge District, Inyo County. This specimen is peppered with fine gold, which can only be seen by close inspection.
272. Keystone Mine, Amador County.
628. Keystone Mine, east vein, Amador County, five hundred and fifty-seven foot level.
629. Keystone Mine, Amador County, west side of vein.
630. Keystone Mine, Amador County, five hundred and fifty-seven foot level, Spring Hill vein, one hundred and fifty feet south of Patton.
631. Keystone Mine, Amador County, five hundred and fifty-seven foot level, south shaft.
1843. Klamath Mine, Siskiyou County.
2826. Knox & Osborn Mine, Calaveras County, sulphuret ore. There is a twenty-stamp mill on the property, with concentration apparatus.
926. Lookout Mine, Tuolumne County.
2734. Little Gem Mine, near Jamestown, Tuolumne County.
916. Louisiana Mine, Tuolumne County.
2871. Macedonian Mine, Kern County.
4278. McKinnon's Flat, Calaveras County, cement, containing gold.
1564. McNulty Mine, Electric Mining Company, El Dorado County, California.
2774. Mad Ox Mine, near Whisky Creek, Shasta County.
5068. Madre Mine, Carga Muchacho District, San Diego County.
3403. Malakoff Mine, North Bloomfield, Nevada County, hard cement, with gold.
925. Mammoth Mine, seven feet thick, Tuolumne County.
2868. Manzanita Mine, Sulphur Creek, Colusa County, gold deposited on the surface of quartz crystals, a most remarkable and interesting specimen.
4754. Manzanita Gold Mine, Sulphur Creek, Colusa County, croppings.
3368. Manzanita Mine, Sulphur Creek, Colusa County, sulphur, cinnabar, and gold, large specimen.
478. Mariposa Tunnel, Mariposa County, two thousand five hundred foot point.
4364. Mark Twain Mine, Angel's Camp, Calaveras County, croppings, very rich in gold.
4357. U. S. Grant Mine, Meadow Lake District, Nevada County.
438. Melones Mine, Stanislaus County, telluric gold—sylvanite.
2421. Mexican Mine, one hundred feet deep on shaft, Mariposa Estate, Mariposa County.
2010. Miller Mine, Washington, Nevada County.
3577. Modesto Mine, Beveridge Mining District, Inyo County, ferruginous quartz with gold in a cavity formerly occupied by a large crystal of pyrite.
3727. Modesto Mine, four miles above Mormon Bar, Mariposa County, sulphuret ore.
3576. Mohmann Mine, Big Oak Flat, Tuolumne County.
1546. Mono Mine, Bodie District, Mono County. Four-hundred-foot level. Sixty feet already passed through.

5052. Monticello Mine, Sulphur Creek, Colusa County.
1833. Mt. Auburn Mine, same vein as the Providence Mine, one hundred and seventy-five foot drift, vein six feet wide, near Nevada City, Nevada County.
2803. Mount Auburn Mine, Providence Ledge, three miles north of Nevada City, Nevada County.
2883. Mountain Mine, Nevada City. Nevada County, sulphuret ore.
675. Morning Star Mine, Siskiyou County.
674. Murchie Mine, five-hundred-foot level, Nevada County, telluric gold ore.
2427. Murchie Mine, Nevada County, two miles from Nevada City, sulphuret ore.
3421. Murchie Mine, Nevada County, gold quartz.
144. Nevada Mine, Nevada County.
4043. Nevada Hydraulic Mine, Chalk Bluff, Nevada County, placer gold.
5213. Nevada Hydraulic Mine, Chalk Bluff, Nevada County, mechanical and semi-chemical analysis of auriferous gravel. (See Second Report of State Mineralogist, 1882, folio 97.)

	Per Cent.	Per Cent Quartz.
Portion "A," zircon sand	00.01	----------
Portion "B," large pebbles	39.80	89
Portion "C," coarse gravel	29.80	63
Portion "D," remained on No. 10 sieve	7.67	57
Portion "E," remained on No. 20 sieve	1.03	59
Portion "F," remained on No. 40 sieve	3.13	78
Portion "G," remained on No. 60 sieve	3.90	86
Portion "H," remained on No. 80 sieve	1.53	80
Portion "K," remained on No. 100 sieve	1.37	82
Portion "L," passed No. 100 sieve	1.47	72
Portion "M," slickens	10.29	Nearly all

5289. Nevada City Mine, one and a half miles from Nevada City, Nevada County, sulphuret ore, with visible free gold.
1204. New Albany Mine, Tuolumne County.
2897. New England Mine, Nevada County, sulphuret ore.
2025. New Toledo Mine, section thirty-one, township two north, range fourteen east, Tuolumne County.
——. Niagara Mine, Shasta County.
5069. Nice and West Mine, Nevada County, cement with gold.
1422. Nioma and Wasatch Mines of the Homer Mill and Mining Company, Homer District, Mono County.
5066. Oakland Mine, Grass Valley, Nevada County. Oakland Gold Mining Company.
1515. Occidental Mine, Nevada County, pyrite and hermatite (rich in gold).
2454. Olsen Mine, Tuolumne County, near La Grange.
1506. Oro Mine, Bodie District, Mono County, medium grade.
2450. Oro Fino Mine, El Dorado County. Thirty foot level said to be rich in gold. This rock is principally quartz, with some calcite and a large quantity of bright crystals of pyrites, very interesting when seen under the microscope.
2821. Owens' River Mine, Goldopolis District, Inyo County, gold and silver ore.
5067. Padre Mine, Carga Muchacho District, San Diego County.
4600. Palma Mine, Cerro Gordo, Inyo County, gold in calcite.
905. Patterson Mine, Tuolumne County, gold quartz in slate. One hundred feet deep.
7. Peter Walter Mine, Placer County.
4197. Pioneer Mining Company, Upper Gold Bluff, Humboldt County, auriferous sands.
3720. Pioneer Union Mine, Humbug District, Placer County. Three hundred feet below the croppings, ledge four and a half feet thick.
390. Pitman Mine, Fresno County.
2329. Pinacate District, twenty-four miles south of Colton, San Bernardino County, rock very rich in gold.
5072. Poule Mine, Clipper Gap, Placer County.
644. Premium Mine, Plumas County.
514. Princeton Mine, Mariposa County.
2026. Prospect Mine, section thirty-one, township two north, range fourteen east, near Rawhide Ranch, Tuolumne County.
648. Providence Mine, Nevada County, gold with pyrites.
709. Quartz Glen, six miles from Mokelumne Hill, Calaveras County.
2172. Royal Arch Mine, six miles south of Modoc Mine, Inyo County.
5312. Sacramento Mine, near Bishop Creek, Inyo County.
638. St. Lawrence Mine, Placer County, near Ophir.
229. St. Patrick Mine, Placer County, gold quartz and iron pyrites.
76. St. Patrick Mine, Placer County, gold quartz.
1960. Shady Glen, near Alta, Placer County, concentrations from hydraulic mines.
347. Shanghai Mine, near Columbia, Tuolumne County.

906. Shaw Mine, Tuolumne County.
3705. Sheep Ranch Mine, Calaveras County, gold quartz, showing free gold.
——. Sierra Buttes Mine, average ore from 8th level, 1,350 feet from surface.
912. Soulsby Mine, Tuolumne County, gold-bearing sulphurets.
913. Soulsby Mine, Tuolumne County, gold quartz in granite, 550 feet deep, one foot thick.
922. Soulsby Mine, Tuolumne County, concentrated tailings.
3703. Soulsby Mine, Tuolumne County, gold quartz.
5329. Soulsby Mine, section thirty-one, township two north, range sixteen east, Tuolumne County, galena, with heavy gold.
5330. Soulsby Mine, Tuolumne County, galena, with quartz and free gold, from above the second level.
5331. Soulsby Mine, Tuolumne County, white quartz, with galena, very rich in gold above the second level.
5332. Soulsby Mine, Tuolumne County, quartz, with gold sulphurets, from the fifth level.
5333. Soulsby Mine, Tuolumne County, quartz, from winze below the bottom level. The deepest workings in the mine, 640 feet.
5334. Soulsby Mine, Tuolumne County, quartz, largely impregnated with gold, very rich, from the stope below the deepest level.
5335. Soulsby Mine, Tuolumne County, quartz, with sulphurets, from above the bottom level, north workings.
5336. Soulsby Mine, Tuolumne County, quartz, with iron pyrite; heavy gold in the quartz, and also in the pyrite; from the No. 6 level.
5337. Platt Mine, extension of the Soulsby Mine, Tuolumne County, quartz, with galena and gold.
5338. Soulsby Mine, Tuolumne County, heavy gold, in close association with granite.
5339. Soulsby Mine, Tuolumne County, quartz, with gold and pyrite.
1252. Spring Valley Hydraulic Mine, Grass Valley, Nevada County, auriferous gravel.
4225. Spring Valley Hydraulic Mine, Cherokee, Butte County, placer gold in cement.
5210. Spring Valley Hydraulic Mine, Cherokee, Butte County, blue gravel, bottom stratum, lying on bedrock, from six to ten feet deep.
5211. Spring Valley Hydraulic Mine, Cherokee, Butte County, white top gravel, from twenty to four hundred feet thick, overlying rotten bowlders (No. 5212).
5212. Spring Valley Hydraulic Mine, Cherokee, Butte County, yellow, or rotten bowlders, stratum from one to ten feet thick, overlying blue gravel, No. 5210, and covered by No. 5211. This deposit is rich in gold.
660. Standard Mine, Bodie District, Mono County.
4453. Star Mine, near Mud Springs, El Dorado County, auriferous quartz, with calcite, also auriferous. Some small specimens brought to the Mining Bureau from the same locality were wholly calcite, in which free gold was imbedded, which led to the impression that the whole fissure was filled with that mineral. This specimen shows this to be a mistake. The occurrence of calcite in mineral veins is not uncommon. The gold in this mine is light colored, from being alloyed with silver—electrum. This and the presence of calcite shows a mineral vein unlike the common quartz ledges of the State, indicating silver and other minerals at a greater depth.
1455. Star Mine, Tuolumne County.
4216. Star of the West Mine, West Point, Calaveras County, pyritic ore (auriferous).
——. Stockton Mine, near Madeira, Fresno County.
2369. Succedo Shaft, fifty feet below Mariposa Tunnel, Mariposa Estate, Mariposa County, gold-bearing quartz.
2422. Succedo Shaft, five hundred feet below the surface, Mariposa Tunnel, mother vein, Mariposa Estate, Mariposa County, quartz.
2853. Sugarman Vein, Sonora, Tuolumne County, crystallized gold.
1695. Summit City, Sierra County, sulphuret ore.
899. Sweeny Mine, Tuolumne County, gold quartz in slate, one hundred feet deep.
8777. Syndicate Mine, Bodie, Mono County.
171. Talisman Mine, Amador County.
1527. Tellurium Mine, Pine Grove, Amador County.
5433. Thomas and Reed's Mine, Poor Man's Creek, Plumas County, concentrations.
2916. True Fissure Mine, Devil's Peak Mountain, Placer County, auriferous pyrites.
2373. Tulloch Mine, near the Summit, Tuolumne County, five miles south of Sonora and Mono road.
480. Gold quartz, Union Mine, Carson Hill, Calaveras County.
139. Ore, from Venando Gold Mine, Napa County, five miles from St. Helena.
332. Gold quartz, Virginia Mine, Grass Valley, Nevada County.
927. Gold quartz, Williams' Mine, Tuolumne County.
1791. Gold in chalcedony, California (?).
2922. Model of gold nugget, found in Oregon Cañon, El Dorado County.
4813. Model of a gold bar, the result of one run made in the North Bloomfield Hydraulic Mine, Nevada County; weight, 6,117.78 ounces troy; gold, fine, 897; silver, fine, 93; total value, $114,280 72. This is probably the largest gold bar ever cast in the State.

SILVER.

In the early years of American occupation of our State the miner was so absorbed in gathering the rich harvest of gold, that he quite overlooked and even scorned metals of lesser value. The idea that California would eventually be a silver producing State never entered his mind. Yet it is now known that the State is rich in that metal, and it is a question if it will not soon vie with the more noble metal in importance and value.

Dr. Trask, the first State Geologist of California, was first to announce its presence in the State, but he little thought how great the development of mines of that metal would be within so few years. It is now known that silver mines occur in almost every county in the State from Del Norte to San Diego. The region lying east of the crest of the Sierra Nevadas bids fair to become a second Peru or Mexico. Every month new discoveries are announced, and the end is not yet.

The production of silver in California has been estimated at $26,000,000. An ideal cube representing that amount was placed on exhibition, as well as ores from all the principal silver mines of the State, which are shown in the following catalogue. The face of the silver cube was $12\frac{3}{10}$ feet nearly. A large output of this precious metal in the near future may be looked for with confidence:

Silver Mines and Silver Ores.

2009. Addenda Mine, five hundred foot level, Bodie, Mono County.
5325. Advance Mine, Coso District, near Darwin, Inyo County. Said to assay $3,000 per ton.
5065. Advance Mine, Monitor District, Alpine County.
2007. Ahuaga Mine, Tioga District, summit of Sierra Nevada Mountains, one mile and a half from Mount Dana, Mono County.
1804. Ahuaga Mine, summit of Sierra Nevada Mountains, one and one half miles northwest of Mount Dana.
5025. Alhambra Mine, Calico Mining District, San Bernardino County, breccia, coated with embolite.
43. Al. Bunnell Mine, Kern County.
140. Al. Bunnell Mine, Kernville, Kern County.
5328. American Flag Mine, Swansea District, Inyo County.
5164. Belle McGilivray Mine, near the surface, Providence Mountains, San Bernardino County.
5175. Belle McGilivray Mine, forty foot level, Providence Mountains, San Bernardino County.
5176. Belle McGilivray Mine, one hundred and twenty foot level, Providence Mountains, San Bernardino County.
4108. Beveridge District, Inyo County.
4128. Beveridge District, Inyo County, silver lead.
1634. Black Chief Mine, Mineral King District, Tulare County.
5321. Black Warrior Mine, Lookout District, Inyo County.
1638. Black Wolf Mine, Mineral King District, Tulare County.
1792. Bodie Mine, from the incline below the four hundred and thirty-three foot level, Bodie, Mono County, quartz crystals on silver ore.
4745. Bonanza King Mine, Slate Range, Inyo County.
5126. Bonanza King Mine, Bonanza King Consolidated Mining Company of New York, Providence Mountains, San Bernardino County; three hundred foot level, south winze.
5127. Bonanza King Mine, Providence Mountains, San Bernardino County; second winze, two hundred foot level (see No. 5126).
5128. Bonanza King Mine, Providence Mountains, San Bernardino County; third winze north, three hundred foot level.
5129. Bonanza King Mine, Providence Mountains, San Bernardino County; four hundred foot level.
5130. Bonanza King Mine, Providence Mountains, San Bernardino County; seventh winze, four hundred foot level.
5131. Bonanza King Mine, Providence Mountains, San Bernardino County; four hundred foot level, north.
5132. Bonanza King Mine, Providence Mountains, San Bernardino County; four hundred and fifty foot level.
5133. Bonanza King Mine, Providence Mountains, San Bernardino County; No. 4 winze, three hundred foot level.

5134. Bonanza King Mine, Providence Mountains, San Bernardino County; No. 4 winze, three hundred foot level.
5135. Bonanza King Mine, Providence Mountains, San Bernardino County; four hundred foot level, fine chloride ore.
3587. Brown Monster Mine, Inyo County, argentiferous galena, showing a radiated structure.
4739. Burning Moscow Mine, Calico District, San Bernardino County.
95. Calistoga Mine, Napa County.
2119. Caroline Mine, Deep Spring District, Inyo County.
558. Centennial Mine, Inyo County.
4280. Champion Mine, Prescott District, Mono County.
805. Chance Mine, Shasta County.
1635. Chihuahua Mine, Mineral King District, Tulare County.
2275. Cinderella Mine, Kern County.
25. Combination Mine, Desert Springs, Kern County.
67. Comanche Mine, Blind Springs District, Mono County, silver lead ore.
2918. Comanche Mine, Blind Springs, Mono County, native silver in partzite.
2919. Comanche Mine, Blind Springs, Mono County, partzite.
5318. Comstock Mine, Darwin District, Inyo County, silver lead ore.
3996. Concordia Mine, Bodie, Mono County, red silver ore.
2323. Deer Creek, Tulare County.
5323. Defiance Mine, Darwin District, Inyo County.
421. Diana Mine, Benton, Mono County.
4134. Ella Blossom Mine, Prescott District, head of Bloody Cañon, Mono County.
2814. Emigrant Mine, Lee District, Inyo County.
1640. Empire Mine, Mineral King District, Tulare County.
2008. French Flag Mine, Swansea District, Inyo County, silver lead ore.
4948. Garfield Mine, Calico District, San Bernardino County, rich silver ore, coated with embolite.
4279. Garibaldi Mine, Prescott District, Mono County, argentiferous galena, with blende and geocronite.
4737. Geneva Mine, Calico District, San Bernardino County.
2182. Gladiator Mine, Mazourka Cañon, Inyo County.
4964. Gobbler Mine, Calico Mining District, San Bernardino County.
4950. Golconda Mine, Calico District, San Bernardino County.
5057. Golden Crown Mine, Prescott District, Bloody Cañon, Mono County; formerly known as the "Antimony Mine."
150. Grand Mine, Coso District, Inyo County.
1120. Grand Mine, Inyo County, argentiferous galena.
4075. Grapevine District, San Bernardino County, embolite.
149. Great Eastern Mine, Panamint, Inyo County.
1098. Great Eastern Mine, San Bernardino County.
1641. Great Mogul Mine, Mineral King District, Tulare County.
345. Great Western Mine No. 1, Panamint, Inyo County.
319. Great Western Mine No. 2, Panamint, Inyo County.
422. Grey Eagle Mine, Benton, Mono County.
4969. Grigsby Mine, Calistoga, Napa County, rich in silver. A recent assay yielded 514 ounces to the ton.
1302. Hidalgo Mine, Inyo County, argentiferous galena.
331. Highland Mine, Panamint, Inyo County.
333. Huron Mine, Panamint, Inyo County,
2180. Indiana Mine, near Swansea, Inyo County, embolite.
2191. Indian Scout Mine, Deep Spring Valley, Inyo County.
1885. Iron Mountain Mine, Shasta County, section thirty-four, township thirty-three, range six west, Mount Diablo meridian. The silver is found in small nodules of sulphuret of iron. The locality and mode of occurrence have not yet been studied.
4230. Jones Mine, four miles from Angels, Calaveras County.
5073. Julia Mine, Lake District, Mono County, silver gold ore.
1793. Jupiter Mine, Bodie, Mono County, six hundred-foot level, north of the locality of No. 1792.
811. Kellenger and Lucy Mine, Copper City, Shasta County.
3541. Kentucky Mine, Sweetwater Range of Mountains, Mono County, horn silver.
256. Kerrick Mine, Benton, Mono County, partzite.
1580. Kidd Mine, six miles easterly from San Luis Obispo.
4736. King Mine, Calico District, San Bernardino County.
1637. Lady Emma Mine, Mineral King District, Tulare County.
1637. Lady Franklin Mine, Mineral King District, Tulare County.
2901. Leach Mine, Ord District, San Bernardino County.
5049. Lizzie Mine, west drift, Ivanpah, San Bernardino County.
961. Lone Star Claim, S. P. R. R. District, San Diego County, silver, lead, and gold ore.
4001. Lookout Mine, Lookout Mining District, Inyo County.
2813. Lucky Jim Mine, New Coso, Inyo County.
5062. Mammoth Mine, Lake District, Mono County.
4109. May Belle Mine, Bodie, Mono County.
2109. May Lundy Mine, Homer District, Mono County.

2078. Mineral Hill, Lake District, Mono County.
313. Minietta Belle Mine, argentite, Inyo County.
2517. Modesto Silver Mine, McGrear Flat, two and a half miles southwest of Sebastopol, Mariposa County.
1508. Modoc Mine, Inyo County, silver lead ore.
1581. Mountain Mystery Mine, six miles northeasterly from San Luis Obispo.
2038. Mount Dana Mine, two miles north of Bloody Cañon, Tuolumne County.
73. New Coso Mine, New Coso Mining District, Inyo County, argentiferous galena.
1119. New York Mine, Inyo County.
1545. Noonday Mine, Bodie, Mono County, argentiferous limestone; assay value, $35 to $50 per ton, two hundred foot level.
4740. Occidental Mine, Calico District, San Bernardino County.
5320. Old Dominion Mine, Snow's Cañon, Inyo County.
4074. Oriental Mine, Calico Mountain, San Bernardino County.
1561. Orient Mine, Bodie Mining Company, Mono County, silver gold ore.
1585. Oro Mine, Oro Mining Company, Bodie, Mono County.
2451. Oro Mine, Bodie, Mono County, pyrargyrite and proustite crystals in quartz.
5302. Oro Mine, Bodie, Mono County, silver-gold ore, three hundred and forty foot level.
5303. Oro Mine, Bodie, Mono County, four hundred and forty foot level.
5304. Oro Mine, Bodie, Mono County, five hundred and twenty foot level.
5305. Oro Mine, Bodie, Mono County, seven hundred and fifty foot level.
377. Pacific Mine, Piru District, Ventura County.
5319. Pacific Mine, Inyo County.
114. Panamint, Inyo County.
4947. Plutarch Mine, Calico District, San Bernardino County, embolite.
4912. Queen Mine, Calico Mining District, San Bernardino County, very rich, showing cerargyrite.
3718. Railroad Mine, Los Angeles, Los Angeles County.
2104. Redwood City Mine, San Mateo County, borings from a well, four hundred and seventy-eight feet below the surface. This specimen is rich in native or free silver. The presence of silver is very remarkable, and will be investigated at some future time.
1113. Resting Springs Mine, San Bernardino County.
5316. Richmond Mine, Deep Spring District, Inyo County.
378. Rose of Sharon Mine, Piru District, Ventura County.
4743. Run Over Mine, Calico District, San Bernardino County.
956. San Francisco Mine, Ivawatt District, San Bernardino County.
4735. San Gabriel Cañon Mines, San Bernardino County, contain native silver in calc spar and barite.
1544. Sigourney Mine, two and one half miles south of the Standard Mine, Bodie, Mono County, argentiferous limestone. This sample is thought to illustrate surface change from gold to silver-bearing rocks.
958. Silver Brick Claim, near Dos Palmos, San Diego County.
5055. Silver Lead Mine, Hornitos, Mariposa County.
1636. Silver Wealth Mine, Mineral King District, Tulare County.
4072. Small Hill Mine, Santa Catalina Island.
4281. Snowdrift Mine, Prescott District, Mono County.
1584. Soper Consolidated Mine, six miles northeasterly from San Luis Obispo.
5063. Tarshish Mine, Monitor District, Alpine County, silver ore with enargite.
104. Tiger Mine, Coso District, Inyo County.
2917. Tower Consolidated Mine, Indian Creek District, Mono County, partzite, native silver, galena, etc.
5311. Trade Dollar Mine, Deep Spring District, Inyo County.
5315. Trade Dollar No. 2 Mine, Deep Spring District, Inyo County.
4111. True Blue Mine, Mono Lake District, Mono County.
4704. Twins Mine, three miles southeast of Calistoga, Napa County.
2183. Union Mine, twelve miles south of Independence, Inyo County.
5064. Valentine Mine, Old Coso, Inyo County, silver gold ore.
5322. Variety Mine, Darwin District, Inyo County.
4952. Veto Mine, Calico Mining District, San Bernardino County.
1583. Victoria Mine, six miles northeasterly from San Luis Obispo.
4063. Walhall Mine, Calico Mountain, San Bernardino County.
1579. Washington Mine, six miles northeasterly from San Luis Obispo.
3425. Waterman Mine, Grapevine District, San Bernardino County.
4234. Waterman & Porter Mine, Grapevine District, San Bernardino County, free silver in gangue of barite.
1582. Whig Mine, six miles northeasterly from San Luis Obispo.
1412. Whiteman Mine, Deep Spring Valley, Inyo County.
2185. Wonder Mine, White Mountains, thirty-five miles north of Independence, Inyo County.
91. Wyoming Mine, Panamint, Inyo County, silver copper ore.
1503. Ygnacio Mine, Cerro Gordo District, Inyo County.
2184. Zulu Mine, Deep Springs District, Inyo County.

QUICKSILVER.

Were it not for the peculiar properties of this most singular metal gold would be still more difficult to gather than it is. Mercury is the only metal known to the inhabitants of this earth, at the present time, that is liquid at ordinary temperatures. It has the property of forming intimate and almost instantaneous association with certain metals, including gold, while it wholly rejects others. It has the property also of becoming a vapor at a temperature much below that of red hot iron. In this condition it can be conveyed in pipes and condensed to a fluid again. It is these properties that render mercury so valuable or invaluable in mining and metallurgy. This metal has been enormously produced, used, and wasted in California. The figures that show this are almost startling, amounting as they do to twenty-seven times the weight of the gold obtained in the State.

Large quantities are sent to other mining districts, both at home and abroad, while a considerable portion is used in the manufacture of calomel, corrosive sublimate, vermilion, mercurial ointment, and other preparations, while some is utilized in gilding, backing for mirrors, clock weights, barometers, and electrical apparatus, and in other minor ways.

The following estimate of the product of quicksilver in California was made by Mr. J. B. Randol, of the New Almaden Mine, the most productive in America, and ranking No. 3 among the mines of mercury in the world. The large sample shown in the Exposition, in which a cannon ball floated, was furnished by that gentleman.

The total product from 1850 to 1883, inclusive, was 1,357,403 flasks of $76\frac{1}{2}$ pounds each. This is equal to 103,841,329 pounds, or $51{,}920\frac{1329}{2000}$ tons. The principal ore from which this metal is obtained is cinnabar, or the sulphide of mercury. It is sometimes found in a metallic state, but not in any considerable quantity. The greater proportion is obtained from very low grade ores, which are treated in very extensive and very expensive furnaces.

The following quicksilver mines and ores were represented:

Quicksilver Mines, and Quicksilver Ores.

446. California Quicksilver Mine, Yolo County, cinnabar, three hundred feet from surface.
540. California Quicksilver Mine, Yolo County, crystallized metacinnabarite.
447. California Quicksilver Mine, Dublin Tunnel, Yolo County, cinnabar, one hundred and fifty feet from surface.
61. Clear Quill Mine, Greeneville District, Sonoma County, one mile from Great Eastern mine, quicksilver.
2269. Coast Range, Kern County, concretionary cinnabar.
487. Eclipse Tunnel, one hundred and thirty feet from mouth, Lake County, cinnabar.
288. El Dorado County, cinnabar.
2744. Great Eastern Mine, Sonoma County, two hundred and forty foot level.
122. Guadalupe Mine, near San José, Santa Clara County, cinnabar, and pyrites.
560. Guadalupe Mine, Santa Clara County, cinnabar, and quartz.
1291. Guadalupe Mine, Santa Clara County, cinnabar.
2279. Guadalupe Mine, Santa Clara County, calcite in ore of cinnabar.
2280. Guadalupe Mine, Santa Clara County, burnt rock.
2281. Guadalupe Mine, Santa Clara County, soot from condensers and furnaces.
2338. Guadalupe Mine, Santa Clara County, rich cinnabar, from different levels, from the surface to one thousand two hundred feet.
2417. Guadalupe Mine, Santa Clara County, croppings.
3730. Guadalupe Mine, Santa Clara County, cinnabar (concentrated from low grade ores).
4929. Guadalupe Mine, Santa Clara County, crystallized cinnabar, in crystallized calcite.
1550. Josephine Mine, San Luis Obispo County, township twenty-seven south, range ten east, Mt. Diablo meridian.
1551. Libertad Mine, San Luis Obispo County, township twenty-seven south, range ten east, Mt. Diablo meridian.
4349. Lake Quicksilver Mine, Lake County, quicksilver ore, with chalcedony and stib-

nite (sulphide of antimony). The mine joins the Manhattan, a well known quicksilver mine, and the above is from a depth of sixty feet. This specimen shows the association of antimony and mercury, which is common not only in California, but in other localities.

180. Los Preitos Mine, Santa Barbara.
2869. Manzanita Mine, Sulphur Creek, Colusa County, cement gravel with cinnabar.
1696. Napa Consolidated Mine, Oat Hill, Napa County, cinnabar in sandstone.
1727. New Almaden Quicksilver Mine, Santa Clara County, quartz, cinnabar, and vein-matter.
1728. New Almaden Mine, Santa Clara County, vein-matter and crystallized cinnabar.
1729. New Almaden Mine, Santa Clara County, cinnabar, native mercury, and vein-stone.
1730. New Almaden Mine, Santa Clara County, dark variety of cinnabar.
1731. New Almaden Mine, Santa Clara County, light or vermilion variety of cinnabar.
1732. New Almaden Mine, Santa Clara County, cinnabar, bitumen, and calcite.
1733. New Almaden Mine, Santa Clara County, cinnabar, vein stone, and alta, showing the junction of the alta and vein—the alta being the country rock of the hanging wall.
1735. New Almaden Mine, Santa Clara County, roasted ore.
1736. New Almaden Mine, Santa Clara County, adobe, ready for the furnace.
1737. New Almaden Mine, Santa Clara County, adobe roasted.
1738. New Almaden Mine, Santa Clara County, soot from condensers.
1739. New Almaden Mine, Santa Clara County, quicksilver.
5347. New Almaden Mine, Santa Clara County, cinnabar, weight 290 pounds.
1275. New Idria Mine, Fresno County, cinnabar with bitumen (aragotite).
2747. Oat Hill Mine, near Pope Valley, Lake County, cinnabar in sandstone.
143. Oakland Mine, Sonoma County.
280. Oceanic Quicksilver Mine, San Luis Obispo County, cinnabar.
1223. Old Chapman Mine, Santa Clara County, rock containing cinnabar.
4355. Old Napa Con. Quicksilver Mine, Pope Valley, Napa County, cinnabar and calcite.
317. Phœnix Quicksilver Mine, twenty miles from St. Helena, head of Pope Valley, Lake County, cinnabar.
552. Pomposa Mine, Santa Barbara County, cinnabar.
349. Sulphur Bank Quicksilver Mine, nine miles northwest from Lower Lake, Lake County.
484. Sulphur Bank Mine No. 2, Lake County, obsidian, sulphur, and cinnabar.
1109. Sulphur Bank Mine No. 2, Lake County, cinnabar and obsidian.
1219. Sulphur Bank Mine, Lake County, cinnabar and sulphur.
1221. Sulphur Bank Mine, Lake County, cinnabar.
4080. Sulphur Bank, Lake County, cinnabar, obtained in refining sulphur from Sulphur Bank before it was known to be a valuable quicksilver mine.
4135. Sulphur Bank, Lake County, cinnabar, separated in refining sulphur. (See No. 4080.)
1261. Uncle Sam Quicksilver Mine, Clear Lake, Lake County, earth with quicksilver.
45. Wall Street Mine, Lake County, cinnabar.
63. Wall Street Mine, Lake County, native quicksilver.
1173. Wall Street Mine, Lake County, quicksilver ore containing free mercury and cinnabar.
3677. Washington Mine, Napa County, concretionary cinnabar.
454. Wright Tunnel, California Quicksilver Mine, Yolo County, cinnabar.

COPPER.

Ores of this metal are found in abundance in California. Owing to reasons before stated the lesser valued metals have not been extensively mined, still considerable quantities of this useful metal have been furnished to the world from our State. During the year 1883 metallic copper, or its equivalent in ores, to the extent of 700 tons, was shipped from California. In 1882, there were shipped from San Francisco to England by sea 864,700 pounds of copper ore, and by rail to the East 126,541 pounds of copper, 1,795,107 pounds of copper cement, and 100,000 pounds of copper ore. The shipments since the dates mentioned have been somewhat larger, but we have not any exact figures or reliable estimates at hand at present.

The value of low grade copper ore has been learned, and great stores of copper lie dormant in such ores, which will eventually be extracted, giving employment to capital and labor in the State, and adding an important and valuable product to commerce and manufactures.

The following localities and mines were represented at the Exposition:

Copper Mines and Copper Ores.

812. Afterthought Mine, Shasta County, melaconite.
2442. American Mine, Candace Consolidated Mining Company, Colusa County.
4351. Beveridge District, Inyo County.
4461. Buchanan Mine, Fresno County.
4485. Bullion District, Plumas County, principally chalcopyrite.
342. Calaveras County.
3017. Campo Seco, Calaveras County, chalcopyrite. Taken from a large quantity at Milton, awaiting shipment.
2439. Candace Mine, Colusa County, cuprite and native copper.
2047. Cedar Mine, twelve miles above Grass Valley, Nevada County.
1889. Cedar Mine, Nevada County, copper ore with free silver. Two specimens; the smaller specimen is remarkable.
804. Copper City, Shasta County, chalcopyrite, erubescite, and pyrites.
801. Copper Hill, Shasta County.
5026. Copper World Mine, Clark's Mining District, San Bernardino County, chrysocolla (silicate of copper).
5028. Copper World Mine, Clark's Mining District, San Bernardino County, copper ore.
5158. Copper ore (cuprite), in beautiful microscopic crystals, with chrysocolla and threads of cerargyrite. There is said to be a large deposit of this mineral near Lundy, Mono County.
2738. Cosumnes Copper Mine, Amador County.
684. Del Norte County.
126. Diamond Mine, Del Norte County.
2880. Eagle Copper and Silver Mining Company, Quail Hill, Calaveras County.
5434. Engel's Copper Mine, Light's Cañon, Plumas County, chrysocolla and malachite in alternate layers, surface botryoidal, and coated with malachite.
5435. Engel's Copper Mine, Light's Cañon, Plumas County, erubescite (bornite).
4486. Enterprise Mine, Bullion District, Plumas County, chalcosite.
2441. Fortuna Mine, Candace Consolidated Mining Company, Colusa County.
4257. Genesee Valley, Plumas County.
5326. Grand Mine, Darwin District, Inyo County.
151. Great Republic Mine, Mount Diablo, Contra Costa County, two specimens.
152. Great Republic Mine, Mount Diablo, Contra Costa County, copper bars.
472. Green Vein, Hamlington's District, Mariposa County.
196. Grizzly Mine, eighteen miles northwest of Healdsburg, Sonoma County.
2137. Grizzly Den Mine, San Luis Obispo County.
2181. Hirsch Mine, nine miles southeast of Independence, Inyo County; same ledge as Old Eclipse. This specimen is principally cuprite.
475. Hunter's Valley, Mariposa County.
685. Ione District, Amador County.
2401. Iron Mountain, near Shasta, Shasta County.
2435. Iron Mountain, Shasta County, azurite, malachite (carbonates of copper), and cuprite (oxide of copper).
2350. Ivanpah District, San Bernardino County, azurite (blue carbonate of copper).
802. Kellenger Mine, Copper Hill, Shasta County.
671. Kentucky Mine, Calaveras County.
4746. Kerrick Mine, Benton, Blind Springs, Mono County, azurite, malachite, and cuprite.
2440. Lellia Mine, Candace Consolidated Mining Company, Colusa County.
4137. Near Lexington, Santa Clara County, chalcopyrite.
1770. Near Lincoln, Placer County, cuprite, malachite, and native copper.
246. Los Angeles County, copper glance.
672. Lost Mine, thirty miles west of the Colorado River, San Diego County, copper ore, malachite, cuprite, azurite, and chrysocolla.
3714. Mammoth Copper Mine, Mono County, principally cuprite.
77. Mariposa County, near Hornitos, chalcopyrite.
2358. May Flower Mine, Mineral King District, Tulare County, cuprite.
4653. Meadow Lake, Placer County, native copper, with cuprite (red oxide of copper).
1656. Mineral Point Lode, thirty miles east of Crescent City, Del Norte County, samples of copper ore with metallic copper reduced from it.
2169. Modoc Mine, Inyo County, azurite (blue carbonate of copper).
2797. Mono Lake, Mono County, cuprite.
2894. Morning Star Mine, Rockland District, Del Norte County.
3696. Mountain Gem Mine, Genesee, Plumas County.
3735. Napa County, native copper.
4223. Native copper, with copper minerals, in a gangue of sulphate of baryta, with specimen mounted for microscopic examination, from a ledge in the southern corner of Trinity County. The ledge is said, by the donor, to be very prominent, and can be seen running in a straight line for twenty miles from the south toward Mount Shasta.
1771. Nickerson Mine, Nevada County, chalcopyrite in quartz.
691. Noble Mine, Amador County.

800. Peck Mine, Copper Hill, Shasta County, azurite.
803. Peck Mine, Copper Hill, Shasta County, copper ore.
806. Peck Mine, Copper Hill, Shasta County, cuprite, microscopic crystals.
808. Peck Mine, Copper City, Shasta County, chalcanthite.
816. Peck Mine, Copper Hill, Shasta County, carbonate of copper.
4274. Phelps' Springs, Stony Creek, Colusa County, chalcopyrite.
3358. Pioneer Mine, Bolinas Bay, Marin County. Assay: gold, trace; silver, twenty-two dollars per ton; copper, ten per cent.
4898. Ravenna, Los Angeles County.
3369. Reward Mine, Genesee Valley, Plumas County, rich copper ore, principally cuprite.
118. San Bernardino County, copper ore.
4387. San Francisco Copper Mine, Spenceville, Nevada County, principally chalcopyrite.
4388. San Francisco Copper Mine, Spenceville, Nevada County, copper matte, concentrated by roasting in heaps, allied to erubescite; by this process the rich copper matte forms a kernel in a mass of protoxide of iron.
4389. San Francisco Copper Mine, Spenceville, Nevada County, copper ore roasted.
4390. San Francisco Copper Mine, Spenceville, Nevada County, copper cement, metallic copper in the form of a powder, precipitated from solution by scrap iron; iron replaces the copper in the solution, forming sulphate of iron, while the copper falls; is dried and shipped to a market.
2136. St. Katherina Mine, San Luis Obispo County.
2331. Santa Amedio Rancho, Coast Range, cuprite, melaconite, malachite, and calcite.
54. Skaggs' Springs, Sonoma County, carbonate ore.
700. Surprise Mine, Mount Diablo, Contra Costa County.
2412. Sweetland Creek Mine. Nevada County, copper shale.
1751. Telegraph Mine, Hog Hill, Calaveras County, native copper and azurite.
4456. Trinity County, cuprite with native copper.
314. Union Mine, Copperopolis, Calaveras County, chalcopyrite.
1433. Union Mine, Inyo County, chrysocolla—silicate of copper.
1499. Union Mine, Inyo District, Inyo County, azurite (carbonate of copper) with galena.
2179. Ygnacio Mine, Cerro Gordo District, Inyo County, azurite (blue carbonate of copper).

IRON.

Iron ores are quite abundant in the State and are of good quality, but it is only lately that they have been worked to any considerable extent. There is one well appointed charcoal blast furnace in operation, but as to the total production there are no reliable figures at hand, nor can information be given as to the cost of production or the financial success of the enterprise, but there is no question as to the excellent quality of the iron produced.

The output has been estimated at 25,000 tons. Should suitable coal be discovered in the State the iron industries would soon grow into great importance, and, as it is, it will probably be found possible to import coke or coal, or both, at a rate sufficiently low to admit of a much larger production.

The California Iron and Steel Company made a special exhibit of the products of this furnace as follows:

Pig iron, Clipper Gap furnace, Nos. 1, 2, 3, 4, and 5. Each representing a different quality.
Samples of iron ore, Lime Quarry Workings, Shaft No. 3, three specimens.
Samples of iron ore, Shaft No. 1, several specimens.
Limestone or marble used as a flux.
Specimen of slags, etc.

These specimens were donated to the National Museum at Washington, by special request.

The following iron ores and minerals from the State Museum were exhibited:

Iron Ores.

2336. Hematite, Alameda County.
2833. Earthy hematite, Monitor, Alpine County.
4987. Hematite, Jackson, Amador County.
87. Hematite, Ione Valley, Amador County.
4652. Iron ore (hematite), from a ledge said to crop out 800 feet in length, near the Amador Gravel Mine, two and a half miles northeast from Jackson, Amador County.

3750. Hematite, nodule (hollow), near Volcano, Amador County.
2885. Hematite (micaceous iron), Feather River, near Oroville, Butte County.
3766. Iron ore (hematite), Big Tree Iron Mine, Calaveras County.
3367. Hematite. Township four north, range ten east, opposite section three, in unsurveyed land, two miles southeast of Campo Seco, Calaveras County. Said to be in large quantities, and to be of easy access.
4356. Hematite, Diamond Springs Township, El Dorado County. The following information is furnished with the specimen: One thousand tons shipped to San Francisco several years ago, were used in the manufacture of iron. The deposit is sixty feet wide; a ledge of marble runs parallel and some distance to the east, say one hundred feet. The block of marble which California sent to the Washington monument came from this ledge. A tunnel is driven in about one hundred and twenty feet, which cuts the ledge sixty feet below the surface. At another point they have sunk a shaft about forty feet, all in ore. Plenty of wood for charcoal. Water costs five cents per inch. Charcoal is now worth fifteen cents—could be furnished for eight cents per bushel.
1606. Hematite, red, used as a pigment by the Indians of Owen's River Valley, Inyo County.
3761. Iron ore (hematite), near St. Helena, Napa County.
3773. Iron ore (hematite), Holden Ledge, township fifteen north, range seven east, Mount Diablo meridian, Nevada County.
1861. Hematite (ochrous), Clipper Gap Iron Mine, section twenty-four, township thirteen north, range eight east, Mount Diablo meridian, Placer County.
1860. Hematite, Clipper Gap Iron Mine, section twenty-four, township thirteen north, range eight east, Mount Diablo meridian, Placer County.
1937. Hematite, from Red Hill, section fifteen, township thirteen north, range eight east, Mount Diablo meridian, Placer County, California Iron Company.

Analysis.

Silica		33.10
Water	Hygroscopic	2.90
	Combined	6.45
Sesquioxide of iron		55.25
Lime		1.65
Sulphur		Trace.
Phosphorus		Trace.
		99.35

This ore contains 38.68 per cent. of iron.

3361. Hematite and magnetite, near Crescent Mills, Plumas County.
4382. Hematite and limonite, Potter's Iron Mine, bank of Pit River, one mile from the fisheries, Shasta County.
4731. Limonite, concretions of, found near Pine Grove, Amador County, first thought, by their external appearance, to be coprolites; No. 4332, which is the same, was so labeled.
4887. Limonite, after pyrite, Red Hill, Butte County.
2455. Limonite, between Jenny Lind and Campo Seco, Calaveras County. Occurs on the top of a round hill, cropping twelve feet above ground and fifteen feet wide, large quantity on the surface.
3760. Limonite and hematite, San Andreas, Calaveras County.
3765. Limonite, Iron Monarch Mine, Campo Seco Township, Calaveras County.
4469. Limonite, near Murphy's, Calaveras County.
553. Limonite, Murphy's, Calaveras County.
3763. Iron ore (limonite), township four north, range ten east, Mount Diablo meridian, opposite section three, in unsurveyed land, two miles in a southerly direction from Campo Seco, Calaveras County.
1896. Hematite, occurs in the rock formation, Kelsey Tunnel, fourteen miles southeast of Cresent City, Del Norte County.
4148. Limonite, near Latrobe, El Dorado County. Vein twenty feet wide. Plenty of wood, water, and limestone. Analysis: Sesquioxide of iron, 78.27; protoxide of iron, 0.80; silica, 6.51; water, 14.75; sulphur, 0.57; phosphorus, 0.02; total, 100.92; metallic iron equals 55.41 per cent.
3717. Limonite, after pyrite, perfect crystals, Chowchilla Valley, Mariposa County.
2397. Limonite concretions, Forest Hill, Placer County.
5426. Impure limonite, after pyrite, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
1552. Limonite, or Hematite, Harrington Iron Mine, San Luis Obispo County, four miles southwest of the City of San Luis Obispo, on subdivision of the Rancho Cañada de Los Osos, township thirty-one south, ranges eleven and twelve east, Mount Diablo meridian. The ledge has a northwesterly direction, with a dip to the west. Supply of ore seemingly inexhaustible. An assay has been made, showing eighty-five per cent of metallic iron.
3762. Iron ore (limonite), San Luis Obispo County, on the line of Monterey County.
2790. Limonite and psilomelane, Santa Clara County.
4966. Limonite, iron ore, Hahn's Ranch, twelve miles south of the Guadalupe Quicksilver Mine, Santa Clara County.
5906. Limonite (botryoidal), eighteen miles south of Redding, Shasta County.

3002. Limonite, Gold Lake, Sierra County.
3774. Limonite, twenty-five miles east of Visalia, Tulare County. Good road, plenty of wood and limestone. Mine lies between two rivers.
2267. Limonite, near Visalia, Tulare County.
65. Magnetite, Sutter Creek, Amador County.
2788. Magnetite, Oroville, Butte County.
301. Magnetite, Butte County.
1667. Magnetite, near Big Red Ravine, two miles from Coloma, El Dorado County.
4254. Iron ore (magnetite), Clarksville, El Dorado County.
689. Impure Magnetite, Green Valley, El Dorado County.
965. Magnetite, El Dorado County, two miles northwest of Shingle Springs.
4644. Magnetite, thirty miles north of Los Angeles, Los Angeles County.
1996. Magnetite, Coulterville, Mariposa County.

Analysis.

Silica	15.50
Sesquioxide of iron	77.78
Protoxide of iron	7.39
Sulphur	Trace.
	100.67

3006. Magnetite in gangue (epidote?), base of Mount Hoffman, Mariposa County.
3005. Magnetite, base of Mount Hoffman, south side of the dividing ridge between Mariposa and Tuolumne Counties.
3768. Iron ore (magnetite), near Benton, Mono County. Analysis by Falkenau & Reese: Peroxide of iron, 93.00; silica, 7.00; traces of sulphide of copper. This ore is said to be in very large quantities.
3639. Magnetite, Solid Iron Mine, Indian District, Mono County. Analysis by Faulknau & Reese: Peroxide of iron, 93.00; silica, 7.00; total, 100.00; graphite and sulphide of copper, traces.
3757. Magnetite, near St. Helena, Napa County.
3767. Magnetite, Grass Valley, Nevada County.
1333. Magnetite, in dodecahedral crystals, six miles from Placer County.
3585. Magnetite, near the New England Mills, Placer County.
1938. Magnetite, section fifteen, township thirteen north, range eight east, Mount Diablo meridian, Placer County, California Iron Company.

Analysis.

Silica	3.23
Sesquioxide of iron	80.05
Protoxide of iron	17.06
	100.34

This ore contains 69.29 per cent of iron.

117. Magnetite, Feather River, near Gold Lake, Plumas County.
819. Magnetite, Tres Pinos, San Benito County.
2274. Magnetite, Coast Range Mountains, San Benito County.

Analysis.

Water	.15
Silica	14.70
Sesquioxide of iron	65.40
Protoxide of iron	18.72
Sulphur	Trace only.
	98.97

4344. Magnetite, magnetic iron ore, San Benito County, fourteen miles from Hollister, sections thirty-one and six, township sixteen south, range six east, San Benito Iron Mine; occurs in large quantities, with limestone.
3759. Magnetite, San Bernardino County, six miles from water,
2886. Magnetite, eight or nine miles north of Mesquite Station, San Diego County.
3756. Magnetite, Mohawk Valley, Sierra County.
2055. Magnetite, Iron Mountain, near Shasta, Shasta County.
20. Magnetite, McCloud River, Shasta County.
1709. Magnetite, Iron Mountain Mine, seven miles from Shasta, Shasta County.
1761. Magnetite, Potter's Iron Mine, Shasta County. Occurs in large quantities at a locality about two miles southeast of the United States Salmon Fishery on the McCloud River, joining an immense limestone formation which crops out one thousand feet high, and extends along the river for four miles. There is an abundance of wood suitable for charcoal, and unlimited water power.

Analysis.

Silica	00.49
Ferrous oxide	19.59
Ferric oxide	79.90
	99.98

Contains 71.16 per cent iron.
579. Magnetite, Yuba County.
3712. Siderite (carbonate of iron), Tejunga Cañon, Los Angeles County. Occurs in a quartz ledge, country rock, granitic.
4907. Bog iron ore, found five miles from Alameda, Alameda County.
1712. Iron ore (oxide), average from tunnel, Iron Mountain Mine, seven miles from Shasta.
4082. Iron ore (pyritic), Laurel Hill, Mono County.
19. Iron ore, McCloud River, Shasta County.
4058. Iron ore. Said to occur in large quantities one mile east of Sperry's Hotel, Murphy's, Calaveras County. Lies between belts of limestone and slate. Plenty of wood and water.
3764. Jaspery iron ore, near Campo Seco, Calaveras County.
3422. Jaspery iron ore, northwest corner of Sonoma County, near Point Arena.
4083. Iron, reduced from ore in a common crucible; mistaken for tin.
4019. Iron buttons, obtained in crucibles from the Campo Seco iron ore, Calaveras County.
3758. Metallic iron (reduced from magnetite), found near St. Helena, Napa County.

Lead and Base Bullion—(Lead containing Gold, Silver, and Copper).

Lead ranks high as one of the mineral products of the State. The metal obtained by the crude processes is seldom so free from other metals as to be sold for pig lead, but is generally to a greater or less extent mixed with metals of greater value or otherwise, and is placed in the market as "base bullion" and sold to refiners as such. From 1878 to 1883 the yield in pounds was as follows:

Base bullion	45,846,800
Lead	32,011,700
	77,858,500

Equal to $38{,}929\frac{500}{2000}$ tons.

Lead Minerals and Mines Producing Lead Ores Represented.

There are no lead mines in California, strictly speaking. All the ores of lead which have been discovered are associated with other metals, as gold, silver, copper, antimony, etc. The following specimens were exhibited:

429. Cerro Gordo, Inyo County, lead stalagmite, droppings from furnace.
4211. Hidalgo Mine, Inyo County, fine grained galena.
1394. Homer Mill and Mining Company, Mono County, galena ore.
5313. Leadville Mine, Inyo County, galena.
2112. May Lundy Mine, Homer District, Mono County, galena. See No. 2109.
1647. Modoc Mine, Inyo County, azurite, anglesite, and bindheimite.
1648. Modoc Mine, Inyo County, anglesite and bindheimite.
1653. Modoc Mine, Inyo County, galena.
2168. Modoc Mine, Inyo County, anglesite, sulphate of lead.
915. New Coso Mine, Inyo County.
1105. New Coso Mine, Inyo County, galena.
295. San Bernardino County, galena.
130. San Bernardino County, litharge.
673. Santa Catalina Island, Coast of California, galena.
4071. Small Hill Mine, Santa Catalina Island, galena.
1880. Sunrising Mine, near Aqueduct City, Amador County, galena in quartz.

Chrome Ores.

Mines of chrome are never in California designated by special names, like those of gold, silver, copper, lead, etc. The reason for this is that the ore is found in bunches and deposits, which are after a time exhausted, and new localities are sought.

3716. Chromic iron, within one mile of Auburn, Placer County.
4470. Chromic iron, near Murphy's, Calaveras County.
174. Chromic iron, Cloverdale, Sonoma County.
4747. Chromic iron, eighteen miles east of Crescent City, Del Norte County.
1402. Chromic iron, El Dorado County, one mile and a half from railroad.

1906. Chromic iron, seven miles east of Folsom, Sacramento County.
1365. Chromic iron, five samples, from as many different deposits, within twenty miles of Fresno City, Fresno County.
3725. Chromic iron, near Iowa Hill, Placer County.
1876. Chromic iron, near Jackson, Amador County.
2431. Chromic iron, near Latrobe, El Dorado County, ledge said to be three to six feet thick.
6. Chrome iron, Litton Springs, Sonoma County.
4903. Chromic iron, near Livermore, Alameda County.
2343. Chromic iron, four and a half miles northeast of San Luis Obispo.
1154. Chromic iron, Los Gatos, Santa Clara County.
3711. Chrome iron, Michigan Bluff, Placer County.
4678. Chromic iron, Mount Hope District, near Forbestown, Butte County.
4196. Chromic iron, near Mountain House, near Downieville, Sierra County.
2731. Chromic iron, one mile south of Mountain Spring House, Amador County.
5120. Chromic iron, southeast quarter of section twenty-one, township fourteen north, range nine east, Placer County.
5050. Chromic iron, found within two or three miles of Nevada City, Nevada County.
1578. Chromic iron, Pick and Shovel Mine, six miles northeast from the City of San Luis Obispo. Direction of the vein, northeast to southwest, dips west forty-five degrees. Ore extracted to July, 1880, four hundred tons.
2493. Chromic iron, ten miles from Portersville, Tulare County.
686. Chromic iron, within six miles of San Francisco.
4640. Chromic iron, found on the road from St. Helena to Knoxville, Lake County, said to exist in large quantities.
797. Chromic iron, near St. Helena.
173. Chromic iron, San José, Santa Clara County.
394. Chromic iron, five miles east of San José, Santa Clara County.
57. Chrome iron, twelve miles from San Juan, San Luis Obispo County.
322. Chromic iron, San Luis Obispo.
2526. Chromic iron, San Mateo County, Pacific slope of the Redwoods, chromic acid 50.12 per cent.
960. Chromic iron, two miles northwest of Shingle Springs, El Dorado County.
2772. Chromic iron, Solano County, near Fairfield.
2768. Chromic iron, near South Fork of American River and nine miles from Folsom. Two thousand tons have been shipped from this mine.
923. Chromic iron, Tuolumne County.
3601. Chrome iron of high grade, from within half a mile of the town of Yreka, Siskiyou County.

HYDROCARBONS AND MINERAL FUELS.

COAL AND LIGNITE.—While it cannot be denied that true coal does not exist in the State, or at least has never been discovered, yet a fair quality of lignite has been somewhat largely produced, which takes the place, to a certain extent, of the more valuable and useful coal, and which, although a rather poor substitute, is better than no fuel and serves many useful purposes. From 1860, to June, 1884, the yield of the Mount Diablo Mines alone was 2,570,461 tons.

PETROLEUM.—In view of the fact that California is poor in natural fuels of the nature of coals or lignites, it is a matter for congratulation that petroleum is likely to be largely produced in the State. The area over which petroleum, asphaltum, maltha, and other hydrocarbons are found is large. Already 388,000 barrels of crude oil have been pumped from the various wells. This oil is becoming more and more generally utilized.

ASPHALTUM is mined and used quite extensively in California. The annual consumption and production is estimated at 3,500 tons, and the price is from $9 to $11, according to quality and market. Considerable attention has been paid to its use for pavements, and a number of useful inventions have been made.

Robert Skinner, of San Francisco, invented a process for manufacturing an asphalt pavement-block by compression, which is briefly described as follows: Calcareous material, after being crushed, is heated and brought in contact with hot asphaltum. This material is then forced into molds under a pressure of not less than 50 tons, after which, having been cooled in water, it becomes homogeneous. A block manufactured by this method (3606),

was exhibited at the Exposition, and it was a pleasure to learn that the walks in front of the main building were laid in these blocks and that they gave great satisfaction. The street pavements laid in New Orleans are better than those of San Francisco. St. Charles Avenue, from Lee Circle to Carrolton, was being laid during the Exposition, and I watched the operation with great interest. The work was being done by an eastern company; the operation was as follows: The ground was first leveled and compacted by passing over it a very heavy iron roller; on this was laid a thick stratum of concrete, consisting of broken stones and hydraulic cement; plenty of time is allowed for this to set. The asphalt is prepared in a special temporary building placed in a convenient position near the work. The crude asphaltum is "cooked" for 72 hours; this operation yields a product which is called "refined." The next process is to place the refined asphaltum in large kettles with a certain proportion of crude petroleum; it is then discharged into a mechanical mixer and five parts of sand added, previously heated to remove moisture; the whole is thoroughly mixed by revolving rollers with blades. While this is going on, limestone is ground to flour and added in the proportion of one sixth; when still further mixed the substance is discharged into an iron cart and quickly driven to the work. When the load is dumped on the surface of the hardened concrete it is spread with hoes and rolled with an iron roller. The operation produces a most beautiful roadway, and from its very nature must be durable.

The following specimens of hydrocarbons and mineral fuels were shown:

Hydrocarbons.

338. Aragotite, a new hydrocarbon, California Quicksilver Mine, Yolo County. See proceedings California Academy of Sciences, vol. 4, p. 218.
156. Asphaltum, one half mile from San Luis Obispo.
328. Asphaltum pierced by shells, Los Angeles County.
543. Asphaltum, Santa Barbara County.
4151. Asphaltum nodules or water-worn bowlders, found on the beach at Santa Barbara.
5638. Asphalt (brea), found in large quantities at Petrolia, section five, township three, range nine west, seven miles from Anaheim, Los Angeles County.
5059. Asphaltum, solid, from a natural well, Steele's Ranch, San Luis Obispo County (see No. 5058).
5058. Asphaltum, liquid, from a natural well, said to be one hundred feet deep, from which it overflows and becomes solid asphaltum, Steele's Ranch, San Luis Obispo County.
5633. Asphalt, liquid, or maltha, Tar Creek, near Sargent, Santa Clara County. This substance flows from the earth in many places and hardens into solid asphalt (see No. 5634); specific gravity, 1.143.
5634. Asphaltum, called by the Mexicans "brea," Spanish for "pitch," found in large quantities at Tar Creek, near Sargent, Santa Clara County. It results from the inspissation of the liquid (No. 5633).
5635. Asphaltum, block, refined from No. 5634 by heating and straining, used for street pavements, roofs, etc., Tar Creek, near Sargent, Santa Clara County.
5636. Asphaltum, refuse in refining crude material (No. 5634), Tar Creek, near Sargent, Santa Clara County.
5637. Asphaltum, free from sand, and otherwise nearly pure; natural result of inspissation of liquid asphalt or maltha (No. 5633). This mineral resembles the purest asphalt from Trinidad, or the Dead Sea; specific gravity, 1.15; Tar Creek, near Sargent, Santa Clara County.
5639. Asphalt, liquid, or maltha, from one of the oil wells at Petrolia, section five, township three south, range nine west, seven miles from Anaheim, Los Angeles County; specific gravity, .969.
5640. Asphalt, liquid, or maltha, from the Puente oil wells, section one, township three south, range ten west, seven miles from Anaheim, Los Angeles County; specific gravity, .920.
110. Bituminous shale, Monterey County.
1264. Bituminous earth, Kelseyville Gas Wells, Lake County.
1740. Bitumen, New Almaden Quicksilver Mine, Santa Clara County.
4755. Bituminous shale, or impure lignite, near Mount Diablo, Contra Costa County. Volatile matter, including water, 24.4; fixed carbon, 17.6; ash, 58.0; total, 100.
5045. Brown lignite (5-foot vein), Temescal Mountains, 25 miles southwesterly of Colton, San Bernardino County, owned by McIntosh & Chaney. Fixed carbon, 27.74; combustible matter, 32.26; water, 20.00; ash, 20.00—100.

2806. Cake of paraffine, from California petroleum.
431. Coal, vein four feet thick, two and a half miles from Carmelo Bay, Monterey County.
987. Coal, Spinks Coal Mine, Lincoln, Placer County.
1301. Coal with gypsum, Antioch, Contra Costa County.
1358. Coal (?), Kelseyville, Lake County.
1800. Coal, thirty-inch vein, Cienega Del Gabian Rancho, San Benito County, near the line of Monterey County.

Approximate Analysis.

Water	18.40
Volatile combustible matter	31.15
Fixed carbon	30.00
Ash	20.45
	100.00

1959. Coal, Black Diamond Mine, Mount Diablo, Contra Costa County.
2334. Coal, Santa Clara Coal Mine, twenty miles east of Santa Ana, Los Angeles County.

Analysis.

Water	7.87
Volatile hydrocarbons	29.93
Fixed carbons	49.53
Ash	12.67
	100.00

2378. Coal, Cajon Pass, San Bernardino County.

Analysis.

Water	9.67
Volatile hydrocarbons	27.67
Fixed carbon	46.53
Ash	16.13
	100.00

2533. Coal, Tejon Pass, Kern County.

Analysis.

Water	10.47
Volatile combustible matter	34.60
Fixed carbon	44.86
Ash	10.07
	100.00

2910. Coal, Panoche Pass, Fresno County.

Analysis.

Water	13.73
Volatile hydrocarbons	31.73
Fixed carbon	31.54
Ash	23.00
	100.00

4235. Coal, Monterey County, township twenty-two south, range thirteen east, Mt. Diablo meridian.
367. Coal, near Ione, Amador County.
982. Ionite, found in spots and streaks through coal, Spinks Coal Mine, Lincoln, Placer County.
2093. Ionite, Ione Valley, Amador County.
4808. Ionite, Clipper Coal Mines, near Lincoln, Placer County.
2094. Coke, made from ionite. No. 2093.
5421. Semi-Lignite, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
5422. Lignite, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
305. Lignite, Boney Mine, Vallecitos, Calaveras County.
1267. Lignite, Mendocino County.
1334. Lignite, Carmelo Mine, Monterey County.
2102. Lignite, Ione Valley, Amador County.
2445. Lignite, San Pablo Creek, Contra Costa County.
2379. Lignite, Telegraph Hill, San Francisco.

Analysis.

Water	1.30
Carbon	16.50
Ash	82.20
	100.00

2513. Lignite, near Bieber, Lassen County.

Analysis.

Water	20.40
Volatile hydrocarbons	11.40
Fixed carbon	9.87
Ash	58.33
	100.00

4096. Lignite, near Lexington, Santa Clara County. Analysis: Volatile combustible matter, 29.5; fixed carbon, 47.0; water, 16.5; ash, 7.0; total, 100.0.

4809. Lignite, Clipper Coal Mines, near Lincoln, Placer County. This material has not yet received the study it deserves. It very much resembles ionite which has been analyzed, and, while it has the appearance of being a very inferior lignite, it serves many useful purposes as a fuel, and is consumed in large quantities in the neighborhood.

5187. Lignite, brown coal, Willits, Mendocino County. A caking and coking coal, resembling the Carbon Hill coal. Analysis: Fixed carbon, 41.75; ash, 39.25; volatile combustible matter, and water, 19.00; total, 100.

4116. Petroleum, crude, near Spanishtown, San Mateo County.

4275. Petroleum, crude, Monterey County.

4276. Petroleum, crude, San Luis Obispo County.

5641. Petroleum, crude oil, green oil, specific gravity .795, from a well on Tunitas Creek, San Mateo County, section twenty-five, township six south, range five west. In April, 1884, several barrels per day were being pumped.

5642. Petroleum, crude oil, specific gravity .830, from Pico Cañon, near Newhall, Los Angeles County. This sample was drawn from the end of the main pipe line at the refinery at Newhall, and is the oil which is being sent by the railroad, both north and south, in large quantities.

5643. Petroleum, refined (coal oil), specific gravity .797, refined at Newhall, Los Angeles County, from crude oil (No. 5642).

5608. Sand impregnated with asphalt, and sand separated from it, Coast Range, seven miles northwest of Santa Cruz.

Sand	80.2
Asphalt	19.8
	100.0

The sand angular of milky transparent quartz. This mineral has been distilled for the oil it contains, but which could not compete with eastern oil; it is used, also, for pavements, without preparation. Paving blocks of fine texture, solid and resisting the heat of the sun, are now made of this material by simple pressure, as patent bricks are made, with no addition except a sprinkling of dry sand in the molds.

BORAX.

This mineral is largely produced in California; a full description and history may be found in the third annual report of this office. The total yield of the State to April 30, 1884, was 23,112,286 pounds. The San Bernardino Borax Company made a special exhibit of refined California borax, and William T. Coleman showed some magnificent crystallized Nevada borax refined in Oakland. A large pile of borax from each of these exhibits was placed on each side of the entrance to the California headquarters, and specimens given as souvenirs to visitors. In this manner several hundred pounds were distributed. The following borax minerals from the State Museum were exhibited:

1200. Borax, crude or tincal, Slate Range, San Bernardino County.

1806. Borate of lime, ulexite, Borax Lake, near Grapevine Cañon, Kern County.

1817. Borax, crude material, from the borax deposits, San Bernardino County.

3379. Borax, refined, San Bernardino County.

4668. Borax, crude, Eagle Borax Mining Company, Death Valley, Inyo County.

4669. Borax, refined (see No. 4668), Eagle Borax Company, Death Valley, Inyo County.

4796. Borax pulverized and refined, the production of the San Bernardino Borax Mining Company. Analysis by Edward Booth: biborate of sodium, 52.68; water, 46.25; total, 98.93.

4956. Borate of lime, ulexite, variety technically called "sheet cotton," containing free boracic acid, Death Valley, Inyo County.

4957. Borax, made from ulexite (borate of lime), decomposed by carbonate of soda.

5219. Boracic acid, manufactured from borate of lime, from Desert Springs, Kern County. (See Third Annual Report of State Mineralogist, folio 29.) Manufactured and presented by the Boracic Acid Manufacturing Company.

5283. Borax, refined by the Harmony Borax Company, in Alameda County.
5286. Borax, refined, manufactured by the San Bernardino Borax Mining Company.
5291. Borate of lime, ulexite, Desert Springs Lake, Kern County. Used by Boracic Acid Manufacturing Company.
5292. Borate of lime, sheet cotton, Desert Springs Lake, Kern County.
5293. Boracic acid, 99.8 per cent. Made by the Boracic Acid Manufacturing Company.
5297. Borate of lime, crude, cotton balls, from which boracic acid is made (see No. 5219), from Desert Springs Lake, Kern County. Described folios 29 and 81, Part II, Third Annual Report of the State Mineralogist. Presented by the Boracic Acid Manufacturing Company.
5298. Borate of lime, crude, variety known as "sheet cotton," described folio 83, Part II, Third Annual Report of the State Mineralogist, from Desert Springs, Kern County. Presented by the Boracic Acid Manufacturing Company.

MANGANESE.

Ores of manganese are abundant in the State. They are used in glass making, in chemical operations, for bleaching, and in the extraction of gold from sulphurets, and in the Bessemer process of making soft iron and steel. When wanted they will be found in sufficient quantities to satisfy all reasonable requirements.

The following manganese ores and minerals were shown:

467. Manganese ore, Hunter's Valley, Mariposa County.
918. Manganese ore, Tuolumne County.
1170. Manganese ore, near Angel's Camp, Calaveras County.
2337. Pyrolusite (binoxide of manganese), Santa Rosa, Sonoma County.
2375. Pyrolusite (binoxide of manganese), near Tomales, Marin County.
3413. Pyrolusite, found in copper shale, Sweetland Creek Mine, Nevada County.
3657. Pyrolusite and rhodonite, section fourteen, township one north, range ten east, Mount Diablo meridian, two miles south of Summersville, Tuolumne County.
3728. Pyrolusite and rhodonite, near Colton, San Bernardino County.
3772. Pyrolusite, three miles from Cloverdale, Sonoma County.
4088. Manganese ore, impure, containing rhodonite (silicate of manganese) and pyrolusite (binoxide of manganese), from a large deposit two miles north of Sonoma, Tuolumne County, at an elevation of 200 feet above the surrounding country. Course of vein, east and west. The vein is nine feet wide, ten feet below the surface; granite on the north side, slate on the south. It can be traced for a mile. Discovered in 1857 by Henry S. Macomber.
4124. Pyrolusite (binoxide of manganese), Knopp's Ranch, near Columbia, Tuolumne County. Found on the surface in bowlders, from the size of grapes to one hundred pounds in weight.
4337. Pyrolusite, impure, St. Helena Mountain, Napa County.
4900. Pyrolusite, Alameda County.
4965. Pyrolusite (binoxide of manganese), Hahn's Ranch, twelve miles south of the Guadalupe Quicksilver Mine, Santa Clara County.
5053. Pyrolusite, impure, three miles from Railroad Flat, Calaveras County.
5107. Pyrolusite, of excellent quality, Sonoma County.

TIN.

Tin ores have been found at one locality only, in the Temescal Tin Mines, San Bernardino County. As yet there has been no yield, nor have the mines been extensively worked or properly prospected. There is some reason to hope that this metal may yet be found in paying quantities at the locality mentioned.

CEMENT.

Hydraulic cement has been found in the State and has been somewhat manufactured. Some artificial cements and stones have likewise been made, but the business has never gained large proportions. The splendid sidewalks that are now being extensively laid in San Francisco are made generally with imported cement. The statement that pozzuolana had been found in the State was entirely without foundation, although among the numerous volcanic rocks of the State that very valuable cement is likely to be found.

The following specimens were exhibited:

182. Cement, Benicia.
183. Cement, Niles, Alameda County.
2035. Cement rock, Washington Corners, Alameda County.

Analysis.

Silica	.05
Sesquioxide of iron	.16
Carbonate of magnesia	.65
Carbonate of lime	99.14
	100.00

2113. Cement, California Portland; works at Santa Cruz, Portland Cement Company.
2114. Cement, California Portland, in its crude state, before being ground, Portland Cement Company.
2115. Artificial stone, manufactured by Portland Cement Company.
3586. Cement nodules, Glenbrook, Lake County, found in a bluish clay covering an area of ten acres.

ANTIMONY.

Traces of this mineral, generally associated with ores of mercury, are found in numerous localities in the State. The metal has been produced in small quantity, but scarcely with profit to those who have engaged in mining it. The outlook, however, is good for more extensive production. The following specimens exhibited represent the principal known localities in the State. The following antimony minerals were shown:

5770. Stibnite, section thirty, township eleven south, range seven east, Alta Antimony Mine, San Benito County. (See Nos. 450, 690, 702, 4099.)
5939. Stibnite, in magnificent crystals, Alta Antimony Mine, section thirty, township eleven south, range seven east, San Benito County. Mine described on folio 374, Fourth Annual Report of State Mineralogist. See also No. 4099.
2804. Stibnite (sulphuret of antimony), near Gilroy, Santa Clara County.
450. Stibnite, Hollister, San Benito County.
690. Antimony ore, Hollister, San Benito County.
702. Antimony ore, Hollister, San Benito County.
4354. Antimony ore, stibnite, said to contain gold, near Kernville, Kern County.
937. Sulphide of antimony, Kern County.
4643. Stibnite, seven miles from Los Angeles, Los Angeles County.
4099. Stibnite (sulphide of antimony) McLeod (?), San Benito County.
1631. Stibnite (sulphide of antimony), Mammoth Mine, Mineral King District, Tulare County.
1642. Stibnite (sulphuret of antimony, see No. 1631), Mineral King District, Tulare County.
4904. Stibnite, sulphide of antimony, Panamint Valley, Inyo County. This deposit has long been known, and may be found located on Atlas Sheet No. 65 D., Wheeler's geographical surveys and explorations west of the one hundredth meridian.
4092. Stibnite (sulphide of antimony), San Emidio Antimony Mine, township ten north, range twenty-one west, San Bernardino meridian, Kern County. For description see "Pacific Railroad Reports," vol. V, folio 291.

ROCKS AND BUILDING STONES.

Building materials are very abundant in California, and can be obtained in nearly every part of the State. Attention has lately been drawn to the importance of replacing the temporary wooden buildings with those of a more substantial nature. At Mokelumne Hill, in Calaveras County, and at St. Helena, in Napa County, a tufaceous volcanic or solfataric stone has been utilized with great satisfaction, and some beautiful as well as durable buildings erected. This stone is so soft when first quarried that it may be fashioned with axes, and with time it hardens. It is likely to prove as useful and valuable as it is extensive. Granite is somewhat also used for foundations, and a few buildings of that material have been erected. It is now well known that beautiful marbles abound in the State, but they are not as yet generally utilized. Brick of the very best quality are

cheaply produced, and many fine buildings are being erected of this excellent and most durable material. It is the intention of this office to make a special collection and study of the rocks and building stones of the State, and to publish the results. The following catalogue of the rocks and building materials exhibited at the Exposition has been arranged alphabetically, for want of time to make a better classification:

5300. Agalmatolite (?), somewhat resembling the Chinese figure stone, and similar to a rock from San Luis Obispo County (No. 4060). This beautiful ornamental stone is found two miles west of Greenwood, El Dorado County, in a vein from six inches to a foot in thickness.
4227. Basaltic fragment from a bowlder of lava, plains between Oroville and Pence, Butte County. Concave on one side, convex on the other, showing how angular fragments of rocks weather into rounded bowlders, without water-washing.
1734. Black alta (argillaceous schist), New Almaden Quicksilver Mine, Santa Clara County.
3365. Block of basalt. Used for street pavement. Mt. Pisgah quarries, one mile south of Petaluma, Sonoma County.
3441. Borings from James Phelan's well. O'Farrell Street, San Francisco: A, 185 feet deep; B, 192; C, 200; D, 225; E, 240; F, 245; G, 251; H, 260; I, 265.
5774. Borings, from bottom of well No. 2, Petrolia, Los Angeles County.
5775. Borings, from a depth of 500 feet, Snow's oil well, Petrolia, Los Angeles County.
5778. Borings, representing section of an oil well, Turenitas Creek, San Mateo County: A, 90 feet; B, 130 feet; C, 140 feet; D, 150 feet; E, 160 feet; F, 170 feet; G, 200 feet; H, 220 feet; I, 234 feet; J, 256 feet; K, 280 feet; L, 290 feet; M, 300 feet; N, 320 feet; O, 356 feet; P, 360 feet; Q, 364 feet; R, 382 feet; S, 386 feet; T, 390 feet; U, 398 feet; V, 403 feet; W, 431 feet; X, 460 feet; Y, 478 feet; Z, 484 feet; aa, 501 feet; bb, 508 feet; cc, 515 to 586 feet.
3732. Breccia, hills back of Oakland, Contra Costa County.
4150. Bowlder of fine grained diorite or basalt, Folsom, Sacramento County. Strongly resembling serpentine externally.
4341. Breccia of red jasper in white quartz, Glenbrook, Lake County.
3014. Building stone, Mr. Wheat's house, Double Springs, Calaveras County.
348. Calcite, Inyo County.
656. Calcite, Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
1224. Calcite, from the Old Chapman Quicksilver Mine, Santa Clara County.
1741. Calcite, New Almaden Quicksilver Mine, Santa Clara County.
1862. Calcite, Clipper Gap Lime Quarry, section thirty, township thirteen north, range nine east, Mount Diablo meridian, Placer County.
2002. Calcite (stalagmite), quarry of Davis & Cowell, Santa Cruz County.
2003. Calcite (white), quarry of Davis & Cowell, Santa Cruz County.
2004. Calcite (blue crystalline), quarry of Davis & Cowell, Santa Cruz County.
2005. Calcite (marble), quarry of Davis & Cowell, Santa Cruz County.
2162. Calcite (black), Amador County, near Volcano.
2163. Calcite, Amador County, near Volcano.
2384. Calcite, Inyo County.
2775. Calcite, Mad Ox Mine, near Whisky Creek, Shasta County.
3420. Calcite, Polar Star Mine, Dutch Flat, Placer County.
4147. Calcite (limestone), Santa Cruz County.
5009. Calcite, bed of the Klamath River, Yreka, Siskiyou County.
3692. Calcite, blue, San Diego County.
4069. Calcite, pink, Small Hill Mine, Santa Catalina Island.
2192. Chrysolite with calcite, near Independence, Inyo County.
5089. Cement rock (impure carbonate of lime), hill west of road to Weston's Cañon, San Gregorio Pass, San Bernardino County.
69. Clay, Ione Valley, Amador County.
167. Clay, Mount Diablo, Contra Costa County.
186. Clay, Ione, Amador County.
241. Clay, Comanche Mine, Mono County.
248. Clay slate, Mount Hamilton, Santa Clara County.
419. Clay, Ione Valley, Amador County.
473. Clay slate, bored by worms, Mono Lake, Mono County.
563. Clay, ferruginous, Ione Valley, Amador County.
980. Clay, surface, Spinks Coal Mine, Lincoln, Placer County.
984. Clay, underlying coal, Spinks Coal Mine, Lincoln, Placer County.
985. Clay, lying between two sand streaks, Spinks Coal Mine, Lincoln, Placer County.
986. Clay, lying between the coal streaks above the main ledge, Spinks Coal Mine, Lincoln, Placer County.
1332. Clay, Duncan Mills, Marin County.
1504. Clay, yellow, mistaken for native sulphur, Redington Mine, Lake County.
1722. Clay wall, Orient Mine, Bodie District, Mono County.
1773. Clay, ferruginous, Clipper Gap, Placer County.

1823. Clay, indurated, corner of Filbert and Leavenworth Streets, San Francisco.

Analysis.

Silica	56.51
Alumina	21.33
Sesquioxide of iron	12.31
Lime	3.53
Water	6.30
Magnesia	Trace.
	99.98

1831. Clay, Dutch Creek, twenty miles northeast of Placerville, El Dorado County.
1944. Clay, near Lincoln, Placer County, called by the potters, blue plastic clay.

Analysis.

Silica	44.82
Alumina	34.54
Combined water	8.37
Hygroscopic water	1.27
Carbonate of lime	3.00
Magnesia	.96
Soda	4.74
Sesquioxide of iron	1.86
Loss	.44
	100.00

1945. Clay, near Lincoln, Placer County, called by the potters white non-plastic clay.

Analysis.

Silica	41.80
Alumina	38.78
Combined water	6.00
Hygroscopic water	1.62
Carbonate of lime	2.64
Magnesia	1.02
Soda	3.46
Sesquioxide of iron	2.12
Loss	2.56
	100.00

2096. Clay, from well at Hotel Del Monte, Monterey, forty-five feet.
2097. Clay, from well at Hotel Del Monte, Monterey, ninety-six feet.
2098. Clay, from well at Hotel Del Monte, Monterey, two hundred and sixteen feet.
2117. Clay, black, stained with oxide of manganese, west or hanging wall of Bodie mines, found throughout the district.
2118. Clay, found opposite Independence, Owen's Valley, Inyo County.
2120. Clay, blue slip, three-hundred-foot level, Dudley Mine, Bodie, Mono County.
2123. Clay, near Jackson, Amador County.
2368. Clay, two miles north of Santa Rosa, Sonoma County.
2732. Clay, with pyrite, three miles north of Ione City, Amador County.
2907. Clay, said to occur in large quantities in Mendocino County, near Point Arena.
3023. Clay, Bodie, Mono County.
3393. Clay, "pipe clay," Malakoff Mine, North Bloomfield.
4100. Clay, five hundred and ten feet deep, basin of Clear Lake, five miles west of Soda Bay, Lake County.
4101. Clay, five hundred and twenty-five feet deep, basin of Clear Lake, five miles west of Soda Bay, Lake County.
4105. Clay, fire, Shasta County.
4106. Clay, "blue clay" (so called), three hundred feet from the Dudley Mine, Bodie, Mono County.
4221. Clay, No. 4220. Burned in a potter's kiln, by Gladding, McBean & Co., which shows it to be well fitted for the manufacture of fine pottery.
4272. Clay (specially suited for the manufacture of fire brick), Michigan Bar, Sacramento County.
4500. Clay, from an artesian well ninety-eight feet deep, near Willow Street, San Antonio, Alameda County.
4646. Clay (kaolin), Amador County, near Sacramento; N. Clark & Sons, agents, Pacific and Sacramento Potteries.
4803. Clay, six foot stratum, forty feet deep, Clipper Coal Mines, near Lincoln, Placer County. (See Nos. 979 to 987.)
4806. Clay, found below the coal beds, seventy-five feet below the surface, Clipper Coal Mines, near Lincoln, Placer County.
4807. Clay, washed, from the sand stratum, thirty feet below the surface, Clipper Coal Mines, near Lincoln, Placer County.
4916. Clay (Nos. 4220 and 4421), baked in a common sewer pipe kiln, by Gladding & Mc-

Bean, who say if it was properly washed and otherwise prepared it would be equal to th best kaolin; Nevada City, Nevada County.
5090. Clay, overlying cement rock (No. 5089), San Gregorio Pass, San Bernardin County.
5791. Clay, "pipe clay," North Bloomfield Mine, Nevada County.
5429. Concretions, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
311. Conglomerate, McCloud River, Shasta County.
2100. Conglomerate, Point Lobos, seven miles southwest of Monterey.
2106. Conglomerate, Pebble Beach, Pescadero San Mateo County.
4065. Conglomerate bowlder, Pescadero, San Mateo County.
5423. Conglomerate (coarse), cemented by iron pyrites, Gold Gravel Hydraulic Min La Porte, Plumas County.
5424. Conglomerate (fine grained), cemented by iron pyrite, Gold Gravel Hydrauli Mine, La Porte, Plumas County.
5425. Conglomerate (coarse grained), cemented by oxide of iron, Gold Gravel Hydrauli Mine, La Porte, Plumas County.
1348. Conglomerate, Bay of San Francisco.
4244. Deposit from Paso Diablo Springs, Inyo County.
2079. Diabase (Feldspar, Pyroxene, and Chlorite), with section for the microscope North Pacific Railroad, near Saucelito, Marin County.
35. Diatomaceous earth, Santa Monica.
240. Diatomaceous earth, Los Angeles.
175. Diatomaceous earth, Ione Valley, Amador County.
436. Diatomaceous earth, San Gregorio, San Mateo County.
444. Diatomaceous earth, San Joaquin Valley, seventy miles from Stockton, near San Carlos Ranch, Pacheco Pass.
557. Diatomaceous earth, Staples Ranch, San Joaquin County.
654. Diatomaceous earth, ten miles north of Petaluma, Sonoma County.
791. Diatomaceous earth, with fossils, Santa Barbara.
793. Diatomaceous earth, with fossils, Santa Barbara.
830. Diatomaceous earth, Monterey.
976. Diatomaceous earth, with fossils, Santa Barbara County.
1184. Diatomaceous earth, near Comanche, Calaveras County.
1185. Diatomaceous earth, Port Harford, San Luis Obispo County.
1246. Diatomaceous earth, Lost Spring Ranch, Lake County.
1217. Diatomaceous earth, Santa Barbara.
1248. Diatomaceous earth, Santa Monica, Los Angeles County.
1283. Diatomaceous earth, Lost Spring Ranch, Lake County.
1284. Diatomaceous earth, Santa Catalina Island.
1331. Diatomaceous earth, Dutch Flat, Placer county.
1362. Diatomaceous earth, near Comanche, Calaveras County.
2459. Diatomaceous earth (?), near Pinole Station, Contra Costa County.
1448. Diatomaceous earth, Port Harford, San Luis Obispo County.
1742. Diatomaceous earth, fourteen miles below San Pedro, Los Angeles County.
1832. Diatomaceous earth, eighteen miles southeast of Santa Rosa, Sonoma County. Lies between strata of Aragonite and Gray Sandstone.
2444. Diatomaceous earth, Ventura County.
2511. Diatomaceous earth, very rich in diatoms, Graham Cañon, five miles south of Santa Rosa, Sonoma County.
2741. Diatomaceous earth, white outcrop on the Salinas road, Jacks' Ranch, near Monterey, Monterey County.
3431. Diatomaceous earth, Cayetano Ranch, Santa Clara County.
3775. Diatomaceous earth (called chalk), Doolan Mine, near Santa Rosa, Sonoma County.
5411. Diatomaceous earth, Bitterwater Ranch, San Benito County.
1216. Diatomite (?), Santa Barbara County. This is found in the strata of diatomaceous earth, and is supposed to have been silicified by soluble silica from beds above. The name was suggested by Dr. W. W. Finch, who discovered it.
1940. Diorite, wall rock of the Clipper Gap Iron Mine, Placer County.
1941. Diorite, near the bridge, section fifteen, township eighteen north, range thirteen east, Mount Diablo meridian, Placer County.
1943. Diorite, township thirteen north, range eight east, Mount Diablo meridian, Placer County.
2042. Diorite, iron mines near Clipper Gap, section twenty-four, township thirteen north, range eight east, Placer County.
2052. Diorite, wall of furnace building, Clipper Gap Iron Mines, Placer County.
2282. Diorite, fine grained (with section), Mineral Hill District, Mono County. This specimen contains more hornblende than No. 2283, which is from the same locality. It contains also considerable finely divided magnetite.
2283. Diorite, fine grained (with section), containing less hornblende than No. 2282, which is from the same locality, and in which magnetite is replaced by pyrites, Mineral Hill, Mono County.
3016. Diorite, with section, cut by Frank Atwood, croppings near Cave City, Calaveras County.
242. Dolerite, east wall, Comanche Mine, Mono County.
2175. Dolomite (carbonate of lime and magnesia), Modoc Mine, Inyo County.

2215. Dolomite, Guadalupe Quicksilver Mine, Santa Clara County.
2238. Dolomite (resembling fossil coral), Morro, San Luis Obispo County.
2524. Dolomite, nodule, spur of hills north of Morro Bay, San Luis Obispo County, six miles from the ocean, and at an elevation of two hundred to three hundred feet. These nodules are found near the surface, and vary in size from a few inches to a foot or more in diameter; many of them have cavities lined with crystals.
2820. Dolomite, Deep Spring Valley, Inyo County.
4483. Dolomite (white), Amargosa Wash, San Bernardino County. This mineral is very common in the Inyo Mountains.
5051. Dolomite, Inyo County.
5088. Dolomite (white), Tujunga Cañon, seven miles from San Fernando, San Gabriel Mountains, Los Angeles County; valuable for building and manufacturing purposes.
5369. Dolomite (impure), found near the State University, Berkeley, Contra Costa County; mistaken for pozzuolana.
5935. Earth (adobe), lying above the "brea" (asphaltum), Brea ranch, near Los Angeles.
5546. Feldspathic rock, which seems to be decomposing into kaolin (No. 5544), near Daggett Station, San Bernardino County.
4958. Fossiliferous rock, near Soledad, San Diego County.
2776. Garnet rock, Calpella, Mendocino County. From a large cropping.
4259. Glaucophane rock, wall rock of the Collier Mine, six miles northeast from Murphy's, Calaveras County.
1431. Gneiss, brought to San Francisco on river schooners and used for street pavements.
5086. Gneiss, said to be found in San Francisco in place, but this needs confirmation.
23. Coarse granite, near Sacramento.
214. Granite, Newcastle, Placer County.
216. Granite, Folsom, Sacramento County.
217. Granite, Rocklin, Placer County.
326. Granite, polished, Rocklin, Placer County.
459. Granite, Yosemite Valley, Mariposa County.
1126. Granite, Mariposa Mine, Mariposa County.
1867. Granite, Rocklin, Placer County.
1882. Granite, Crystal Lake, Summit Valley, Nevada County.
1884. Granite (micaceous), near Penryn, Placer County.

GRAVELS, HYDRAULIC.

1675. Mechanic analysis of:

Portion A, coarse non-magnetic	56.6
Portion B, fine non-magnetic	18.4
Portion C, magnetic	25.0
	100.0

A—Contains garnets, sulphides of iron, various dark colored grains, and a striated mineral which, under the microscope, resembles selenite.
B—Is principally quartz sand. There are some amorphous particles of a red color, and the mineral resembling selenite. There are no zircons.
C—Is almost entirely magnetite.
1210. Gravel, San Pablo, Contra Costa County.
5941. Gravel, distinct from the sandstone; used in macadamizing streets, Los Angeles.
548. Hornblende rock, Santa Barbara Mountains.
2263. Hornblende rock, Healdsburg, Sonoma County.
2913. Hornblende rock, Folsom, Sacramento County.
4266. Hornblende rock, Gold Run, Placer County.
1320. Hydromagnesite, Market Street Cut, near Guerrero Street, San Francisco.
4219. Impressions of leaves in the so called "white lava," (4471), two miles from San Andreas, Calaveras County. This specimen seems to prove two facts: First, the formation must have been soft, to admit of the leaves being imbedded; second, the lava could not have been in an igneous state, or the leaves would have been burned, and could not possibly have left their impression as seen in the specimen. The formation must have been volcanic mud, which preceded the igneous flow of true lava with which it is capped.
2443. Incrustation, mud volcanoes, Colorado Desert, San Diego County.

Analysis.

Water	2.35
Chloride of sodium	1.26
Sesquioxide of iron	2.16
Sulphate of lime	1.79
Carbonate of lime	78.10
Carbonate of magnesia	2.84
Silica, clay, etc.	9.97
	98.47

94. Jasper, Potrero, San Francisco.
551. Jasper, Murphy's, Calaveras County.
559. Jasper, near St. Helena, Napa County.

569. Jasper, near St. Helena, Napa County.
902. Jasper, Tuolumne County.
1203. Jasper, Saucelito, Marin County.
1720. Jasper, six varieties, near Saucelito, Marin County.
2409. Jasper, showing glacial polish (?), Market Street Cut, San Francisco.
3416. Jasper, Bald Prairie, Placer County.
3749. Jasper, Little Shasta, Shasta Valley, fourteen miles east of Yreka, Siskiyou County.
5043. Jasper, red, creek bed near Windsor, Sonoma County.
5162. Jasper, red pebbles, beach at Monterey.
5431. Jasper, red pebbles, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
5596. Jasper, red, polished, three specimens, hills end of Rannall Street, San Francisco. This jasper is probably metamorphic, silicious, and ferruginous mud, and is found in great abundance on the hills. The polish of the specimens shows that it is unfit for ornamental purposes, which would otherwise be inferred from its appearance in the rough state.
5597. Jasper, red (see 5596), showing a naturally polished surface, first thought to be caused by a glacier, but closer inspection leads to the opinion that it is caused by movement of the mass when in a soft state (slickensides). The large blocks upon which it is found seem to be "erratics;" some of the faces bear a striking resemblance to those polished by glaciers. Found on the hills back of San Francisco. Drifting sand may possibly have caused the polish.
5598. Jasper, angular fragments, found in the railroad cut, Southern Pacific Railroad, just beyond Rannall Street, San Francisco, in a large deposit without stratification, and resembling the morraine of a glacier. It is difficult to account for this formation by any other theory.
5599. Jasper, breccia of red, in white quartz, hills back of San Francisco.
5769. Jasper, red, Hathaway Gold Mine (croppings), Calaveras County.
268. Kaolin, Kern County.
1095. Kaolin, Tuolumne County.
4220. Kaolin, seven miles southeast of the Town of Grass Valley, Nevada County, section three, township fifteen north, range nine east; deposit, six feet thick; surveyed area, about ten acres; actual area, unknown. For analysis see report of Professor Hilgard, in the annual report of the State University for 1881.
5284. Kaolin, sections four and five, township sixteen north, range eight east, Nevada County.
5285. Kaolin, baked in potter's oven, by Gladding & McBean, and pronounced by them to be a good white burning clay, or kaolin, from the deposit No. 5284, Nevada County.
5544. Kaolin, crude, found near Daggett Station, San Bernardino County. Mr. Daggett believes it to be the result of the decomposition of a feldspathic rock (No. 5546), which occurs in great abundance. He thinks there is doubt as to its being found in quantity.
5545. Kaolin (No. 5544), cleaned by washing, found near Daggett Station, San Bernardino County.
5593. Kaolin, mechanical analysis of, from San Bernardino County, near Daggett Station (see No. 5544); portion purified by washing, 85.45 per cent.
5594. Kaolin, mechanical analysis of (No. 5544); coarser impurities, 7.21 per cent.
5595. Kaolin, mechanical analysis of (No. 5544); finer impurities, 7.34 per cent.
198. Lava, Mendocino County.
219. Lava, Napa County.
383. Lava, compact, near St. Helena, Napa County.
1694. Lava, basaltic, near Calistoga, Napa County.
1875. Lava, red, Butte Mountain, near Jackson, Amador County.
2371. Lava, near Santa Rosa, Sonoma County.
3018. Lava, trachytic (?) which caps isolated hills between Milton and San Andreas, Calaveras County.
3649. Lava, brecciated, found in immense cliffs, Little Shasta River, Shasta County.
4228. Lava, basaltic, showing a scale, which is due to oxidation of iron to limonite, near Doon's Mill, Butte County.
4471. Lava, white (so called), indurated volcanic ash, near Murphy's, Calaveras County.
4673. Lava, which exists in immense quantities on the borders of Mono Lake, Mono County. Owens River cuts through this formation in a deep cañon. It is easily decomposed, and supposed to yield the soda salts so abundant in that region. It crops out also at Adobe Meadows, in Mono County. It is well worthy of a critical examination.
4406. Lava, white, so called, probably indurated volcanic ash, Southern Pacific Railroad, Los Angeles County.
4972. Lava, and pumice, Alviso, Santa Clara County. The Guadalupe River winds through a chain of volcanic vents. They rise but a few feet above the valley.
5084. Lava, cellular, with zeolite, Soledad Cañon, Los Angeles County.
5109. Lava, cellular, Captain Jack's Cave, Modoc Lava Beds, Modoc County.
165. Limestone, calcite, Santa Cruz.
565. Limestone, San Bernardino County.
1680. Limestone, tufaceous (thinolite?), Lassen County, section thirty, township thirty north, range fourteen west.
1863. Limestone (marble), Clipper Gap Lime Quarry, section thirty, township thirteen north, range nine east, Mount Diablo meridian, Placer County.

1866. Limestone (marble), Cave Valley, near Auburn, Placer County.
1910. Limestone (hydraulic?) found at the residence of Captain J. M. McDonald, San Francisco.
1981. Limestone (fossiliferous), Almaden Consolidated Quicksilver Mining Company, southwest quarter section thirty-four, township twenty-six south, range ten east, San Luis Obispo County; elevation fifteen hundred feet.
1982. Limestone, Bridgeport, Mono County.
1983. Limestone, Tres Pinos, San Benito County, fifteen miles east of the town.
2171. Limestone, Modoc Mine, Inyo County.
2428. Limestone, weathered (possibly glacier grooving), Cave City, Calaveras County.
3440. Limestone, arenaceous, found in the bed of the river, near Yreka, Siskiyou County.
4376. Limestone or marble, blue, with veins of white, Pence, Butte County. It is soluble in hydrochloric acid with effervescence, leaving a small hepatic residue—when struck with a hammer it emits a fetid odor—anthraconite—burns to a pure white lime, which slakes perfectly. This stone is well adapted for building purposes, as a useful and ornamental stone. Valuable also for manufacturing purposes.
5019. Limestone (water-worn bowlder), Posa Creek, foothills of the Sierra Nevada, Kern County.
5083. Limestone, near Auburn, Placer County.
5349. Limestone, silicious, with what seems to be graphite or molybdenite in small scales, Kern County.
5412. Limestone (marble), Bitterwater Ranch, San Benito County.,
2789. Lithographic stone (?), Kern County, exact locality not given.
2322. Magnesite (carbonate of magnesia), Tulare County.
5159. Magnesite, Damascus, Placer County. Large quantities of this mineral at the locality.
59. Marble (white), fifteen miles from Monterey.
141. Marble, near Angel's Camp, Calaveras County.
266. Marble, Bear Creek, three miles from Colfax, Nevada County.
267. Marble, Abby's Ferry, Tuolumne County.
710. Marble, Giallo Antico, Tehachapi, Kern County.
904. Marble (white), Tuolumne County.
1939. Marble (white), section fifteen, township thirteen north, range eight east, Mount Diablo meridian, Placer County. This marble has been used in San Francisco for the generation of carbonic acid in the manufacture of mineral waters. It is used also as a flux in iron smelting.

Analysis.

Silica	.15
Sesquioxide of iron	.35
Lime	55.72
Carbonic acid	43.78
	100.00

2011. Marble, white, Tehachapi, Kern County.
2799. Marble, black, near Central Pacific Railroad, two miles above Colfax, at the lower end of the high trestle, Placer County.
2807. Marble, half a mile from the railroad depot, Auburn, Placer County.
3387. Marble, from the Cave at Cave City, Calaveras County.
3604. Marble, water-worn, bed of the Tuolumne River, Tuolumne County.
4894. Marble, white, nine miles north of Ione, Amador County.
5344. Marble, red, a beautiful ornamental stone, bearing a good polish, Amador County.
5543. Marble, fine white, slightly bluish green, suitable for building stone and lime, Inyo County, near C. and C. R. R.
5341. Metamorphic slate, which accompanies the quartz vein, Soulsby Mine, Tuolumne County. (See No. 5329.)
5342. Metamorphic slate, with quartz attached, Soulsby Mine, Tuolumne County. (See No. 5329).
798. Mica schist, Gold Lake, Plumas County.
1092. Mica schist, Ivawatt District, San Bernardino County.
4236. Mica schist, Berkeley Hills, Alameda County.
316. Obsidian, banded, Clear Lake, Lake County.
376. Obsidian, Glass Mountain, near St. Helena, Napa County.
481. Obsidian, Sulphur Bank Quicksilver Mine No. 2, Lake County.
483. Obsidian, White Ranch, nine miles west of Lower Lake, Lake County.
482. Obsidian and sulphur, Sulphur Bank Quicksilver Mine No. 2, Lake County.
484. Obsidian, sulphur, and cinnabar, Sulphur Bank Quicksilver Mine No. 2, Lake County.
485. Obsidian, Occident Mine, Lower Lake, Lake County.
992. Obsidian, Rosebaugh Ranch, Sulphur Bank, Lake County.
993. Obsidian and cinnabar, Rosebaugh Ranch, Sulphur Bank, Lake County.
1197. Obsidian, near Lower Lake, Lake County.
1207. Obsidian, near Kelseyville, Lake County.
1258. Obsidian with iron pyrites, Lake County.
1390. Obsidian, volcanic glass, Mono Lake, Mono County.

1890. Obsidian, Sonoma County.
4674. Obsidian, variegated, near the southern end of Goose Lake, Modoc County.
4908. Obsidian, variegated, near McBride's Ranch, Mono County.
1858. Orbicular, diorite (napoleonite), near Rattlesnake Bar, El Dorado County.
4060. Ornamental stone, allied to agalmatolite (pagodite), etc. A hydrosilicate of alumina, magnesia, lime, iron, etc., San Luis Obispo County.
1549. Pacific magic polish, Las Tablas Creek, San Luis Obispo County. West half of the northwest quarter of section twenty-two, township twenty-six south, range ten east, Mt. Diablo base and meridian. It is not diatomaceous earth. Under the microscope the particles are seen to be regular in size and quite amorphous. The deposit is one thousand three hundred feet above the sea level, lies horizontally, and is about six feet in thickness. An analysis is being made by the Agricultural Bureau at Washington.
2370. Painted rock (so called), twelve miles from Santa Rosa, Sonoma County.
1222. Pebbles, from the beach at Crescent City, Del Norte County.
1903. Pebbles, from the shores of Mono Lake, Mono County.
2271. Pebbles, Sebastopol, Sonoma County.
2847. Pebbles, twelve samples, from the beach at Pescadero, San Mateo County.
4906. Pebbles, found beneath the coal, Clipper Coal Mine, Lincoln, Placer County.
5161. Pebbles of porphyry, beach at Monterey, Monterey County.
5432. Pebbles of metamorphic rock, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
5771. Pebble sand, in which coil oil is found, Snow's Well, near Petrolia, Los Angeles County.
5983. Pebbles of jasper, from Pebble Beach, Pescadero, San Mateo County.
5984. Pebbles of lydian stone or basanite, Pebble Beach, Pescadero, San Mateo County.
5985. Pebbles of porphyry, Pebble Beach, Pescadero, San Mateo County.
5986. Pebbles of chalcedony, Pebble Beach, Pescadero, San Mateo County.
5987. Pebbles of sedimentary rock, Pebble Beach, Pescadero, San Mateo County.
5988. Pebbles of fine sedimentary rock, Pebble Beach, Pescadero, San Mateo County.
1116. Pitch stone, Paso Robles, San Luis Obispo County.
1091. Porphyry, foot wall Standard Mine, Bodie District, Mono County.
1542. Porphyry (?), argentiferous, Bodie Mine, Bodie Mining District, Mono County.
1789. Porphyritic diorite, Clipper Gap, Placer County.
2887. Porphyry, red, eight or nine miles from Mesquite Station, San Diego County.
3402. Porphyry bedrock, Malakoff Mine, North Bloomfield, Nevada County.
3418. Porphyry bowlder, Polar Star Mine, Dutch Flat, Placer County.
4057. Porphyry (probably diorite), Placer County. Said to be found in large quantities. A very beautiful building and ornamental stone, equal to the finest porphyries of Egypt and Europe.
4112. Porphyry, seventy-five feet thick, Bodie Mine, Mono County.
1762. Pumice stone, near Mammoth City, Mono County.
959. Pumice stone, near Dos Palmos, San Diego County.
1645. Pumice stone or volcanic ash, found six hundred yards southerly from the easterly part of Lake Merced, San Francisco County. Extensively used as pulverized pumice stone.
3698. Small pebbles of pumice stone, Colorado Desert, five miles west of Volcano Station, Southern Pacific Railroad, San Diego County.
443. Pumice, Mono Lake, Mono County.
247. Quartzite, southern part of Los Angeles County.
397. Quartzite, Geysers, Sonoma County.
471. Quartz hacked, Pine Tree Mine, Mariposa County.
955. Quartz pebbles, near Big Tank, Colorado Desert, San Diego County.
1117. Quartz breccia, Paso Robles, San Luis Obispo County.
1446. Quartz breccia, Hirschman's Hydraulic Mines, Nevada County, from Paris Exposition collection.
1528. Quartz and chalcedony pebbles (selected), Pescadero Beach, San Mateo County.
2748. Quartz diorite, west wall of the Champion Mine, Providence Belt, Nevada County.
2422. Quartz, Succedo Shaft, five hundred feet below the surface, Mariposa Tunnel mother vein, Mariposa Estate, Mariposa County.
2781. Quartzite (wall rock), Mad Ox Mine, near Whisky Creek, Shasta County. (See No. 2274.)
3022. Quartz with remarkable impressions of crystals, of a mineral probably orthoclase, from Volcano, Amador County. This rare specimen should be carefully studied.
3398. Quartzite, Malakoff Mine, North Bloomfield, Nevada County.
3706. Quartz, rose, Hope Valley, Alpine County.
3707. Quartz, rose, Yokhe (?) Valley, Tulare County.
3708. Quartz, rose, Plumas County.
5430. Quartz pebbles, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
1088. Quartzose, trachytic, diorite altered, probably from near some large ore body Bodie, Mono County.
1088. Quartzose, trachytic, diorite altered, the feldspar mostly sanidin. Hanging wall Standard Mine, Bodie District, Mono County.
4794. Rock soap, San Benito County.
3389. Bedrock, Malakoff Mine, North Bloomfield, Nevada County.
3390. Bedrock, Malakoff Mine, North Bloomfield, Nevada County.

3395. Bedrock, Malakoff Mine, North Bloomfield, Nevada County.
3399. Bedrock, Cherokee, Nevada County.
3400. Bedrock at flume, Milton Mine, Nevada County.
3397. Bedrock, Gold Run, Placer County.
3401. Bedrock, American Mine, near North San Juan, Nevada County.
3408. Bedrock of Manzanita Mine, Nevada City, Nevada County.
3407. Bedrock at flume, Milton Mine, Nevada County.
3410. Bedrock at end of flume (gneiss), Milton Mine, Nevada County.
3414. Bedrock, Malakoff Mine, North Bloomfield, Nevada County.
3391. Bowlder, Polar Star Mine, Dutch Flat, Placer County.
3409. Bowlder, Malakoff Mine, North Bloomfield, Nevada County.
3419. Bowlder, Polar Star Mine, Dutch Flat, Placer County.
2280. Burnt rock, Guadalupe Quicksilver Mine, Santa Clara County.
1750. Cap rock, overlying the depression between Bodie Bluffs and Silver Hill, Bodie District, Mono County. Five hundred feet thick on Silver Hill.
1262. Casing, from north side Uncle Sam Quicksilver Mine, near Clear Lake, Lake County.
3404. Chalcedonic bowlder, Polar Star Mine, Dutch Flat, Placer County.
1749. Country rock, Mineral King District, Tulare County.
3582. Country rock with section for the microscope (trachyte), Rocky Bar Mine, Grass Valley, Nevada County.
3583. Country rock, with section for the microscope (trachyte), Rocky Bar Mine, Grass Valley, Nevada County.
2143. Country rock, east (not determined), Euchre Bar Mine, Placer County.
1477. Foot wall, New Almaden Quicksilver Mine, Santa Clara County. From Paris Exposition collection.
2876. Foot wall, Conrad Mine, Duncan Hill, near Auburn, Placer County.
5082. Foot wall of the Great Eastern Quicksilver Mine, Sonoma County, 220-foot level (see No. 5081).
2356. Formerly the highest point of Mount Diablo, Contra Costa County.
440. Glacier polished rock, Yosemite Valley, Mariposa County.
1723. Green rock, met with before reaching the so called foot wall, new Almaden Quicksilver Mine, Santa Clara County.
2144. Hanging wall (east), Euchre Bar Mine, Placer County.
2416. Hanging wall, Gold Run Mine, Webber Creek, El Dorado County.
2877. Hanging wall of the Conrad Mine, Duncan Hill, near Auburn, Placer County.
3359. Inclosing rock, with microscopic section, Pioneer Mine, Marin County. (See No. 3358.)
708. Piece of Blossom Rock, Bay of San Francisco.
1543. "Red float," found, as a rule, over the surface of Bodie Bluff, Mono County, and which imparts a characteristic red color to the whole belt.
1828. Rock formation, Sam. Simms Mine, in which roscoelite was first discovered, Granite Creek, El Dorado County.
1829. Rock formation, Sam. Simms Mine, in which roscoelite was first found. When the thin quartz veins cross this formation gold is no longer found. Granite Creek, El Dorado County.
1830. Rock formation, in which roscoelite is found, near Mr. Kimble's house, El Dorado County.
5601. Rock formation, found near Campo Seco, Calaveras County, with section for microscope. Analysis by W. D. Johnston:

Silica	72.00
Alumina	26.20
Lime	.51
Iron, sesquioxide	.60

The analysis and section are from the small piece; the large one is softer.

2746. Rock resembling halleflinta, Fruit Vale, Alameda County.
4340. Rock resembling halleflinta, Spanish Ranch, Plumas County.
15. Rock from serpentine belt, San Francisco County.
516. Rock specimen, Mariposa Tunnel, Mariposa County, two thousand-foot wall rim.
564. Rock specimen, near St. Helena, Napa County.
567. Rock specimen, Ione Valley, Amador County.
963. Rock specimen, Big Tank, Colorado Desert, San Diego County.
1587. Rock specimen, Frenchman's Road, Bear Valley, Mariposa County.
1713. Rock specimen, face of tunnel, Iron Mountain Mine, seven miles from Shasta.
1883. Rock specimen, four miles south of Crystal Lake, Nevada County.
1907. Rock specimens (two with pyrites), tunnel of the Contra Costa Road and Tunnel Company, one hundred and eighty-five feet from the face.
1942. Rock specimen, township thirteen north, range eight east, Mount Diablo meridian, Placer County.
1961. Rock specimen, San Francisco.
1962. Rock specimen, ocean beach, ten miles south of San Francisco.
1963. Rock specimen, road from Oakland to Berkeley, Contra Costa County.
1964. Rock specimen, Calistoga, Napa County.
1965. Rock specimen, Mark West, near Santa Rosa, Sonoma County.

1968. Rock specimen, fifteen miles from Monterey, Monterey County.
1970. Rock specimen, Butte Creek.
1971. Rock specimen, Pine Flat, Sonoma County.
1972. Rock specimen, Lower Lake, Lake County.
1974. Rock specimen, McCloud River, Shasta County, five samples.
1984. Rock specimen (jaspery), Monitor, Alpine County.
1985. Rock specimen (wall rock), Bonanza Queen Mine, Fresno County.
1986. Rock specimen, Kearsarge District, Inyo County.
1987. Rock specimen, Kearsarge District, Inyo County.
1988. Rock specimen, Kearsarge District, Inyo County.
1989. Rock specimen, Kearsarge District, Inyo County.
1990. Rock specimen, Kearsarge District, Inyo County.
1991. Rock specimen, Kearsarge District, Inyo County.
1992. Rock specimen, Kearsarge District, Inyo County.
1993. Rock specimen, Kearsarge District, Inyo County.
1994. Rock specimen, Kearsarge District, Inyo County.
1995. Rock specimen, Kearsarge District, Inyo County.
2186. Rock specimen, Deep Springs District, Inyo County.
2187. Rock specimen, found in large masses on the eastern slope of the White Mountains, Inyo County.
2415. Rock specimen, foot-wall at sixty feet, Gold Run Mine, Webber Creek, El Dorado County.
2733. Rock specimen, Soledad Cañon, Los Angeles County.
2808. Rock specimen, road between Auburn and the iron furnace, Placer County.
3405. Rock specimen, bridge at Yuba River, below Blue Tent, Nevada County.
3669. Rock specimen, locality, Inyo Range, two thousand feet above Owen's Valley, Inyo County, of peculiar interest, consisting of alternate layers of quartzite and limestone. On the weathered surface the limestone has been cut away, probably by the action of drifting sand, while the quartzite remains clear and sharp. The specimen is an interesting study, the question suggesting itself how the two minerals were deposited so evenly and with such alternate regularity. When found the strata were vertical.
3734. Rock specimen, Los Angeles County, seven miles from Alpine station.
4024. Rock specimen (so called soap rock), San Buenaventura, Ventura County.
5340. Rock specimen, country rock, granite, or quartz diorite(?), Soulsby Mine, Tuolumne County. (See No. 5329.)
5413. Rock specimen (jaspery metamorphic), Coal Mine, San Benito County, township nineteen south, range eleven east.
5414. Rock specimen (metamorphic), Coal Mine, San Benito County, township nineteen south, range eleven east.
5416. Rock specimen (conglomerate), Coal Mine, San Benito Connty, township nineteen south, range eleven east.
5419. Rock specimen (not determined), Coal Mine, San Benito County, township nineteen south, range eleven east.
5420. Rock specimen (not determined), Coal Mine, San Benito County, township nineteen south, range eleven east.
4212. Rock specimen (undetermined), Eureka, Humboldt County.
4242. Rock specimen (marked "iron ore"), Chimney Rock Mine, township four south, range ten west, Mount Diablo meridian. This is certainly not an iron ore, although it seems to contain specular iron in small quantities.
4267. Rock specimen (not determined), near Colfax, Placer County.
4676. Rock specimen, fragment detached in cutting the base of the State line monument, near McBride's Ranch, Mono County. (See No. 4676.)
4679. Rock specimen, detached in cutting the shaft of the State line monument between California and Nevada, near McBride's Ranch, Mono County. (See No. 4676.)
5287. Rock specimen, hanging wall, Nevada City Mine, 600-foot level (see No. 4853); the mine is situated one mile and a half from Nevada City, Nevada County.
5288. Rock specimen, foot wall of the Nevada City Mine, one and a half miles from Nevada City, Nevada County. (See No. 5287.)
442. Rock, summit Mount Dana, Tuolumne County(?).
3396. Rock used in paving the flumes, Milton Hydraulic Mine, Nevada County.
5027. Rock with barite, Copper World Mine, Clark's Mining District, San Bernardino County.
1548. Dividing rock separating the "white cap" from the "brown yellow," South Belvidere Mine, six hundred and thirty feet deep, Bodie District, Mono County.
633. Vein matter with pyrites, Keystone Mine, Amador County.
2139. Vein matter, hanging wall, Euchre Bar Mine, Placer County.
2140. Vein matter, foot wall, Euchre Bar Mine, Placer County.
2141. Vein matter, near the hanging wall, Euchre Bar mine, Placer County.
4463. Vein matter, Santa Anita Mine, Poorman's Creek, Nevada County.
432. Wall rock of 431, two and a half miles from Carmelo Bay, Monterey County.
632. Wall rock and vein matter, Keystone Mine, Amador County, five hundred and fifty-seven-foot level, east wall.
1478. Wall rock, horse, Idaho Mine, Grass Valley, Nevada County. From Paris Exposition collection.

1479. Wall rock, Maryland Mine, Grass Valley, Nevada County. From Paris Exposition collection.
1725. Wall rock, in or near the foot-wall, New Almaden Quicksilver Mine, Santa Clara County.
1726. Wall rock, in or near the foot-wall, New Almaden Quicksilver Mine, Santa Clara County.
1846. Wall rock of quartz vein (No. 1845), Jenny Lind, Calaveras County.
2028. Wall rocks, New Toledo Mine (see No. 2025), Tuolumne County.
2188. Wall rock of Indiana Mine, near Swansea, Inyo County. (See No. 2180.)
2333. Wall rock of serpentine, called "green rock," Guadalupe Quicksilver Mine, Santa Clara County.
3779. Wall rock (blue dyke), Jupiter Mine, six hundred-foot level, face of west drift, Bodie District, Mono County.
3780. Wall rock, Syndicate Mine, Bodie District, Mono County.
4090. Wall, or country rock, San Emidio Antimony Mine, Kern County.
4462. Wall rock, slate, Santa Anita Mine, near the Washington Mine, Poorman's Creek, Nevada County.
2142. West country rock (serpentine), Euchre Bar Mine, Placer County.
1548. Sample of the dividing rock separating the "white cap" from the "brown yellow," South Belvidere Mine, six hundred and thirty feet deep, Bodie District, Mono County.
1547. Sample, broken from one of the chalcedonic bowlders, strewn over the surface, beginning on the Syndicate Claim and crossing the Tioga, Standard, Bodie, and Mono Claims, Bodie, Mono County. These bowlders are built up in strata, which disintegrate into concave layers.
2272. Sand rock with chalcedony, ten miles west of Havilah, Kern County.
453. Sandstone, near San José, Santa Clara County.
914. Sandstone, eighteen feet thick, Tuolumne County.
1205. Sandstone formation, Saucelito, Marin County.
1486. Sandstone, Glenn Mills, San Mateo County.
2166. Sandstone, eight miles west of Napa City, Napa County.
4215. Sandstone, suitable for building stone, Eureka, Humboldt County.
4258. Sandstone (?) (stained red), Santa Margarita Ranch, San Diego County, near San Luis Rey.
4480. Sandstone, Glenn Mills, San Mateo County.
5081. Sandstone, west side of Great Eastern Quicksilver Mine, Sonoma County, supposed to be the footwall (see No. 2744).
5417. Sandstone (coarse grained), Coal Mine, San Benito County, township nineteen south, range eleven east.
5418. Sandstone (fine grained), Coal Mine, San Benito County, township nineteen south, range eleven east.
4142. Sandstone nodule (pear-shaped), San Lorenzo River, near Santa Cruz, Santa Cruz County.
5080. Sandstone, sedimentary, Seal Rock, off Point St. George, northwest boundary of California.
810. Sandstone, fossiliferous, near Shasta.
4451. Sandstone, variegated, near Buchanan Copper Mine, Fresno County.
1518. Sandstone, feldspathic (?), sedimentary rock, composed of feldspar, quartz mica, and hornblende, Telegraph Hill, San Francisco.
2110. Sandstone, weathered, Pescadero, San Mateo County.
658. Scoria, Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
833. Saponite, rock soap, Ventura County.
4239. Schist with garnets, mouth of Russian River, Sonoma County.
5346. Schist, with impressions of fossil plants, found in the lignite near Vacaville, Solano County.
5801. Sedimentary deposit, Chalk Bluffs, near surface, containing impressions of fossil leaves.
5787. Sedimentary matter, North Bloomfield Mine, Nevada County.
4473. Sedimentary deposit, found in digging a well, at a depth of seventy-five feet, near Roseville Station, Placer County.
178. Sedimentary rock, San Francisco.
222. Sedimentary rock, Cliff House, San Francisco.
1681. Sedimentary rock, Oil Creek, San Luis Obispo County, found in slabs from two to eight inches thick, and from one to three feet wide.
2376. Sedimentary deposit resembling diatomaceous earth, twelve miles east of Santa Rosa, Sonoma County.
488. Serpentine, Bear Valley, Mariposa County.
449. Serpentine, Key's Tunnel, California Mine, Yolo County.
513. Serpentine, three hundred yards northeast of Pine Tree Mine, Bear Valley, Mariposa County.
8. Serpentine, transformation from gabbro, and microscopic section. Peninsula of San Francisco.
544. Serpentine, Fort Point, San Francisco.
554. Serpentine, Fort Point, San Francisco.
580. Serpentine, Yuba County.

1273. Serpentine, Market and Guerrero Streets, San Francisco.
1539. Serpentine (polished), center of Lone Mountain Cemetery, San Francisco.
1540. Serpentine (five varieties), Lone Mountain Cemetery, San Francisco.
1686. Serpentine, Market Street Cut, San Francisco.
1724. Schistose serpentine, met with before reaching the so called foot wall, New Almaden Quicksilver Mine, Santa Clara County.
2778. Serpentine (polished), Kelseyville, Lake County.
3415. Serpentine (?), Bald Prairie, Placer County.
4146. Serpentine, Monterey, Monterey County.
3736. Shale (with lignite), near San Bernardino, San Bernardino County.
4910. Shell rock, Sandstone Bluff, township one north, and on the Humboldt meridian, Humboldt County.
2189. Silicious breccia (buhr mill stone), Little Butte, section thirteen, township thirteen south, range thirty-five east, Mount Diablo meridian.
911. Slate and granite, Bodie District, Mono County.
237. Slate and pyrites, Mariposa Tunnel, two thousand six hundred and twenty-foot point, Mariposa County.
3015. Slate, which crops out over a large extent of country between San Andreas and Cave City, Calaveras County; strike nearly west northwest, dip nearly vertical.
4959. Slate, near Red Hill, Butte County.
4079. Slate, near Emigrant Gap, Placer County.
5993. Slate, roofing, from El Dorado County.
577. Slickensides, Yuba County.
5192. Slickens, typical specimen of, taken from the American River, near Sacramento. For description and analysis, see Second Report of the State Mineralogist, folio 99.
5782. Slickens, finely divided, American River.
5785. Slickens, Manzanita Mine, Nevada City.
5786. Slickens, North Bloomfield Mine, Nevada County.
5789. Slickens, North Bloomfield Mine, Nevada County.
5779. Slickens, samples of dry, American River, Twelfth Street Bridge, Sacramento.
5780. Slickens, American River, Sacramento.
5797. Slickens, Marysville, Yuba County.
5798. Slickens, Polar Star Mine, Dutch Flat, Placer County.
3751. Soil, Frink's Spring, Colorado Desert, San Diego County.
3753. Soil, average sample, near Volcano Station, Southern Pacific Railroad, Colorado Desert, San Diego County.
3754. Soil, five miles east of Volcano Station, Southern Pacific Railroad, Colorado Desert, San Diego County.
3755. Soil, two miles east of Frink's Spring, Colorado Desert, San Diego County.
5772. Soil, Tehachapi Pass, Los Angeles County.
5773. Soil, from the cut made by the railroad at Newhall, Los Angeles County.
5784. Soil, American River bottom, Sacramento; used to fill up gardens.
172. Steatite, soapstone, Placer County.
578. Steatite, Yuba County.
908. Steatite, eight feet thick, Tuolumne County.
1443. Steatite, fourteen miles below San Pedro, Los Angeles County, on the coast.
1459. Steatite wall rock, Maryland Mine, Grass Valley, Nevada County. From Paris Exposition collection.
1654. Steatite, Fresno County.
1685. Steatite, two miles northeast of Jackson, Amador County.
1864. Steatite, Stockbridge Soapstone Works, township fifteen north, range nine east, Mount Diablo meridian, near Colfax, Placer County.
2050. Steatite, Taylorville, Paper Mill Creek, Marin County.
2270. Steatite, mountain, Kern County.
2366. Steatite, Tule River, Tulare County.
3644. Steatite, cut in the form of bricks and of the same size, to be used as substitute for fire-brick, Lewis, Mariposa County.
3724. Steatite (much resembling French chalk), Pine Flat, Sonoma County.
4472. Steatite, near Murphy's, Calaveras County.
2057. Stratified formation, old lime kiln, near Clipper Gap, Placer County.
659. Syenite, Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
4016. Talcose rock, wall rock of the Idaho Mine, Grass Valley, Nevada County.
2276. Talc in quartz, Yosemite Gold Mine, Mariposa County.
920. Talcose slate, Tuolumne County.
1298. Talcose slate, gold bearing, El Dorado County.
568. Trachyte, near St. Helena, Napa County.
1310. Tripolite, Santa Barbara.
42. Tufa, Kern County.
2125. Tufa, Sulphur Springs, Mono County.
5427. Tufa (?), very interesting formation, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
5994. Volcanic breccia, used as a building stone in Susanville. It is said to resist the action of fire, as shown during a recent conflagration in that town. Section five, town-

ship twenty-nine north, range thirteen east, eight and one half miles from Susanville, Lassen County.

1391. Volcanic conglomerate, Mono Lake, Mono County.

1644. Volcanic rock, Kelsey Valley, Lake County, taken from a well ten feet deep. It is several feet in thickness. Sinking the well was discontinued owing to the emanation of large quantities of carbonic acid gas.

2512. Volcanic ash allied to pumice stone, Calaveras County, eighteen miles from Lodi.

4750. Volcanic tufa (so called white lava), a similar rock is used in Europe in building ovens for bread baking (See No. 4751), found near Etna Springs, Napa County.

4499. Volcanic ash, Chalk Bluffs, Nevada County.

4893. Volcanic ash (?), Ione Valley, Amador County.

5542. Volcanic ash, tufa or lava, Mono County, near Carson and Colorado Railroad.

The following is a list of minerals of lesser value which have been produced in the State in considerable quantities, with figures showing the estimated production as far as known: Salt, annual yield bay salt, 40,000 tons. Sulphur, annual yield, 1,881,697 pounds. Lime, annual yield, 2,757,742 barrels. Gypsum and chrome iron are largely produced, but no reliable figures can be given.

The State is rich also in other economic minerals which will eventually be worked, and which can be found when wanted. The following are worthy of special notice: Barite, bismuth ores, clays, diamonds, feldspar, kaolin, magnesian minerals, mineral and alkaline waters, ochre, platinum, quartz sands, zinc ores, etc.

SUNDRIES EXHIBITED BUT NOT CLASSIFIED.

4030. Cream of tartar (containing ninety-seven per cent of bitartrate of potash), manufactured from California argols (see Nos. 4145-4210) Pacific Cream Tartar Works, San Francisco.

4145. Crude argols, Krug's Vineyard, St. Helena, Napa County.

4210. Crude argols, taken from the interior of California wine casks (see No. 4145).

3610. Fibrous bituminous artificial stone block for street pavements, manufactured by the Cosmopolitan Paving and Asphaltum Company.

1366. Floating bricks, made from diatomaceous earth, with a small quantity of clay. Useful for the building of light masonry, filling in of walls, and between floors of wooden buildings, to render them to a certain extent fire-proof. These bricks are made wholly of California materials. Similar ones were shown in the Italian Department of the Paris Exposition of 1878.

2967. Fire brick, made of California clay.

5201. Fire bricks, from California fire clay at Lincoln, Placer County. The clay from which they are made underlies ionite (see No. 982).

4786. Great seal of the State of California (in gold). Exhibited at the Paris Exposition of 1878.

1754. Ingot of antimony, from California ores.

4753. Nickel ore, said to be found in San Benito County.

1901. Ore containing nickel, Metallic Mine, near Cisco, Placer County.

1902. Ore containing nickel, Chief Mine, near Cisco, Placer County.

2410. Ore (galena, blende, and stibnite), from Dunlap Mine, head of Santiago Cañon, Los Angeles County.

3638. Rock soap, Ventura County, Ventura Rock Soap Company.

931. Rock soap (marine), Ventura County.

932. Rock soap (toilet), Ventura County.

933. Rock soap (laundry), Ventura County.

934. Rock soap (tooth powder), Ventura County.

935. Patent compressed paving tile or slab, asphaltum base with cement top.

3752. Salt, mud volcanoes, at Volcano Station, Southern Pacific Railroad, Colorado Desert, San Diego County.

4273. Salt, Inyo Range, forty miles northeast of Independence, and near to Benton, Mono County.

4282. Salt (island salt), Union Pacific Salt Company, Alameda County.

4449. Salt, Owens River Valley, Inyo County, between Bishop Creek and Big Pine; said to occur in large quantities.

5189. Salt (No. 1), manufactured in 1882, at Mount Eden, Alameda County. The details of the manufacture of bay salt are described in the Second Report of the State Mineralogist, folio 217.

5115. Salt, mud volcanoes, San Diego County.

5309. Solar salt, from the great deposit in the bed of an ancient lake in the Colorado Desert, San Diego County, now being worked by the New Liverpool Salt Company.

71. Solar salt, ten miles from Panamint, Inyo County.

1868. Slag, from lime quarry at Alabaster Cave, Placer County.
2264. Section of a pipe nearly filled with carbonate of lime, Frink's Spring, Colorado Desert, San Diego County. This pipe lay in the ground for only two years. The mineral is aragonite, containing magnesia, sulphate of lime, oxide of iron, and silica, as impurities.

SUNDRY SPECIAL EXHIBITS.

Large ornamental garden vase and specimens of pottery, sewer pipes, terra cotta, etc., by Gladding, McBean & Co. of San Francisco. After the Exposition these specimens were sent to the Louisville Exposition, from which they will be returned and placed in the State Museum.

Hand crusher and apparatus, by John Taylor & Co. of San Francisco. This apparatus is fully described in Mr. Attwood's paper under the head of *gold*.

Samples of petroleum paint, by the Paraffine Paint Company of San Francisco.

The following State maps were also exhibited:

Amador County.
Bodie County.
Butte County.
California and Nevada.
Calaveras and Tuolumne Counties.
Humboldt County.
Monterey County.
Marin County.
Merced County.
Nevada County.
Sutter County.
Sonoma County.
San Luis Obispo County.
San Joaquin County.
Solano County.
San Francisco County.
San Francisco City and County.
San Francisco Around the Bay.
Tuolumne County.
Yolo County.

Notes of a Flying Trip of Seventeen Days through the Gold Mines of Georgia and other Mining Localities in the South.

Being much interested in the exhibit of minerals made by the Southern States at the Exposition, and especially in the representation made by Georgia, North Carolina, and Alabama, I determined to visit some of their most important mining districts. With this view I left New Orleans by the Queen and Crescent, or Northeastern Railroad, April 21, 1885. The road crosses a portion of Lake Pontchartrain on twenty-two miles of trestlework. On the opposite side of the lake the train passed extensive turpentine, tar, and pitch works, which I had an opportunity to observe, and gained practical information as to the mode of producing these valuable articles of commerce. This may be of importance to California, as it is known that we have extensive forests of pine, which could yield a vast quantity of turpentine, if required. During the civil war, when the Southern supply was cut off, our State, to a considerable extent, met the demand for that valuable product. During that period extensive works were put up and successfully conducted near Dogtown, Butte County, an account of which has been given in the second annual report of this office, folio 209.

When we crossed Pearl River I noticed that while the stream was sluggish it carried a quantity of yellow mud, resembling the hydraulic slickens of California. In the pineries the soil is not fertile. The sands are usually yellow, or of a red or pink shade, and contain a water-washed gravel resembling that of the hydraulic mines of California, particularly in the vicinity of Dutch Flat, a notable placer mining district of our State.

The town of Meridian, in Mississippi, is a thriving, busy, enterprising place, with substantial buildings, and is an important railroad center. Its elevation above sea level is about two hundred feet.

Birmingham, in Alabama, is a new town which has grown within a few years from a simple railroad crossing to a well built, enterprising, manufacturing town of great importance to the South. This advance has resulted from the discovery of extensive beds of coal and iron, lying side by side, in the vicinity, and the presence of a railroad system, which, by offering facilities for cheap transportation, makes it possible to work the mines to advantage. I remained in Birmingham two days, which I spent in visiting the mines and furnaces, and studying the conditions by which cast iron can be made more cheaply than it can be produced in Pennsylvania or elsewhere in the United States. The results of my observations will be found elsewhere under the head of "Alabama." Thomas G. Davies, General Superintendent of the Sloss Iron Furnace, furnished me with much valuable information.

The next point of interest reached was Chattanooga, Tennessee. At Chattanooga Mr. Andrews, of Andrews & Barton, lawyers, took me in a carriage to places of note and interest: to Lookout Mountain, the National Cemetery, and through the beautiful suburban streets and drives. From an eminence I was shown the town and river, and the battle grounds, which will be for many years celebrated in United States history. I visited the Citico Iron Furnaces, where Mr. Edward Doud, the Manager, conducted me over the works. These works are described under the head of "Tennessee." I left on the twenty-fifth of April, by rail, arriving at Marietta, Georgia, after a few hours' journey. Marietta is a delightful little town, but is neither enterprising nor progressive. As yet it does not seem to have caught the infection which has made Atlanta and Gainesville what they are.

At 9 A. M. on the twenty-sixth, I left Marietta by the Marietta and North Georgia Narrow Gauge Road. The country in this region is hilly and the climate delightful. The soil, generally, along the line of the road, is poor, but in some spots is exceptionally good. The county seems to be as well adapted for the cultivation of grapes and other fruit as any part of California. There are many small but comfortable homesteads on the road, and the prevailing appearance is one of comfort and quiet prosperity.

After leaving Marietta the altitude is decreased, and remains about one hundred feet below Marietta, until beyond Mabel. For some distance the course of the road is along the River Etowah, a narrow, sluggish, muddy, winding stream. The surrounding country is exceedingly picturesque, with occasional broad landscapes of great beauty.

Near Tate there is a marble quarry, two and a half miles from the road. This marble is mentioned elsewhere. Tate is the shipping point, from which there is a branch track laid to the quarries. The works where the marble is wrought are at Marietta. The product finds a market chiefly in the north and west, Chicago, Cincinnati, St. Louis, and other cities employing considerable quantities. It is rather attractive in appearance, being white veined with blue. There is a mountain range here called the Long Swamp Mountains.

Jasper and Talking Rock are passed before reaching Ellijay, the present termination of the road. Ellijay is a beautiful town, the county seat of Gilmer County. The people do not seem to realize what a beautiful spot they live in. With a little more enterprise it might be made one of the most desirable residence spots and attractive resorts in the State.

On the twenty-seventh I left Ellijay by private conveyance, accompanied by Mr. W. S. Albright of Chattanooga, who has valuable mining interests in Georgia. The road we took follows the grade of the railway for some distance, and the direction is almost due northeast. It crosses a spur of

the Blue Ridge at an altitude of about nineteen hundred feet. Six miles from Ellijay we passed old workings of placer gold mines, which were practically abandoned on the discovery of gold in California. The ancient pits and bowlder piles were almost an exact picture of many abandoned diggings in California. Some persons have lately recommenced operations and have taken out some gold. The country looks like California, and it would seem as if the grounds could be worked to advantage, if water, dump, and permission of the agriculturists, could be obtained. Having no interest in solving these questions, I made no special inquiries, nor did I leave the road for the purpose of investigation. To an old Californian the piles of sluice boxes and mining ditches with muddy running water, had a homelike aspect. On the road we passed White Path Chalybeate Springs, at which beautiful and romantic locality there is a hotel which is a noted Summer resort. Passing Cherry Log at an elevation of fifteen hundred feet, we reached a deposit of limonite iron ore, which had the appearance of being worked. I was so interested in the fact that it was possible to work an iron mine under such conditions, that I stopped and made an investigation. I found no regular deposit, but an open cut into a red hill. The cut was not more than a hundred feet long nor over ten to fifteen feet deep. I found in the red earth, however, nodules of limonite, but they were not very abundant. Near a sluice box at a small running stream near by, I found where the ore was being worked, and the nodules separated and laid up in a small pile.

From this circumstance I concluded that it was gold that was being sought, and that the iron ore was not considered, for I could not understand how it could be of any value so far from coal. As the men had gone to dinner I could not make any inquiries, but, entering the carriage again, we soon met Mr. John Buchanan, the owner of the iron mines, and from him gained the following information: The nodules of limonite are gathered and hauled to Hemptown, near Morgantown, where there is a rude forge, consisting of a trip hammer driven by water, and a furnace. The fuel used is charcoal. The ore is heated and hammered, returned to the furnace for a second heating, and again placed beneath the hammer. This process is continued until soft, malleable, and tough iron in bars is obtained, which are used by the local blacksmiths for making horseshoes and other common iron work. The capacity of the works is only twenty-three tons of soft iron in a year. The manufactured iron is sold at three cents a pound. This makes the value of the entire output of the furnace $1,380 per year. I asked Mr. Buchanan how much he received per ton for his ore, upon which he informed me that he hauled it to Hemptown and received at the forge, twelve and one half pounds of soft iron bars in return for each ton of ore delivered. This, at three cents per pound, netted him thirty-seven and a half cents per ton.

The circumstance of meeting Mr. Buchanan, and the interesting facts gleaned from him, led me to consider that we in California might derive a valuable lesson from this primitive iron mining in Georgia. If our people in California would consider how much better their condition is than that of the people I have just been describing, they would be less disposed to complain of what is considered "hard times." It is pleasing to consider that there is no necessity for our people to resort to such primitive plans to furnish themselves with iron, or other industrial necessities, but it would be better for us if we could be more economical, and display more enterprise in utilizing the products of the State, instead of importing what we could produce at home. This method of making iron directly from the ore is called the Catalan process, because it has been practiced in Cata-

nia, in Spain, from the most remote period known to history down to the present time. It is undoubtedly the simplest method of making iron, but it cannot be employed on a large scale, because it is a very crude process, wasting both ore and fuel. When, however, the ore is found in abundant quantities, and both fuel and labor are cheap and plentiful, as in Georgia, it is a good process, and can be employed to advantage. The method may be briefly stated. The ore is heated in an inexpensive furnace of peculiar construction, by means of charcoal placed under the influence of a powerful blast, which is generally obtained by falling water in a tube which becomes entangled with a quantity of air which rises into a closed chamber, while the water flows away. The compressed air is then conveyed in pipes to the furnace. When the first charge of ore falls down, in a semi-fused condition, more is added, until a mass or bloom of spongy iron is obtained, which is placed under the trip-hammer and welded into an ingot of compact and very superior iron. The oxygen of the ore forms carbonic oxide with a portion of the charcoal, by which the metallic iron is set free.

Continuing on our way, at the crossing of the Oconee River, we passed a large pile of pure white talc by the roadside, and were informed that much of this mineral was taken out and shipped elsewhere.

After living in the sultry atmosphere of New Orleans the weather here was particularly enjoyable. If made specially to order it could not have been more delightful. Our next halt was at Morganton, the county seat of Fannin County, situated at an altitude of 1,800 feet. Here I learned more of the iron manufacture at Hemptown, and the names of the proprietors—Messrs. Johnson, Wilson & Son. Crossing the Young Cane Mountain at an elevation of 2,245 feet, we arrived at Blairsville, a beautifully situated mountain town, having an altitude approximating 1,955 feet. This place occupies a central position in a very interesting and important gold region. In the year 1845, gold was discovered at Coosa, a little hamlet about five miles distant from Blairsville. The mining excitement in those days ran high, and upwards of a thousand miners were on the spot at one time. Of the metal extracted, some $500,000 was coined at the Dahlonega Mint alone. During my stay at Blairsville and vicinity, I was the guest of Judge C. J. Wellborn, and with this genial host began to realize the full meaning of old-time southern hospitality.

On the twenty-ninth of April we left Blairsville on horseback and rode in a northerly direction, toward the Gum Log Mining District. At a church on a hill, six miles distant from Blairsville, we sent the animals back and proceeded on foot, over a beautiful mountain route, to Gum Log Hill, which is described elsewhere under the head of "Georgia." At Old Gum Log we were hospitably entertained by Mr. Gregg.

From this point we went on to Wellborn Hill, a few miles distant, remaining until the first of May, as the guests of Mr. J. Van Brown and family, who did all in their power to make us comfortable, and furnished us with valuable information regarding the surrounding country. The scenery from this point is superb. The view of the distant blue hills of North Carolina equals in picturesque beauty the scenery along the fairest portions of our Coast Range. Being near the line of North Carolina we crossed over one day and visited Brasstown and the neighboring gold mines, returning the same day. This was all I saw of that State. The Marietta and North Georgia Railroad will soon be completed to within ten miles of Gum Log and fifteen miles of Blairsville. A. G. Kinsey, the manager of the road, whom I afterwards met at Atlanta, informed me that in the course of a few months the rails would be laid to Murphy in North Carolina.

On the second of May I left Blairsville in a private carriage furnished

by Judge Wellborn and driven by his brother, Mr. Erastus Wellborn, Mr Albright who had been with me since leaving Chattanooga, having returned to Wellborn Hill. The day was especially fine, the air cool and bracing and I found a thick coat comfortable.

Crossing Atkins' Mountain, at an elevation of 2,175 feet, and approaching the Blue Ridge, the climate and scenery so strongly resembled California that I could hardly realize I was in Georgia, and not in my own State. The summit of the Blue Ridge is thirteen and a half miles from Blairsville. In traversing this mountainous district, I could not avoid noticing the numerous opportunities for water power which have never been utilized. The really fertile lands are not cultivated to their full capacity; but I found that the people deliberately chose a life of ease to one of industry, and preferred dispensing with the luxuries of life to the labor of procuring them. As they always have every necessary comfort and are never destitute, I began to think that perhaps their condition was preferable to the worry and toil that we of the North think essential to supply our wants and needs. What impressed me most was the general absence of books and newspapers in the houses I visited; yet I was informed that there was a marked awakening in Georgia on the subject of education and schooling, and that efforts were being made to extend the school term to nine months in the year, instead of three months as heretofore. At Atlanta and at Gainesville I was informed that this had already been effected. With better facilities for education, the people of the mountain region of Georgia—a healthy, vigorous race, who have the clear brains and strong natures of a people bred in high altitudes—will undoubtedly be stimulated to improve their homes and to cultivate their lands to better advantage.

As we neared the Blue Range the road became rougher, and more outcroppings of rock were visible. These rocks were usually gneissoid, with mica schist and shales with small veins of quartz. In passing, I noticed on the surface in several localities the same tabular, granular quartz which is auriferous at Gum Log and at Wellborn Hill. At an elevation of two thousand eight hundred and fifty-five feet in the pass, I perceived a well defined quartz vein, which, if in California, would not long remain without being prospected. It was several feet thick in places, and the quartz looked promising. There are high mountains on each side of the pass, and the summit was found to have an approximate altitude of three thousand one hundred feet. On the other side of the mountains the road descends rapidly southward. Toward Dahlonega the route passed a miners' ditch, crossing the cañons in flumes like those in our State. Ten or twelve miles from Dahlonega I observed good looking float quartz by the roadside. The season on the south side of the mountains is fully two weeks earlier than on the north side. The trees were in full leaf, and the country appeared at its best.

Seven miles from Dahlonega we passed the Garnet Mill, and saw a ten-inch pipe which conveyed water under pressure to the turbine wheel that drove the mill. The building was a pleasing feature of the landscape and bore a marked resemblance to a California quartz mill of the first class.

The very interesting and beautiful town of Dahlonega was named from the Cherokee words Ta-la-ne-ga, meaning yellow metal or yellow money. My barometer here indicated an altitude of fourteen hundred and eighty-five feet, which is probably within fifty feet of the correct figure. The town is situated in the center of a well known gold field, discovered and successfully worked before those of California. The mines lie principally on Findley Hill, a ridge which rises from a hundred and fifty to two

undred feet above the town. Findley Hill is covered with barren looking loat quartz and broken gneissoid rocks. The scenery from the summit is articularly pleasing. The landscape has not the element of sublimity hich marks the high mountain regions of the Pacific Coast, but partakes f the restful beauty of foothill and valley. In the distance the purple eaks of the Blue Ridge rise above the thickly wooded green hills of the reground, while Dahlonega lies in the green lap of the valley. The mines this vicinity, and the manner of working them, which differs from nything practiced in California, are fully described under the head of Georgia."

In Dahlonega I had the pleasure of meeting many intelligent gentlemen, ho greatly facilitated my efforts to obtain the information of which I was quest, and to whom I am also indebted for numerous courtesies. Col. William P. Price, a gentleman of prominence in the legal profession, and ho has occupied an important political office under the State, is familiar ith the mining laws and land divisions of the district. He was the prime over in the successful effort to have the abandoned United States Mint ansferred to the State, as well as in organizing the Georgia Military and Agricultural College. Colonel R. H. Moore, another old resident, gave me uch information bearing on the early history of the gold mines. Mr. J. O. Robertson, who formerly lived and mined in Plumas County, California, furnished me with specimens, and accompanied me to the principal mines. John Huff, Superintendent of the Barton and Hand, and Ralston Mines, was in California from 1851 to 1854, at Iowa Hill. His familiarity with the mines of Dahlonega and the processes employed, was of great assistance to me. Mr. C. L. Perrin, Superintendent of the Georgia Consolidation Gold Mining Company and the Ivey and Bast Consolidation Companies, and Mr. J. W. Steuart, Superintendent of the Keystone placer mine, from which he gave me fine specimens, also rendered me valuable service.

I remained in Dahlonega two days, during which I diligently examined the mines and mills within a radius of two miles, with the town as a center. Most of the principal mines of the district lie within this area. A full description of them, and the manner in which they are worked, is given under the proper head.

On Monday, May fourth, I left Dahlonega by stage, and in the evening arrived at Gainesville, which lies about 120 feet below. This is a thriving town, where the people are strongly imbued with the spirit of the New South. A number of fine brick buildings have recently been erected, and a noticeable air of progress distinguishes the place from many of the mountain towns through which I had lately passed. Gainesville is not a mining place, but there are gold mines about three miles southeast of the town. These are the Merck mines, which have gained some celebrity, but whether with reason or not I could not learn, nor could I spend the time to visit them. From Gainesville to Atlanta, a distance of about forty miles, the passage was made by the Atlanta and Richmond Air Line Railroad.

There is something about Atlanta which arouses the surprise of every stranger, a sentiment quickly changed to admiration when he has spent a few hours in the streets of the city. The parks and streets are fine and well kept; the private dwellings elegant, and generally surrounded by ornamental grounds and gardens; the public buildings are stately and imposing; the hotels commodious and well kept, and charges moderate; the newspapers are liberal in their principles and ardent in their advocacy of measures for the advancement of the people, the city, and the State. In many respects the place resembles European cities, and on a lesser scale, is strongly suggestive of the City of Paris, probably on account of its broad

and cleanly streets and the iron bridges which cross the railroads. Prosperity, enterprise, bustle, and thrift are its most striking characteristics. Atlanta is the capital of the State, and was incorporated as a city in 1849. It is a leading railroad center, and has a number of important institutions of learning, a State library, and several other public libraries. It is quite a manufacturing city, and manufactures are encouraged, and are rapidly increasing, so that a large capital is centered there. During the civil war Atlanta was the scene of a desperate struggle; the people suffered every hardship, and a large portion of the city was burned or otherwise destroyed. She has now wholly recovered from the effects of this blow to her prosperity, and entered upon a new era of peace and progress, which is very gratifying to behold. After one day's stay I returned to New Orleans by the Georgia Pacific Railroad, passing Oxford, Birmingham, Meridian, and other important places of local importance, arriving at my destination on the morning of the seventh of May, "California day," in season to take part in the exercises.

I desire to express here my obligations to the Queen and Crescent Railroad and the Marietta and North Georgia Railroad Companies, and to their employés, for favors extended, which materially aided me in my investigations; and I cannot speak too warmly of my appreciation of the unusual courtesy and hospitality extended to me wherever I went.

Altitudes.

These altitudes were taken with a good mountain aneroid barometer, but without any check against atmospheric changes, for which reason they are only approximate, but will serve to show the character of the country passed over. The elevations in capitals are taken from published measurements, and from them my own observations were modified:

BIRMINGHAM, ALABAMA	596	Young Cane Mountain, Georgia	2,245
CHATTANOOGA, TENNESSEE	665	Blairsville, Georgia	1,955
MARIETTA, GEORGIA	1,133	Gum Log, Georgia	1,925
Ballground, Georgia	1,105	Wellborn Hill, Georgia	1,975
Tate, Georgia	1,285	Atkins Mountain, Georgia	2,175
Jasper, Georgia	1,435	Blue Ridge Pass, Georgia	3,095
Ellijay, Georgia	1,285	DAHLONEGA, GEORGIA	1,519
White Path Springs, Georgia	1,485	Columbia Hill, Georgia	1,685
Cherry Log, Georgia	1,565	GAINESVILLE, GEORGIA	1,227
Blue Ridge, or Ellijay Pass, Georgia	1,695	ATLANTA, GEORGIA	1,045
Morgantown, Georgia	1,805		

The first discovery of gold in the Southern States seems to have been in Virginia, near the Rappahannock River. The first published notice appears to be in Jefferson's Notes on Virginia, as mentioned by Whitney (*Metallic Wealth of the United States*, folio 15). A lump was found weighing seventeen pennyweights, equal to .85 ounces. In 1799 a lump of gold was found by a young man named Reed, in Cabarrus County, North Carolina, which is said to have been "as large as a small smoothing iron," rather an indefinite description, but conveying the idea of a large nugget, even from the California standpoint. He kept it in his possession for some years, and then, not knowing or suspecting its value, sold it for a few shillings. Soon after, gold was discovered in Montgomery County, where small washings were conducted and several large nuggets were found in the two counties. One found in Cabarrus County weighed twenty-eight pounds (408.32 ounces), and others from four to sixteen pounds (58.3 to 233.32 ounces). The first workings were very primitive and crude, and the yield was small, with the exception of the large nuggets mentioned. The average yield was sixty cents per day to each individual employed.

No deposit that did not yield one pennyweight (.05 ounces Troy) to the hand was considered worth working. The first workings were confined to the beds of streams. The surface soil was removed and a characteristic clay or gravel deposit washed in a small cradle and finished in a mining pan. In 1825 gold was found in Montgomery County, in a quartz vein, from which 15,000 pennyweights (750 ounces Troy) were taken in a short period. This was the first true gold mine ever worked in the United States.

Gold was discovered in Habersham County, Georgia, in the Summer of 1829, and so abundant was the yield that the United States Mint received $212,000 of the metal during the next year. A large quantity of the gold was used for jewelry, and no record could be kept of it. The excitement attending these discoveries attracted from six to seven thousand gold seekers to the new fields, which led to the discovery that the whole Appalachian chain of mountains was more or less auriferous. In 1829 South Carolina sent $3,500 to the United States Mint. The active period of gold mining in the South extended from 1828 to 1845. When gold was discovered in California, in 1848, many Georgia miners came to our State, bringing with them the benefit of their experiences in the South, and it was from them that we learned to use the pan and the rocker, rude appliances, but of incalculable value to us during the early period of our western gold mining. Upon these primitive instruments we have engrafted our improvements, until our methods of gold mining, albeit still far from perfect, are the best that have ever been contrived. Now we can proudly say that our State is the model for the world. Our hydraulic apparatus has been sent to the most distant parts of the earth in the care of our most expert miners; and we teach the delvers of Africa, Spain, Australia, New Zealand, and the Southern States, to do well what the law no longer permits us to do in California. Our early Californians were assisted and instructed by miners from the southeastern States. We now return the compliment by sending them improved appliances, which they are using to good advantage; and, if I am not much mistaken, the more general working of the gold mines of the South will do much to restore the prosperity of the States in which the miners live.

MINERAL EXHIBITS MADE BY OTHER STATES AND TERRITORIES IN THE GOVERNMENT BUILDING.

In attempting to describe the minerals shown by other States, I am aware that I have undertaken a subject to which it will be difficult to do full justice. It is not my purpose to describe every mineral shown, but to state the general character of the exhibits and the impression they made on me. No doubt I overlooked some interesting and important exhibits, but this must be attributed to the vastness of the building and the profusion of the materials gathered together. The minerals mentioned in what is to follow I actually saw, and examined as carefully as the nature of the circumstances would admit.

ALABAMA.

Alabama was created a Territory March 3, 1817, and admitted as a State December 14, 1819. Its area is 50,722 square miles. Population in 1880, 1,262,505. The capital is Montgomery. Floor space occupied at the Exposition, 7,800 square feet. This State is divided into 66 counties. The northeastern portion is of a broken, mountainous character, from which the surface slopes southward to level, or nearly level plains. The extreme southern part of this State is low and flat. Some portions of the soil are poor, but generally it is well suited for agriculture, which is the principal business of the people. The crops are generally cotton and corn. The mineral resources of Alabama have only lately attracted attention; the chief products are coal and iron.

It is only recently that the existence of coal in Alabama has been brought to public notice. The South was supplied for many years from Pennsylvania, 2,000 miles distant, and from England, 5,000 miles away; while within 250 miles of tide-water in the Gulf of Mexico, lay these extensive fields. A notice of the coal lands of Alabama was published in *Silliman's Journal* in 1834. In 1850 coal began to be mined on the banks of the Warrior River, and was conveyed down that stream in rude flat-boats. With the extension of the railroad system the fields became more accessible, and were extensively worked. The great Warrior coal field takes its name from the river; it is very extensive, and the coal is of excellent quality, suited for the manufacture of iron, and for making coke. At the present time all the coal mined in Alabama is transported by rail, the principal market for it being New Orleans, Mobile, Galveston, Montgomery, Selma, and other towns in Alabama, Georgia, and Mississippi. Much of it is consumed in the manufacture of iron in Alabama and Georgia. In 1869 the yield from these mines was 11,000 tons, which increased so rapidly that in 1883 the output was 1,000,000 tons. The cost of mining a ton of coal and loading it on cars, does not exceed one dollar. Coke is sold at the ovens for $1 80 per ton. The cost of transportation to Mobile is $2 per ton, and to New Orleans $2 20 per ton. It is sold in these cities at $3 75 per ton. The productive coal field of Alabama is estimated at 5,350 square miles. The Pratt mines, which principally supply the iron furnaces of Birmingham, were opened in 1878. The company working them is known as the Pratt Coal and Coke Company. The openings are only six miles from Birmingham, to which the coal is brought by rail. There are fifty coke ovens at the mine, and

many more at the furnaces in Birmingham, running night and day. Most of the coke is used for the manufacture of iron.

By a fortunate circumstance, vast beds of the best quality of iron ores lie alongside these coal fields, while limestone, essential as a flux, is also found in the same locality. This association of minerals, and an abundance of cheap labor, make it possible to produce iron cheaper than in any other locality in the United States.

In April, 1885, I visited the iron and coal mines and furnaces at Birmingham. The town has an altitude of 596 feet above the sea level, and is admirably situated for manufacturing. Twelve years ago the site of this thriving place was occupied by a single farm house. The Birmingham Iron Works at the east end of the town were established in 1882. The first stack went into blast April twelfth, and twelve months later a second furnace went into operation, both of which have been running continuously ever since. The united capacity of both furnaces is 60,000 tons of iron per annum. The Mary Pratt furnace and plant occupy 30 acres of ground; operations were commenced April 7, 1883. The furnace is said to be one of the best and most complete of any in the United States; one hundred men are employed, and the daily output is 50 tons of iron, which, being of a peculiar character, is sold principally in Indiana, where such a quality of iron is required. The Alice furnace is the oldest in Birmingham; it was begun in September, 1879, and went into blast in November, 1880. There are two stacks. No. 1 is 63 feet high, 15 feet bosh, with a capacity of from 45 to 60 tons per day. No. 2 is 75 feet high, 18 feet bosh, with a capacity of from 75 to 100 tons per day. The ores are red and brown hematite. The product of these furnaces is sent to Cleveland, Chicago, St. Louis, Detroit, Terre Haute, Centralia, Louisville, Cincinnati, Evansville, Nashville, Chattanooga, Atlanta, and all southern cities. The quality of the iron is said to be equal to any made in the United States. The Birmingham Rolling Mills have puddling furnaces with a capacity of 100 tons per day. They make all kinds of soft iron, and use gas under the boilers, but help out with coal, which costs, delivered, from $1 15 to $1 25 per ton.

Red Mountain takes its name from its color, which is imparted by oxide of iron. It is estimated that there are 50,000,000,000 tons of iron in it; the only drawback to an unlimited production is the want of a market sufficiently large to receive it. The cost of transportation only, prevents competition with Pittsburgh and other northern iron manufacturing localities. The iron ore, coal, limestone, and sand, all being found in abundance within a radius of six miles, make it possible to produce iron at the low cost of $11 50 per ton, with a fair margin of profit. The Black Warrior River, an affluent of the Alabama, is navigable to Tuscaloosa, 378 miles from tide water. A joint memorial of the General Assembly of Alabama was sent to Congress, asking that the river above Tuscaloosa be improved at the expense of the Government, so that coal and iron from the vicinity of Birmingham could be cheaply conveyed to Mobile, where ships might be supplied and the joint product sent to United States coast cities and foreign lands.

Gold is found in Alabama in Cleburne, Talladega, Coosa, Randolph, Clay, Tallapoosa, Chilton, Fayette, and Marion Counties. These counties are in the general trend of the Apallachian chain of mountains; the gold occurs both in quartz veins and in alluvial deposits. It is the opinion of Eugene A. Smith, State Geologist, that forty years' working of the auriferous deposits have to a considerable extent depleted them, and at the time of the publication of his report, in 1884, there were no mills in operation.

The quartz specimens I saw were of two distinct characters: the granular quartz found in Georgia and North Carolina, and a glassy, flinty quartz in which I found a few specks of gold; but the specimens I prospected on my return to San Francisco, which were from Talladega, yielded no gold. The Talladega gold fields are situated on the East Tennessee and Georgia Railroad. The gold is said to be difficult to save, owing to the presence of talc in the rock. I obtained a specimen from the "Harold" mine, Clay County, nineteen miles east of Talladega. The quartz is glassy and hard, but shows free gold. The "Logpit" mine is in the same county, twenty-one miles east of Talladega. This information and the specimens were obtained from D. A. Smith, whom I met at Birmingham. Mr. Giles Edwards, of Birmingham, says that he knows of a gold placer in Alabama which will pay one dollar per day by panning. The total gold and silver from Alabama, deposited in the United States Mints up to June 30, 1883, was:

Gold	$222,729 90
Silver	6 15
Total	$222,736 05

The Alabama general exhibit at the Exposition was large and imposing. The mineral department, also large and important, was in charge of Wm. S. McNeill, of Mobile. Eugene A. Smith, State Geologist, was active in making the collections, but was not present in person. The State made no appropriation. There were two separate exhibits, one made by the Louisville and Nashville Railroad Company, which occupied the central part of the space, while the other consisted of State collections by the geological survey, and specimens collected and contributed by private individuals, by invitation of the Commissioner. As a whole, the collection was very full and creditable to the State and its friends.

In the geological survey collection there were shown a fine suite of silicified wood and carboniferous and tertiary fossils, including vertebræ of Zeuglodon cetoides. Among the coal fossils were several large stumps of Sigillaria. There were also some fine shell marbles on exhibition. Of fertilizers, there were marls and phosphatic nodules; of minerals, the most noticeable were asbestus in long fibers, barite crystals, chalcopyrite, corundum (of which there was a crystal 11 inches high and 5 inches in diameter), kaolin, limonite (needle ore), and a variety called kidney ore, in remarkably fine specimens and in large masses, from Blount County. Of ores, there were copper shales, gold quartz from the Blue Hill gold mines, Tallapoosa County, and Dadeville ore. The rock collection included building stones, feldspathic rocks, clays and fire-brick made therefrom, hydraulic cement, limestones and marbles, lithographic stone, etc.

The following is copied from a handbook of Alabama prepared for the Exposition:

BUILDING STONES, LIMESTONES, POTTERY MATERIALS, ETC.

The Alabama building stone was represented in the display furnished by the Ingleton Quarries and Steam Stone Works, Dickson, Colbert County, consisting of the following pieces:

Highly finished slab with name of the firm, letters in relief, beautifully sculptured and polished.

Architraves with inscriptions.

Cubical blocks of various sizes and finish.

Square oblongs, three to four feet long, four inches through.

Flat square pieces, similar length, one inch thick.

Large monumental tablet, resting upon a square base four feet in height, ten feet long, and over five tons in weight.

One half inch polished slab, two by four feet.
Slab of cloudy marble from Talladega.
Building stone of Lauderdale County.
Square block of red syenite, polished, Talladega County.
Fine grained limestone for building. Lauderdale County.
Square block of finished oolitic limestone. Lauderdale County.
Slab of same material.
Square flat piece of same material.
Finished windowsill of same material.
Square block finished building stone. Lauderdale County.
Square blocks finished building stone. Brown's Quarries, Colbert County.

These building stones, known as "Alabama building stone," from the sub-carboniferous strata, or mountain limestone, are ranked among the best building materials of their class. They are very compact, quarried in large masses without flaws, easily worked, of great resistance to atmospheric influences, and admit of a finish to make them applicable for various purposes in ornamental architecture. The polished marble tablet of the same material from Tuscaloosa represents the crystalline, white, cloudy, and gray marbles of great purity and softness of grain which occur in inexhaustible quarries in the belt of crystalline limestones that separates the lower silurian strata from the archæan rocks.

Cornice of white Talladega marble.
Crystallized limestone. St. Clair County.
Crystallized limestone, silicious. St. Clair County.
Limestone, used for flux at the furnaces of Birmingham. From the quarries at Blount Springs, Blount County.
Fire clay, invaluable in the construction of furnaces. St. Clair County.

Of fossils there were two long glass showcases filled with coal plants, some of which were magnificent specimens. The railroad company's exhibit consisted generally of large and imposing specimens, in which coal and iron were the prominent features.

Of minerals there were in this collection good specimens of yellow ochre. Of iron ores there were large masses of hematite, from Red Mountain, near Birmingham, much resembling the Clipper Gap iron ores of Placer County, California. Also large masses of limonite or brown hematite, from Jefferson County. A fine arch, supported on columns of iron and surrounded by manufactured ironware, stoves, castings, pig iron, chains, bars, etc., was exhibited by the Birmingham Iron Works. Between the iron columns was placed a high plate-glass case in which was shown a pyramid of broken pig iron.

ARKANSAS.

Arkansas was created a Territory March 2, 1819, and admitted as a State June 15, 1836. Its area is 52,198 square miles. Population in 1880, 802,525. Capital, Little Rock. Floor space occupied in the Exposition, 9,300 square feet. The State is divided into 64 couties.

A pamphlet was prepared by the Hon. C. M. Taylor, Commissioner, for distribution, from which the following is condensed. It was entitled

ARKANSAS' EXHIBIT AT THE WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXPOSITION, 1884-1885, AT NEW ORLEANS, LA.

ARKANSAS.

Arkansas was settled by the French in the year 1670, and was purchased by the United States, from the French Government, in 1803. The dimensions of the State embrace an area of 33,406,720 acres, about the size of England, and its climatic position is propitious, as it lies between thirty-three and thirty-six degrees north latitude, and between the meridians of eighty-nine and ninety-four degrees west longitude. It is bounded on the east by the Mississippi River; bisected by the Arkansas River; and the White, Black, St. Francis, and Ouachita all flow through it into the Mississippi.

PHYSICAL GEOGRAPHY AND SOIL.—The eastern part of the State, bordering on the Mississippi River, has an exhaustless alluvial soil, heavily timbered and adapted to the most profitable character of agriculture. Passing westward the surface gradually becomes more elevated. Near the center of the State it is rolling or hilly, while in the west the hills grow into mountains, of which the principal are the Ozark, with extensive reaches of table lands. North of the Arkansas River the landscape is beautifully diversified with hills, prairies, and woodland. The country between the Arkansas and Ouachita Rivers is

of a partly diluvial and partly alluvial formation, being composed of broad and fertile bottoms, with occasional ridges. South of the Ouachita it is divided largely between ridges and valleys, well watered by the numerous streams that rise in the hills and mountains of the west. Southward of these ridges and valleys, and extending to the southern boundary of the State, the country is generally undulating and overgrown with vast pine forests. The alluvial lands, covering a large portion of the State, are very fertile, and the greater portion of the hilly region is susceptible of cultivation, while for the growth of fruits, and especially the grape, no better land can be found.

MINERALS.—The coal fields of Arkansas are very extensive, covering an estimated area of 12,000 square miles, and in the valley of the Arkansas, where coal mining is most largely conducted, the beds run to nine feet in thickness. In quality analysis proves this coal to be fully equal to the Lykens Valley coal of Pennsylvania, which makes it first class, both for steam and for manufacturing purposes. In the hilly region, including Crawford, Dallas, Grant, Hot Springs, Independence, Izard, Lawrence, Madison, Pike, Polk, Saline, Sevier, Sharp, Searcy, Sarber, Van Buren, Montgomery, and Yell Counties, are magnetic, hematite, carbonate, and specular iron ore; manganese and associate metals; lead, antimony, zinc, marble, gypsum, kaolin, whetstone, slate, granite, marl, niter, and paint earths. The hematite iron beds in some places crop to the surface in acres of area, with limestone and timber in the vicinity for fluxing and charcoal. Sevier County claims the largest body of antimony, and Polk County the best deposit of manganese ever discovered. Soapstone is being quarried in Pulaski County, and the gypsum beds of Pike County promise to prove a source of great profit. Immense quarries of marble, pink and gray, are being operated in several counties, notably in Madison, and slate quarries are opened in Pulaski, Polk, Pike, and Sevier Counties, the slate, in point of durability, evenness of cleavage, and beauty of color, being equal to that which forms such a great source of profit in Vermont. The zinc ores of this State are represented to compare favorably with those of Silesia, and have a superficial area of thousands of acres. The vast mines of Arkansas may be regarded as a continuation of those of Missouri, which terminate, though broken at intervals, in the great iron mines of Texas. Never failing large water-power and all the accessories for smelting and refining are contiguous to these deposits. In this region the most active powers of industry are destined to be the blast furnace, the rolling mills, steam and water power. Here, too, when capital becomes diverted from gambling to honorable industry, is promised a dense civilization in successful competition with the metal workers of Pennsylvania over the iron trade of Mexico and Central and South America.

WONDERFUL SPRINGS.—The Hot Springs of Arkansas issue forth from the Hot Springs Mountain at an elevation of 800 feet above the level of the sea. There are seventy-one of these springs, with a temperature ranging from 93 degrees to 157 degrees Fahrenheit, and discharging 335 gallons of water a minute. This water flows into a pretty mountain stream twenty-five feet wide, and causes a vapor to rise from the surface. Most of the springs are covered with stone and cemented, and many of them have an elevation of fifty or seventy-five feet above the valley. There is an abundance of gravity for sending the water into the upper stories of buildings. The water is conveyed through iron pipes to the great tanks and bathing-houses in the valley. The superintendent of the reservation has had two large tanks constructed, holding, respectively, 20,000 and 30,000 gallons, in which the water drawn in over night for use next day loses less than one degree in temperature. Composed of acids and mineral bases, the effects of this water in many forms of chronic diseases are wonderful. Its power, like that of the physician, probably consists in repairing drains by copious diaphoresis for the removal of obstructions that clog the system. An old physician, contrasting the curative powers of the springs with those of medicine for rheumatism, gout, neuralgia, erysipelas in all its forms, sterility and diseases of the kidney, illustrates his opinion by saying: "In those cases the human system may be compared to drainage, in which the mains and sewers are out of order. The right thing to be done in such a case is to remove the obstructions, instead of trying to dip out the accumulated silt and water with a ladle."

The Mammoth Spring, in Fulton County, is a phenomenon worthy of description. The main body of water, issuing from an opening a hundred and twenty feet in circumference, flows uninterruptedly at the rate of 8,000 barrels a minute, affording valuable power for manufacturing purposes. From compression, probably, so large an amount of carbonic acid is held in solution that the surface of the wonderful fountain is in a constant state of effervescence.

The Arkansas Industrial University, situated at Fayetteville, was established in accordance with the Act of Congress providing for "such branches of learning as are related to agriculture and the mechanical arts," without excluding other scientific and classical studies. By adequate State aid, Arkansas has carved out several professional chairs, and so imparted to the school the more substantial features of a university. The medical department has a full professorship, and the course of study embraces three years. Branching from the institution is the State Normal School for the education of colored teachers. It is located near Pine Bluff, and is one of the handsomest educational edifices in the State. The building is of brick with slate roof and trimmings of granite. It cost $12,000, and contains a large assembly room, four recitation rooms, and cloak rooms for both sexes. Besides the public schools, university and institutions for the blind and deaf mutes, there is a large number of private schools, seminaries, and colleges which are largely attended. For peace, civic virtue, and high social culture, the people of Arkansas stand as high as those of any other State in the Union. That the State has a fair-sized

crime record is not surprising when the advantage which its immense forests present as a hiding place for fugitives from the ends of justice from other States is considered; but it is satisfactory to know that as railroads and telegraph lines have become more extended, the crime record has fallen off proportionately. As for the citizens of Arkansas, they are a law-abiding, rights-respecting people, and plentifully supplied with churches and preachers.

Jay Guy Lewis, M.D., was in charge of the exhibit. The mineral collection was large and interesting. Of the specimens shown, the most valuable, and those of the greatest interest to the mineralogist, were the following:

Building and ornamental stones, including marbles, limestones, sandstones, granite, serpentine, porphyry, and slate.

Of the marbles there were shown a cretaceous inoceramus limestone; encrinal marble, a red crinoidal marble, and a sub-cretaceous limestone.

Also, five slabs of very fine quality and different varieties from Eureka Springs, Carroll County.

There were also some very handsome slabs and cubes of red marble.

The granite shown was of peculiar structure and very beautiful.

Among the minerals were large masses of blende; fine crystals of brookite; calamine in large masses; calcite of a green color; chalcopyrite disseminated through a flinty quartz gangue, which could be crushed and concentrated, but which I was informed does not occur in large quantities; coal from Little Rock in large blocks; similar specimens of bituminous and semi-bituminous and semi-anthracite coal; clays of refractory nature, suitable for the manufacture of fire-brick, samples of which were also shown.

A special exhibit of earthenware was made by the Little Rock Pottery Company. It embraced articles useful and ornamental, some of which were quaintly artistic, showing grotesque forms of animals and reptiles. Of fossils there was a fine collection from the carboniferous, including coal fossils, and a well displayed collection of tertiary fossils, prominent among which was the tooth of an elephant. Gypsum was shown in large blocks, and selenite in fine crystals; also satin spar. Of glassware a special display was made by the Marrieton Glass Works.

Magnetite, natural magnet or loadstone, manganese ores, pyrolusite in large quantities, psilomelain, novaculite or Wachita oil stone, rough and manufactured, was shown in large masses, blocks, and slabs of three varieties—Arkansas hone stone, Wachita oil stone, and Elixter water stone. Yellow ochre of good quality was also shown.

There was a good display of the ores of copper, gold, iron, and silver.

Of quartz there were some magnificent specimens from the Hot Springs. A special exhibit was made by J. M. Blake, who showed fine crystals, both native and cut into various ornamental forms, such as charms, sleeve buttons, pins, and other jewelry. Also a bottle, an anvil, and a cask cut in crystal without a flaw; the latter was the largest crystal, cut into a special form and highly polished, of which I have any knowledge. There is only one imperfection in it—an inclosure, that it might be very interesting to study microscopically. The cask is about eight inches long, and five inches in diameter, and weighs about ten pounds. It is surrounded by four hoops of gold. I cannot make up my mind whether the latter adornments are appropriate or a blemish to the artistic character of this interesting object. A magnificent specimen of crystals in a single group was purchased for the California State Mining Bureau, and is now placed in the State Museum. It is said to be the finest ever taken from the locality, and is perhaps the finest in the United States.

Among other minerals worthy of mention were schorlomite, good speci-

mens of smithsonite, steatite, stibnite, perofskite in fine crystals, and black tourmaline.

A fine special collection was shown by the Biological and Geological Department of the Arkansas Industrial University of Fayetteville, Washington County. It was displayed in seven table cases, one of which was devoted to metalliferous ores and the results of assays, and cupels upon which were beads of gold or silver. Other cases were devoted to galena and zinc ores, and one to quartz crystals from the Hot Springs. The fossils mentioned elsewhere were included in this collection.

Gold has been found in White County, but has never been worked with profit.

COLORADO.

Colorado was created a Territory February 28, 1861, and admitted as a State August 1, 1876. Area, 104,500 square miles. Population in 1880, 194,327. Capital, Denver, which is also the principal city. Floor space occupied at the Exposition, 6,600 square feet. The State is divided into 21 counties, and was formed from portions of Kansas, Nebraska, New Mexico, and Utah. It is traversed by the main range of the Rocky Mountains, and contains some of the highest peaks in the United States, rising to an elevation above 14,000 feet. It may be considered as consisting of three great natural divisions, viz.: the mountain ridges, including the "Park" system; the "Piedmont" or "foothill" region; and the plains. The mountains abound in minerals and mineral springs, and gold, silver, and lead are largely produced, seventy per cent of the former coming from Gilpin, Clear Creek, Boulder, Park, and Lake Counties.

The principal silver mines are in Clear Creek County, the development of which commenced in 1869. Iron, coal or lignite, clays, and salt, are important mineral products.

Colorado possesses great agricultural as well as mineral resources, and is capable of supporting a large population, but like California, and most of the great Western States and Territories, it owes its present and immediate prosperity to the discovery of gold within its borders. This occurred after the great and important era of the discovery of gold in California, which led to the finding of the precious metal in Australia, New Zealand, and the Western States of the Union, and gave a fresh impetus to the prosperity of the world. The first discovery of gold in Colorado was made in 1852 by a Cherokee cattle trader, near the mouth of Clear Creek. The first mining district was organized by N. G. Russell, a Georgian, who, in 1858, discovered gold on Dry Creek, about seven miles south of the present site of Denver, in 1858. The "Pike's Peak" excitement and immigration followed this discovery. The deposits of Colorado gold and silver in the United States Mints up to June 30, 1883, were:

Gold	$41,958,869 48
Silver	22,386,458 79
Total	$64,345,328 27

The State made no appropriation for the New Orleans Exposition. Its magnificent exhibit was made by the exertions of private individuals. The mineral exhibit was not only large but imposing, the ores and minerals being shown in quantities; piles of ores containing in some cases more than a ton, conveyed to the mind the impression that the ores were to be found in that prosperous mining State in great abundance. This was the case with most of the States and Territories of the Great West, a lesson learned

at the Denver Exposition, at which the large quantities of ores shown was a special feature.

Colorado showed but few special minerals. The main idea seemed to be to call attention to the economic minerals and to their abundance.

Boulder County showed piles of ores, principally galena and pyrite and mica in tolerably large sheets, but of inferior quality. A case was devoted to a collection of fine telluride ores. The Van Buren Mine, Central Mining District, Richmond Mine, Gold Hill District, and other noted mines were represented.

The Gilpin County exhibit was in charge of Dr. A. C. Hall. It consisted of large piles of ores and a monument, the base of which represented the silver produced by the county, $5,000,000, and the shaft the gold product from 1859 to 1885, $45,000,000.

The first gold quartz vein found in Colorado was discovered May 6, 1859, by John H. Gregory, in what is now known as the Gregory Mining District in Gilpin County.

Gunnison County made a fine display of ores and minerals, among which were coal, iron ores, silver lead ores, and freestone. Of special minerals there were shown: Amazon stone in magnificent crystals associated with smoky quartz, also in fine crystals, and very fine specimens of astrophyllite and cerusite in splendid interlaced needle crystals.

The Counties of Lake, Eagle, and Chaffee, were represented by Lewis R. Sharp, as Special Commissioner. This exhibit was very fine and extensive. Leadville, Lake County, exhibited piles of lead bullion, and the Leadville Smelting Works piles of lead and silver, and fine specimens of gold in leafy flakelike crystals, resembling California specimens from the Cedarberg Mine in El Dorado County.

From Pitkin County a general collection of ores was sent by the Denver and Rio Grande Railroad Company.

An exhibit of muffle furnaces, fire-brick muffles, crucibles, etc., all of good quality, was made by the Denver Fire Clay Company.

Clear Creek County was represented by piles of ores, principally gold. In a special case were shown fine specimens of galena, beautifully crystallized, from the Stevens mine.

A peculiar feature of the Colorado exhibit was a scene painted and displayed like theatrical scenery, of mountain views and landscapes, including the Mountain of the Holy Cross. In front of this artistic work was a beautiful garden and miniature ornamental grounds.

CONNECTICUT.

One of the original thirteen States. Area variously estimated at 4,674 and at 4,750 square miles. Population in 1880, 622,700. Capital, Hartford. Floor space occupied at the Exposition, 6,468 square feet. The State is divided into 8 counties. Its surface is diversified by numerous hills, of which the "Blue Hills" present the highest elevations. Mines are but few in number. Copper is found in limited quantities, and argentiferous lead mines have been worked at Middletown. There are also deposits of sulphate of baryta, limestone, flagstone, marble, granite, good brick clay, feldspar, etc., and several mineral springs are known to exist.

The collective exhibit was made by the State. The mineral portion was not large but was interesting. There were two table cases of choice crystallized minerals, all exceptionally fine. The style of arranging the specimens and the mode of labeling them was very elegant. Each specimen was placed on a thin block beveled on one edge. The block was painted

black, which offered a relief to the white printed label and the mineral itself. The labels were on slips, with names of species in large black type, and were fastened to the block by two small round-headed nails. The effect of this arrangement was very fine.

A large slab of sandstone was exhibited on which the tracks of some animal were finely shown. A similar specimen will be sent to the California State Mining Bureau. There were blocks of freestone and granite, each a cubic foot in size, to illustrate the character of the best building stones of the State; also large rough masses of quartz and orthoclase feldspar, suitable for mixing, when pulverized, with clay or kaolin, for the manufacture of porcelain—these were from Glastenbury.

While the mineral exhibit from this State was small, it contained features of much importance, and was specially noticeable from the regard to cleanliness shown in the arrangement and care of the specimens. The minerals were sent by the Wesleyan University.

DELAWARE.

One of the original thirteen States. Area, 2,120 square miles. Population in 1880, 146,608. Capital, Dover. Floor space in Exposition, 3,600 square feet. The State is divided into 3 counties. It is not in any particular a mining State. There are no mountains, although the northern part of the State is somewhat hilly. The principal minerals are iron and clay, or kaolin. The mineral department was represented by two small cases of rocks and minerals, in one of which iron ores, kaolin, dolomite, orthoclase, mica, etc., were shown. The other contained specimens illustrating the geology of the State, collected during the survey made by James C. Booth in 1837–38, and Fred. D. Chester in 1882–84, with section. It was interesting but small. Elsewhere in the general exhibit were shown manufactured iron: axles and carriage and wagon hardware, boiler plates, sheet iron, galvanized and corrugated, and window glass.

FLORIDA.

Created a Territory March 30, 1822. Admitted a State March 3, 1845. Area, 59,268 square miles. Population in 1880, 269,493. Capital, Tallahassee. Floor space in Exposition, 8,325 square feet. The State is divided into 39 counties. Florida is not a mineral State; it is nearly level, the highest land being only a few hundred feet above the sea. The notable minerals shown were amethyst, lapis lazuli, lignite, and iron ores. The iron ores are not worked, but were smelted on a small scale during the war. They are from Levy County. Samples of clay and brick were on exhibition from Bellevue Brickyard, Escambia County, West Florida. An interesting sedimentary coral rock, resembling fine-grained pisolite, from Key West, was shown. It is used in building.

One of the most attractive features of the Florida exhibit was a beautiful relief map of the State, horizontal scale two miles to the inch, vertical scale fifty feet to the inch. It was much admired. I regret I cannot describe the fine exhibit, made by this State; other than mineral.

GEORGIA.

One of the original 13 States. Area, 58,000 square miles. Population in 1880, 1,542,180. Capital, Atlanta. Floor space at Exposition, 3,937 square feet. The State is divided into 136 counties. The surface is greatly

diversified. Along the coast and Florida line the country is low and swampy, the elevation for twenty miles or more inland being not more than forty feet. From thence it gradually rises to the summits of the Appalachian Mountains. The highest elevation in the State is Enota Mountain in Towns County, which rises 4,798 feet above the sea. This would not, however, be considered a high mountain in California.

A general description of the country in which the principal minerals are found has been given elsewhere.

The State made no appropriation to exhibit its resources in the Exposition. The really fine display was by individuals.

The minerals were arranged in eight plate-glass table cases, and in heaps on long side tables. The crude ores and minerals were shown in considerable quantities.

The minerals most worthy of special mention were: building stones; coal; copper ores; corundum, in fine crystals and in large masses; dolomite; gold quartz; gold ores, pyritic; limonite; hematite; iron ores (one variety called honeycomb limonite); limestone, used as a flux in iron smelting; limonite, stalactitic; limonite, geodetic; called pot ore; manganiferous iron ore (spiegeleisen); marbles, several varieties, one pink colored, resembling onyx, aragonite; pyrite, containing chalcopyrite, very solid and suitable for the manufacture of sulphuric acid, copper, and other products.

The choicest and best arranged specimens displayed in the table cases mentioned, were from the private collection of N. P. Pratt, Associate United States Commissioner. The following were the most interesting among them: amethyst crystals; anthophyllite; asbestus; barite in fine crystals; buhr stone; beryl in fine large crystals; chlorite; chrysocolla; corundum, in fine crystals, one five inches longest diameter. There were also crude emery, and emery wheels and slabs in great variety. Copper, native; genthite; graphite; gypsum; haloysite; hematite, one variety stalactitic and botryoidal; hornblende; limonite after pyrite, very fine; magnetite; margarodite on corundum; mica in large sheets and of excellent quality; mica hexagonal in good crystals; opal; ochre, fine; peacock iron ore, limonite(?) with iridescent surface, colors purple and green, very fine; pisolite; psilomelaine; pyrolusite, needle crystals, fine; ruby corundum, fine; rutile; sapphire, fine blue; smoky quartz crystals; staurolite; steatite; tourmaline, black.

Several Southern railroad companies made exhibits of Georgia minerals. The following paper was specially prepared for the Augusta *Chronicle*, centennial edition, 1885:

THE GEOLOGY AND MINERAL RESOURCES OF GEORGIA.

The topography of a country is always intimately related to its geological structure. The mountains, valleys, and plains are resulting features dependent primarily upon the character of the rocks. The mountains and ridges of Georgia, probably without an exception, owe their relative elevation above that of the surrounding country to the greater capacity of their rocks to resist the erosive influences of the atmosphere, and not to independent upheavals, according to the popular idea of their origin. Throughout middle and northern Georgia the strata lie in a series of great folds, and the beds of rock outcrop at all angles between the horizontal and the vertical; in this way the harder and softer materials of the formations are successively brought to the surface, and the streams, naturally selecting the softer beds, have washed out the hollows and valleys, leaving the harder layers on the higher grounds. This is well illustrated in northwest Georgia, where the valleys are scooped out of the softer shales and limestones, while the more resisting sandstones and conglomerates are left behind in the general wearing down of the country, and now enter into the structure of the mountains. A geological section here shows the strata in folds like a fluted ruffle, and the mountains, with few exceptions, are situated on the synclinal or downward folds, so that the valleys, rather than the mountains, are on relatively "upheaved" strata. A plausible explanation of this fact is suggested in the evident tendency of an upward flexure to loosen the texture and promote the disintegration of the rocks, while the downward fold tends by compression to

harden them. Whatever may have been the original surface of the country, the present features are largely, if not altogether, due to erosion controlled by the elevation above tide and the other conditions alluded to as favoring or resisting its action.

The northern part of the State is diversified with elevated table lands on the northwest and high mountain chains on the east, with a broad intervening valley subdivided by long lines of ridges. This section abounds in magnificent scenery of the most varied character. The Lookout table-land rises to an altitude of twenty-four hundred feet above the sea, and the Blue Ridge Mountains to nearly five thousand feet above the sea and four thousand above the Oostenaula Valley.

Middle Georgia has a rolling or hilly surface, and resembles the more northerly part of the State in the general northeasterly trend of the ridges. This region is comparatively level, and its mountains, with few exceptions, on such elevations as would hardly receive the distinctive name of a ridge in northern Georgia. Stone Mountain, in DeKalb, is a cone of denuded granite standing six hundred feet higher than the adjacent country. Graves Mountain, in Lincoln, and Pine Mountain, in Harris, are elevations of a few hundred feet, which are conspicuous features in the landscape.

Georgia has within her limits nearly all the geological formations, and perhaps every variety of mineral that can be found on the eastern side of the continent.

The Archæan or Metamorphic covers the larger part of middle and northern Georgia. This is defined on the south by a line crossing the State at the heads of river navigation from Augusta to Columbus, and passing near Milledgeville and Macon, and in the northern limits by the Cohutta, Allatoona, and Dug Down Mountains.

The formation is made up largely of different series of granites, gneisses, and mica schists, each, when it constitutes the country rock, giving rise to peculiarities of surface, soil, and growth. The gray granites and gneisses afford the gray gravelly soil that characterizes the larger part of this section of the State, while the syenitic or hornblende granites and gneisses gives rise to the red clay soils, and some of the mica schists to the sandy areas. The thickness of the formation has been estimated at twenty thousand feet. It is divided into two principal groups, the Laurentian and Huronian. The latter, which is the upper portion of the series, is thought to be represented in the gneiss, chloritic beds, conglomerates, and slates of the Cohutta region in northern Georgia. Until recently the rocks were believed to be non-fossiliferous, and the name of Azoic Age (without life) was given to the formation, but the discovery some years ago of a fossil, the eozoon, in the Laurentian of Canada, carries the horizon of earliest known life many thousand feet downward.

Minerals of economic importance are found in every part of this wide metamorphic area. Gold in greater or less quantity is distributed throughout the section, but has been found in paying quantity principally in five belts crossing the State with the general trend of the rocks and hills in a northeasterly and southwesterly direction. One of these follows the course of the Chattahoochee River from Habersham to Troup. The others extend approximately parallel with this, two on the north, each side of the Blue Ridge, and two south of this, in middle Georgia.

The gold fields north of the Chattahoochee were the first discovered, and have been the most extensively worked. The gold region elsewhere in the State has been very incompletely explored, and in larger areas in which this mineral may be expected it has not been looked for. Prospecting with pick, shovel, and pan ceased at the outset of the California gold excitement, and it is only where gold was found in paying quantity by the pioneer with such rude appliances that more extensive mining is now carried on. In middle Georgia the country is less broken, and the rocks more generally covered with soil and other products of their own decomposition, and rich veins and placer deposits may lie deeply buried beneath this detritus.

Silver, lead, copper, and pyrite are found either within the gold belts or extending parallel and in close proximity to them. The last named mineral, until recently regarded as almost worthless, is now mined in this State for the manufacture of sulphuric acid. It is commonly accompanied by copper, silver, lead, and other minerals of value, but exists in many localities in sufficient close proximity to railroads to be profitably mined for the sulphur alone.

There is a long list of other valuable minerals peculiar to this metamorphic region. Among the more important and abundant of these are mica, asbestus, corundum, talc, graphite, kaolin, soapstone, manganese, baryta, and magnetic and other iron ores.

The best and most desirable building material may be had in the granites that extend in three or four ranges quite across the State. Three principal varieties have been observed. The gray granite, of which that found near Atlanta is typical, is composed of quartz and feldspar, with a dark colored mica. A syenite, or dark granite, is found on the eastern side of the State, in which hornblende is a constituent, and a granite found north of Augusta, Macon, and Columbus, near the southern limits of the metamorphic, contains a pink feldspar that, combined with the other materials, give a flesh color to the stone. The varying proportions among the constituent minerals in each of the kinds here mentioned multiply the varieties in shade of color to an almost infinite extent.

Marble, fine in quality and of the most durable character, is found in a belt of country extending through the Counties of Fannin, Gilmer, Pickens, and Cherokee. Associated with the white statuary marble of this lode are colored and variegated marbles in great variety.

The silurian, devonian, and carboniferous formations occur in the northwest counties, with an aggregate thickness of more than ten thousand feet. The beds are more or less

fossiliferous throughout, and consist of alternating series of limestones, slates, and sandstones, or conglomerates. The silurian is found in ten counties, and the devonian and carboniferous in seven.

The coal measures are confined, principally, to the Counties of Dade, Walker, and Chattooga, and covering an extent of two hundred square miles. Throughout this area there are from two to five beds of coal, some of which are worked at Coal City, in Dade County.

In the undeveloped coal field of Lookout Mountain, the beds have been worked to a very limited extent in a few localities, only for the neighboring blacksmith shops. The beds of coal, where naturally or accidentally exposed, vary from a few inches to five feet in thickness, and but few explorations have been made for the discovery of the beds when not thus exposed.

Encircling these coal fields, or extending parallel with them at short distances, are ridges with inexhaustible supplies of iron ore. These red ore beds at their outcroppings have a linear extent in Georgia of one hundred and twenty miles, and underlie extensive areas. East of this, in the same section of the State, the limonite, or brown ores, occur also in vast quantities.

Among other minerals of this section, now known to exist in quantity, may be named manganese, baryta, halloysite clay, variegated marbles, hydraulic cement, yellow ochre, limestone, roofing slate, and a variety of building stones. In addition to these, petroleum, gypsum, and galena are known to occur here in a number of localities, and may be found hereafter in paying quantity. Most of the lead of commerce comes from a geological formation in the northwest that is represented here by large areas, and in which the mineral has been found already in small quantity.

The building stones of this region exist in great quantity and in many varieties. The Tennessee varieties of red variegated marbles are found in Whitfield, flesh and dove colored marbles in Polk, and other shades, from nearly white to black, are found here and in other localities of this section.

The cretaceous and tertiary formations of the State remain to be mentioned. The cretaceous covers a triangular section lying south and east of Columbus. The surface is here somewhat more broken than in other portions of southern Georgia; but aside from this, there is little in the surface features to distinguish it from the country south of it. The marl beds contain phosphates and glauconite, or green sand.

The tertiary beds overlie the cretaceous, covering it entirely, it is thought, east of Macon, and extend in a broad, sandy area into Florida and to the estuaries along the coast. The surface is rolling near the larger streams, and in what is known as the lime-sink regions, but elsewhere nearly level. The country rises from the coast in two or three parallel terraces, reaching an altitude of about five hundred feet above tide near the northern limits of the formation.

The principal timber is that of the long-leaf pine, but the growth includes most of the varieties found elsewhere in the State, with bays, cypress, palmettoes, and others of a semi-tropical type not found further north.

Of the valuable mineral deposits of this section the clays are among the most important. An extensive deposit of white clay of the best quality for fine pottery is found near Augusta, and extends for some distance across the State in the direction of Macon. Buhrstone and marl beds cover a large part of the State south of these clays. Marl is found throughout this section, either outcropping on the hillsides or banks of streams, or at moderate depths below the water level of the country. Some of these beds in character approach nearly to that of a pure chalk.

The buhrstone is associated with the marl beds, but covers a less extent of country. It is found in heavy beds on the Savannah River, and at other points on the eastern side of the State, and is pronounced equal in all respects to the best French.

Lignitic coals, yellow ochre, timber, and opal may be found in several localities.

Quarternary deposits cover a low section of country bordering on the coast and extending in width from ten to twenty miles from the coast, embracing the palmetto and live oak region of the State.

Marls and phosphates have been found in a number of localities. Little search has been made for phosphates and valuable deposits. They probably may be found in this section.

Some only of the more abundant minerals have been mentioned in the order of the geological formations to which they belong. To name all now known to occur here would make up nearly the entire list of useful minerals and extend this article much beyond the designed limits.

Georgia is not equaled by any of the older States in her mineral resources, surpassing most of them in the abundance, and all in variety. But it can hardly be said that she is ahead of the hindmost in their development. Her coal is to a large extent unworked, and also the iron ores. With mountains of granite and marble she goes to Vermont for material no better or superior. With oolitic limestone in north Georgia crumbling beneath a profusion of better material, she goes to Indiana for rotten limestone with which to build a capitol, and so through a long list of materials existing at home and purchased from abroad. The most important sources of future wealth to the State now lie dormant in her undeveloped minerals and water powers. With the latter might be done the manufacturing for the world. The development of these would give a powerful stimulus to all other industries, and it is the highest interest of the State, and the noblest aim of her statesmanship, to promote its accomplishment.

Georgia contains gold fields of great extent and importance, and of an entirely different character from those of our Western States and Territories. For this reason I was specially interested in the mineral exhibit of this State, and visited some of the principal gold localities, knowing that I should find much that, when written, would interest our California and Western gold miners.

Gold was discovered in Georgia in 1828. In twenty years the placers were practically exhausted, after which veins and deposits began to be worked, as at present. The gold belt is about one hundred miles wide, and extends from North and South Carolina to Alabama, in a direction northeast by southwest, across the northern and eastern portions of the State. The first gold discovered was on the present line of the Marietta and North Georgia Railroad, near Jasper. The White Path gold mines, six miles northeast of Ellijay, were worked shortly after the Coosa mines, and much resembled them. The rush to the gold placers was like that to the Pacific Coast in 1849. The miners encroached on the Cherokee reservation, and even the United States troops could not keep them from the Indian lands. This period was known as the "Intrusion," and became an era from which Georgia mountain men reckon dates. In 1830 the Indian Territory was purchased, and the country called Cherokee was afterwards divided into several counties. The gold lands were obtained from the Indians by treaty, and immediately divided into forty-acre lots by lines running north and south, east and west. The lots are arranged in districts, numbered from 1 up, and run as high as 1,296; some districts are much smaller; I think the average is about 1,224 lots in a district. This system is at first very perplexing to one who has been accustomed to the surveys of California and the newer States.

The following counties in Georgia contain gold: Carroll, Cherokee, Cobb, Dawson, Fannin, Forsyth, Gilmer, Gwinnett, Habersham, Hall, Lincoln, Lumpkin, Paulding, Pickens, Rabun, Towns, Union, White. At the close of 1883, by report of the Director of the Mint, there were 600 stamps in Georgia, most of which were in operation.

Gold is found in Georgia as in California, in river placers and in place in quartz veins, but the great gravel deposits of California have no representative in that State. The river placers much resemble those of California, and the method of working them is similar. The gold is generally clean, but some specimens from the Keystone placer claim, near Dahlonega, which I examined microscopically, were somewhat coated (rusty). The Keystone claim is in the bed of the Chestatee River, three miles south of Dahlonega. Mr. Stewart, the Superintendent, showed me a vial of gold, coarse and clean, of an ounce or more in weight, which much resembled the best of California placer gold. He has some difficulty in saving the rusty gold, but there is only little of it. It is now proposed to turn the entire river from its bed in a flume, and to work it as in California.

The quartz gold of Georgia is generally clean and free from coating; amalgamation takes place immediately on contact with mercury. The following is the result of an examination and assay of an average specimen from Wellborn Hill, Union County, made since my return:

Percentage of gold	.0153+
Ounces in ton of 2,000 pounds	4.47
Value per ton	$92 40

The gold was very yellow and bright. A specimen from the Ralston Mine showed gold in the form of thin leaves. At first glance the specimen resembled those artificial preparations of gold leaf, sometimes used by unprincipled

miners to deceive the unwary, but a close examination under the microscope showed the gold to be natural and in place. I had the curiosity to measure the thickness of these leaves in decimals of an inch with a Jackson micrometer, and found them to be .00125+, or 800 leaves to the inch. The quartz in which the gold is found is generally granular when pure, somewhat resembling loaf sugar, and it has a singular resemblance to itacolumite, which is quite abundant in the gold regions of Georgia and North Carolina. "Itacolumite is a schistose quartz rock, containing mica; the finer kind is sometimes flexible" (Dana). "Schistose quartzite, in which the quartz granules are separated by fine scales of mica, talc, chlorite, and sericite" (Geikie), "sometimes contains native gold and diamonds" (Von Cotta). Having conceived the idea that the gold-bearing quartz of Georgia and the flexible sandstones called itacolumite might be identical, I commenced a series of experiments which proved very interesting. Selecting a specimen of itacolumite from Georgia I subjected it to a critical microscopical and physical examination. It was found to consist of granular transparent quartz, associated with a very small quantity of a dark colored mineral in angular fragments, with an occasional scale of a mineral resembling mica. There was not enough of the dark colored mineral to give it a distinctive character, much less to impart to it the property of flexibility, which it had to an eminent degree. When the auriferous granular quartz was compared with it side by side on the same glass slide, the appearance was exactly similar, except for the presence of the foreign mineral mentioned, which was absent in the granular quartz. This examination shows that the so called Georgia itacolumite does not answer the description given by the geologists. A number of samples were then prospected for gold, but none was found.

A typical specimen of the auriferous quartz from Wellborn Hill was then examined. One portion was concentrated in a horn spoon and the gold collected and weighed; the percentage did not materially differ from the sample mentioned above. 10 grams of the quartz was boiled in nitro-hydrochloric acid, the residue, 92.3 per cent, consisted of pure transparent quartz; some black non-magnetic particles observed in the original sample, were wholly dissolved. The soluble portion was examined and found to contain iron only, with perhaps traces of other substances, which in the rough examination were ignored. The specific gravity of the rock was 2.654. It is so easily pulverized that it can sometimes be crushed between the fingers like loaf sugar. At Wellborn Hill I made all my tests by crushing the quartz on a stone with my geological hammer. Mr. Melville Attwood has presented the State Museum a specimen of auriferous granular quartz from the Telluric Gold Mine, San José, Minas Geraes, Brazil, which bears a singular resemblance to the Georgia quartz. Connected with all the gold mines is a peculiar, very ferruginous rock, universally called "brickbat," because it breaks into cubical masses resembling in color and form an ordinary broken brick. It is light, soft, easily crushed, and decomposes into the red characteristic soil of the district. It is possibly the source of the iron beds found in the same region. It is probably sedimentary and lies conformably on gneiss or mica schist, in which all the quartz veins are found. It has been prospected frequently and found to contain no gold that can be collected. It may, nevertheless, be the mother of the placer gold; it seems also to be allied to itacolumite, and is probably a variety of it. The specific gravity is 1.584. Boiled in nitro-hydrochloric acid 28 per cent dissolves. The residue, still containing some undissolved black particles, is found to consist mainly of grains of transparent white quartz, like the gold-bearing rock. On being decomposed with alkalies it yields 51.5 per cent of silica. The

residue consists of alumina and sesquioxide of iron, with perhaps traces of other substances. No lime or magnesia were found.

Approximate analysis of brickbat after drying in water bath:

Silica	41.60
Alumina	26.06
Sesquioxide iron	32.34
	100.00

When wet it smells strongly of alumina. It absorbs 20 per cent of its weight of water, giving off at the same time air, which rises in small bubbles.

The brickbat decomposes to ochre and sand and changes to hematite, forming successively the yellow and red ochres so common in the gold regions.

It is easily disintegrated, and with water forms a soft yellowish-red, somewhat plastic mud. Placed in a Schultz apparatus and washed with water under small pressure; a golden yellow, fine-grained ochre flows over the edge of the vessel. What remains when the water flows clear, is redder in color. On increasing the pressure or head, a second portion overflows, leaving a small residue of coarser particles or sand in the following proportion:

Ochrous portion	94.45
Sandy residue	5.55
	100.00

The residue, when seen under the microscope, appeared to be particles of quartz enveloped in limonite. As this could not be disintegrated without crushing the quartz, it was boiled in nitro-hydrochloric acid, by which treatment a portion of the envelope was dissolved; a portion rendered flocculent was removed by washing. A small portion of quartz showing a curious cellular structure remained. None of the particles were rounded, but all were angular, like the finer particles of the auriferous gravels of California.

MANNER OF WORKING THE AURIFEROUS MATERIAL.

It has been stated that the quartz veins, which are generally small and not continuous, are found in a micaceous schist lying on gneiss. The schist is easily disintegrated, and contains gold probably derived from the decomposing quartz. I saw no special quartz vein worked as in California. The system of collecting the gold combines the hydraulic and milling process. The workings are connected with the mills by long lines of sluices, made like the common placer sluice-boxes of California, but somewhat larger.

Water is brought to an elevation sufficiently high above the workings, which are open cuts, to give about 100 feet pressure. The water is frequently pumped up by steam engines, which seems a strange feature to a Californian. From small pressure boxes the water is conveyed in eight-inch pipes to small nozzles, with orifices not over two and one half inches in diameter. The water is projected in feeble streams on the soft micaceous schist which passes in the form of mud down the sluices to reservoirs near the mills, which are sometimes at long distances from the workings. When sufficient matter has accumulated, the gateway of a small adjacent reservoir is opened and the material is "boomed" into the mill, where it settles on the floor behind the batteries in a muddy mass; 250 inches of water are used in booming. The floors are made water tight, but there is a fine grating which allows the excess of water to run off. The stuff to be crushed consists of soft mica schist, bits of gold quartz, a large quantity of brickbat, and a small

portion of gold. The stuff is fed into the mills and amalgamated in the battery. The gold is free and amalgamates readily. I have never seen copper plates kept in better condition than in these mills. This is owing to the fact that the rocks contain no sulphurets or anything to contaminate the mercury. In the sluices there are placed riffles consisting of four or five scantlings, connecting by cross cleats one inch square, which are placed downward, and extending across the sluices, beneath the scantlings, form riffles at which gold and heavy matter collects. Quicksilver is poured in at times, which serves to save the gold, some of which is collected before reaching the mills. The sluice boxes are cleaned up at stated periods by taking out the lower riffles first and washing down the concentration to a large cleat placed across the sluice. The final cleaning up is made in a miner's pan as usual. No blasting is ever used to assist the streams in disintegrating the soft rocks. The whole operation is on a very small scale, but the methods are economical and the results are said to be satisfactory. The cost of mining and milling at the Barton and Hand and Ralston and Gordon Mines, near Dahlonega, is estimated by the Superintendent at 22½ cents per ton, and the average yield of gold two dollars per ton. If quartz only was milled, the yield would be very much greater in proportion to the amount crushed, but it is a question if it would pay better than the cheap system now employed. It occurred to me that it would be an improvement to pipe down through sluices as now, but to shoot off by means of a grizzly all the larger fragments of quartz, brickbat, etc.; to hand-pick the quartz which contains all the gold not already free, and to throw it up in piles. The finer matter which passed through the grizzly could be treated as in California, in block-paved sluices with mercury, and on undercurrents, by which the free gold would be practically saved without the use of the mills. After the sluices were cleaned up they could be used to boom down the quartz if that mode of conveyance should still be found cheaper than hauling to the mills by teams. I am convinced that large quantities of float quartz could be gathered on the surface that would pay to work in a mill. This could be ascertained by making a multitude of horn spoon tests of the float quartz. The prospectors employ the most primitive methods of testing the quartz; but few have seen a horn spoon or know of its use. I saw a skillet used instead of a miner's pan, and did not observe in any of the mining localities I visited, a batea, or any convenience for pulverizing quartz, or for systematic prospecting. Most of the tests were made on a shovel and the crushing done in the crudest and most imperfect manner. I am satisfied that more gold could be saved if these mines were more carefully and systematically worked. This is easy to say, but it is not so easy to suggest a material improvement without more carefully studying the conditions, and perhaps by using the experience gained by those who have long worked the deposits. I observed here the operation of the universal law that governs the production of gold. If it was not difficult to obtain it would have but little value. I was pleased to notice the Howland riffle, a California invention, in use, and to learn that it gave great satisfaction. When compared with similar operations in California these workings seem insignificant. There are no costly bedrock tunnels. The sluices are small and there is no dump as we understand it in California. The quantity of water used and the pressure are small, and the hydraulic apparatus quite diminutive. No paving blocks, undercurrents, blankets, concentrators, chlorination works, electric lights, telephones, derricks, hoisting works, or rock breakers are used, nor is there an assay office at Dahlonega, the center of the Georgian gold fields. But the mills are well built and well managed. The stamps are generally lighter than ours, but on the other hand the material is very easily crushed.

The mills are generally run by water power and are kept clean and in good order. Tar is used instead of grease on the cam shaft, which runs down and gives that part of the mills an untidy appearance, but otherwise it is found to be better than grease, as it does not interfere with the amalgamation if a portion falls into the battery.

The principal productive gold mines of Georgia are in the vicinity of Dahlonega. They are in what is known as the Findley belt and the Pigeon Roost sand vein or mineral belt. The Findley group are the Findley, Singleton, Griscomb, Fish Trap, and Cleveland. The Pigeon Roost group are Ivey, Pigeon Roost, White, Chicago and Georgia, Dahlonega, Auraria, Proserpine, Danæ, High Tower, and Palmour. The veins lie generally parallel and have a strike about northeast and southwest. The Etowah River crosses some of them in a serpentine manner.

The mines in the immediate vicinity of Dahlonega lie on Findley ridge. Considerable work has been done on the west of this ridge, and piping over both sides. There is no dump for extensive workings, nor would the farmers long permit it if there were. Water could be brought to the top of the ridge, but only at great cost. Passing along the top of the range from which the water is drawn for hydraulicing, I found the Columbia reservoir 260 feet above the mill. The water is forced up through a five-inch pipe by a steam engine, 100 feet or more. The cost of pumping this water is said to be $4 per day, but I thought this a low estimate. The auriferous matter in the opening is stratified and dipping. It is schistose with small veins of quartz, and lies on a bedrock of gneiss. The Findley mine, from which the ridge takes its name, was the first discovered. It is not now worked. Water from the supply ditch is sold at 10 cents per 24 hours miner's inch. A United States Branch Mint, established at Dahlonega by Act of Congress March 3, 1835, commenced coining in 1838, from which time until closed, during the civil war, it coined 1,381,784 gold pieces, valued at $6,121,916. In July, 1871, the buildings and grounds were transferred to the State of Georgia, and became the North Georgia Agricultural College, with imposing buildings and prominent position.

The Barton and Hand mine lies three miles southwest of Dahlonega. An attempt to "dry mine" resulted in failure. The fine forty-stamp mill was erected in 1882. The company use 150 to 200 inches of water from a ditch owned by themselves. One hundred and fifty tons per day are crushed. All the stamps are driven by one cam shaft, which extends through the mill. Mr. John Huff, the Superintendent, showed me through the works and mill. Here I saw a three-inch hydraulic nozzle, the largest I had met with in Georgia. Water is pumped up by steam for piping. It was found here that the yield of gold was proportional to the distance of the mill from the cuts, owing no doubt to greater disintegration in the sluices.

The Bast and Ivey Consolidated is about a mile southeast of Dahlonega, in the Findley belt. The mill has 20 stamps. Water is pumped up to a reservoir, 100 feet above the cuts, with a capacity of 130,000 gallons, from which it is brought down in ten-inch pipes to a nozzle of two inches. The auriferous matter has been experimentally treated in pans, but with what success I did not learn. The gold is contained mostly in thin quartz veins in soft mica schist.

The Columbia Mine lies on Findley Ridge, near Dahlonega. The mill has 20 stamps, run by water; a ten-inch pipe supplies a turbine wheel. Water for piping is forced up to a reservoir by steam power. Cost of wood, $2 per cord; common labor, 90 cents per day; engineer, $1 per day. The Columbia Mill is 100 feet below the hotel at Dahlonega. The quartz veins in the cuts are narrow and not continuous. The schists are highly

ferruginous, and there is a large quantity of brickbat to be removed with the auriferous matter. The workings are about 100 feet long by about 50 feet wide and 25 or 30 feet deep. There is no hard bedrock, but at a certain distance below the surface there is a soft rock, which, however, could be picked or blasted and piped off without difficulty. The small pressure box is 250 feet above the mill, but only about 100 feet above the cuts. The mill is generally cleaned up once a week, and Saturday is the day selected for that purpose.

The Lockhart Mine is on Findley belt. The ore deposit or vein is from 6 to 10 feet wide. It is worked in two mills, of 5 and 10 stamps.

Auraria, with its group of mines and mills, lies six miles southwest from Dahlonega. At and near Auraria there were the following mills in 1881:

Chicago and Georgia	10 stamps.
Auraria	10 stamps.
Wells	10 stamps.
Cleveland	10 stamps.
High Tower	10 stamps.
Bell	10 stamps.
Total	60 stamps.

Yield of gold near Auraria, 1881, $8,000; in 1883, $10,000 (estimated).

The Fish Trap is one and a quarter miles from Dahlonega. It has what is considered an ore channel 75 feet wide. The yield from the 20-stamp mill is fair but the mine is not continuously worked.

At the Gordon Mine I met John W. Weaver, Superintendent, who gave me much valuable information as to the general character of the mine, manner of working, yield, etc., and some characteristic specimens, which have been placed in the State Museum. At the mill 20 stamps only were running, but 30 more were being put in place. The 20 stamps crush 60 tons of stuff in a day, yet they weigh only 450 pounds each. The ore bins at the end of the sluices and near the mill are very well and conveniently arranged. They have a capacity equal to the floor space in the mill behind the batteries. The sluicing is continued until sufficient material has collected in the bins for a run, when it is boomed into the mill as usual.

The Ivey Mine is on Pigeon Roost belt, more than one and a half miles southwest of Dahlonega. Water is supplied from the Hand Ditch. At the new mill there were 60 stamps running. The mill is driven by water under a pressure from a 180-foot head. A steam engine is supplied for use in the event of a short supply of water or an accident to the pipes or wheel. The Bast belongs to the Georgia Consolidated Mining Company. The yield of gold for the year ending June 1, 1883, was as follows:

Ivey	$38,289 64
Bast	22,482 11
Total	$60,771 75

The Pigeon Roost Mine is in the Pigeon Roost belt. There is a small mill of ten stamps. The cut is about 250 yards from the river. There was not ore enough, at my visit in May, to keep the mill running continuously. In the river at this point there were formerly very rich placers. Some large nuggets have been taken out.

There is another interesting gold field that I visited and studied, which is on the same auriferous belt but further north. The largest adjacent

town is Blairsville, which is the county town of Union County. It has been mentioned elsewhere, and the country about it described. The Gum Log Mine, or deposit, lies in a small hill, the body of which is soft shale, rich in gold, which comes no doubt from the multitude of thin quartz veins which intersect the hill. On the creek near by stands an old mill with partly decayed overshot wheel, in which the auriferous quartz was worked for gold, years and years ago. Still no consecutive work has been done beyond coyoteing and the making of some small open cuts, yet from the prospects I made I am convinced that with judicious working the whole hill could be made to pay.

Judge Wellborn, of Blairsville, informed me that when he was a boy the old Gum Log was worked by a company. He was sent with 1,900 pennyweights of gold to mint at Dahlonega. This was taken out by hand-beating. They then put up a trough, in which four stamps dropped. There were no screens or plates. The water slopped over, and but little gold was saved. A man came along and obtained permission to work the tailings, and he obtained 1,000 pennyweights of gold.

Wellborn Hill, a mile or so from the Gum Log, is also a very promising locality. The mine is fairly well opened, and there is a good mill ready for operation when the water is turned into the ditch, which is also nearly ready for working. I saw no reason why the mill should not be started up and the quartz crushed with success. The mill has ten stamps, with space and ample power for ten more. A projected tunnel, the entrance of which is near the mill, will cut the vein at a considerable depth, and can be made an outlet from the mine for years to come. When all the upper works are exhausted, lower levels could be pumped through the tunnel by water power. I prospected the quartz, and found some of it rich in gold.

I think quartz could be gathered on the surface of the ground over a large area of country, which would pay in the mill. Labor can be obtained for $10 per month or 50 cents per day, and found. Board costs $1 50 per week. The mine was discovered about twelve years ago by Edward D. Rodgers. He used to pay 40 cents per bushel for crushing the ore to sand in stump mortars, with stamp pestles made by setting iron wedges in stems of wood, which, for convenience, were attached to spring poles. He then rocked the sand with quicksilver. The gold obtained gave him a profit of about $1 per bushel. The stump mortars may still be seen. The tree was cut down and the stump sawed off square. The concavity was made by burning with live coals, assisted by judicious use of the ax. While this was a rude substitute for a crushing apparatus, it served a useful purpose, and enabled the miners, in an imperfect manner, to extract the gold that under other conditions would have been practically inaccessible. There has at no time been a mill at this mine. The new mill has not yet turned a wheel.

On my return to San Francisco a sample of quartz from Wellborn Hill, weighing 320 grams, was crushed and sifted, and at my request Mr. Melville Attwood carefully washed it in a batea. The prospect, or residue, weighed 0.1263 grams. It contained a little quartz, but was largely gold, beautifully clean and bright, and part of it in distinct crystals. There were some particles leaf-like, but crystalline. The rock was very easily crushed. The only rock in California that I have a knowledge of, which resembles it, is at Fresno Flat, Fresno County. The prospect was all mounted on slides, and exhibited at a meeting of the San Francisco Microscopical Society.

The Nancy Brown Mine, near J. Van Brown's house, has the same general character and direction. It has been opened in several places, and

nsiderable work was done on it before the war. Mr. J. B. Pewitt has ved at Brasstown, just over the line in North Carolina, for twenty-eight ars, and is very familiar with the country. He says that $7,000 worth of ld has been taken out of this mine. Mr. Hunt, the storekeeper, can show here $4,000 worth of gold has been expended. A small five-stamp mill th overshot wheel and rude square wooden stamps, was once placed in e mine. The old screen I saw. It was coarse and imperfect, and the won- r is that so much gold could have been saved with so rude an appliance. wo years ago Mr. Pewitt gathered five tons of float quartz from the surface the ground that paid $10 a ton when worked after a primitive method. The discovery of this mine was made many years ago. Mr. Pewitt found small cropping in the road. He panned it and prospected the earth about ith negative results. A woman told him she had panned gold from a pring near by. He examined the spring and found gold. In four days he ok out $163 worth of gold from float rock, after which he found the Nancy rown vein. No work has lately been done upon this property.

The Old Field Mine near by was discovered since the war. Many years go in the branch below, Mr. Kinsey ground-sluiced the lower end of the ein as a placer mine, and with slave labor extracted $1,200 worth of gold. n seeking the source of the gold the ledge was found. The ore is considered ow grade, but it has the same general appearance as the other. The vein as also the same general course. It has not been worked to any great xtent, and now lies idle.

There are several promising mines near Blairsville. Judge Wellborn showed them to me and gave me much information concerning them. They are wholly undeveloped. The Alice Mine was prospected by a small open cut, several years ago. There are two small veins exposed, which seem to be well defined, and show large croppings at the surface. The ore and the mine seem promising, and they should be more thoroughly explored. The gold miners in Georgia seem to be timid. They make their explorations too cautiously. I saw mines that in California would be considered worthy of sinking on for several hundred feet, prospected only to a depth of from five to fifteen feet. In all my tour through the gold mines, I saw no hoist- ing works, not even a whim. Some day the prospecting will be conducted on a larger scale, and perhaps with better results.

Gold mines of considerable promise are found in Nacoochee Valley, White County. I did not visit them, but was furnished with the following note by Gorham Blake, an old Californian, who is interested in the district:

LOUDSVILLE, WHITE COUNTY, GEORGIA, May 28, 1885.

In White County, Georgia, gold was discovered early, when the ground was occupied by the Cherokee Indians. Many nuggets were found in Nacoochee Valley, and within two years a Mr. Lumsden found several thousand dollars in nuggets in his garden, rang- ing in value from $5 to $400. There are several gold-bearing quartz veins near this beau- tiful valley. A twenty-stamp mill is now just completed for Mr. Childs, a banker in Georgia. Also, prominent for over forty years, has been the old "Sprague" and "Lewis" gold mines, now owned by the Forest Springs Gold Mining Company. The "Lewis" vein is ten to twelve feet in width, and yields per mill process well. Rossiter Raymond's report on tests of ore from this mine gave an average of $26 per ton. The rock contains mas- sive sulphurets in abundance, which are rich in gold, and the vein can easily supply a twenty-stamp mill. The "Sprague" vein is from three to four feet thick, and is in places very rich. A fair mill test showed $18 13 per ton. Several other auriferous veins are on this property, which will be opened in good time. A ditch is completed five miles long, supplying abundance of water for mill power, pumps, and hydraulic purposes. Large amounts of rich gravel deposits are near the Sprague vein. It is expected these mines will show large returns when worked, as a large amount of gold has already been taken out above the water line. Labor being but seventy-five cents per day, and nature assist- ing so much to facilitate the working of these mines, they cannot fail to be profitable.

The old "Loud" mines are sand and gravel, and have been worked profitably for over fifty years by panning, toms, and sluices. Pockets of gold, one to the amount of seven

and three-quarter pounds of fine dust have been found. In another pocket seven nuggets, from the size of a pea to a pigeon's egg, were found. This property is ow by merchants in Athens, Georgia.

Gold is found in Carroll County. Judge Bonner has been working mine since 1841. He reported to Geo. Little, State Geologist, that average yield was $11 40 per ton from quartz, while some of the plac were rich. At Villa Rica the gold occurs in quartz and in placers. 1855–6, 5,000 pennyweights were taken out of a stream in six weeks.

YIELD AND PRODUCTION.

The Director of the Mint thinks the average yield of gold from Geor mines is from $1 25 to $1 50 per ton.

The total yield of gold in Georgia:

From 1829 to 1838 is estimated at	800,000 oun
From 1838 to 1849 is estimated at	200,000 oun
	1,000,000 oun

The sum total of gold and silver deposited from Georgia mines in Uni States Mints up to June 30, 1883, was as follows:

Gold	$8,043,25
Silver	1,52
	$8,044,77

The yield of gold for the year ending June 30, 1867, was estimated by Ross Browne as $28,758 20.

In 1876, Governor Smith, in a communication to the Director of the Mi estimated the yield for the fiscal year at $150,000. In 1880, the cens year, the estimate is $81,029. 1881, estimated yield, $125,000. In 18 the estimated yield was $312,500, of which Lumpkin County produc $225,000. The Director of the Mint estimates the yield for the year 1883

Gold	$199,
Silver	1,
	$200,

The mint at Dahlonega coined gold from the commencement to Febr ary 28, 1861, to the value of $6,115,929.

The gold fields of Georgia will yield the precious metal for years come, if the miners are allowed to work the deposits.

ILLINOIS.

Territory, March 9, 1809. State, December 3, 1818. Area, 55,410 squa miles. Population in 1880, 3,077,871. Capital, Springfield. Floor spa in Exposition, 6,750 square feet.

The State is divided into 102 counties. Next to Delaware and Louisian it is the most level State in the Union. In the northwest corner of t State, near Galena, there are some low hills.

Illinois is essentially an agricultural State, but the mineral productio are also important.

It is well supplied with coal, in fact it has been asserted that the who State is a vast coal field. The area of the beds is estimated at 30,0 square miles.

Some of the veins are from six to eight feet thick. More than 2,000,0

ons of coal are annually mined in the State. The iron ores found in the oal measures are considered of but little value. Salt is made from saline prings.

Lead is found in very large quantities at Galena, in Jo Daviess County, nd in small quantities in the southern part of the State.

At the Exposition, the mineral display was not large. One case contained pecimens collected by the State Geological Survey which was very interesting. The most noticeable minerals and mineral products were galena in ery large and very perfect cubes, bars of pig lead from the same ore, a edestal of onyx marble, potters clay, a fine series of building stones, pottery, including sewer pipes, terra cotta, brick, ornamental tiles, coal from arious localities, etc.

INDIANA.

Territory, July 4, 1800. State, December 11, 1816. Area, 33,809 square miles. Population in 1880, 1,978,301. Capital, Indianapolis. Floor space at Exposition, 6,800 feet. State divided into 92 counties. The collective exhibit from Indiana was not made officially by the State, but by private individuals.

Indiana has no mountain land. Two thirds of the surface is nearly level. Marbles and limestone are found in quantity. The most valuable mineral mined is coal, which occurs in great abundance.

The following is an extract from a handbook published for the Exposition:

THE GREAT COAL FIELDS.

The Indiana coal fields embrace an area of over 7,000 square miles, offering seven workable seams at a depth ranging from 50 to 220 feet, and averaging 80 feet below the surface. The seams vary in thickness from 2½ to 11 feet, averaging 4½ feet. The quality is fair to good, as shown by analysis in the Geological Reports. An area of 600 square miles in this field yields a superior block or "splint" coal, which is used in the blast furnace as it comes from the mine without coking. Our block coal is rich in carbon, and remarkably free from sulphur and phosphorus, and well adapted to the preparation of Bessemer steel, etc. The abundance of coal and ease of access cheapen this fuel. It may be had on every line of railway, from 5 to 10 cents per bushel, or at $1 50 to $2 80 per ton.

Near the coal fields there are available beds of iron ores.

The mineral exhibit made by Indiana was not large. To me the most interesting feature was the magnificent terra cotta work—tiles, fire-brick, and other products of clay. This special exhibit consisted of drain pipes, tiles, earthenware, pressed brick, encaustic tiles, very fine and in great variety of design and color, some beautifully painted by the pupils of St. John's Academy, Indianapolis—several highly ornamental pediments of red terra cotta—and beautiful designs of various natural objects in the same material were finely shown. The clay was from Dubois County.

There were also large blocks of coal and some geodes, a few of which were broken to show the internal crystallization, but they were not fine.

The State abounds in building stones. One magnificent block of sculptured Indiana oolitic limestone was shown and greatly admired. The following description of this stone is from the handbook mentioned before:

THE BEST BUILDING STONE IN THE WORLD.

The State abounds in the finest building stone in the world. By far the most beautiful and valuable stone for architectural purposes is the Indiana oolitic limestone. The supply is simply inexhaustible, as it lies in massive strata of from 20 to 70 feet thick, over an area of more than fifty square miles. These strata are homogenous, equally strong in vertical, diagonal, or horizontal sections. The stone comes from the quarry so soft as to be readily worked by saw, chisel, or planing machine, while on exposure it hardens to a strength of from 10,000 to 12,000 pounds to the square inch—a strength amply sufficient to

sustain the weight of the largest structure in the world. In use it presents a handsom creamy brown appearance, gradually whitening with age. It is of almost unprecedente purity, containing an average of 96.8 per cent of carbonate of lime, a purity rarely, if eve surpassed, and scarcely equaled in the world. Hence its advantage over the magnesia limestones, as it is not affected by decay in an atmosphere charged with the gases burning stone coal. In natural outcrop it presents bold perpendicular faces to the el ments, showing every scratch and mark, unaffected after the exposure of thousands years, unlike any other stone or rock. It is quarried in prisms six by ten, 50 or 100 fe long, putting to shame the boasted prodigies of Egyptian story and effort. It is then ra idly sawed into blocks and dimension forms, and steam planers carve, mold, and smoo it like clay or wood, and more accurately than mallet and chisel. It is now fit to carved and polished into the finest kind of sculptured and ornamental work.

Ready for the mason or sculptor, it is alive and resonant, answering with a cle metallic ring each touch or blow. This resonance is an excellent test of the perfect uni of its particles, and as a result it is highly elastic, bending under pressure and reboundi to place when relieved from it. This elasticity enables Indiana oolitic limestone to ada itself without cleavage or disintegration to changeable climates, where material will frequently subject to a change of from 20° to 60° of temperature in a few hours; as large buildings the outside will be subject to a temperature of 25° below zero in Winter, 120° above it in Summer, while the inside will remain at 60° or 70°—differences of 50° 80° in the extremities of the same stone—with their accompanying effects in expansion contraction. The strains of heat and frost will tear down buildings and sides of mou tains with their great expansive forces, and even steel and iron will give way before then Here, then, is presented to the builder and architect a new and wonderous element in a "elastic stone," a potent quality which, united with its other sterling excellencies strength and beauty, makes Indiana oolitic limestone the best in the world for expose work in buildings in localities subject to great climatic changes. It has been and is no being used in many of the finest public structures in the country. The new $2,000,0 Court House at Indianapolis, the new State House, the Post Office, and many churche in that city, the Custom House at Louisville, the City Hall and the water tables of Lin coln Park in Chicago, many fine structures in St. Louis, the Cotton Exchange in Ne Orleans, and many public and private buildings in New York and Philadelphia, and th exposed parts of the new State House of Illinois, are built of this stone.

While Indiana cannot be classed among the gold-producing States, it is interesting to know that $40 13 in gold of State production is recorded in the reports of the United States Mint as having been deposited in that institution.

IOWA.

Created a Territory July 3, 1838. Admitted to the Union March 3, 1845. Area, 55,045 square miles. Population in 1880, 1,624,615. Capital, Des Moines. Floor space in Exposition, 10,175 square feet. The State is divided into 99 counties. The surface is generally undulating, but there are no mountains or high hills. The principal minerals of the State are coal, lead, gypsum, and building stones. The area of the coal fields of the State is estimated at 20,000 square miles. The coal is bituminous and of excellent quality. Lead is produced in very large quantities near Dubuque. The iron found in the State is in small quantities, and its exploitation has not as yet become important. The following extracts bearing on the mineral resources of Iowa are taken from a pamphlet entitled:

IOWA—NOTES ON THE GEOLOGICAL FORMATIONS, BY S. CALVIN, SUPERINTENDENT GEOLOGICAL DEPARTMENT, WORLD'S EXPOSITION AT NEW ORLEANS.

The galena limestone is a coarse, vesicular, heavy-bedded, buff-colored, magnesian limestone that lies directly on the Trenton. It occurs in the upper portions of the bluffs for some distance above Dubuque, while just at Dubuque it makes up the entire bluff from base to summit. Rich deposits of lead ore—*Galenite*—occur in the caves and crevices of the galena limestone. The galena limestone affords excellent material for heavy masonry; and the *Dubuque lime*, that has long been known with so much favor throughout counties farther west, is manufactured from this formation.

The coal measures occupy a large area in central, southern, and southwestern Iowa. They constitute one of the most important geological formations, their chief claim to consideration resting on the inexhaustible stores of coal that are included at different heights between the rocky layers. The coal product of Iowa will be discussed by Captain Head, so that it remains for me only to say that the coal measures, in common with the

other geological formations, furnish in many localities most desirable stone for building purposes. Limestones prevail in the upper part of the carboniferous series, and are utilized extensively in Madison, Montgomery, Taylor, Page, and other southwestern counties. The upper coal measure limestones furnish beautiful series of fossils, illustrating the animal life of the carboniferous seas, while the delicate ferns and curiously sculptured trees, whose remains occur associated with the beds of coal, throw light upon the character of terrestrial vegetation during the coal period.

Overlying the coal in Webster County are immense beds of white and gray gypsum that are already beginning to take rank as deposits of great commercial importance. These beds furnish material for the manufacture of plaster of Paris. The rock itself, soft and easily cut into desired shapes, is used as building stone, while the *Cardiff Giant* is one of the well known products of these interesting deposits.

The following information was obtained from Mr. E. H. Calkins, of Burlington: The Legislature made no appropriation. $5,000 was received from the State allotment. The cost of the exhibit is estimated at from $15,000 to $16,000. The several counties were assessed, and the next Legislature will be asked to pass a bill to meet the deficiency. Should that body fail or decline to do so, the counties will be compelled to meet the expenses. Professor S. Calvin, of the Iowa State University, deserves special credit for the geological exhibit, arranged by him and under his special care.

The mineral exhibit from this State was not large, but was specially fine and important. It was well selected, and every specimen would be considered a gem in any collection. The fossils were devonian, upper silurian, and carboniferous. The whole collection was contained in six, not large, vertical cases. Many of the corals were shown also in polished slabs. I noticed a neat way of labeling, by tacking the card to a movable block laid in the paper trays, being of the same rise as the paper edge, which brings the label up to the level of the edge. The card was fastened by small round-topped nails. The minerals shown were few, but exceptionally fine, and there were no duplicates. Among them the following were the most noticeable: blende; calamine; calcite; copper, native, a single erratic block brought to the State during the drift period; galena, in large masses and crystals; gypsum-selenite, the curved variety, very fine.

Rocks, etc., were represented by a small but fine collection of lithological specimens and photographs of quarries, and soils in glass prisms, showing the thickness.

KANSAS.

Territory, May 30, 1854. State, June 29, 1861. Area, 81,318 square miles. Population in 1880, 996,096. Capital, Topeka. Floor space occupied at Exposition, 10,175 square feet. State divided into 104 counties. The surface is an undulating plateau, the elevation of which is from 750 to 3,500 feet above sea level. The principal mineral productions of the State are coal, salt, gypsum, building stones, clay, lime, etc.

The coal measures underlie the eastern portion of the State, with an estimated area of 17,000 square miles. The veins of coal vary from very thin seams to others seven feet in thickness. There are five distinct workable beds or veins. The Cherokee coal averages three and one half feet in thickness. Coal is extensively mined in Cherokee and Crawford Counties. The fuel is good quality, cokes well, and is comparatively free from sulphur and phosphorus.

Salt is found in beds from six to twenty-eight inches thick. It is crystalline and of good quality. It is also made from brines.

Gypsum occurs over an area of many square miles, and is manufactured extensively into plaster of Paris and land plaster in large mills.

Building stones of dolomite and limestone abound.

The miocene formation of the cretaceous strata, which extends over a large

area of the State, contains chalk. At Wakeeney, Trego County, works have been established for the manufacture of whiting. This is the only known locality of chalk in America.

Iron ores are found, but are not yet smelted.

Petroleum has been found, but has not as yet become important.

The exhibit at the Exposition was made officially by the State. Although Kansas made one of the best collective exhibits in the Government Building, the mineral resources were but poorly represented. Among the few minerals shown the following were the most interesting and important: blende, crystallized in large slabs; calamine, very fine; galena, in large cubes, very fine specimens; pyrites, cockscomb variety, one splendid mass of several hundred pounds in weight; smithsonite, ores of zinc, lead ores and zinc bars manufactured at Pittsburgh; rocks and building stones, several varieties; also clay pottery, brick, etc.

The centennial vase, of a soft stone resembling volcanic ash, was presented by the ladies of Wyandotte City.

KENTUCKY.

Admitted a State June 1, 1792. Area, 37,680 square miles. Population in 1880, 1,648,690. Capital, Lexington. Floor space in Exposition, 13,100 square feet. The State is divided into 116 counties. The western part is nearly level. The southeastern portion is crossed by the Cumberland Mountains. The greatest altitude is 3,000 feet.

The mineral exhibit at the Exposition was not large but was very interesting. I regret that I cannot here describe the magnificent collective exhibit other than mineral, made by this State. In the private office of the Commissioner and officials connected with the State Geological Survey were numerous geological maps and publications and pamphlets setting forth the resources of the State, which were widely distributed.

The principal economic minerals found in Kentucky are coal and iron; of the former there were columns showing the thickness of the coal beds and great pyramids of cannel and bituminous coal, with characteristic fossils and descriptive information of great value. Petroleum and coke were also shown.

Of ores there are but few in the State. Lead in the form of galena with blende and fluorspar occurs, but not in paying quantities.

Of rocks and building materials—oolite and shell limestones, lithographic stone, fine in appearance but defective, owing to fine cracks in it; sandstone, silicious conglomerates, millstone grits, etc., were shown. A large number of five-inch cubes and a number of one-foot cubes, and still others in irregular masses, were also shown. A sample of fire-clay, said to be of excellent quality, but more resembling lithomarge than fire-clay, and potters clay called "Indianaite," were on exhibition; also bricks, glass sand, and building materials.

Of minerals there were shown fine specimens of galena, calcite, fluorspar, etc.

While the mineral display at the Exposition was so small it was interesting to be informed that the Museum of Natural History of Kentucky contains more than 40,000 specimens, and the museum attached to the Public Library has over 100,000 specimens, a large proportion of which are from the mineral kingdom.

I had the pleasure of meeting Mr. W. M. Linney, of the State Geological Survey, from whom I obtained publications and much valuable informa-

tion. A system of exchange was planned for the future, which will, I trust, be to the advantage both of California and Kentucky.

LOUISIANA.

State, April 30, 1812. Area, 41,346 square miles. Population in 1880, 934,946. Capital, Baton Rouge. Floor space at Exposition, 9,805 square feet. Louisiana is divided into 57 parishes, equivalent to counties. The surface of the State is generally low and level. The highest land is only 200 feet above the sea level. The known mineral resources are but small, and did not make a very large showing, although of considerable interest.

The following general description of the State, the City of New Orleans, the attractions and accommodations offered visitors to the Exposition, and account of the mineral exhibit, is compiled from the *Times-Democrat Almanac*, 1885, certain handbooks, and the newspapers:

GOVERNORS OF LOUISIANA—*Under French Rule.*

Sauvolle	1609
Bienville	1701
Lamothe Cadillac	1713
De L'Epinay	1716
Bienville	1718
Boisbriant, *ad interim*	1724
Perier	1725
Bienville	1732
Marquis de Vaudreuil	1742
Kerlerec	1753
D'Abbadie	1763

Under Spanish Rule.

Antonio de Ulloa	1767
Alexander O'Reilly	1769
Luis de Unzaga	1770
Bernardo de Galvez	1777
Estevan Miro	1784
Francisco Louis Hector, Baron de Carondelet	1787
Gayoso de Lemos	1792
Sebastian de Caso Calvo y O'Farril, Marquis de Caso Calvo	1799
Juan Manuel de Salcedo	1801

As a Part of the United States.

W. C. C. Claiborne, Territory of Orleans	1804
W. C. C. Claiborne, State of Louisiana	1812
Jacques Villere	1816
Thomas B. Robertson	1820
Henry Johnson	1824
Pierre Derbigny	1828
A. Beauvais (acting)	1829
Jacques Dupre (acting)	1830
Andre B. Roman	1831
E. D. White	1835
Andre B. Roman	1839
Alexandre Mouton	1843
Isaac Johnson	1846
Joseph Walker	1849
Paul O. Hebert	1853
Robert C. Wickliffe	1856
Thomas O. Moore	1860
Henry W. Allen, Governor under the Confederate Government	1864
Michael Hahn, Governor under the Federal Government	1864
J. Madison Wells (acting)	1864
J. Madison Wells	1865
Joshua Baker, appointed by the military authorities	1867
B. F. Flanders, appointed by the military authorities	1867
H. C. Warmouth	1868

John McEnery, Governor *de jure* 1872
W. P. Kellogg, Governor *de facto* 1872
Francis T. Nicholls 1877
Louis Alfred Wiltz 1880
S. D. McEnery 1881

THE CITY OF NEW ORLEANS—HISTORICAL AND DESCRIPTIVE.

The City of New Orleans was founded in 1718 by Bienville, the Governor from the French settlement of Biloxi, Mississippi, who sailed over from that place with his followers, landing at the Spanish Fort, on Lake Pontchartrain, four miles from the city; finally moved over to the river shore and started a settlement, in the locality of the French Market. He gave the settlement the name of New Orleans in honor of the reigning family of France.

New Orleans grew very slowly under French domination and had only attained a population of 3,000 inhabitants in 1769, when it (included in the Colony of Louisiana) was ceded to Spain. Some better progress was made under the Spanish rule by reason of the opening of trade relations with the Western and Northwestern States and Territories, immediately after the close of the Revolutionary War, so that in 1801, when the colony was ceded back to France, New Orleans contained about 8,000 inhabitants. In 1803 it was ceded by France to the United States. It then had a population of 10,000. In 1810 it had a population of 22,000. In 1830, 46,000. In 1840, 102,000. In 1850, 116,000. In 1860, 169,000. In 1870, 191,000. In 1880, 216,000. At this time about 240,000.

City Government.

New Orleans—Incorporated 1804. Reorganized in 1852, 1870, and 1882. Municipal election in April of every fourth year.

Mayor—J. V. Guillotte.
Treasurer—I. W. Patton.
Commissioner of Public Works—John Fitzpatrick.
Comptroller—J. N. Hardy.
Commissioner of Police and Public Buildings—Pat. Mealy.
City Attorney—Walter H. Rogers.
City Surveyor—D. M. Brosnan.

The City of New Orleans is situated in the alluvial portion of Louisiana, which at one time formed a portion of the bed of the Gulf of Mexico. It is located principally upon the east or left bank of the Mississippi River, about 106 miles from its mouth at the Jetties (South Pass). The city extends a distance of ten miles along the left bank of the river, with a width of settlement from a half mile to three miles.

The natural surface of the city is very nearly a level, with the drainage from the river back to the swamp and canals in the rear, and from thence to the lake. Lake Pontchartrain, four miles immediately north of the city. It is a body of salt water, having direct tidal connection with the Gulf of Mexico.

The Mississippi River enters the corporate limits of the city from the west, then turns sharply to the south, then to the east, then to the north (forming a crescent, from which the city receives its popular designation of the Crescent City), and finally turns and leaves the city in a southeastern course.

On the west or right bank, the suburbs of Algiers and Gretna are situated. Constant communication is kept up by means of steam ferries. The wharves of the city extend for many miles up and down both banks. Shipping of the deepest draft lie readily at the wharves. The channel of the river opposite the city shows depths running from 150 to 200 feet. The banks of the river are higher than the larger portion of the surface of the city.

The drainage of the city is surface or open drainage, and cellars or underground improvements for occupancy are not practicable. The principal business streets are paved with the large granite blocks. Some streets are paved with cobblestones, and St. Charles Avenue, from Lee Circle to Napoleon Avenue, has the asphaltum pavement.

The Street Railway System.

The City of New Orleans is favorably situated for street railways, and has an admirable system of them. Canal Street, a wide and beautiful thoroughfare, runs directly back from the river in a northwesterly direction, nearly equally dividing the city—especially dividing the old, or French portion (lower) from the new, or American portion (upper). Nearly all of the street car systems center on Canal Street. From that street nearly every portion of the city can be readily and promptly reached by them. There are six distinct street car companies, and twenty-four different lines. The rate of fare is invariably five cents.

Streets.

Streets run parallel with the river and at right angles with it. As the course of the river is that of circles it follows that streets run in all directions. Down town and business streets are generally quite narrow—from thirty to sixty feet wide. Many of the residence streets, like Esplanade, Claiborne, and Rampart in lower town, and St. Charles, Louisiana, and Napoleon Avenues and Jackson Street in upper town, are wide and capacious.

Streets change their names on crossing Canal Street.

Street Numbers.

Numbers run back on streets each way from Canal Street, and from the river back on all cross streets. Owing to irregularity in the size of squares the system of numbering is imperfect. Numbers run one to the lot, which in frontage vary from twenty-nine to thirty feet, and lots average about twelve to the block. On parallel streets the even numbers are on the river side, and on cross streets on the upper side.

Points of Interest.

A city of the age, historical associations, and cosmopolitan population of New Orleans cannot fail to present many points of interest. The St. Louis Cathedral (built in 1724) and the ancient Court Buildings on either side, the trio overlooking Jackson Square, are very interesting to the visitor.

Likewise the celebrated French Market (the most extensive and complete in the world) a couple of blocks further down the river. And still a couple of blocks beyond the market is the United States Mint, always an attractive object to visit.

The Granite Custom House, foot of Canal Street, the United States Barracks down on Lower Levee, and Chalmette Cemetery (United States) on the famous battle grounds of eighth of January, 1815, are places of deep interest to every stranger.

The different cemeteries, especially Metairie, Greenwood, and Washington, afford unique and interesting experiences to the stranger. A visit to the long line of wharves and to the multitude of shipping from all parts of the world, furnish a most interesting and valuable experience.

A visit to some of the cotton compresses in the city, of which there are a large number, would interest any one not familiar with the huge and powerful machinery used. Likewise would a visit to the sugar refineries.

The lower or French town, with its peculiar, quaint-tiled roofed structures, and flower-embowered courtyards, and Latin-tongued inhabitants, presents to the antiquarian and student constant surprises.

The cemeteries, or, as they may be appropriately termed, the sepulchers of the dead, afford such a contrast to those of other cities and sections that they prove attractive objects for visiting and investigation. The system of intra-mural burial, necessitated by the hydrographic condition of the soil, is peculiar to New Orleans. Metairie, Greenwood, and Washington Cemeteries are well worth visiting.

There are numerous parks well worth visiting; and several noted monuments and statues. Jackson's in Jackson Square; Franklin's in Lafayette Square; Lee's in Lee Circle; Clay's on Canal Street; Margaret's at Margaret Place—all will afford interesting study.

There are about 150 miles of street car lines in the city. A trip over every line will, in the experience secured, and in the different phases of life observed, repay the visitor for the time taken.

Suburban Resorts.

Notwithstanding the physical situation of New Orleans, surrounded as it is with cypress or open swamps, it possesses several very attractive suburban resorts. The oldest and formerly most widely celebrated is Milneburg, on the south shore of Lake Pontchartrain. It is reached by the old Pontchartrain Railroad, the first railroad actually finished in the New World, built in 1831. It is also reached by a shell drive or road. It possesses fine bathing facilities and first-class restaurants. From its wharves, during the Spring and Summer seasons, steamers run regularly to the resorts on the north shore of the lake—Mandeville, Lewisburg, Madisonville, Covington, and Abita Springs. Spanish Fort, a mile further to the west, has grown up to be a resort of unusual interest and magnificence. It has large, beautiful, and elaborate gardens, commodious hotels and restaurants, an immense hall, and a splendid theater and opera house. Trains reach it regularly on the Spanish Fort Railroad, leaving Basin at Canal Street. Fare fifteen cents round trip.

New Lake End, two miles still further west on the lake shore, has manifold attractions as well as the amplest accommodations as a suburban resort. It has a first-class hotel, kept in the best style, a large theater or opera house, and innumerable other accommodations. Facilities for bathing, rowing, sailing, and fishing are unrivaled here. Out of Bayou St. John steam and sailing craft in large numbers cover the lake and tributaries. The New Lake End Railroad, starting on Canal, between Carondelet and Baronne Streets, run regular trains. Fare fifteen cents round trip.

Tchoupitoulas line, green cars, green lights, starts every three minutes from Canal, near Camp, goes up Tchoupitoulas to the grounds, landing at entrance near Mexican National Headquarters Building. Fare five cents.

The time by street cars from Canal Street to the Exposition grounds is from thirty-five to fifty minutes.

Excursions by Land and Water.

The opportunities for interesting and instructive excursions are innumerable. On the Shell Beach Railroad, eighteen miles to old Proctorville and Lake Borgne; on the Louisville and Nashville (at one cent a mile excursion rates), to the famous watering places along Mississippi Sound; by the same route to Mobile and all points in Florida; by Morgan's Louisiana Railroad to the beautiful country of the Teche, the scene of Longfellow's popular Acadian romance and poem of Evangeline; by the same route to the remarkable

salt deposits of Petit Anse, 140 miles from the city; by this same route you cover Texas and Mexico.

By water you can go to nearly every point of the compass. Constant excursions run to the jetties, giving admirable opportunities of viewing famous sugar plantations and orange groves. Magnificent boats are constantly leaving the city, traversing the upper rivers and bayous, making short and long trips, nearly all having special excursion rates. By steamer you can reach all of the leading Gulf ports—Mexico, Belize, Honduras, Panama, the Bay Islands, Jamaica, Cuba, and the Florida ports.

Places of Amusement.

No city of its size has a greater *penchant* for diversion and amusement, nor goes to a greater expense for its gratification than New Orleans. Its inhabitants are indeed a pleasure-loving, a pleasure-seeking, and a pleasure-experiencing people. It enters into their business calculations and arrangements. Hence, opportunities are abundant, the supply keeping pace with the demand.

The famous French Theater de L'Opera, Bourbon and Toulouse, evidences the high taste and former extravagance of the people. It was built expressly for high or grand opera. A French grand opera troupe is now organizing in Paris to come over and give a season.

The Grand Opera House on Canal, the Academy of Music, and the St. Charles Theater on St. Charles Street, between Poydras and Perdido Streets, are the three legitimate theatrical resorts of the city. Legitimate dramas, grand and bouffe operas only occupy their boards. These theaters are under the able and experienced management of Mr. David Bidwell, one of the most sagacious theatrical managers of the country. Mr. Bidwell is the proprietor of the last two mentioned theaters. His influence and relations with the profession are such that he can always secure the best attractions, and New Orleans is constantly indebted to him for opportunities of theatrical enjoyment and experience equal to those of the first cities of this country.

As evidence of the character of entertainment afforded by Mr. Bidwell, the attractions presented by him at this writing (January 28) are as follows: Her Majesty's grand opera troupe (Mapleson's), among the members of which are Patti, Mlle. Nevada, etc., at the St. Charles, John T. Raymond (Col. Mulberry Sellers) at the Academy, and Aimee in French opera bouffe at the Grand Opera House.

Grunewald Opera House, foot of Baronne, presents attractions of a high class in drama, opera, and concert.

TULANE UNIVERSITY.

Administrators.

Senator Randall Gibson, President.
Chas. E. Fenner, First Vice-President.
James McConnell, Second Vice-President.
P. N. Strong, Secretary and Treasurer.
Dr. T. G. Richardson.
Edgar H. Farrar.
Cartwright Eustis.
R. M. Walmsley.
W. F. Halsey.
Ed. D. White.
Rev. B. M. Palmer.
Henry Ginder.
Governor McEnery.
Warren Easton.
Samuel H. Kennedy.
W. R. Stauffer.
J. T. Hardie.
Mayor Guillotte.

Professors.

Wm. Preston Johnston, President.
R. H. Jesse, Latin.
J. L. Cross, Mathematics.
Robert Sharp, Ph.D., English and Greek.
Brown Ayres, Physics, Chemistry, and Astronomy.
J. H. Deiler, German.
L. C. Reed, Principal of High School.
J. R. Ficklin, Vice-Principal of High School.
Alcee Fortier, French.
J. Armstrong, Latin and Mathematics.
A. S. Wheeler, Assistant Professor of Mathematics and Physics.
Walker Fearn, Spanish and Italian.
Geo. Gessner, Assistant Professor of Greek.
J. M. Ordway, Applied Chemistry and Technology.
F. J. Gustine, Penmanship.

RAILROADS IN LOUISIANA.

Chicago, St. Louis, and New Orleans; from New Orleans to Cairo, Ill., 571 miles; 93 in State; owned by the Illinois Central.

Clinton and Port Hudson; from Clinton to Port Hudson, 21½ miles; all in State.

Louisiana Central; from Port Allen to Lombard, 28 miles; all in State. To be extended to Opelousas.

Louisville, New Orleans, and Texas, a part of the Huntington (Chesapeake and Ohio) system; from New Orleans to Memphis, 450 miles; 90 in State.

Louisiana Western; from Vermillionville to Orange, Texas, 112 miles; 106 in State. Controlled by the Southern Pacific.

Morgan's Louisiana and Texas; from New Orleans to Alexandria, with branches to Houma, Thibodeaux, St. Martinsville, and Avery's Salt Mine, 265 miles. Controlled by the Southern Pacific.

New Orleans and Mobile (now leased to the Louisville and Nashville); 141 miles; 33 in State.

New Orleans Pacific (controlled by the Texas Pacific); from New Orleans to Shreveport and branch to Baton Rouge, 335 miles; all in State.

Mississippi, Terre aux Bœufs, and Lake Borgne; from New Orleans to Shell Beach, 19 miles; all in State.

Natchez, Red River, and Texas (narrow gauge); 16 miles; all in State.

New Orleans and Northeastern, part of the Cincinnati, New Orleans, and Texas Pacific system; from New Orleans to Meridian, 194 miles; 42⅞ in State.

Vicksburg, Shreveport, and Pacific; from Delta to Shreveport, 148 miles; all in State.

West Feliciana; from Bayou Sara to Woodville, Miss. Length of road 27½ miles; 20 in State.

Texas Pacific (Shreveport branch); from Marshall, Texas, to Shreveport. Length of road in State, 17 miles.

A FEW AUTHENTIC STATEMENTS ABOUT LOUISIANA.

Louisiana has a total area of 40,790 square miles, or 26,105,600 acres. This State extends down to 28° 50′ north latitude, and its northern boundary is 31°.

By the indentures of the coast bays and coast line between the mouths of the Sabine and Pearl Rivers, it has a front on the Gulf of Mexico of about 1,000 miles.

The inland water surface—bays, lakes, bayous, and rivers—have an area of about 2,328 miles, making the land and water surface about 43,000 square miles.

The hilly lands of Louisiana	12,332,920 acres.
Level lands, about	12,773,000 acres.

These lands may be classed as follows:

Good uplands	5,248,000 acres.
Pine hills	5,497,600 acres.
Pine flats	1,585,000 acres.
Bluff lands	1,587,320 acres.
Prairie region	2,483,000 acres.
Arable alluvial	3,615,000 acres.
Wooded alluvial (swamp)	2,752,000 acres.
Coast marsh	3,338,000 acres.
Inland water surface	1,228,000 acres.
Coast bays	1,100,000 acres.

Such is the irregular shape of these land and water surfaces that it is impossible to obtain an accurate statement about any of them.

Hernando De Soto.

"In the year 1539 Hernando De Soto, one of the most illustrious companions of Pizarro in the conquest of Peru, came with a thousand men of infantry and three hundred men of cavalry to the country of the Chickasaw Indians, and encamped in their territory in Mississippi."

He had with him gentlemen of the best blood of Spain. This was but forty-seven years after the discovery of America by Columbus, 393 years ago. Gayarre, in his History of Louisiana, says:

"Now De Soto is encamped in the territory of the Chickasaws, the most ferocious of the Indian tribes. And lucky was it that De Soto was as prudent as he was brave, and slept equally prepared for the defense or the attack.

"Hark! in the dead hour of a Winter's night, when the cold wind of the north, in the month of January, A. D. 1541, was howling through the leafless trees, a simultaneous howling was heard, more hideous far than the voice of the tempest.

"The Indians rush impetuous with firebrands, and the thatched roofs which sheltered the Spaniards are soon on fire, threatening them with immediate destruction. The horses, rearing and plunging in wild affright, and breaking loose from their ligaments; the undaunted Spaniards, half naked, struggling against the devouring element and the unsparing foe; the desperate deeds of valor executed by Soto and his companions; the deep toned shouts of 'St. Jago and Spain, to the rescue;' the demon-like shrieks of the red warriors; the final overthrow of the Indians; the hot pursuit by the light of the flaming village; form a picture highly exciting to the imagination."

Father Marquette and Joliet.

"One hundred and thirty years had passed away since the apparition of Soto on the soil of Louisiana without any further attempt of the white race to penetrate into the fair region, when, on the seventh of July, 1673, a small band of Europeans and Canadians reached the Mississippi, which they had come to seek from the distant City of Quebec. That band had two leaders, Father Marquette, a monk, and Joliet, a merchant."

Robert Cavalier De La Salle.

"Seven years after the expedition of Marquette and Joliet had rolled by, Cavalier De La Salle came to the mouth of the Mississippi with forty soldiers, three monks, and the Chevalier De Tonti.

"In March, 1699, Iberville and Bienville entered the mouth of the Mississippi.

"Sauvolle was the first Governor of Louisiana. He died in 1701, and was succeeded by Bienville.

"In 1706 the French girls brought to the colony were indignant at being fed on corn bread, and threatened to leave the colony on the first opportunity. This is called the petticoat insurrection.

"Thirty-five colonists died of starvation in 1705. After an existence of nine years the French colony in Louisiana did not exceed 279 persons. Its principal wealth consisted of 50 cows, 40 calves, 4 bulls, 8 oxen, 1,400 hogs, and 2,000 hens.

"In 1724 the white population of New Orleans amounted to 1,700 souls and the black population to 3,300 souls.

"In 1727 New Orleans had no levees, and was subject to yearly overflows. It was a vast sink or sewer."

In 1735 Bienville wrote:

"One hundred thousand pounds of tobacco are made at Pointe Coupee; two women raise silkworms for amusement and succeed very well; eggs should be sent by the government to the Ursulines, who would teach the industry to the orphans, whose education is intrusted to them. The cultivation of cotton is advantageous, but the planters experience great difficulty in cleaning it from the seed. Pitch and tar are made in some abundance.

"Balize Pass, which was sixteen feet deep in 1728, in 1738 was fourteen and one half feet, and which Bienville said was filling up rapidly, is now known as Southwest Pass.

"De Vaudreuil, Governor of Louisiana in 1744, commanded the planters to have their levees made.

"In 1744 the population of New Orleans was 800 souls, not including 500 soldiers and the women and children.

"A terrible hurricane in 1746, like that of 1740, destroyed the crops of the colony and would have reduced the inhabitants nearly to starvation had it not been for boats from Illinois that annually supplied them with flour.

"In 1751 the Jesuits sent some sugar cane from Hispaniola to the Jesuits of Louisiana, and some negroes who were used to the cultivation of this plant. The experiment was abortive, and though cane continued to be cultivated successfully, it was forty-four years (1795) before the manufacture of sugar was successful.

"Sixty-four girls were sent by order of the King of France by the same vessel that brought the first sugar cane. These girls were married to such soldiers as had distinguished themselves for good conduct. And these, in consideration of their marriage, were discharged from service. Such is the humble origin of some of the most respectable and wealthy families of Louisiana.

"In 1752 Michael de la Rouvelliere made a favorable report on the agriculture of Louisiana. 'The cultivation of the wax tree,' says he, 'has succeeded admirably. Mr. Debreuil alone has made 6,000 pounds of wax. Some went to the seashore, where the wax tree grows wild, in order to use it in its natural state.' It is the only luminary used here by the inhabitants, and it is exported to other parts of America and France."

[The wax myrtle still grows in great luxuriance on the banks of the bayous in the sea marsh and in numerous places in Southern Louisiana. It produces a small berry from which the wax is made. The wax has more the consistency of the best mutton tallow than of wax.—D. D.]

"In 1755 the Acadian settlement at Grand Pré, Nova Scotia, was broken up by the English, under command of General Winslow, and the inhabitants, 1,923 persons, were taken prisoners and most of them transported to different States. Their houses and barns were burned by the English, and their property confiscated to the crown.

"In 1767 there was a considerable emigration to Louisiana from the Alibamons and Illinois districts, which had been ceded to the English, and from the Province of Acadia, or Nova Scotia. This year about 650 Acadians had arrived in New Orleans, and from that town had been sent to form settlements in Attakapas and Opelousas, under the command of Andry. In 1762 Louisiana was ceded to Spain. In 1766 Ulloa, the new Spanish Governor, arrived; also 216 Acadians arrived.

"The census was ordered by Governor Ulloa in 1766, and the whole population of Louisiana consisted of 1,903 men and 1,044 women, married and unmarried—1,375 male, and 1,240 female children; total, 5,562. The blacks were about as numerous as the whites; but the population was somewhat reduced by an epidemic, resembling in some respects yellow fever.

"O'Reilly's administration under the Spanish Government continued to 1770.

"Louisiana was ceded to the United States by Napoleon Bonaparte in 1803–4, for $9,375,000.

"Bonaparte, after the sale of Louisiana, said: 'This accession of territory strengthens forever the power of the United States; and I have just given to England a maritime rival that will sooner or later humble her pride.'

"The day may come when the cession of Louisiana to the United States shall render the Americans too powerful for the continent of Europe."

Wealth Locked Up in Louisiana Soil.

The most of Louisiana soil is rich. The pine hills and pine flats are usually considered poor, but under high cultivation the most of these lands may be made very productive. They contain most of the elements of a good soil, and only need humus and lime to make them rich.

The following is by an anonymous writer in a late New Orleans newspaper:

Some of the prairie land is poor, but most of it is rich.

The good uplands are productive.

The bluff lands are composed chiefly of fine silt, and are very productive. Some of the finest forests and noblest trees in the State are on bluff lands.

The arable alluvial lands are all rich, most of them wonderfully productive.

Wooded alluvial, or swamp lands, are all the richest lands in the State. When reclaimed and properly drained they will produce crops for centuries equal to the richest lands of the Nile. The subsoil is as rich as the surface soil to the depth of ten or fifteen feet. Underdrained, the value of this soil could not be surpassed on this continent or in the world.

The coast marsh soil is usually rich, made up of vegetable and animal matter and shells, abounding in humus and lime, two invaluable fertilizers. Posterity will convert the lands on the Louisiana coast and the swamp lands into gardens, and orchards, and meadows, and fields more beautiful than anything ever seen on this continent. Fruits and underdrains will drive malaria and mosquitoes and other annoyances from these wet regions, and health, beauty, and fertility will spring up in their places.

It can be easily demonstrated that the soil of Louisiana, in a high state of cultivation, is capable of producing the following crops:

The cotton lands—1,000,000 bales of cotton of 400 pounds each.

The sugar lands—1,500,000 hogsheads of sugar of 1,100 pounds net, or 825,000 tons of 2,000 pounds, and 2,500,000 barrels molasses, 40 gallons net.

The rice lands—3,000,000 bushels, or 1,000,000 barrels of rice, 230 pounds net.

The corn lands—100,000,000 bushels corn.

Also, 100,000,000 bushels rust proof oats, rye, barley, and other small grains; 50,000,000 bushels sweet potatoes; 20,000,000 bushels of peas and beans; 10,000,000 gallons of honey; 1,000,000 tons of hay.

Broad surfaces of meadows and pastures capable of making three to five tons of hay to the acre. Add to this 1,000,000 acres devoted to fruits—oranges, figs, strawberries, grapes, pears, apples, peaches, plums, and other fruits adapted to varieties of soil in different portions of the State.

The treasures of natural fertilizers in our vast and numerous shell banks, in our swamps, in the bottoms of our bayous, vegetable deposits ten to twenty feet deep, and our field pea, more valuable than all of the other fertilizers named.

Millions of cattle, horses, mules, swine, sheep, goats, domestic fowls, etc., can be made profitable in this State.

Numerous factories may be and will be built up in the State to work up raw materials, cotton, wool, jute, ramie, yucca filamentosa, etc., and for canning fruits and vegetables, oysters, shrimps, and other things—the oyster fields and fisheries may be made to yield $15,000,000 yearly.

Louisiana at one time since the war had but 2,045,000 acres of land in cultivation, and never cultivated 3,000,000 acres; and yet she has made in one year crops worth at the market prices nearly a hundred million dollars.

Tobacco Culture in Louisiana.

Tobacco, rice, and indigo were the principal staple productions of Louisiana a hundred years ago. In 1793 and later, in consequence of the ravages of insects upon the indigo plant, a greater impetus was given to the cultivation of tobacco.

In 1802, 2,000 hogsheads of tobacco were exported from New Orleans, and tobacco was cultivated all along the river as high up as Natchez.

About 1785, Pierre Chenet, a descendant of the Acadian French, discovered a process of curing that gave rise to the perique tobacco. The cultivation of perique tobacco is confined chiefly to the parish of St. James, about fifty miles above New Orleans. This tobacco, put up in carrottes usually weighing four pounds, but sometimes two pounds and less, is strong, rich, gummy, tough, and dark, with a shining luster.

Wheat in Southern Louisiana.

Before the country on the Ohio River was settled up and cultivated, and before the flatboats of the West brought flour, and corn, and bacon to Louisiana, the old inhabitants of Iberville parish, and other parishes, made their own wheat. It is not certain that some kind of Winter rust proof wheat would not do well now in some portions of the sugar parishes of Louisiana. It is raised in the upper parishes.

The Live Stock of Louisiana and its Productions.

The live stock on the farms of Louisiana alone, not those of towns and cities, on June 17, 1880, amounted to 651,703 head, as follows: 104,428 horses, 76,674 mules and asses, 41,729 working oxen, 146,454 milch cows, and 282,418 other cattle.

The number of swine amounted to 633,489; the number of sheep 135,631.

The Louisiana wool crop in 1881 amounted to 406,678 pounds, averaging three pounds to a sheep.

There were but 916,089 pounds of butter made on Louisiana farms in 1879, about 19 pounds to a farm (48,292 farms).

There were but 7,618 pounds of cheese made in Louisiana that year, and but 29,579 tons of hay, averaging less than one ton of hay to a farm. Most of the farmers made no hay at all, leaving the cattle to live by the principle of "root hog or die."

The Chicken and Egg Crop.

Louisiana had 1,490,907 barnyard and other fowls in 1879, and the egg crop is put down in the census at 3,392,246. If a million hens had laid but 12 eggs each in a year it would have given 12,000,000 eggs. There must have been a great many eggs stolen and not accounted for in 1879.

Sugar, Molasses, and Honey—Cotton.

Louisiana, in 1879, made 171,706 hogsheads of sugar (about 94,438 tons), 11,696,248 gallons molasses, and 400 pounds of sorghum sugar and 33,777 gallons of sorghum syrup, and 168,441 pounds of honey.

The cotton crop amounted to 864,787 bales; the rice 23,188,311 pounds.

Potatoes and other Farm Products.

The sweet potato crop of Louisiana in 1879 was 1,318,110 bushels; the Irish potato crop 180,115 bushels; the tobacco crop 55,954 pounds; 9,889,689 bushels of corn; 229,840 bushels of oats; 5,034 bushels of wheat raised in the north part of the State.

The farmers of Louisiana make their crops under very trying difficulties of numerous kinds, which we cannot now particularize.

LOUISIANA MINERALS AT THE EXPOSITION.

The exhibit of the "Pelican State" at the World's Exposition has proved a revelation to many people from abroad and some from home, regarding the varied products of the State. Sugarcane and the sugar made therefrom, cotton and Spanish moss were expected by everybody, but many features of the exhibit are totally unexpected and have called forth expressions of surprise from many visitors. Of these features perhaps the most striking is the

Mineral Exhibit.

The many people from other States who have looked upon Louisiana as being mainly an immense bank of black earth covered with the rank vegetation of tropical countries, will be surprised to learn that in that State are found coal, iron, petroleum, gypsum, sulphur, and salt. Of these the latter is the most important, and is produced in the largest quantities.

The mineral display in the Louisiana exhibit contains, in addition to the specimens of the above mentioned minerals, many specimens of interest both to the geologist and the casual spectator. The petrifactions shown are marvelous. Huge trees are turned into stone while preserving the woody fiber and bark.

The excellent mineral exhibit of Louisiana was collected and installed by Mr. Ed. Enderlee, Special Geological Commissioner, to whose skill and energy great praise is due.

Coal.

Like the deposits of iron, the coal seams of the State are almost entirely undeveloped. Yet sufficiently large quantities have been discovered to indicate that the productive coal fields of the State are far greater in area than has hitherto been supposed; a fact of much importance in connection with the development of the iron mines noted above; the coal found is of a variety known as lignite, which has been successfully used as fuel in Shreveport and other interior towns. Deposits of this coal underlie nearly the whole upland country, from the Sabine to the Ouachita River. Specimens are sent for exhibition from Bienville, De Soto, and Webster Parishes, in two of which the deposits of coal accompany those of iron.

Petroleum is found in Calcasieu Parish, about sixty miles from the coast. Large quantities of carburetted hydrogen gas pass out of the oil spring in a continuous stream, and can be used for lighting and heating purposes by merely being conducted in tubes.

Iron.

The iron of the State is found scattered in immense quantities over an extensive section of Louisiana. North of the Red River iron ore is found from Ouachita to Badian River, and from the Arkansas line it extends nearly to the Red River; south of this it appears in De Soto, Natchitoches, Rapides, and Sabine. Bienville Parish is singularly rich in iron ore, and great forests of pine and oak, necessary for furnishing charcoal, accompany the metallic deposit. Bienville Parish sends to the mineral exhibit of the State a large block of iron ore (*limonite*) weighing about two tons, together with various other mineral specimens. From Bossier Parish comes a large block of hematite, the analysis of which shows it to contain 44.85 per cent of metallic iron. Claiborne Parish shows limonite containing 52.40 per cent of metallic iron. Webster Parish sends iron ore in various forms containing 49.5 per cent metal. In the cases of hand specimens are shown several more specimens of iron ore from different parishes of the State, indicating that the range of the iron deposit is very wide.

Salt.

North of Red River, in Bienville and Bossier Parishes, there are immense quantities of saline waters and saliferous deposits, the latter being especially found in the beds of ancient lakes. In the low flat beds of these basins, which lie below the ordinary level of the country, the wells are sunk to a depth of from twelve to twenty feet, where the salt water percolates through the soil and furnishes an abundant daily supply. This is boiled in kettles, and each well furnishes from twenty to twenty-five bushels of salt per day.

In a line beginning about twenty miles west of the mouth of the Atchafalaya, on the coast of Belle Isle, and running nearly due east, are ranged five islands—Belle Isle, Cote Blanche, Week's Island, Petit Anse, and Miller's Island.

The islands rise from the low marsh and prairies by which they are surrounded, and form mounds of various sizes. The chief of them is Petit Anse (Avery's Island), which is 185 feet above the sea-tide level, and contains an immense deposit of common salt. Petit Anse is situated in Bayou Petit Anse, six miles from the north shore of Vermilion Bay, which is an arm of the Gulf. It is fifteen miles to the mouth of that bay, where there is a fine land-locked harbor of eight feet depth.

The following are the general results of the chemical analysis of Louisiana rock salt: Louisiana rock salt presents the form, appearance, and optical properties of pure chloride of sodium. The large crystalline masses are so perfectly transparent, free from all extraneous matter, and uniform in their structure and density, that they would be suitable in all respects for the most delicate philosophical experiments upon the transmission of light through different media.

The sample of Louisiana salt submitted to analysis, as well as the largest masses, weighing several tons, are of remarkable purity. This very valuable natural product of Louisiana is represented at the Exposition by large quantities of the native product as it comes from the mines; also cut and carved into various forms and sizes, and ground into table salt and packed in bags.

Sulphur is also found in Calcasieu, and in such prodigious quantities that this one deposit could supply the whole country with sulphur and with the gypsum that occurs with it. The sulphur is of unequaled thickness and purity.

These descriptions, from the very best authority, leave but little more to be said. The minerals that most attracted my attention were the following:

Four cases shown by the New Orleans Academy of Sciences, containing some fine minerals and fossils.

Of rocks and building stones but few were shown. There were some excellent bricks, common and pressed; some were curiously mottled. Some good pottery and terra cotta were also shown, and limestones from Shreveport; some newly discovered veined marble, sandstones and white sand, suitable for glass making.

Fertilizers were represented by marls, containing fossil bones and green sand marl.

There were some good gypsum and selenite from the saline basins; limonite from Webster and other parishes, and salt, in a large pyramid, from Iberia, also among the mineral exhibits.

MAINE.

Admitted a State, March 15, 1820. Area, 31,674 square miles—another estimate, 35,000 square miles. Population in 1880, 648,936. Capital, Augusta. Floor space at Exposition, 4,417 square feet. The State is divided into 16 counties. The surface is generally hilly and mountainous. The highest point, Mount Katahdin, has as elevation of 5,200 feet above sea level. Maine is not specially a mineral State. It is noted, however, for its fine building stones and for its lime, which is extensively manufactured and exported. There are some promising deposits of iron, and mines of lead, zinc, silver, and copper. The roofing slates are very fine.

The exhibit at the Exposition was made officially by the State. The mineral department was not large. There were ten cubical blocks of granite of about one foot face, specimens of galena, blende, chalcopyrite, mica, graphite, native silver, and silver ore from Deer Island, quartz and feldspar

from Auburn, tin ore from Winslow, terra cotta, including drain pipes and large vases. It is not generally known that gold has been produced in Maine. The precious metals deposited in the United States Mints up to June 30, 1883, was as follows:

Gold	$5,592 69
Silver	22 00
	$5,614 69

MARYLAND.

One of the original thirteen States. Area, 11,124 square miles. Population in 1880, 934,943. Capital, Annapolis. Floor space at Exposition, 8,262 square feet. The State is divided into 23 counties. The surface of the eastern shore is generally low and level. The northwest is mountainous. The Alleghany Mountains cross the State, but do not rise to a great height. In the bare hills near Baltimore chromic iron was found in large quantities and was extensively mined and exported, principally to Scotland. It was for many years a noted locality, but the deposits, if not exhausted, are at least less productive, and the demand for that useful mineral is now to a large extent supplied by California. There are some mines of copper in the State, and iron ores are raised and smelted in numerous blast furnaces. Limestones and marbles of good quality are found. The serpentines are worked for magnesia. Maryland has extensive coal fields which are largely worked. The celebrated Cumberland coal comes from this State. Some gold has also been found, although the amount is but small. Maryland is credited with a deposit of $1,600 15 in the Mints of the United States.

The Maryland collective exhibit at the Exposition was by the State and the City of Baltimore. An appropriation of $5,000 was made by the State. Some of the minerals and natural history specimens were sent by the Academy of Sciences of Baltimore and arranged by Professor Otto Lugger.

The mineral exhibit was large and important. The best specimens were placed on flat table cases. The collection consisted of minerals, rocks, fossils, ores, and manufactures. Of minerals the following were the most interesting: asbestus; chalcopyrite, fine; hematite; limonite; quartz crystals, large and fine; serpentine; stalactites; steatite.

Of rocks and building materials there were shown: building stones in many rare and beautiful varieties; bricks, white and red; clays; granite; glass sand; hydraulic cement; marbles. On a special table were placed a variety of marbles and breccias of various colors and varieties, some very fine and beautiful. One piece was a fac simile model of the Washington Monument, five feet high, made of the same marble, from the Beaver Dam Marble Quarries, Baltimore County.

Slates of the best quality for roofing, called peach blossom slate. There was also shown terra cotta in considerable variety. One very artistic panel represented a group of boys in a laboratory, playing with an electrical machine. There were also ornamental, glazed, and pressed brick, fire-brick and ornamental tiles. One of the most beautiful specimens of this class shown was a block of green, verde antique marble, the finest I have ever seen. It was 8x10x4 inches, beautifully polished. A slab of this stone was exhibited at the Paris Exposition of 1878, where it attracted much attention and was greatly admired.

Of fossils, there was a large exhibit in flat table cases. It included palæontological specimens from the Hamilton, Medina, Permian, and Coal measures. The coal flora was specially fine. There were also two

cases of Tertiary fossils, including many shark teeth, resembling those from South Carolina. All the fossils were from the State.

The ores were displayed on large terraced tables. They represented considerable variety, and were of importance. The iron ores and coals were shown in large quantities, the latter in cubical blocks.

A special exhibit of manufactured copper was made by the Baltimore Copper Company; some of the copper sheets were very large.

A case of Maryland minerals was loaned to the State by A. E. Foote, of Philadelphia. It contained many large and showy specimens, but they were not labeled. One specimen of native gold in quartz from near Alexandria was quite a surprise, as I had no idea quartz could be found in that locality.

A very interesting and remarkable ethnological collection was exhibited by Prof. S. V. Redizer, of Zion School, Baltimore.

A special exhibit was made by the Baltimore and Ohio Railroad Company. One of the most interesting specimens was an exquisitely sculptured block of blue sandstone from Cheat River. The Johns Hopkins University building, in Baltimore, is built of this stone. The block was about ten inches cube. This company showed also coke, iron, granite, iron ores, coal, limestones, building stones, bricks, enameled and pressed, and ornamental tiles, terra cotta, etc. All the specimens were fine.

MASSACHUSETTS.

One of the original thirteen States. Area, 7,800 square miles. Population in 1880, 1,783,085. Capital, Boston. Floor space in Exposition, 7,031 square feet. The State is divided into 14 counties. The surface is diversified. The western portion is mountainous; further east lies the valley of the Connecticut River. The eastern and northeastern portion is hilly, and the southeastern generally low.

The principal mineral resources of the State are building stones, principally granite; iron ores, and a few of lesser importance. Attempts have been made to work certain trivial veins of lead, containing a little silver, gold, and copper, but without successful results. Up to June 30, 1883, Massachusetts silver was deposited in the United States Mint to the value of $917 56.

The collective exhibit at the Exposition was made by the State officially. The mineral exhibit was not large, but the specimens were all exceptionally fine and well selected. The building stones were highly finished and polished.

Of the minerals shown the following were the most important and interesting: beryl, one large crystal, 5 inches in diameter, was from Royalston; chalcopyrite; feldspar, used in making glass; garnets, fine; graphite; limonite; pyrite, used in making sulphuric acid; quartz, used in glass making and in pottery; spodumene.

Of ores, there were some iron ores, and a large specimen of quartz, said to contain gold, from Medford.

Rocks and building stones were represented by many fine specimens, including an exquisite column on pedestal. The column was partly polished and chiseled to show a vine in polished relief.

Marble dust very extensively used and scythe stones of mica schist.

Fine red terra cotta tiles, ornamented bricks, and elegant vases were also shown, and fine slabs showing tracks of birds and animals, and others with ripple marks and rain drops. These were very interesting.

MICHIGAN.

rritory, June 30, 1805. State, January 26, 1837. Area, 58,915 square s. Population in 1880, 1,636,937. Capital, Lansing. Floor space in osition, 6,750 square feet. The State is divided into 77 counties. It is ded naturally into two peninsulas bordering on Lake Superior, Lake higan, Lake Huron, Lake Erie, and Lake St. Clair. The southern insula is generally low and flat, and is devoted to agriculture. The hern is rugged and mountainous, with streams falling so rapidly as to rd abundant water power.

he summits of the Porcupine Mountains rise to an altitude of 2,000 feet. northern peninsula affords an abundance of valuable minerals, the cipal being copper, iron, salt, slate, and gypsum; the first is the most ortant and valuable. The yield of metallic copper from 66 mines dur- 29 years, from 1855 to 1883, was $386,659\frac{1934}{2000}$ tons, the value of which $172,035,566. The above figures are taken from a statistical table by P. Swineford, Commissioner of Mineral Statistics, 1884. From the same lication we learn that from 1860 to 1883, inclusive, salt was produced the extent of 27,547,727 barrels; from 1866 to 1883, inclusive, gypsum manufactured as follows: ground plaster, 734,675 tons; plaster of is, 1,234,943 barrels of 300 pounds each.

n 1845 iron ore in paying quantities was found. The first iron manu- tured was in bloomeries. In 1858 the first iron furnace commenced rations, since which pig iron has been largely produced. Coal is mined small way. The copper mines of Lake Superior were anciently worked a people who used stone axes and hammers. There was no tradition ong the Indians showing that the mines had been worked. On *Isle yal* a multitude of battered stone hammers have been found. The plan opted by the ancient miners to obtain the metal seems to have been the ilding of fires on the outcroppings and sudden quenching the hot rocks h water, by which they became cracked and partially disintegrated. ey were then broken down with stone hammers and the copper picked or ken out. There is no reason to suppose that they melted the metal, but was most probably hammered into articles of use and ornament.

The principal copper mines are on Keweenaw Point and Isle Royal. chigan is the most productive copper region in the world except Chili. e metal is associated with silver, not in the form of an alloy, but in joined asses. This association is very remarkable. Ontonagon, Houghton, and eweenaw are copper producing counties. The principal iron mines lie Marquette County. At one time the production of iron was greater than at of any State except Pennsylvania. Both silver and gold have been oduced in considerable quantities. The precious metals deposited in the ited States Mints up to June 30, 1883, from Michigan:

ver	$3,528,339 72
ld	139 71
Total	$3,528,479 43

The exhibit at the Exposition was made officially by the State.

The mineral department was valuable, extensive, and instructive. Fifty- ve mines of copper and iron were represented, and one of gold and silver. e most important mineral exhibit was of copper and iron in the form of es, metal, and manufactured articles. In the mines the copper is nearly

all found in a metallic condition; sometimes in large masses, at others disseminated through a trachytic rock with epidote. This is crushed, concentrated, and the copper melted. Large masses are not so easily handled. When not larger than five or six tons they are hoisted out and placed in reverberatory furnaces where they finally melt and run into kettles from which the metal is ladled into ingot molds. If larger they must be cut. This is an expensive operation as well as difficult and laborious. After many experiments it has been found most practical and economical to cut with cold chisels into masses of the above size or less. The cutting is done by hand at an average cost of one dollar per superficial inch of surface. Contracts are sometimes made at a less rate. Ingots of red copper were shown, also copper bars and magnificent ores of copper from the various mines. One special case was devoted to the display of specimens of rare beauty and richness. The difference between the copper ores shown by Arizona and by Michigan was very remarkable. The Detroit Copper and Brass Company showed copper and brass wire sheets, rivets, and copper bottoms for teakettles and wash boilers, tinned on one side.

Some large and fine specimens of iron ores were shown. They were hematite, magnetite, and specular iron.

One specimen of gold quartz was labeled as assaying from $3 to $80 per ton. From the appearance of the rock I was compelled to take this statement with considerable allowance.

Fine building stones were shown. Some fine grained sandstones and brown slates, of excellent quality, and in every way suited for roofing. The slate could also be cut into pieces suitable for use as billiard table tops. The slates come from Baraga County.

Gypsum of excellent quality was shown from Grand Rapids. It is largely used as a fertilizer, and for building and other purposes.

A preparation called "alabastine" was exhibited from Grand Rapids, which is used as a substitute for kalsomine. The base is calcined gypsum. It is in the form of a white or colored powder. For use it is mixed with boiling water and laid on the wall with a brush. It is said to be extensively used.

Large quantities of salt, both crude and manufactured, were also shown.

MINNESOTA.

Territory, March 3, 1849. State, May 11, 1858. Area, 83,531 square miles. Population in 1880, 780,773. Capital, St. Paul. Floor space at Exposition, 10,175 square feet. The State is divided into 75 counties. Minnesota is a plateau State, lying nearly in the center of the continent. It forms a catchment basin in which three of the great river systems of North America head. The St. Lawrence, the Mississippi, and the Red River of the North all have their fountains in this State. The highest land in the State is 1,680 feet above the sea-level, and the average altitude is 1,080 feet. The principal economic minerals found in Minnesota are iron, copper, slate, limestone and other building stones, peat, and salt. Ores of gold and silver have been discovered on the shores of Vermilion Lake, but the quantity and quality are unknown.

The collective exhibit was made officially by the State, and an appropriation of $32,000 was provided for that purpose. The mineral exhibit was

under the charge of Prof. N. H. Winchell, State Geologist, assisted by his son, Horace V. Winchell. The most important part of the collection was from the general museum of the University of Minnesota, geological and natural history survey. This consisted of specimens of nearly uniform size, embracing the rocks and minerals of the State, all very fine and well selected. There were cases filled with characteristic fossils; also a large collection of geological maps, photographs of scenery, etc. Many copies of the geological surveys of the State were distributed. The most prominent specimen in this exhibit, and the most imposing in the building, was a monument of stone weighing 21 tons, from the quarry of W. B. Craig & Co.—the Mankato Empire stone ledge.

This quarry has been opened about twenty-five to thirty years, but has not been worked extensively until purchased by the present owners three years ago; has a frontage of 1,500 feet; is opened to full depth of ledge, about 40 feet, consequently can furnish any dimension desired in the way of bridge stone, coping, engine beds, flagging, sawed work, flooring, tiling, and all kinds of house work. This quarry, having been worked so extensively for the last three years, is now in condition to furnish a better quality of stone than ledges generally do.

Mankato ledges have furnished stone for the arch bridge at Minneapolis, Blair bridge on the Missouri River, a large number of bridges on the Minnesota and Blue Earth Rivers, Seventh Street improvement arches, St. Paul, piers on Cedar and Iowa Rivers, piers on C. & N. W., C. St. P. M. & O., M. & St. L. roads, piers for N. P. railroad bridge, Superior, St. Louis River, curbing, guttering, and paving for St. Paul, Minneapolis, and Omaha, building stone throughout the States of Wisconsin, Iowa, Nebraska, Minnesota, and Dakota Territory.

This monument is more fully described in the following paper on the mineral exhibit, by Professor N. H. Winchell, State Geologist, specially prepared at my request:

THE MINERAL EXHIBIT OF MINNESOTA AT THE NEW ORLEANS EXPOSITION, BY N. H. WINCHELL, STATE GEOLOGIST.

Of the actual mines of this State but little can be said, since the iron mines, situated near Vermilion Lake, are the only ones in existence in the State. Great hopes and expectations, however, are lately excited by reports of gold and silver discoveries in the northern part of the State, but these reports lack confirmation by reliable authority, and may turn out like many another *ignis fatuus* of the prospector.

The mines at Vermilion Lake were opened last year on a large and systematic scale, the output of iron ore, in about two months, being about sixty-two thousand tons. It was carried by vessels on Lakes Superior, Huron, and Erie to furnaces at Cleveland, Buffalo, Pittsburgh, and other eastern cities. It comes at once into competition not only with the carboniferous iron ores of Pennsylvania and Virginia, but with iron ores of the same grade taken from the iron mines in northern Michigan and Wisconsin, which are in the same geological horizon as the Vermilion mines. These iron ores are hæmatite with small quantities of non-titaniferous magnetite and göthite.

About twenty-five hundred pounds of this iron ore were exhibited in the departments of geology, fauna, and flora of the Minnesota State exhibit.

Repeated assays give a content of 66 to 69 per cent of metallic iron, from .03 to .06 of one per cent of phosphorus, and from less than 1 per cent to 5 per cent of silica, with no appreciable amount of sulphur. These analyses show that the ore is sufficiently low in phosphorus for bessemer use, and ought to rank among the best in the United States. The mines are farther west than any now existing in the Lake Superior district, and probably will ultimately control a large market extending over the western country. They should not long be compelled to send their products to the Eastern and Middle States for smelting and manufacture, whence the same iron is again sent west, perhaps passing through the State of Minnesota to find its place of consumption. The freightage of the manufactured products directly from Minnesota to supply this western demand, will ultimately be seen to be so much cheaper than the carriage of the ores east and the manufactured article again west, that the ways and means for avoiding this double transportation will be sought and found by the shrewd capitalists of the State. Such articles would compete successfully in the western markets with those of eastern manufacture. The coal of Iowa or Illinois would have to take the place of that of Pennsylvania, unless charcoal could be substituted.

In the existence and exploitation of such bodies of iron ore the whole nation takes a deep interest. It opens out another of the avenues in which flow the wealth and industry of the American citizen, and through which return the elements which make up our civilization, and the power that enables us to maintain our rank among the nations of the earth.

These mines are all owned and managed by the Minnesota Iron Company, of St. Paul.

Various other minerals, though not of metallic value, were to be seen in the same exhibit. One of the most curious, and one that has an archæological and poetic interest attached to it, is the famous *catlinite*, or red pipestone, of which numerous articles, as well as calumets or peace-pipes, have been made by the Indians, specimens of which were on exhibition. For a full description of this mineral and of the locality, consult the Final Report on the Geology of Minnesota, vol. I, pp. 537–543. This is the material of the great peace-pipe of which Longfellow writes in his legend of Hiawatha; a legend which was still further illustrated by the little artificial waterfall, a faithful reproduction of the falls of Minnehaha, which splashed a few feet distant.

Another interesting mineral was *thomsonite*, a zeolite from the cupriferous rocks of the north shore of Lake Superior, which exhibited many colors, and, if a little harder, would be very valuable as a gem for jewelry setting. When cut and polished, or when polished without cutting, its internal radiated structure is shown on the surface in cats'-eye forms, or in alternating bands of color which anastomose in a fibrous suture, encircling the whole exterior of the specimen. These specimens vary from white and cream color to red, through pink, and to green. Some specimens that are wholly of a sub-translucent green color have received the name *lintonite*, and considerably resemble, outwardly, the gem chrysoprase.

In this exhibit, also, were numerous specimens of the green-star mineral from Isle Royale, *chlorastrolite*, which is a zeolite from the copper-bearing rocks of Lake Superior. It weathers out as the trap rock decays, and is found among the gravel stones on the beach of the lake. It takes a good polish and its color is spotted light and dark green. Besides these, various other zeolitic minerals from the igneous rocks, and all the usual minerals of the archæan rocks, were to be seen in this exhibit. The crystalline rocks were represented serially by hand samples dressed three inches by four inches and about one inch thick. Two large masses of native copper, one found at Taylor's Falls, and one, weighing eight pounds and containing a large per cent of silver, alloyed with the copper, found at Temperance River, on the north shore of Lake Superior, in the State of Minnesota, were objects of much curiosity and examination. These samples have been derived from the copper-bearing rocks by the natural decay of the rocks and the transporting agency of the glacial epoch. Such are not infrequent in the drift deposits in the eastern portion of the State. Yet, notwithstanding these indications of the presence of copper in these rocks, and after considerable prospecting and some shafting into the beds in favorable localities, no successful mining of copper has yet been done in the State.

Besides the foregoing, and not mentioning especially the exhibit of stoneware from Red Wing, kaolinic and pottery clays, and the soils, which were displayed in covered glass jars, the roofing slate, the red pressed brick from Dresbach and Duluth, nor numerous objects of geological interest, the Minnesota exhibit contained a full series of the native building stones of the State, embracing granite, gabbro, sandstone, quartzite, and limestone. The granites were represented by a monument rising about sixteen feet, from the quarries at East St. Cloud, in Sherburne County, supplied by Breen & Young, who own and work the quarries. This is a gray firm medium grained granite, containing hornblende, capable of sustaining a pressure, according to the tests of General Q. A. Gilmore, of 28,000 pounds per square inch. Besides this monument, several cut blocks a foot square illustrated this stone. Mr. Quimby, of Duluth, exhibited a small monument of the gabbro, which he works, showing on one side a beautiful polish. This is generally known as "Duluth granite" though in no sense a granite if the term be properly used. This rock consists of labradorite, principally, and of diallage and magnetite. Very rarely can any of the internal iridescence that labradorite frequently exhibits, when partly decayed, be seen in this rock. It cuts easily, *i. e.*, more easily than granite, because it contains no quartz, but it is tough rather than hard, and hence does not break under a blow from the hammer as easily as granite. Its strength is 27,250 pounds per square inch. Before the close of December, Mr. Quimby's monument was sold to Mr. George Stroud, marble dealer, of New Orleans.

The potsdam quartzite, from Pipestone County, was exhibited by several cut blocks and by a large glaciated slab, and by another curiously ripple-marked slab. This rock, though very hard, is being considerably used. It can be broken with facility. Its fractured edges are straight, and the builder can avail himself of the natural surfaces as broken from the quarry, in the dressing of his blocks for the building, thus avoiding much of the cost of facing. Its color is red or light red, and its strength under pressure is 27,750 pounds.

The sandstones exhibited were from the Upper Cambrian (St. Peter, Jordan, and St. Croix formations), and were rather soft and friable to serve extensively for general building. It is possible that after the quarries are more wrought the hardness of the stone will increase. They were from Jordan, in Scott County, from Dresbach, in Winona County, and from Hinckley, in Pine County. The last mentioned is a promising sandstone. It has a medium sized grain, and a reddish-buff color, and greater hardness than any of the others. It is mainly silicious, while those from Jordan and Dresbach are also feldspathic and even micaceous. Besides these sandstones, which are light colored or gray, a brown sandrock quarried at Fond du Lac, was also exhibited in blocks cut one foot square. This is a durable and valuable building stone, though evidently also feldspathic.

The dolomites or dolomitic limestones played a very important part in the mineral exhibit of Minnesota. Cut blocks, one foot square, were exhibited from Red Wing, Frontenac, Winona, Stillwater, Mankato, Kasota, and Nininger. These were all very similar buff dolomites, but containing a noteworthy per cent of silica. They are extensively used for building, and have acquired throughout the northwest an enviable reputation for their excellent qualities. They are in heavy beds, easily wrought, very durable, have a light and attractive clean exterior, and can be cut into ornamental forms with safety. The Frontenac stone especially, which stands among the first, and was also exhibited in a baptismal font 3½ feet high, cut entirely from one block, has a finely porous, open structure; the Kasota stone has a light yellowish-pink or "fawn-color," and the Winona and Red Wing samples were of a light buff, similar to those from Nininger and Stillwater, though somewhat more coarsely vesicular. The Mankato stone was exhibited by one of the most imposing objects in the whole building. This was a spindling monument, four feet square at the base, made of nineteen blocks, rising thirty-three feet above the floor. This was surmounted by a staff which supported a gilded crescent, which, on either side bore the motto *L'Etoile du Nord*. Slightly above the crescent, resting upon an invisible wire, glittered a golden star, the highest object erected within the building. This monument was designed and constructed by W. B. Craig & Company, of Mankato, and was intended to show the alternations of the natural layers of the quarry from which the blocks were taken, from bottom to top. This monument was left standing in its place when the Minnesota exhibit was dismantled and returned home. If its foundation be made more secure it will form a permanent ornament in the park after the buildings are removed. It is well worth preservation and would be one of the most lasting mementoes of the great Exposition.

Other limestones, less magnesian, were similarly illustrated by square blocks, six inches in thickness. These came from Mantonville, in Dodge County; from Clinton Falls, in Steele County; from Minneapolis, in Hennepin County; and St. Paul, in Ramsey County. These are less desirable stones, but some of them are extensively used, particularly those of St. Paul and Minneapolis, where foundations for nearly all structures are made of this blue limestone, taken from the Trenton formation.

There was on exhibition, also, in this department, a jar full of chloride of sodium, or common salt, made from the brine of a flowing well in Kittson County, in the extreme northwestern corner of the State. This manufacture is not carried on as yet as a regular business, the brine having been discovered but recently, in the sinking of a well for domestic and farm uses. But this salt points out another natural resource of the State of Minnesota, which may develop hereafter into important proportions.

Mention should also be made of a very fine collection of meteorites, from all parts of the world, which was to be seen in this exhibit. This collection numbered 66 specimens, from as many different localities.

MISSISSIPPI.

Territory, April 7, 1798. State, December 10, 1817. Area, 47,156 square miles. Population in 1880, 1,131,597. Capital, Jackson. Floor space at Exposition, 11,812 square feet. The State is divided into 73 counties. The surface of Mississippi, except the Mississippi bottom, is generally hilly and undulating. The highest land is less than 800 feet above sea level. The collective exhibit was very fine and extensive, but the mineral display was small.

MISSISSIPPI STATE EXPOSITION BUREAU.

Gov. Robert Lowry	President.
Gen. S. D. Lee	A. and M. College, Prof. of Mineralogy and Geology, University of Miss.
E. G. Wall	Jackson.
S. A. Jonas	Aberdeen.
J. G. McArthur	Daleville.
J. Poitevant	Pearlington.
Wm. Oliver	Wesson.
A. B. Hurt	Winona.
A. M. Paxton	Vicksburg.
M. L. Jenkins	Meridian.

At the first meeting of the Exposition Bureau, held March 28, 1884, Major S. A. Jonas was unanimously elected as State Commissioner, and was directed by the President to take charge of the whole work of making an exhibit of the vast resources of Mississippi at the World's Exposition at New Orleans, Louisiana.

The special geological exhibit was made by Dr. M. D. Spillman, of Columbus. It consisted largely of Permian, Cretaceous, and tertiary fossils, most of which were very fine and in an excellent state of preservation. An arrangement has been made with Dr. Spillman by which duplicates will be obtained for the California State Museum.

The minerals shown were but few, consisting of galena formed in nodules, selenite, limonite, hematite, lithomarge, yellow ochre, lignite—poor. Of rocks there were some good building stones, soils; clay, and brick made from the clay, the latter with a peculiar mottled appearance. Glass sand, from Pascagoula, and glass made from it. Pottery and terra cotta, from Holly Springs.

The crowning glory of this collection was the spine and part of the skeleton of Zeuglodon cetoides, found in Jasper County, by Prof. L. C. Johnson, of the United States Geological Survey, and arranged by Dr. W. Spillman. The individual was 80 feet long. Some fine teeth were found with it.

It has long been believed that gold existed in this State, but according to the investigations made by Prof. Wailes, State Geologist, the precious metal has only been found in minute grains at one locality, and not in paying quantity. There seems to be in the State a propensity to play practical jokes or to hoax the credulous, alluded to by Prof. Wailes. I mention this here because a specimen was sent to me from Mississippi which was manufactured purposly to deceive. On the other hand I was shown a specimen of granular quartz rich in gold, said to have been found near Jackson. From its strong resemblance to the ores of Georgia and North Carolina, I have no faith in the story of its being picked up on the surface in Mississippi, as claimed; still, this State lies in the general direction of the gold belt, and that metal may be eventually found.

MISSOURI.

Territory, 1812. State, August 10, 1821. Area, 65,350 square miles. Population in 1880, 2,168,380. Capital, Jefferson City. Floor space at Exposition, 6,000 square feet. The State is divided into 114 counties. The Missouri River divides the State into two unequal parts. The southern portion is hilly, increasing in altitude as the Ozark Mountains are approached. The northern part is more level.

The principal economic minerals found in the State are coal, lead, iron, and building stones. The coal beds cover an area of 7,000 square miles. Veins of 18 inches are considered workable.

The State made an appropriation of $5,000, which, joined to the same amount received from the Exposition, made up the small sum from which the fine collective exhibit was made.

The Commissioner applied to Professor G. C. Broadhead, State Geologist, and other prominent citizens, by whose combined efforts the State exhibit was made. All the labeling of minerals and geological specimens was by Professor Broadhead. No reports or maps could be obtained.

The State collection of minerals was displayed on terraced tables. The collection was not large but contained interesting and fine specimens.

The most noteworthy minerals shown were: azurite; barite, fine; blende in dolomite; calamine, fine; calcite, galena, and blende, all fine, the latter in splendid crystals; calcite, dog-tooth variety, fine crystals; coal; galena in very fine cubes; galena with blende, both finely crystallized; pyrite, cockscomb variety, very fine; specular iron, Pilot Knob, fine; specular iron, Iron Mountain; ores, etc; fire-clay; fire-bricks; clay retorts. A large private exhibit of terra cotta, consisting of ornamental terra cotta, sewer pipes, fire-brick, etc., and one glass-maker's pot, all by Evens & Howard of St. Louis, and a similar display by Reeves & Kirkpatrick of Calhoon; clay used in the manufacture of ironstone ware; a fine display of brick by the Hydraulic Pressed Brick Company of St. Louis. This exhibit consisted of pressed and ornamental brick, and an elaborate and magnificent circular fireplace and mantel, with wainscoating and ornamental surroundings, all in brick-work, certainly the finest work of the kind I have ever seen. Great credit is due to the builders for this artistic handling of a base material.

Iron ores in very large specimens from Iron Mountain were shown, and pig lead. Pig iron in great quantities was exhibited by the Missouri Pacific Railroad Company. *Rocks and Building Stones*—granite crushed, used in the manufacture of artificial stones; granite in blocks; marble, red, very fine; porphyry, serpentine—sap green, with darker green blotches or irregular spots. Syenite—red and gray, one cylinder and one foot cube of each, Syenite Granite Company of St. Louis. There were also 20 table cases of ethnological specimens. The whole collection was offered for sale for three thousand dollars. It would redound to the credit of our California public spirited citizens if they would purchase for the State Museum some of the very fine collections sometimes offered for sale at very low rates.

NEBRASKA.

Territory, May 30, 1854. State, March 1, 1867. Area, 75,995 square miles. Population in 188–, 452,402. Capital, Lincoln. Floor space at Exposition, 8,325 square feet. The State is divided into 65 counties. Nebraska is a vast plain, sloping gently towards the Mississippi River. There are no mountains except at the west, where the Black Hills and Rocky Mountains

begin to rise. But few minerals seem to be worked in the State. Building stones and good brick clays abound, as do also potter's clays. As coal is scarce peat is to a considerable extent utilized. Extensive salt springs are found in the State, and alum slates are known to exist.

The State is specially suited for agriculture, and the agricultural exhibit was very grand and comprehensive.

The mineral display was very small, almost nothing, consisting only of some coal from Richardson, a few building stones and bricks, and a column showing the thickness of the soil in Elk Horn Valley (nine feet).

NEVADA.

Territory, March 2, 1861. State, October 31, 1864. Area, 104,125 square miles. Population in 1880, 62,266. Capital, Carson. Floor space in Exposition, 3,495 square feet. The State, which is larger than any other except Texas and California, is divided into 14 counties. The general surface of Nevada is table land, with an average altitude of 4,500 feet. The highest land is about 8,000 feet above sea level.

The principal economic minerals in the State are silver, gold, borax, salt, lead, sulphur, copper, antimony, gypsum, marble and building stones, nitrate of soda, manganese, and good clay, suitable for the manufacture of pottery and brick.

Nevada is properly called the Silver State, the output of that metal being almost as remarkable as that of gold in California. The State collection was shown in twenty glass table cases. There was no special separation of the minerals from the ores, and the collection included many fine specimens from localities outside the State. In the description which follows none but those from Nevada will be mentioned. Besides the minerals in the cases there were large piles of characteristic ores from the most important mines of the State, including those of silver, gold, lead, antimony, quicksilver, nickel, cobalt, etc., and a large collection of photographs of scenery, mining views, machinery, mills, furnaces, etc.

While the lands are not generally suitable for agriculture they are fertile and could be made to support a large population if water could be procured for irrigation.

The mineral exhibit of Nevada at the Exposition was really very grand and comprehensive. It was under the charge of W. M. Havener, in the absence of the Commissioner. Mr. Havener not only carefully guarded the specimens, but employed his whole time in calling attention to the resources of his State. California, Nevada, Arizona, and Oregon formed a special Pacific Coast group, with interests in common, and were mutually proud of each other.

The most interesting minerals shown were: amethyst crystals, very fine, Belcher Mine; azurite; borax crystals, very fine; calcite crystals, Justice Mine, fine; cerusite, in fine needle crystals, Hamburg Mine, Eureka County; chalcedony, pink and white, Aurora, Esmeralda County; chalcanthite (sulphate of copper), Bluestone Mine, Lyon County; cinnabar, Steamboat Springs; diatomaceous earth, large cubical specimen on pedestal; erythrite, Churchill County; gay-lussite, Ragtown Lake; gold crystals, Red Cañon, Douglas County; nitrate of soda; obsidian, variegated; pisolite; pyrargyrite; salt, solar, crystals; selenite, from a deposit said to be 40 feet thick; native silver, very fine, Cortez District; sphalerite, zinc blende; stibnite, Battle Mountain; sulphate of alumina; sulphur, Steamboat Springs; sulphur, Rabbithole Mountains; tourmaline (black), in white quartz, Washoe

County; turquoise, Esmeralda County; ulexite; wulfenite, extra fine crystals, Eureka County; wulfenite, Tecoma, Elko County.

An interesting and valuable exhibit of rock specimens from the walls of the Overman Mine was made. These specimens numbered 464, of uniform size. They were taken every five feet to the 2,340 foot level. From a scientific standpoint this collection was specially interesting and attractive. They were donated to the State of California, as shown in the following correspondence:

OVERMAN MINE, FORMAN SHAFT, SUPERINTENDENT'S OFFICE,
VIRGINIA CITY, NEVADA, May 3, 1885.

Mr. Henry G. Hanks:

DEAR SIR: You will probably remember having a conversation with Col. Samuel T. Curtis and myself, in San Francisco, about samples of the rock taken from the Forman Shaft, and your expressing a desire to obtain them for your State collection.

Col. W. M. Havener, Deputy Commissioner for this State, has them on exhibition at New Orleans, and if you still desire to obtain them, I will present them to you for the cabinet of the State of California, and you can ship them directly to San Francisco with your exhibit when you return them. I will also present the cabinet I had made for them, if your State will pay the expense of transporting it from this place to San Francisco.

Yours truly,

CHARLES FORMAN.

CALIFORNIA STATE MINERAL EXHIBIT,
WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXPOSITION,
NEW ORLEANS, May 10, 1885.

Mr. Charles Forman, Superintendent Overman Mine, Virginia, Nevada:

DEAR SIR: I am in receipt of your letter dated May third. I cordially thank you, in the name of the State of California, for the magnificent donation you have announced.

Of all the specimens in your grand Nevada State exhibit, the section of your shaft shown by the specimens indicated, has been the most interesting to me. I am well aware of the labor and foresight required in making this section, and the important lesson it teaches. I promise you that it shall be well displayed in the new museum building, and that we will, in the near future, have sections cut and mounted for the microscope.

Our museum is fortunate also in the possession of a full series of rock specimens from the Sutro Tunnel and its branches. The two collections will be displayed together, and will always remain for inspection and study in the California State Museum.

Col. Havener requests me to say that he has received from you an order to transfer the collection at the close of the Exposition.

I have the honor to remain, very truly,

HENRY G. HANKS,
State Mineralogist.

The production of silver and gold by the State of Nevada has been very large; the exact amount will never be known, because no official record has been kept.

The total deposits of the precious metals from that State in the Mints of the United States up to June 30, 1883, were as follows:

Silver	$85,657,436 82
Gold	18,523,757 41
Total	$104,181,194 23

The total yield of both metals from 1861 to 1874, inclusive, has been estimated at $169,000,000.

The Consolidated Virginia Mine alone yielded to September 30, 1876:

Silver	$20,656,299 65
Gold	15,477,620 71
Total	$36,133,920 36
Number of bars	10,874

The California Mine produced during the same period as follows:

Silver	$5,044,382 32
Gold	4,631,337 15
Total	$9,675,719 47
Number of bars	2,452

Total yield of both mines:

Consolidated Virginia	$36,133,920 36
California	9,675,719 47
Total	$45,809,639 83
Total number of bars	13,326

The great Comstock ledge is at the present time practically exhausted, but new ore bodies may be found both north and south of the old workings which still contain much low grade ore, which in the bonanza times was considered too poor to work, but with lower prices and cheaper labor, can be extracted with profit, and the great mine is likely to yield a moderate annual crop of silver for many years to come. Other mines in the State are also very promising, and it is not to be supposed that all the rich silver mines have yet been discovered. Other minerals are utilized. The borax produced has been given in the third annual report of this office. This is likely also to be produced for many years. The same may be said of salt, nitrate of soda, sulphur, and other minerals, all of which will add to the future prosperity of Nevada, our sister State.

NEW HAMPSHIRE.

One of the original thirteen States. Area, 9,392 square miles. Population in 1880, 343,991. Capital, Concord. Floor space in Exposition, 4,805 square feet. Divided into 10 counties. The surface of the State is diversified. It is crossed by the White Mountains. Mount Washington is 6,293 feet high, but the average elevation of the State is but 1,200 feet above sea level.

While New Hampshire is not a mineral State some ores are found, but have not been extensively worked. Gold has been extracted; as shown by the reports of the Director of the Mint, that State is credited with deposits of gold in the Mints up to June 30, 1883, to the value of $11,020 55. Auriferous quartz is mined at Lisbon. Some iron mines have been somewhat worked. The ores are magnetite, hematite, and specular—but little pig iron has been produced. Some ores of copper and lead are also found. Chalcopyrite with other copper ores has been discovered in some quantity at Gardner's Mountain. Pyrites, suitable for the manufacture of sulphuric acid, is rather abundant, and a small deposit of tin ore has been mined at Jackson. Of minerals the following are known: beryl, mica, idocrase quartz crystals, cyanite, staurolite, molybdenite, graphite, tourmaline, garnets, galena, chalcopyrite, columbite, iolite, and others. Mica is quite extensively mined. Granite is largely quarried—the Concord granite has a wide reputation well known.

The mineral exhibit by this State consisted of twelve cubical blocks of granite and other building stones, all highly polished, and a relief map on a scale horizontal of one mile to the inch and a vertical scale of 1,000 feet to the inch. The effect of this map was very fine. California should have a similar one. The collective exhibit was made by the State.

NEW YORK.

One of the original thirteen States. Area, 47,000 square miles. Population in 1880, 5,082,871. Capital, Albany. Floor space in Exposition, 7,200 square feet. State divided into 60 counties. The surface of the State is very irregular. Some parts are mountainous, others are nearly level plains. The economic minerals are iron, building stones, roofing slates, lead and copper ores, salt, gypsum, hydraulic cement, petroleum, etc. No State in the Union has been so carefully or thoroughly studied geologically. Many voluminous reports and maps have been published. Professor James Hall has been for many years State Geologist. His son, Charles E. Hall, was in charge of the mineral exhibit at the Exposition. The collection consisted principally of fossils and rocks from the Geological Survey collections at Albany. They were placed in four table cases and were beautifully arranged and shown. Some of the fossils and rocks were types and were the most perfect obtainable. One case contained thin slices of fossils and photographs of the same, magnified 20 diameters. They were prepared by C. E. Beecher, of the New York State Museum at Albany, and were the finest specimens of rock sections I have ever seen. The machine by which these remarkable sections were cut is figured in the Thirty-*fifth* Annual Report of the New York State Museum of Natural History, and some of the photographs are reproduced in the same volume. The specimens were large and thin, and were mounted on ground glass and so placed that the light passed through them from behind. There were 97 sections of well known fossils in the case. This was a most remarkable exhibition of the kind.

The iron ores were arranged on a pyramidal table, besides which large specimens were piled on the floor. Specimens of ores and pig iron were shown by the Port Henry Iron Company, Jefferson Iron Company, Antwerp, and others.

Large blocks of building and ornamental stones were shown. There were some splendid specimens of fine-grained marble. Of the ornamental stones the ophite marble, exhibited by the Ophite Marble Company of New York, was the most beautiful. Ophite, from *ophites* (snake stone), is a variety of serpentine, so called because it is mottled like the skin of a serpent. The quarry, from which this beautiful stone is taken, is at Moriah, New York, but the works are at Swanton, Vermont. The specimens were in great variety, in slabs, blocks, and columns. The mottled ones were remarkably fine. The company has informed me that a fine specimen will be sent to the California State Museum.

One of the most interesting features of the New York exhibit was a column, thirty feet or more in heighth, showing a stratagraphical section of the rocks of the State from the gneiss to the carboniferous conglomerate. It was an imposing object in the Exposition. There were also five maps of deposits of iron, petroleum, lead, graphite, salt, and gas wells in the State, the work of the geological survey.

Some fine terra cottas in many varieties, from Glen's Falls, were shown. They were red and buff colors, also plain molded and pressed brick architectural terra cotta of elegant design in red and buff, common brick, fire bricks, ironstone pottery, and slabs of marbleized slate.

Of minerals there were but few shown. A small case of New York minerals was loaned by A. E. Foote of Philadelphia, but the specimens were not catalogued. The Dixon Graphite Company had a small showcase of graphite from Ticonderoga and manufactured articles.

Some fine specimens of salt in its manufactured state were also shown. S. Dessau of New York made a fine exhibit of diamonds in the rough from Brazil and South Africa and finely cut stones; also, black carbons used in the arts for cutting hard substances and for diamond drills. The largest rough diamond shown weighed six carats and the largest carbon eight carats.

The Cleveland gem displayed in this exhibit was a very attractive and beautiful object, one not often seen in America. From Mr. C. W. Kennedy, who was in charge, and from a letter from Mr. S. Dessau, in answer to one from me asking certain questions, I obtained the following information concerning this magnificent gem. The rough stone weighed 78 carats = 312 grains. It was found some ten years ago in Kimberly, South Africa, brought to London and held for nine years by a syndicate who expected to sell it to some potentate. It was purchased and cut by Mr. Dessau, and when Mr. Cleveland became President of the United States it was named the "Cleveland gem." It required three months to cut it: It is one shade off absolute white color, but is without any flaw. It has 128 facets, which are more than on any other stone. It is cut according to the rules of Jeffries, the angles being 90 degrees. The present weight is 42¼ carats = 169 grains. This stone remained three months at the Exposition, when it was sold to a well-known actress for $40,000, and is now in Scotland, where it attracts much attention, being the first stone of its value ever cut in America. Mr. Kennedy allowed me to hold it in my hand and to examine it critically, a favor I highly appreciated.

NEW JERSEY.

One of the original thirteen States. Area, 8,320 square miles. Population in 1880, 1,131,116. Capital, Trenton. Floor space in Exposition, 7,400 square feet. State divided into 21 counties. The surface of the northwestern portion of this State is mountainous; central part, hilly; southern, low and generally undulating. The principal economic minerals found in the State are zinc ores, extensively worked; building stones, lime, iron, greensand marl, peat, copper ore, pyrite, etc. The collective exhibit of New Jersey at the Exposition was very imposing. The mineral section was full and comprehensive, being a remarkably fine and well ordered display.

Eight table cases contained the special and really fine exhibit of the State Geological Survey, made under the direction of Prof. George H. Cook, State Geologist. There were also shown very fine geological maps of the State, and reports of the survey. The showcases were a combination of table and vertical, and were placed around a central kiosk. The whole arrangement was in excellent taste. The cases were clean, and the specimens beautifully arranged and labeled.

Two large slabs of red sandstone, with footprints of birds and animals, were conspicuously placed in special vertical cases. They were from the Vineland Quarry, Morris County. The most noteworthy specimens in the table cases were: *analcite*, very fine specimens; *apophyllite*, in calcite, fine; *arsenopyrite*, very fine; *asbestus*, green; *calcite*, in many fine varieties and splendid crystals; *calamine*, also very fine, some in large botryoidal masses; *chalcopyrite; chrysotile*, in serpentine; *copper*, native in calcite; *datholite*, very fine; *dysluite*, with jeffersonite, fine; *fowlerite*, in calcite; *franklinite*, very fine; *garnets*, very large crystals in calcite, the largest ever found, very fine; *graphite*, fine; *hematite*, red, fine; *hydromagnesite; jeffersonite*, fine; *limonite*, large mass, Dickinson's Mine; *limonite*, with sphalerite (zinc

blende), franklinite, and willemite; *magnesite; malachite; marmolite*, fine; *magnetite*, with serpentine; *magnetite*, two large blocks, Hurd Mine, Morris County, with fine specimen of slickensides from the same; *magnetite* (natural magnet), large mass on pedestal; *molybdenite; natrolite*, fine; *orthoclase; pectolite*, very fine; *prehnite* and pectolite, fine; *sapphire; serpentine*, variety known as (precious or noble serpentine), very fine; *siderite*, fine; *steatite*, fine; *stilbite*, fine; *tephroite*, with franklinite; *vivianite*, fine; *willemite*, franklinite, and zincite, two large masses, Sussex County; *zincite*, in flat crystals, very fine.

Of ores, there were shown magnetic iron ores from a number of mines. Many specimens of broken pig iron from Oran furnace, Morris County, and from the Andover Iron Company, Warren County; *pig iron* and manufactured malleable iron, twisted and bent to show texture and quality; spiegeleisen (manganese iron), of 12 and 26 per cent manganese, exhibited by the Passaic Zinc Company; *mineral wool, manganese ores*, etc.

ROCKS, BUILDING STONES AND MATERIALS, POTTERY, ETC.

There were shown 32 blocks of building stones, 5 or 6 inch cubes, and 200 specimens of rocks, all very fine. There were two cases of clays, showing all the varieties in different conditions, from the coarse material to the finest washed sediments, and the minerals added to the clay in the manufacture of fine porcelain.

There was a fine exhibit of porcelain wares, manufactured by the Trenton International Pottery Company, consisting of beautiful chamber and dining sets of semi-porcelain, equal to any I have ever seen; also, plumbers' ware in great variety. A larger commercial exhibit was also made by this company in the main building. A similar display was made by the Mercer Pottery Company, of Trenton, and the Willett's Manufacturing Company. It may be well to say here that all the materials required in this manufacture are found in abundance in California, and there seems to be no reason why our people should not engage in this business to their own advantage and that of the State. Elegant and artistic terra cotta work was also shown, with photographs of specially fine pieces not on exhibition. They were from the works of the Perth Amboy Terra Cotta Company and the A. Hall Terra Cotta Company, of Perth Amboy. A display was made of terra cotta lumber, from the Terra Cotta Lumber Company; this form of building material is described elsewhere. Fine specimens of plain and ornamental brick and fire-brick were shown by several makers.

There was also a fine display of glassware by the Salem Glassworks, including large tubulated retorts, carboys of extra size, graduates, labeled reagent bottles, and other chemical glassware.

Roofing slates of good quality, and manufactured oxide of zinc, were also shown.

Of fossils, a fine mastodon's tooth and a large collection of tertiary fossils were shown, and thirty glass jars of marls.

NORTH CAROLINA.

One of the original thirteen States. Area, 50,704 square miles. Population in 1880, 1,399,750. Capital, Raleigh. Floor space in Exposition, 11,675 square feet. State divided into 94 counties. The coast and swamp land sections of this State extend from 80 to 100 miles inland. The mid-

dle rises gradually to the mountain section in the western part of the State.

North Carolina is a pronounced mineral State, but its resources are only partially developed. The main chain of the Appalachian Mountains cross the State. Sugar Loaf Mountain rises 3,978 feet above sea level, the Grandfather 5,897 feet, and Clingman's Mountain 6,707 feet. In these mountains numerous valuable minerals are found, and no doubt a thorough prospecting would develop others now unknown. The principal minerals now worked are gold, copper, iron, lead, zinc, mica, corundum, etc.

From a handbook of North Carolina, prepared for the State Board of Agriculture, and from other publications, I glean the following information:

Gold is found in 28 counties. It occurs in veins of quartz with sulphurets. Near the surface it is generally associated with limonite, deeper with chalcopyrite, galena, blende, mispickel, and tellurium minerals. The auriferous area covers nearly half the State. The present productive field is 12,000 square miles. In the handbook very many gold mines are enumerated and described.

Gold has been mined in this State from very early times. In several localities in the mountains, ancient shafts have been found of which there is no history. The most important one is in Cherokee County. It is a vertical well timbered shaft, 100 feet deep, with a tunnel extending to the bottom from the foot of the hill. These old workings are supposed to have been made by the Spaniards. The principal counties producing gold are Mecklenburg, Lincoln, Montgomery, Rowan, and Randolph.

From the *Quarterly Journal of Science, Literature, and Arts*, published in London, in 1825, I have made the following extracts:

"Native gold in North Carolina." Professor Olmstead gives the following account of large pieces of native gold, whilst speaking of this auriferous district: Large pieces of gold are found in this region, although their occurrence is somewhat rare. Masses weighing four, five, and six hundred pennyweights are occasionally met with; one mass was found that weighed in its crude state twenty-eight pounds avoirdupois. This was dug up in Reid's Mine within a few inches of the surface. It was melted down and cast into bars soon after it was found. The spot where it occurred has been since subjected to the severest scrutiny but without any similar harvest. * * * Mr. Reid found a gold specimen in quartz; the gold weighed twelve pennyweights.

The gold country of this district is not less than 1,000 square miles and is situated between the thirty-fifth and thirty-sixth degrees of north latitude, and between the eightieth and eighty-first degrees of longitude west of London.

At the close of 1883, according to the report of H. C. Burchard, Director of the United States Mint, there were in North Carolina 52 quartz mills with 415 stamps, 20 Chilian mills, 8 batteries, 3 chlorination works, and 2 metallurgical works.

During the census year 1880, the precious metals were produced as follows:

Gold	$108,953 00
Silver	100 00
Total	$109,053 00
1881, gold	$115,000 00
1883, gold	$167,000 00
Silver	3,000 00
Total	$170,000 00

Gold and silver from North Carolina deposited in United States Mints to June 30, 1883:

Gold	$10,834,202 79
Silver	47,345 20
Total	$10,881,547 99

Production during the year ending August 19, 1878:

Gold	$160,000 00

The following paper was prepared at my request by C. D. Smith, Geologist and Mineralogist of Franklin, North Carolina, whom I had the pleasure of meeting at the Exposition, in the North Carolina department:

Henry G. Hanks, State Mineralogist of California:

DEAR SIR: I regret my inability, owing mainly to the heavy tax on my time in other and previous engagements, to furnish the paper I promised you concerning the gold and gold-bearing rocks of the extreme western portion of North Carolina, and a part, at least, of northeast Georgia. Were I to undertake a full and complete statement of all my observations, and the facts collected during twenty-seven or eight years spent in researches over the gold-bearing region extending from South Carolina to Alabama, it would occupy, no doubt, more space than you could well afford in your report. It will, perhaps, be sufficient, then, if I present a brief collation of the most salient features concerning the geological and lithological relations of the gold-bearing rocks, and my general impressions as to the mode of the occurrence of the gold.

The first fact to be considered, is that the gold does not occur strictly in any one class or series of rocks, though the principal part of the gold production may be traced to a definite geological age (the Huronian). In order to a more thorough understanding of the gold-bearing fields of this southern section, it is proper that I also state that the Blue Ridge mass in its upheaval split and separated the Huronian rocks, which at the time of the upheaval were superimposed upon the granite and gneiss of which the Blue Ridge is composed. The ridge is evidently the crest of a fold in the rocks—a fold, however, that does not stand erect, with anticlinal dip on either side, but a fold broken on the crest, which brings to the surface and exposes the gneiss and granite. This fold is also bent over to the northwestward, giving the strata an inclination to the southeast of an average of about 45 degrees. In this breakage and tilting of the fold, the Huronian rocks are turned under the older rocks, presenting an inverted order as to geological age on the north side of the ridge, while on the south side they are more irregular in their inclination. In some instances they have dropped down on the great granite fold, forming a synclinal dip. At other times they stand perpendicular on edge; and then, again, incline at various angles to the southeast. On either side of this great ridge, the Huronian rocks, and the transition rocks between the Huronian and Azoic proper, constitute the great domain of the gold of the South Atlantic States. It is also a noteworthy fact, that the principal part of the gold found here occurs in or near the bottom beds of the Huronian series, and about the contact of that series with the transition or upper Laurentian, as it has been called. Sometimes gold occurs about the middle of the Huronian series. We have an example of this in Cherokee County, North Carolina. In the granular limestone or marble of the Valley River belt, there occurs a cellular quartz, bearing argentiferous galena and gold. The gold in this case occurs mainly in the quartz, but it is also found as free gold mechanically mixed with the galena. It should be noted, also, that there is neither iron sulphurets nor any other associated minerals with the galena and gold. These limestones, which constitute a member of the Huronian series, are interstratified with the quartzites, slates, and sandstones belonging to that series. Some of these sandstones are of the class designated as itacolumite.

In this same grouping of the Valley-river zone there occurs on the south side of the valley a bed of talco-micaceous slates, which abound in crystals of staurolite. This bed, though in its position overlying the limestone and its more immediate associates, is, in point of geological order, an underlying bed. Along and at the foot of this bed the principal placer mining of the district has been done. All the accumulated gravel heaps from the washings abound in staurolite crystals, and at some points rutile also. The pittings and excavations have been, in many places, pushed up against the staurolite slate, where it rises somewhat abruptly. Fragments and bowlders of the staurolite slate are common upon the surface. I have observed in some of these bowlders fragments of angular quartz and an iron oxide, which is evidently an altered pyrite. It is also a significant fact that most of the gold obtained along this line has been from the surface, and not from well defined gravel beds, as they are usually called. Indeed, the accumulations from the process of washing consist of angular quartz fragments, slate, and staurolite. By collating these facts, and reasoning from them as the best data at my command, I have settled down in the conviction that the staurolite slate here mentioned is the source of the gold found in this belt of placer mines. I must, however, state another fact, which may be of

interest. At one point in this belt there was discovered, some years ago, an apparent laminated quartz vein, bearing gold. It is questionable, however, as to this being a vein in the proper sense of the term. Is it not more likely to be an intercalated wedge of quartz, or more properly speaking, an integral part of the slate. I have seen similar wedge-shaped masses at other localities, which proved to be nothing more than intercalations and segregations, as part of the sediments of which the slate is composed. I believe gold often occurs as a sediment; that is, I mean to say that it was formed into scales and grains, and as such was deposited with the other elements which make the slates. By manipulating slates I have obtained such rounded particles which occupied no other place in the slate than one of its sedimentary parts. Now, whether the gold belonging to this staurolite slate was deposited as free gold with the slaty elements, or existed originally in an iron sulphuret, I have no positive information, having never tested these slates, as I did others in Georgia many years ago. Be this as it may, I have scarcely a doubt that the chief part of the gold in the placers under consideration has come from these staurolite slates. This belt is worthy of further and more careful research and investigation. The largest nuggets found in this Valley-river zone have ranged from fifteen to thirty pennyweights. This zone passes in a southwest direction into Georgia, and in it is the White Path Mine, which, in earlier times, yielded a large amount of gold.

On the south, and much nearer towards the summit of the Blue Ridge, there is a belt of micaceous and talco-micaceous schists which belong to the transition rocks, that are gold-bearing. This is known in that district as the Gumlog and Brasstown belt. The occurrence of gold in this zone is more distinctively in quartz veins. Indeed, gold-bearing quartz veins are numerous, beginning with those near Blairsville, in Union County, Georgia, and passing down Gumlog Creek and crossing Brasstown into Clay County, North Carolina, and continuing northeast up Tesquittee Creek. I have not examined the slates thoroughly that line the veins, but I have no knowledge that any gold has ever been found in them. So far as my observation extends, the probabilities are strong that there are reliable gold veins in this zone. At one of the localities on Gumlog, the quartz vein carries sphalerite (blende) and galena, as well as gold. The gold in the veins of this belt occurs with iron pyrite. All these veins, however, have undergone those atmospheric alterations which have resulted in the oxidation of the sulphurets in their upper parts, so that free milling ores are obtained towards the surface. The value, however, of these veins is unknown, for there has never been made a fair test of any vein, as to its extent and persistency, on the whole length of the outcrops—a distance of about thirty miles. The best and richest ores in the Gumlog section were picked up during the war by the people living near the locality, and partially crushed by hand in small iron mortars for the gold they would yield. Nor was this, under the circumstances, so trivial a matter as might be supposed. I found detached ores upon the surface that a good panner could crush in a hand mortar, and make his pennyweight of gold per day. As suggested above, the surface was stripped of those rich specimens, and scarcely anything can now be seen. That district, however, is an inviting one for research, investment, and enterprise. Should it fall into skillful hands and be subjected to intelligent management and the improved methods for saving gold now in use, I have no doubt it will be numbered amongst the prosperous mining districts of the country.

I now turn to another field, which is larger in its proportions and of much greater extent every way. There is a zone lying on the south of the axis of upheaval (the Blue Ridge mass) that extends from Alabama through Georgia, South Carolina, North Carolina, and into Virginia. It is ramified through its entire length with gold-bearing rocks, and varies in width, at least apparently so, if judged by the outcrops and developments. I traversed it some years ago, from South Carolina to Alabama, and having experimented with and studied the lithological relations and habits of the gold-bearing rocks, I obtained some information and suggested some theories regarding the sources and mode of occurrence of the gold, which may perhaps be interesting to those who may be prosecuting researches in that direction. It has afforded me some pleasure to know that some of my opinions have been verified by subsequent developments.

Inasmuch as I located the first point for hydraulic hose works in Georgia, I will confine myself in the succeeding statements mainly to that section. Micaceous and chloritic slates occupy the center of the Nacoochee and Dahlonega belt, though there are occasional interfoliations of talco-micaceous shales. Some of the veins are walled on one side with a variety of gneiss, and on the other with one or the other of the slates just mentioned. What was known twenty-five years ago as the White & McGee vein, in the Nacoochee District, is an example in point. This vein, as I saw it, had a central quartz axis, the quartz being laid down in jointed blocks, after the order of bricks laid one upon another.

While the quartz did not contain gold in itself proper, I found grains of gold in a soft hydrated manganese which often formed layers between the quartz blocks as thick as a knife blade. There was nothing here to entitle it to the name of a vein. The walling of this narrow quartz zone on one side was a sort of fine grained gniess rendered friable by partial decomposition. The wall on the other side consisted of a chloritic or micaceous shale rendered also soft and friable. The gold was found to exist in these wallings, and the whole mass was taken for some eight or ten feet wide and crushed. In my examination I did not find any sulphurets and indeed but little evidence that any existed in the rocks that were crushed. Somewhere in the forties, Col. Reynolds, with a small but rude mill, realized from this gold channel, as it should be called, 37,000 pennyweights of gold of high grade in one year. In the same neighborhood, on what was then known as the Eng-

land lot, there was a quartz vein from four to six feet thick and standing nearly perpendicular. The pioneer miners had dug pits upon it at different points for half a mile, and no doubt tested the quartz for gold, and not finding any had abandoned the search. It lay in this condition for quite a number of years, but finally falling into the hands of Mr. J. R. Dean, Jr., he turned the waters of his canal upon this property and hosed out the whole ravine below, which had been rich and pretty well worked over. Reaching the quartz vein he found it inclosed in an arenaceous mica shale. This shale on either side contained some iron oxide, evidently the result of altered pyrite. These linings of the vein were very rich in gold. A large per cent of them yielded to hose, while other portions more quartzose and of course less friable were laid aside for stamp work. Singular as it may seem to most gold miners, Mr. Dean tried a great many experiments with the quartz but never did he find so much as a particle of gold in it. Indeed, it bore no evidence of mineralization and was utterly barren in the precious metal. The facts developed at these two mines exploded the theory that quartz only carried gold. I had, after numerous experiments, advanced the conjecture that the slates and shales of the district carried more gold than the quartz ledges or veins, and this conjecture was verified, at least, in these instances. How far these slates and shales may have been mineralized by iron pyrites, and with what tenacity gold adheres to that mineral in its occurrence, I will not, with the present evidence, undertake to say. But I will say that the facts I have stated are suggestive and should lead to more thorough investigation of the question. I have no doubt that much valuable stamp material was rejected by the early miners as worthless slates and mere wallings of the gold-bearing quartz. Had I been in other circumstances I would ere this have been in possession of additional and perhaps valuable facts touching this question.

In the same (the Nacoochee District) I have a few facts to state in regard to placer mining. As early as 1856 I discovered a system of granite dykes passing through the gold-bearing belt. I observed certain points at which the old miners testified that large nuggets had been found. I had come to the conclusion that, in the earth's laboratory, gold is often held in solution, and reasoning from these standpoints I advanced the theory that the heat and chemical conditions produced by these dykes had a good deal to do in the deposition and crystallization of the gold into large nuggets. Now as to the feasibility of my theory, I shall rely upon the facts subsequently developed. There was a point in a narrow ravine three or four hundred yards from the White & McGee vein, and on a different range, where nuggets weighing from 50 to 60 pennyweights had been found, as the old miners alleged. First, Mr. Dean, at my suggestion, turned the water down there and sluiced off the point of the ridge, finding quite a number of nuggets in the red clay of the hillside, one of which weighed 387 pennyweights. Afterwards he hosed out the ravine which had once been worked over, commencing at the creek and continuing up to the point where the coarse gold and nuggets had been found. Here he uncovered a granite dyke, above and away from which no gold was found. This convinced him that there was something in the theory I had suggested. After the close of the war Mr. Dean was succeeded by Captain Bosworth as Superintendent of the mines. Taking the hint from former results, he continued the canal so as to enable him to hose out a dry hollow, including the head of the Richardson branch. Here he worked a whole Summer, taking up 33,000 pennyweights of gold, some nuggets weighing as much as 400 pennyweights. The foreman of the hose company which did this work told me that at the extreme head of this hollow they struck and uncovered one of those narrow granite dykes, and that above and beyond it they did not find any gold.

At old Captain Richardson's residence, down the creek, a granite dyke trended immediately by the house and diagonally along the hillside. Below the house and garden there is a flat dropping off suddenly to the creek bottom. Around and on this descent there was a coarse gravel bed very rich in gold, which was worked over during the first mining operations in that section. I often urged Captain Richardson to have the flat where his garden and stables were located worked out, but he persistently declined to do so. Since his death his grandsons worked over that ground and quite up to the house and near the dyke. They obtained a fine lot of gold, amongst which were some large and singularly shaped nuggets. One of these was very interesting indeed, having the shape of a fish, somewhat like those found amongst the earliest vertebrates. Then, again, sixteen or eighteen miles northeast on the range, is what was known as the Shelton Mine, on Soquel River. This was worked at an early period, and one mass of gold found that weighed three pounds. Subsequent work uncovered a granite dyke, and upon the back of this dyke an 18-pennyweight nugget was found, to which and in which fragments of feldspar were observed, as though the gold had been crystallized in contact with the granite.

In conclusion, upon this point, let me say, that it is a significant fact that in all this work at the four localities, work carried down to the bedrock, there were no quartz veins discovered. So it is evident that these large nuggets did not come from quartz ledges, unless we adopt the theory that the ledges were shallow and were entirely broken down and swept away. In that case, the force necessary to have removed the large masses of the veins would have certainly carried away, at least, the finer gold, which was not the case, as it yet remains in the gravel beds of the lower sections of the drainage area, and in the surface. Indeed, the further from the dyke the smaller the gold is, showing that the drift forces have been moderate. However this gold may have been formed, and whatever may have been its original source or conditions, these facts just stated are suggestive, and are worthy of thought by all who are in any way interested as scientists or miners.

I am apprised of the reluctance with which men abandon old theories. Some author of profound erudition in his branch puts forth a theory, and thousands embrace it, and believe that he was incapable of committing a mistake. His theory was perhaps the best that could be given with the lights before him. I believe, nevertheless, that no one is really fit to be a mineralogist or geologist who goes into the field of scientific research wearing straight jackets, be the pattern new or old. It requires an untrammeled brain to arrive at truth.

As there is great similarity in the gold-bearing rocks of the whole zone, from Alabama to Virginia, I will let this discussion of the points mentioned, with which I am most familiar, speak for the whole. I do not undertake to say that the same conditions which I have described exist at every locality. Nor can other localities require those I have discussed to conform to their peculiarities. If, however, the facts and suggestions put forth in this paper shall lead to the discovery of any great truth, or shall result in any discovery in the field of practical mining, of general benefit, I shall have my reward.

On his return to his own State, Mr. Smith sent me some specimens of gold, from a new discovery in Transylvania County, which I examined with the following results:

The gold was of a deep color, bright, and free from coating, and was more than semi-crystalline. Some pieces showed a tendency to assume the form of threads, on which indistinct octahedral crystals were strung like beads—a form not uncommon in California. A few particles were pale colored as if touched with mercury or alloyed with silver (electrum).

The test assay was made by panning, collecting the gold prospect, and weighing.

The percentage of gold was .01, one part of gold in 10,000 parts of quartz.

Ounces per ton of 2,000 pounds	2.91+
Value per ton of 2,000 pounds	$60 28

The residue left with the gold in panning showed, under the microscope, transparent quartz and particles of hematite and limonite, but no crystals or pyritic matter.

The quartz from which the gold was washed was partly white and crystalline granular, resembling loaf sugar, and almost as easily crushed; partly like alabaster or very fine grained dolomite, but the larger portion was very ferruginous, being mixed with ochery matter, which was found to be limonite. Although this oxide is probably the result of change from pyrite, there is nothing left to show how this change took place, all traces of the original mineral being lost.

The following letter, in reply to one of inquiry from me, contains valuable information regarding the manner of working, yield, and cost of gold mining in North Carolina. I much regret I could not visit the gold mines of this State:

HOOVER HILL, RANDOLPH COUNTY, N. C., May 14, 1885.

Henry G. Hanks, Esq., New Orleans:

DEAR SIR: I have received your letter of twenty-eighth ultimo, and am sorry you will not visit this neighborhood.

The following are answers to the questions you ask:

Capital—Foreign (London), 120,000 shares of 10 shillings each.

Stamps—Twenty.

Yield per ton—In 1884, $6 13. Yield per ton for four months ending April 30, 1885, $10 84 per ton.

Fineness of bullion—Say, 780 gold and 210 silver.

Prospective workings—Mine is being opened out vigorously by sinking and drifting. One shaft is down 250 feet, and another about a quarter of a mile distant, 140 feet.

Labor—Both colored and white employed in the mine in about equal numbers; all engineers and carpenters are white. Both colored and white blacksmiths are employed; the mill hands are all white. Common laborers get 75 cents per day of 10 hours, strikers 80 to 90 cents, miners $1 25 to $1 35, carpenters $1 25 to $1 50, blacksmiths $1 50, engineers (12 hours) $1. Picked colored labor in the mine is fairly satisfactory.

The company has just declared an interim dividend for six months ending April thirtieth, at the rate of 5 per cent per annum, 3 pence per share.

Yours respectfully,

WM. FRECHEVILLE.

Besides gold, North Carolina is rich in other minerals. Coal is found, but it is not as yet important. The following economic minerals occur in the State: *agate; agalmatolite*, from a large deposit called soapstone, used in a large way by manufacturers of wall papers, also in soaps, cosmetics, and for adulterations; asbestus; barite; *building stones; chromic iron*, found in considerable quantity; *corundum*, found in abundance and used in the manufacture of emery—one crystal now in the museum of Amherst College, in Massachusetts, weighs 312 pounds; diamonds—several have been found in the State; *graphite; grindstone grits*; *kaolin* and clays, quite abundant; *limestones; limonite; marbles*, many beautiful varieties; *marls*, very abundant and important; *mica*, in coarse granite. This mineral is mined in six counties. One deposit in Mitchell County yields one ton of merchantable mica per month; pyrite, sometimes auriferous, suitable for the making of sulphuric acid; *pyrolusite*, binoxide of manganese; *serpentine; copper ores* are found in many localities in the State, generally associated with auriferous ores. The principal mines, or those which give the most promise of prospective value, are in Guilford and Ashe Counties.

The mineral exhibit of North Carolina was specially fine; some remarkably beautiful and rare specimens were shown. The collection was under the charge of William Earl Hidden and C. D. Smith, both of whom have furnished papers for this report. I am much indebted to them, also, for valuable verbal information. The choicest specimens were arranged in plate-glass cases, placed under and about a central dome or kiosk, covered and resplendent with plates of mica. The rarest and most interesting of these are described in the following paper:

SPECIAL PAPER BY WM. EARL HIDDEN, ON THE MINERALS OF NORTH CAROLINA EXHIBITED IN THE GOVERNMENT BUILDING.

AUGUST 21, 1885.

In the North Carolina section the minerals of special merit were numerous. Noteworthy were the gems and precious stones in their natural and cut shapes. Of minerals of scientific interest more than one hundred and fifty species were exhibited. Here appended the reader will find enumerated the specialties shown by this one State:

Native Gold.—Over $5,000 in value in nuggets from various counties in the middle and western section of the State. One nugget from Montgomery County weighed four and one half pounds (4½ pounds).

Tetradymite (bismuth telluride).—From Davidson County, with gold.

Altaite (lead, etc., telluride).—From Kings Mountain, in calcite with gold.

Barnhardite (46 per cent copper).—From Cabarras and other counties.

Ferrous-chloride (stagmatite, Lawrencite).—In the Rockingham County meteoric iron.

Corundum.—In crystals and masses of varied color from many counties. From Macon County a series of gems, *i. e.*, the ruby, oriental topaz, oriental emerald, sapphire, and asteria, from the famous "Jencks Mine." Single crystals of many hundred dollars value were found there some ten years since. Massive pink corundum from Clay County was shown in quite large plates that were translucent.

Gahnite (zinc spinel).—Dark green crystalline masses, having great hardness, were shown from Mitchell County. They contained 38 per cent zinc.

Uraninite (uranium oxide).—Large masses of this rare mineral found in Mitchell County, and having a density of about 9. Color, magnetite-black.

Rutile (titanium oxide).—This is one of the species in which North Carolina stands preëminent as furnishing the finest crystallizations yet known, those from Alexander County being the best prisms of the highest luster of one to three inches in length, geniculated and beautifully terminated with many planes. By transmitted light they had a fine ruby-silver color.

QUARTZ.—In particular, the exhibit of quartz crystals was very interesting and complete. Nearly all the known forms were shown. A series of rare forms such as Professor Gerhard vom Rath has described recently in "Zeitschrift für Krystallographie und Mineralogie," were of uncommon interest. He writes, "These crystals from Alexander County surpass all others in interest, since they possess all the remarkable features shown by other localities." Fluid-bearing crystals with moving bubbles of large size, and crystals and masses containing rutile (fleche d' amour) in golden needles, were also shown. A crystal ball, limpid and perfect, was exhibited from Alexander County. It was cut in Newark, New Jersey. It measured 2¼ inches in diameter.

Spodumene.—Clear yellowish-green crystals and the rare emerald-green variety, *i. e.*, *hiddenite*, were shown as cut gems and as natural crystals. Of the latter, it is necessary to state that it has obtained a value of $100 per carat and upwards and vies with the emerald in beauty and brilliancy. It has only been found in Miller's Township, Alexander County, North Carolina.

Beryl.—Pale bluish and greenish crystals, weighing from a few ounces to those of over forty pounds, were noticed. In the gem line, were yellow, blue, and green tinted stones of great brilliancy. These latter came from Mitchell, Yancy, Macon, and Alexander Counties; mostly in the mica mines. Resembling the fine productions from Siberia, were a few transparent prisms from Alexander County of remarkable crystallographic interest; one in particular, which, in its uncut state, was as brilliant as a gem, and had over forty planes in its termination, and had twelve sides. Quite unprecedented for American localities, was the exhibit of emeralds discovered in the Hiddenite Mine, in Alexander County. Noteworthy is the extraordinary size of some of the emeralds found at this mine—one measured 8½ inches long, and weighed nine ounces; another was 5 inches long; one measures 3½ inches, and is very clear. For three emerald crystals from this mine, sold in their rough state, $1,250 was paid by an American collector who wished to retain them in their natural condition as crystals.

Zircon.—Many pounds of large crystals from Henderson County, which locality furnished 1,800 pounds in one year. From Burke County a few brilliant and highly modified crystals of perfect transparency, and of various tints of brown, pink, yellow, and purple.

Epidote.—Fine crystals (implanted), from Yancy County.

Allanite.—A variety rich in yttrium, from Mitchell County; found with samarskite.

Muscovite (mica).—The wonderful exhibit of this mineral, from this State, will long be remembered. The dazzling pavilion covered with this mineral was ample evidence of the wealth of North Carolina in mica. The yearly outputs are calculated to reach $150,000 in this State alone. Sheets uncut and cut were shown in special cases, of from six inches to twenty inches square, with a few exceptional crystals of nearly two and a half feet in diameter.

Orthoclase (feldspar).—One large crystal of about forty pounds weight.

Albite.—Two groups of finely-twined (parallel to the base) and brilliant crystals from Alexander County.

Samarskite.—Until found in North Carolina one of the very rarest of minerals. Over 1,000 pounds in irregular masses were taken out of the Wiseman Mica Mine, in Mitchell County, at one time, since which remarkable discovery very little more has been found. It contains thirteen or more rare elements, among which are columbium, tantalum, uranium, cerium, yttrium, phillipium, and decipium.

Of Rare Minerals.—Fine specimens were shown of columbite, tantalite, gummite, uraninite, hatchettolite, and fergusonite.

Xenotime.—Fine crystals from Burke County, Mills' Mine.

Monazite.—Remarkably large and brilliant crystals from Alexander County.

Apatite (phosphate of lime).—Clear transparent crystals from Alexander County, and large opaque ones from Yancy County.

Pyromorphite (phosphate of lead).—Fine crystallizations of a green color, from Davidson County.

Dolomite.—Clear crystals implanted on gneiss, associated with quartz, rutile, mica, and apatite crystals. Alexander County.

Siderite.—Brown translucent crystals, similar to last.

Cerussite.—Fine crystallizations, from Silver Hill Mine, in Davidson County.

The mineral, hiddenite, mentioned in the above paper, was specially beautiful and attracted much attention. The following extracts from a New Orleans paper, contain more information concerning it:

For the benefit of those interested we subjoin a few facts gathered from a conversation with Mr. William Earl Hidden, the discoverer of the hiddenite. Hiddenite was unknown prior to February, 1881. It received its name from Dr. J. Lawrence Smith (now deceased), of Louisville, Ky., who was the first to recognize its true chemical nature, and finding it new, gave it its name in honor to the discoverer.

It seems that the discovery was of the nature of a scientific deduction, somewhat like that of Humboldt's regarding diamonds in the Urals. Mr. Hidden, who was carrying forward a systematic search for platinum through the Southern States, under the patronage of the famous Thomas A. Edison, came across, in Alexander County, North Carolina, a few pieces of beryl, which in their edges showed a tinge of color which verged distinctly on that of the emerald. On this observation he formed the following hypothesis, *i. e.*, that a region which could produce beryls having a slight tint of the true emerald color, might, or ought to, furnish the *pure emerald*, if proper search was made for them. Accordingly, at his first leisure he revisited the locality and commenced a systematic search for the *source* of the crystals of beryl which up to that time had only been found loose in the surface soil. After five weeks of fruitless effort, a vein was found at a depth of eight feet below the surface, in which he not only found the true emerald he had been seeking for, but along with it many slender crystals having emerald color, but totally different in all other respects from the emerald proper. It was to these slender crystals that later were given the name hiddenite.

Possessing, as they did, all the requirements of a gemstone, *i. e.*, hardness, beauty, rarity, and brilliancy, it was not long before the merits of the new found gem was appreciated by the jewelers and the *dilettanti*, and a lively competition sprang up for their possession. Almost at once sales were made at the high rate of $100 per carat, and within a year after the discovery the gem had been successfully introduced in the gem marts at home and abroad as one of the highest rank.

To-day it is the very rarest among the precious stones; fewer of them exist as far as known, and virtually none are now for sale. The stones have usually been spoken for—ordered—long before they were found, such is the demand for them.

Hiddenite is everywhere confessed, when in its best shades, to have a livelier and more brilliant color than the emerald. No less an authority than Prof. Dana writes in the last appendix to his invaluable system of mineralogy that "hiddenite is highly valued as gems, and in consequence of its pleochroism (many colors) has a peculiar brilliancy which is lacking in the true emerald."

A fact of probable interest is that all the work done at the mine, situated in Alexander County, has been more than repaid by the sales of gems found.

Besides the central collection, ores and economic minerals were shown elsewhere in quantities, among which I noticed the following: *coal; coprolites; copper ores* and *shales*, suitable for leaching; *copper ingots; gold quartz*, resembling the ores of California; *iron ores*, and pig iron, from various localities and furnaces; *tin ore*, and stream tin, from Cleveland County; *rocks and building stones*, including marbles, in a number of varieties, some very fine; *leopardite*, some very large and fine specimens. A leopard was shown sculptured from this rock. Blocks were also shown of dendritic and mottled varieties; *furnace-hearth fire-proof stone; glass sand; shell rock; itacolumite*, very flexible and fine. One of the most interesting specimens of this group was a fine monolith 19 feet long, finely chiseled, and resting on short pillars of the same fine grained granite. It was from the Anderson granite quarries.

Of economic minerals not mentioned in Mr. Hidden's paper, there were shown: *barite*, very fine; *chalcosite; chalcopyrite*, in large masses, very fine; *chrysocolla; galena*, some specimens resembling the argentiferous galena from Deer Island, Maine; *garnets*, of extraordinary size, some being 4 inches in diameter; *limonite*, after siderite, very fine; *meteorite*, a small iron with section showing Widmanstattian figures; *pyrite* in crystals, very fine; *serpentine*, mottled variety; *siderite* in quartz, and in fine crystals; *staurolite crystals; steatite; sun stone*, fine; *the Hendricks gem*, a magnificent topaz, found in 1879 in Burke County. It is large and perfect; cut as a rose brilliant.

OHIO.

State, November 29, 1802. Area, 39,964 square miles. Population in 1880, 3,198,062. Capital, Columbus. Floor space in Exposition, 6,700 square feet. State divided into 88 counties. The surface is diversified with hill land, and plateau lands having an elevation of 300 to 1,060 feet above the sea. The highest land (1,540 feet) is in Logan County.

The principal minerals found in the State are coal, iron, clay, gypsum, peat, salt, petroleum, lime, hydraulic cement, marls, and building stones. Coal is the great mineral staple of the State. The coal fields cover an area of 10,000 square miles.

The grand collective exhibit was made officially by the State. The mineral section contained numerous fine specimens, many of them being shown in large quantities.

The general exhibit of the State Geological Survey was specially fine; no catalogue could be obtained containing the names and showing classification of the specimens.

A relief map of Ohio was brought to the Exposition as late as the middle of May. It was built up of plaster of Paris by Wyndham C. Jones, C.E.,

of Cleveland. The horizontal scale was 4 miles to one inch, and the vertical scale 300 feet to an inch. It was constructed from 2,000 altitudes. This map was very well made and was both instructive and interesting.

Coal was shown in large masses or blocks and sections of veins or seams. One, the "big vein," Randall, Perry County, seemed to be from 12 to 14 feet thick. Fine samples of coke were also shown. Pig iron, too, was displayed in large quantities.

Fine samples of gypsum were on exhibit. This mineral is extensively utilized in the State.

The display of the manufacture of clays was also very fine. The most interesting object was a glassmaker's pot, made from Ohio clay. There were also fine garden vases, tiles, fire-brick, pressed brick, ornamental tiles, pottery, roofing tiles, and common and refractory clays.

A prominent object in the Ohio mineral exhibit was a pile of grindstones rising like a monument many feet high. The lower stone was 7 feet in diameter and the upper small one was only 5 inches.

In the Geological Survey collection there were many building stones in cubes, including all the best in the State.

The archæological exhibit made by Ohio was very fine. It represented relics of the stone age and the mound building period. The collection contained many if not all the fine specimens shown at the Centennial Exposition and described and figured in the "*Final Report of the Ohio State Board of Centennial Managers to the General Assembly of the State of Ohio, 1877.*"

OREGON.

Territory, August 14, 1848. State, February 14, 1859. Area, 95,244 square miles. Population in 1880, 174,768. Capital, Salem. Floor space at the Exposition, 3,325 square feet. The State is divided into 23 counties. Oregon is divided into two unequal parts, Eastern and Western Oregon, by the Cascade Mountains, which rise to a heighth of from 4,000 to 10,000 feet; a few peaks are still higher. The summit of Mount Hood is 11,934 feet above sea level.

Besides the mountains mentioned, there is a coast range running nearly parallel to and about 25 miles distant from the seacoast. Some of the summits of this range are from 1,000 to 4,000 feet high. The principal minerals in Oregon, as far as discovered, are gold, silver, copper, and nickel ores. Lignite, good building stones, including limestones, granite, syenite, slates, sandstones, and marbles, salt springs, mineral waters, steatite, clays, pottery, and brick material, etc.

The collective exhibit made by Oregon was not large, but was creditable to the State.

The mineral exhibit was also small, but contained a number of interesting and even remarkable specimens. The State is indebted to Mr. J. W. Virtue for special work and for fine specimens loaned from his private cabinet. The mineral exhibit consisted of ores, minerals, rocks, building materials, etc., in table cases, and larger specimens on tables uncovered. The State made an appropriation and appointed Mr. Virtue Special Mineral Commissioner.

The counties in Oregon which are considered and designated *mineral counties*, are Baker, Grant, and Union. Gold and silver have been largely produced.

To June 30, 1883, precious metals from Oregon were deposited in the Mints of the United States as follows:

Gold	$17,392,549 36
Silver	46,391 05
	$17,438,940 41

The following estimates of the annual production of the precious metals combined, are from reports of the Superintendent of the Mint, and from those of R. W. Raymond:

1874	$609,070 00
1875	1,665,000 00
1876	1,601,000 00
1878	1,100,000 00
1879	1,170,000 00
1880	1,105,000 00
1881	1,140,000 00
1882	865,000 00
1883	680,000 00
	$9,935,070 00

Before 1874, the bullion product of Oregon and Washington was estimated in aggregate.

In the Oregon mineral exhibit the following special specimens were noticed and examined:

Gold nuggets.—From near Baker City, taken from gravel claims 10 to 117 feet thick. Hydraulic mining is in active operation at the locality. *Coarse gold nuggets*, from the Nelson Hydraulic Claim, from which $40,000 worth has already been taken out.

Cinnabar.—Grant County—float. The vein has never been found.

Hematite.—Baker City. Fine.

Fine grained galena.—Sparta Mine, Union County.

Limonite.—Oswego Iron Works. Pig iron was shown made from this ore.

Of ores, there were shown:

Rich gold quartz.—From Connor Creek, and from the Virtue Mine, Baker County. This is free milling ore. The gold obtained is 925 fine.

Silver lead ore.—From the Garfield Mine, head of Powder River, Baker County. Specimens from the *Monumental Mine*, Eastern Oregon. The ore contains gold and silver; the bullion product is worth from $9 to $11 per ounce.

Pyritic ore.—Westfield Mine, Grant County.

PENNSYLVANIA.

One of the original thirteen States. Area, 46,000 square miles. Population in 1880, 4,282,891. Capital, Harrisburg. Floor space at Exposition, 5,400 square feet. State divided into 66 counties. Pennsylvania is the second State in population and wealth in the Union. The southeastern part of the State is generally level. The central portion is mountainous. The most important chain of mountains is the Alleghany, from the summits of which the lands slope towards the State of Ohio.

The principal minerals of economic value found in Pennsylvania are coal, iron, petroleum, building stones, copper, chromic iron, zinc, and a few others of minor importance.

The area of the coal fields of this State is 12,774 square miles.

The total petroleum production from 1859 to 1882 inclusive, was 209,028,000 barrels of 42 gallons.

The total mineral products of Pennsylvania for the year 1870 amounted to $76,208,390.

Pennsylvania is very abundantly supplied with fuels, for which reason

she is one of the greatest, if not *the* greatest manufacturing State of the Union. Within a few years natural inflammable gas has been added to the list, and the new fuel seems to be cheaper than even petroleum. As there are a few accidental gas wells in California, and a probability of other sources being found by prospecting for, I have thought best to give the following paper on that subject in full:

From "The Mercantile, Manufacturing, and Mining Interests of Pittsburgh." Issued by the Chamber of Commerce, 1884.

NATURAL GAS.

SUBSTITUTION OF NATURAL GAS FOR COAL—ECONOMY AND WIDE UTILITY—THE NATURE AND EXTENT OF SUPPLY.

This report would fail of its intent and purpose if it did not take cognizance of the marvelous store of caloric and dynamic agency, recently so profusely brought forth by drilling in and around Pittsburgh. Though natural gas has been found for many years back in Western Pennsylvania, in boring for salt water and petroleum, its value as a means of generating heat and power has only been recognized within a comparatively short time. The extreme wastefulness with which the petroleum resources of this region have been drawn upon, owing to the apparently insurmountable difficulty of limiting production to such a degree as would correspond to consumption, now bids fair to be repeated in the more rarified fluid under discussion. The chief factor by which it is distinguished, in an economical sense, from petroleum, is that natural gas cannot be transported so readily for long distances as petroleum. While the latter has the whole civilized and semi-civilized world for a market, the former can only be conveyed a limited distance by means of pipes.

Friction and technical difficulties make it quite certain that the consumption of natural gas will be confined to within very narrow limits of its native place, and it is apparent that the substitution of natural gas for coal in our industries, will give Pittsburgh such a commanding position in manufactures, as will secure to her far more widely expanded markets than she formerly possessed.

The general introduction of natural gas as a fuel, has been retarded by certain legal proceedings involving corporate rights; and secondly, by the delay due to the passage of a municipal ordinance. In the meantime drilling for gas had received such a stimulus by the success obtained in the first ventures, that hundreds of derricks were erected within the city limits and immediate proximity, by the middle of the Summer of 1884. The producing wells number already a score, and the abundant supply of gas is now an assured fact, beyond the possibility of doubt.

An entire or absolute substitution of gas for coal is not likely to occur, but so much is certain, that "Smoky City," by which Pittsburgh has been familiarly known to three generations, will, in the near future, become a misnomer. The consumption of coal, locally, has been over three millions of tons per annum. This amount, according to reasonable estimate, will be reduced to one half, or even one third. The equivalent of five thousand tons of coal per day, may be supplied by a dozen gas wells, or even less. A single well has furnished gas equal to twelve hundred tons of coal per day. The peculiar competitive features of petroleum and natural gas wells, noted at the outset, obtain in full force, and will cause the price of fuel, so long as the supply lasts, to be at a minimum. There are at least thirty thousand real estate owners in Alleghany County and adjoining, every one of which enjoys the prospect of finding gas on his own ground by boring a six-inch hole, the cost of doing so being only from three to four thousand dollars.

It is by no means a sanguine view to say that Pittsburgh will save from two to three millions of dollars annually by the subtle fuel, besides the great advantage in many lines of manufacture that, by reason of its absolute purity, and the perfect control of the process of combustion, the product is not only cheapened but also improved.

There is still another valuable quality in natural gas, which, strange to say, has been largely overlooked. The pressure of hundreds of pounds per square inch, with which the gas issues forth, furnishes in itself a source of power of surprising extent, economy, and convenience. Calorific consumption requires that this pressure should be reduced to one or two per cent of its original amount, and the other may be utilized in dynamic devices of various kinds, and the value of the gas still remain unimpaired, or rather it may be left in a form exactly adapted to burning. In fact, it may not be altogether fanciful to look forward to the day when the same service pipe shall deliver power and heat as well as light.

The world has for a long time been wanting a motor for domestic use and light manufacturing purposes, and by the means indicated thousands of pneumatic engines for running lathes, sewing machines, elevators, etc., may be introduced here, not only lightening the labors of the household, but establishing diversified and lucrative employment for tens of thousands. The minor industries that generally cluster around the primary forms of production, are still in a very undeveloped state in our city, and it is much to be desired that they should be fostered here for reasons that will suggest themselves.

Natural gas and its uses have received such tardy recognition that the whole field of inquiry is practically unexplored. There is no literature on the subject, hence this paper

may in general terms at least present the salient features and the latest and most authentic information obtainable on the subject. In so doing we avail ourselves of the report of a special committee appointed by the Engineers Society of Pittsburgh, which committee devoted several months of research and inquiry to the subject of natural gas, and presented the results of its labors at a meeting held in May last.

Natural gas from western Pennsylvania is, in most cases, a mixture of more or less complex character. The few investigations published during the past few years tend to show that it is essentially composed of the hydro-carbons of the series known in chemistry as paraffines.

The members differ in their relative proportions of carbon and hydrogen. The vapors of these hydrocarbons are heavier as the proportion of carbon is greater. The calorific values show the superiority of marsh gas, weight for weight, over all the others. Some are odorless; among the others the odor is stronger in proportion as the amount of carbon is greater. A remarkable similarity of chemical properties is exhibited by all, and by reason of the strong attraction existing between them, the boiling point of a mixture is always found to be considerably higher than that of its most volatile constituent. They are theoretically the point of departure for the formation of a great number of useful compounds, such as alcohol, chloroform, acetic acid, and glycerine, but on account of serious technical difficulties, due chiefly to their remarkable resistance to ordinary chemical reagents (paraffin, parum and affinis), they have never yet been turned to practical account. They are not actively poisonous.

In the lower sand rocks of the oil regions occur probably all the members of the series, the less volatile flowing as petroleum and the more volatile existing in a state of compression, ready to escape through every opening.

Natural gas is, then, a mixture of the most volatile of these hydrocarbons, carrying various quantities of the vapor of the less volatile compounds. The lightest member, marsh gas (so called from its constant occurrence among the products of vegetable decay), is the chief element of the gas supplied to Pittsburgh. In addition to these, hydrogen, carbonic acid, carbonic oxide, oxygen, and nitrogen are found.

As the gas and oil sands all have a slight dip towards the southwest the gas in the southern part of the region is drawn from rock strata which are higher in the geological series than those yielding the gas in northern Pennsylvania and New York State. If any attempt at a generalization may be made with the few data at disposal, it appears, therefore, that the deeper strata yield, in general, a gas of higher specific gravity and illuminating power.

Analytical data covering a greater area of gas producing territory may in the future throw important light on the interesting question of the origin of gas and oil. The theory which traces both to the seaweed of the ancient Devonian sea, which once covered western Pennsylvania, has been very generally popular. Exhalations of combustible gas have been frequently met with in other countries, though nowhere in quantity comparable with the prodigious outflow from the gas wells of western Pennsylvania. Wells drilled for natural gas, outside of the oil regions, are of recent date, with a few exceptions. The wells at New Cumberland, West Virginia, have supplied gas for more than twenty years for the manufacture of bricks. The East Liverpool wells have been burning twenty-five years and are still productive. At Beaver Falls natural gas has been used for six years in a cutlery works, but lately the gas has failed, presumably on account of the wells becoming filled up, either with paraffine wax in the pores of the rock, or with an incrustation of lime and magnesia, as it is said they have never been cleaned out since they were drilled. At Erie so many wells have been drilled to the stratum of gas rock that it has become partially exhausted. In the oil regions a gas well was looked on rather as a curse than a blessing, and as most of the wells produce gas as well as oil, and so many were drilled to the same sand or rock, it soon exhausted the supply.

Besides the several wells that have been found within the municipal limits of Pittsburgh and Allegheny City within the last few months, our city has the advantage of being able to tap three or four gas belts or fields: The Butler County field, which supplies Spang, Chalfant & Co.; the Bull Creek or Tarentum field, which struck gas at 1,147 feet depth, and supplies the Pittsburgh Plate Glass Company, Pennsylvania Salt Manufacturing Company, and will supply Richards & Hartley's and Challinor & Taylor's new glass houses, and Godfrey & Clark's new paper mill; the Murraysville or Turtle Creek and Lyons Run field, which tapped the gas at 1,337 feet depth and supplies the gas for the Acme Gas Company, used by the Edgar Thomson Steel Works; the Fuel Gas Company, who furnish gas to the several mills and glass houses on the South Side; the Penn Fuel Company, who furnish the Union Iron Mills, Park Brothers & Co., limited, Wilson, Walker & Co., Hussey, Howe & Co., Shoenberger & Co., and many other works in the same neighborhood on the Allegheny River; the belt or field in Washington County, in which is the celebrated McGuigan well, the gas from which is being piped to the South Side. No doubt other prolific fields will be found to produce gas in the near future.

The more durable wells tap the gas productive strata generally at a greater depth than a thousand feet. It is a common opinion among those versed in the management of gas wells, that the outflow is subject to a gradual diminution, tending ultimately to total extinction. Evidence of this is to be found in all parts of the gas territory, where gas wells have been long in use. In many localities, however, there is reason to think that the gradual falling off of the supply of a well is due to the choking up of the pipe by a deposit of salt or paraffin, rather than to the failure of the original source. This is notably the case with the Freeport gas wells.

Natural gas, next to hydrogen, is the most powerful of the gaseous fuels, and if properly applied, one of the most economical, as very nearly its theoretical heating power can be utilized. It is used for almost all the purposes to which coal is applied, with one notable exception, viz.: for smelting ores in blast furnaces, and it is our belief that at no distant day it will be used for this, but not in the present style of furnace.

Being so free from all deleterious elements, notably sulphur, it makes better iron, steel, and glass, than coal fuel. It makes steam more regularly, as there is no opening of doors and no blank spaces are left on the grate bar to let cold air in, and when properly arranged regulates the steam pressure. Boilers will last longer, and there will be fewer explosions from unequal expansion and contraction, due to cold draughts of air let in on hot plates.

Gas engines of large size can be built to be driven by natural gas, as in the case of the Otto and other styles.

For domestic purposes a beautiful fire can be made, dust, ashes, and coal carriage avoided; smoke, and the smoked ceilings and walls of Pittsburgh, may become things of the past; yet, if sold at about fifty cents per thousand cubic feet, it is much more costly than coal, especially if used in grates and stoves constructed for coal. The invention of burners for its more economical consumption in stoves must follow its general introduction. Most of its users consume it in such a crude manner that they fail to get its best results, the difficulty being the expense of making the necessary changes in the burning. There is, however, one exception where it is being used with economy, in Siemen's regenerative furnaces.

The committee determined experimentally the value of natural gas as a fuel in comparison with bituminous coal in generating steam. One pound of coal evaporated nine pounds of water, and one pound of gas (23.5 cubic feet) evaporated twenty pounds of water. In other words, 1,000 cubic feet of natural gas will evaporate 800 pounds of water, and to do the same with coal requires 90 pounds, or about 1¼ bushels.

So long as meters are not employed in measuring the volume of gas consumed in manufacturing establishments, it is scarcely probable that owners will study economy in its use. But with an increased demand for natural gas—particularly when its superior heating qualities and low price, as compared with coal, are understood—the officials of the supplying companies will doubtless take such action as will prevent the reckless waste of this valuable natural product. If, for instance, as it might be shown by cheap contrivances easily applied, a factory could be better supplied with only one third the present consumption of gas, the owners would certainly deem it no hardship if a meter was placed at their establishment, provided rates were not increased. In fact, it is most probable that a perfect system of supply will reach many more consumers, and with rates much lower than have heretofore been charged. At present the want of method by the companies forbids as rapid a development of the gas supply as the public wants really require. Heretofore it seems that contracts have been made to supply the gas at rates only a trifle less than the cost of coal; but in the haste to declare dividends the companies seem to forget that by permitting its reckless waste by a few large consumers, they are crippling a resource which would yield better financial results through a more general distribution at more reasonable rates.

Natural gas has about one half the illuminating power of coal gas. By means of fans, a mechanical mixture with the vapor of heavy hydrocarbons can be effected, whereby illuminating gas, at a cost of not more than 40 to 50 cents per thousand cubic feet, can be offered the public. These heavy hydrocarbons, the products of refining petroleum, have hitherto had but a low commercial value. Possibly the same elements may also be supplied from the smoke of the thousands of coke ovens in the vicinity.

It has also been attempted to apply natural gas to the conversion of iron into steel.

Experiments having in view the dephosphorization of iron through the agency of the hydrogen of natural gas have been made, but thus far the results have been very unsatisfactory. Imperfectly burned at a high temperature, the gas deposits carbon in a form having a remarkable density. Upon this principle the manufacture of electric light carbons is now carried on.

The tendency of the gas, under pressure, to absorb and carry off oil and grease, leads to its being used for the cleansing of delicate fabrics.

The powerful reducing action of the gas upon metallic oxides at high temperature may lead to its application to the smelting of metals on a large scale.

The application of gas to glass making, on account of the purity of the fuel, has led to the production of superior plate glass. More rapid fusion is possible, and covered pots are found unnecessary.

The varying requirements of a large iron works will render it desirable to be able at all times to control an unlimited volume of gas, supported by high pressure.

The importance of having the high pressure mains, as they enter the city, subjected to careful tests, and the mode of laying such pipes under municipal supervision, are evident. The fact that natural gas, if mixed with air, will explode on contact with fire, and is in effect the dreaded fire damp of the coal mines, is no argument against its introduction and general use under due precautions. The qualities which render it explosive when mixed with excess of air are the very ones which render it valuable as a producer of light and heat. The following trials were made with a view to ascertaining the limits of its inflammability. Different mixtures of measured quantities of natural gas and air were prepared, and, also, mixtures in the same proportions of coal gas and air. The effect was noted when a coal gas flame was plunged into each. From these results we concluded that in a room filled with air containing 1–10 to 1–12 natural gas, the danger would be one

of explosions; above or below these limits there would be danger of fire but not of explosion. On the other hand, if the air in a room contains 1-6 or 1-7 coal gas, contact with flame would cause explosion, while with an admixture of 1-10 or 1-11 of coal gas, there would be danger of fire, but not of explosion. As will be seen, as regards safety, there is a difference in favor of coal gas. Natural gas brings with it from the well, minute quantities of heavier liquid or solid hydrocarbons in the form of vapor or spray, by the force of the gas under pressure, which imparts to it a strong and characteristic smell.

A peculiar substance resembling butter is often taken from the mains bringing the Murraysville gas to the city. This substance was found to contain common salt, water, small quantities of lime and magnesia salts, coarse sand, and a considerable quantity of solid paraffin, all blown into light froth. The odor of the gas in the mains appears to be dependent upon traces of condensible hydrocarbons, for if kept in a closed vessel for a few days, the gas becomes absolutely odorless. The odor will diminish more and more as it is carried away from the wells, or from the high pressure mains. This may explain the contradictory statements upon this point which have found circulation.

It has been found that air containing 10 per cent of Murraysville gas (fresh from the high pressure mains) has a decided odor; this is also true of Freeport and Creighton gas, but the same gas, after standing in an air-tight glass for twenty-four hours, lost every trace of odor.

In conclusion, it may be of great importance to all interested, to call attention to the remarks made by Professor J. P. Lesley, the Chief of the State Geological Survey, in relation to the so called "belt theory." Often lines have been run in locating oil and gas wells, having a certain compass-bearing from another well, and the professor combats this notion in the following words:

"It is needless to remark, that this method of locating an oil or gas well from another, must necessarily prove ineffectual, because it imagines the plane of the oil to be in the vertical, whereas it spreads horizontally. Local surveyors and civil engineers, not being trained geologists, are naturally disposed to overvalue the powers of their special professional instruments, the compass or transit, and it is not to be wondered at if, in the confusion of men's ideas about oil, and the origin of natural gas, the engineer's compass should have made a stiff fight to keep the field over which it had, so to speak, the right of preëmption.

Since rock oil and gas in union with salt water are held by horizontal layers of loose sand and gravel, and since these layers of sand and gravel were of course deposited in and by running water, currents in an ancient and probably rather shallow sea, it is clearly useless to attempt to follow their irregular courses underground by surveying straight transit lines across the present surface of the country. The straighter the compass line is run—in other words the more skillful the engineer—the less will his line correspond to the real lines of direction of the ancient oil and gas bearing sand and gravel banks meandering and branching a thousand feet beneath him. He can no more tell, by means of his compass, through what narrow channels in the narrow and more or less crooked sand bar the oil is slowly moving, than a boy, by drawing lead pencil lines on the top of a pile of boards, can tell what is the direction of the grain, or the movement of a worm in the hundredth board down from the top.

Even on the impossible supposition that his lines may for once correspond to the grain of the hundredth board, they certainly could not correspond also to the grain or worm holes of the hundredth and tenth board, representing, say the second sandrock of the oil; and still less to the hundred and twentieth, representing the stray sand; the hundred and thirtieth, the third sand, etc.

The collective exhibit of Pennsylvania was made officially by the State, and was very grand and comprehensive. The mineral exhibit was made principally by the State, but partly by individuals and railroad companies.

In the State collection there were shown specimens from various coal fields or mines, and rocks and building stones.

Fine specimens of *anthracite coal* from the mines of the Philadelphia and Reading Coal Company were exhibited. They resembled jet. One specimen weighed 1,600 pounds.

Anthracite coal from the Girard estate. One block weighing 3,255 pounds, jetty black and lustrous, was also shown.

Coke from Connellsville; very fine.

Piles of *crude iron ore* and *pig iron*.

One case contained 16 specimens of iron and iron ores, pyrolusite, etc., with analysis of each on label, a very instructive and interesting exhibit by Carnegie Bros. & Co., Bessemer.

One case containing specimens of steel, beautifully shown, by Miller, Metcalf & Parkin, Pittsburgh.

C. G. Hussey & Co., Pittsburgh, showed copper and brass manufactured

goods. One circular disc was a quarter of an inch thick, and at least 10 feet in diameter. There were also planished and tinned ware, brass kettles, etc.

Piles of *copper ore* (chalcopyrite in calcite) from French Creek Mine, Chester.

Rocks and building stones in great variety. On one small column of dark veined marble, attention was called by the label to certain obscure figures, which had a vague resemblance to a human figure.

One case of minerals was shown by the Lebanon Valley College. It was a small collection, but the specimens were clean, and neatly labeled and displayed.

Two large double cases of Pennsylvania minerals were loaned to the State exhibit by A. E. Foote, of Philadelphia. They contained a general collection of the principal minerals of the State, all of which were good specimens—some magnificent—all labeled with name and locality. There were in all 250 specimens. The following is a list of the most interesting:

Alophane,
Amethyst,
Amphibole,
Andalusite,
Anglesite,
Anthophyllite,
Anthracite,
Ankerite,
Apatite,
Apophyllite,
Aragonite,
Autunite,
Azurite,
Barite,
Beryl,
Biotite,
Bornite,
Brucite,
Calamine,
Calcite,
Celestite,
Cerussite,
Chabazite,
Chalcopyrite,
Chrysocolla,
Copper, native,
Corundum,
Cuprite,
Cyanite,
Dendrites,
Deweylite,
Diaspore,
Doppelerite,
Enstatite,
Fluorite,
Fibrolite,
Galenite,
Garnet,
Göthite,
Graphite,
Greenockite,
Halotrichite,
Hematite,
Heulandite,
Hyalite,
Hydrocuprite,
Limonite,
Magnesite,
Marcasite,
Margarite,
Melaconite,
Melanterite,
Molybdenite,
Muscovite,
Oligoclase,
Orthoclase,
Penninite,
Pyrrhotite,
Pyrite,
Pyromorphite,
Pyroxene,
Quartz, green, blue (in many varieties),
Randanite,
Ripidolite,
Rutile,
Saponite,
Serpentine,
Siderite,
Sphalerite,
Staurolite,
Stilbite,
Sulphur,
Tourmaline,
Uranite,
Wollastonite,
Wulfenite,
Yellow Ochre.

A very interesting exhibit of slate from quarries in Bangor was made by Benedict & Davis. The display was made in a slate-covered kiosk. It consisted of roofing slates, billiard table tops, and a slate burial case or sarcophagus.

RHODE ISLAND.

One of the original thirteen States. Area, 1,306 square miles. Population in 1880, 276,531. Capitals, Providence and Newport. Show space in Exposition buildings, 3,565 square feet. The State is divided into 5 counties. The surface is generally rough and hilly, but there are no mountains.

There are but few minerals in the State of economic value that are worked. They consist of slate, anthracite coal of inferior quality, iron ore, limestone and marble, serpentine, granite, and other building stones.

Rhode Island is not in any sense a special or important mineral State.

The State minerals were displayed in two small glass table cases. The collection was small, but contained all the characteristic species in good and in some instances fine specimens.

SOUTH CAROLINA.

One of the original thirteen States. Area, 29,385 square miles. Population in 1880, 995,577. Capital, Columbia. Floor space in Exposition,

10,175 square feet. State divided into 32 counties. The coast is flat and sandy. For 100 miles inland there are low hills which increase in altitude to the summit of the Blue Ridge in the northwestern part of the State. The highest land (Table Mountain) is 4,000 feet above sea level.

South Carolina may properly be classed with the important mineral producing States of the Union. The principal minerals of economic value are gold, copper, lead, marbles and building stones, iron ores, chrome iron, corundum, ochre, steatite, and phosphatic minerals used very extensively as fertilizers and for the manufacture of phosphorus.

Gold

Has been somewhat largely produced in South Carolina. The general character of the deposits and manner of working do not differ materially from those described under the head of Georgia and North Carolina. There are several vein mines worked which resemble those of California.

1867	$1,200 54 in gold from this State was deposited in the United States Mints.
1875	No gold produced.
1880, yield	$40,000.
1881, yield	35,000.
1882, yield	22,500.
1883, yield	57,000.

Gold was more largely produced in this State before the discovery of that metal in California.

The total deposits of South Carolina gold in United States Mints from 1804 to June 30, 1883, was:

Gold	$1,468,854 10
Silver	457 76
	$1,469,311 86

Forty-two imitation gold bars, representing $1,000 each, were exhibited by the Haile Gold Mining Company, of Lancaster County, as the product of last year.

Specimens of gold quartz were shown from the West Gold Mine, Union County, which resembled the auriferous quartz of Fresno Flat, Fresno County, California. This mine was opened in 1882, and commenced milling with 20 stamps in 1883.

The gold belt crosses the northwest portion of the State. Large nuggets have been found and many mines worked.

MINES IN SOUTH CAROLINA.

Report of State Agricultural Society, 1884.

ANDERSON COUNTY.

Number of mines in the county (?) Mica, corundum, plumbago, and others. This county contributed among the largest of the collections of minerals of any county to the agricultural department.

Number of quarries (?) There are numbers of good quarries in the county, notably at Pendleton, Simpson's Mill, Dark Corner Township, Honea Path, Williamston, on Tugaloo and Seneca Rivers, and Wilson's Creek. The latter has been used for millstones.

CHESTERFIELD COUNTY.

Number of mines in the county, 3. Name and names of proprietors: Brewer Mine; Kirkley Mine, owned by C. L. Evans; Oro Mine, owned by J. J. Hicks. Location: Brewer and Oro, Jefferson; Kirkley, Mount Croghan.

Character: Brewer, free ore, surface washing; Kirkley, same character, not in operation; Oro, gold-bearing rock, no free ore, not in operation.

Capital employed: Brewer, $60,000; Oro, $1,500; total $61,500. Value of annual product,

Brewer, $10,000. Percentage of metal to ore, per ton, Oro ore now being assayed in New York. Class of machinery, first class. Number of hands, 10. Increase or decrease in business within the year, no statement. Percentage of net profit, not stated.

KERSHAW COUNTY.

Number of mines in the county: Only one gold mine, not worked.

Number of quarries, 2; not worked now. Character: Granite, equal to any in the world; unlimited supply.

LANCASTER COUNTY.

Number of mines in the county: About 10. Names, location, and proprietors: Haile Gold Mine, Flat Creek Township; Gay Gold Mine, Flat Creek Township; Blackman's Mine, Flat Creek Township; Jones Mine, Flat Creek Township; Shuter Mine, Beaufort Township; Hunter's Mine, Gills Creek Township; Stevens' Mine, Gills Creek Township; Indian Land Mine, Indian Land Township; Funderburk Mine, Beaufort Township; one not named.

Character: The Haile Gold Mine is a first class vein. The Gay Mine is of fine promise. These are the only two now operated. Capital employed in both mines, about $300,000. Product, from $3,000 to $7,000 per month. Class of machinery: The most improved for separating sulphur from the gold. Number of hands employed, 110 white. Increase or decrease in the business in the last twelve months: A considerable increase—about 30 per cent.

The Haile Gold Mine is operated by a wealthy New York company. The operation of the works goes on night and day for every day of the week, Sunday not excepted. The machinery used is of the most improved pattern. There are two roasting furnaces and twenty-stamp mills, propelled by powerful steam engines. In all there are about five steam engines. The great trouble hitherto has been the separation of the sulphur from the gold. This is now successfully effected by the use of the roasting furnaces and the highly improved machinery introduced by the northern proprietors.

In connection with this mine the company operate a large store and also a steam sawmill. They have lately erected a church at or near the place. Around these mining and other works there has grown up a village of some moment. And indeed it may be well said that this company is doing a great deal for Lancaster County. The mine is improving in reputation, and is probably surpassed by few if any in the State. It is well known that gold can be found anywhere, more or less, in the eastern part of the county, and it is thought that this may prove to be a famous gold region, needing only development.

No quarries in the county in operation.

LAURENS COUNTY.

1. Number of mines in the county: none worked. Traces of gold abound in the county and some traces of silver have been found. There is an extensive field of corundum near the town of Laurens, on lands of Mrs. Susan W. Simpson, of E. P. Simpson, and others.

2. Quarries in the county: 1. Location, thirteen miles west of Laurens, near Brewerton Post Office. Character, limestone and marble of the best quality. Class of machinery, "drills, hammers, and wheelbarrows." Capital employed, $500. Value of annual product, $1,000. The best quality of soapstone abounds in several localities; also best quality of marble and limestone, and first class building and working granite. All these resources are neglected, but must some day invite attention and development.

OCONEE COUNTY.

There are no mines worked in the county, though minerals, especially gold, abound, and gold has been successfully mined.

PICKENS COUNTY.

1. Number of mines, etc.: None yet developed. The county has asbestus, mica, granite, and gold.

2. Number of quarries: only one partially developed. Character, granite of the best quality. Class of machinery, primitive. Capital employed, little or none—not over $150. Annual outturn, not over $500 worth of stone delivered.

UNION COUNTY.

1. Number of mines in the county: 5 gold mines. Two of these mines are operated, and three are not:

First—The West Mine, owned and operated by the West Mining Company: is composed of northern proprietors, and is located twelve miles northwest of Union C. H. It has been worked about two years by the present company. The veins are in talc and mica-slate formation. A 20-stamp mill is in operation day and night. From 50 to 75 hands—25 white and 50 colored—are employed, with a capital of about $20,000. The value of the ore is from $2 to $50 per ton.

Second—The Thompson or Fair Forest Mine; is located twelve miles northwest of Union C. H., and adjoins the West Mine. The formation is the same as the West Mine. A 10-stamp mill is now operated at the mine. The value of the mill is about $5,000. The value of the ore is from $5 to $100 to the ton. There are three well defined veins on the property that assay high. This is a very valuable mine. The number of hands at present employed is 20, colored.

Third—The Nott Mine; is located about ten miles northwest of Union C. H., and about three miles from Glenn Springs. This mine is slate formation, with quartz ore in large bodies, and reported to be a true fissure vein by M. Tuomey, State Geologist. This mine is not now operated, but it was before the war, by a company composed of South Carolinians. The value of the ore is from $5 to $100 per ton. It was very productive formerly, and yielded an immense profit. Ore was taken from the vein that yielded 3,000 pennyweights in eleven bushels of ore.

Fourth—The Norris & Nucholls Mine; is located sixteen miles northeast of Union C. H., on the Pacolet River. The mine is not in operation. It was worked previous to the war and paid well. The value of the ore is from $3 to $100 per ton.

Fifth—The Posey Mine; is located about eleven miles northwest of Union C. H., near the West Mine. It is of the same formation as the West Mine, and the ore is about the same value. This mine was operated before the war, and was considered very rich.

The general exhibit of South Carolina was large. The mineral section was altogether a remarkable exhibit. The most striking object was a pyramid of "*Phosphates*" from 25 to 30 feet high, built of medium fragments. At the base large masses were piled, also bags of manufactured fertilizers and glass jars of prepared fertilizers. On sunken panels the following statistics were painted:

Total value of fertilizers manufactured	$3,000,000
Annual shipment of phosphate rock	400,000 tons.
Annual shipment of fertilizers	155,000 tons.
Total value of phosphates mined, per annum	$2,500,000

A large block of South Carolina marl found beneath the phosphate beds, three or four feet thick, was shown in this section.

A SKETCH OF THE HISTORY, ORIGIN, AND DEVELOPMENT OF THE SOUTH CAROLINA PHOSPHATES.

Compiled by A. R. Guerard, A. R. S. M., Mineralogist for the New Orleans Exposition for the Department of Agriculture, Columbia, South Carolina.

THE HISTORY OF THE DISCOVERY.

South Carolina (sometimes known as Charleston) phosphate, was discovered in the latter part of 1867, at a place called "Lambs," about twelve miles above Charleston, on the Ashley River. The marls of Carolina appear to have been known and identified by geologists as far back as 1797. In 1832 attention was drawn by Mr. Ruffin, of Virginia, to the fact that these marls were valuable as a fertilizer; and in 1848 Tuomey, in his Geological Report of South Carolina, speaks of irregular and water-worn fragments of marl stones, found in the Ashley River marl-beds, and claims for these a value far above the Virginia marls, because they contained from 1 to 10 per cent of phosphate of lime. In 1850, Prof. Holmes, of Charleston, read a paper before the "American Association for the Advancement of Science," in which he described nodules of marl rock, referring to them as "silicious" masses. So called "rocks" or "stones," found lying on the surface of the land, or turned up in plowing, were well known to old planters on the coast. But it is evident that, though these rocks or nodules were long an object of scientific investigation and local curiosity, the true nature and chemical composition of the Carolina phosphates were as yet unknown and unsuspected. It was not until 1867 that the late Dr. St. Julien Ravenel, of Charleston, upon receiving some specimens of these nodules, recognized their value and pointed out their agricultural importance. The deposit *in situ* was discovered by Prof. F. S. Holmes, who, with Dr. Ravenel and Dr. Pratt, of Atlanta, shares the credit of a discovery which has proved and must continue to be a source of wealth to South Carolina, and a benefit to agriculture, both in this country and in Europe, the importance of which cannot be estimated. It may seem strange that the value of this deposit should not have been recognized before, when it was lying here, seen, but neglected, under the very eyes of geologists and chemists, some time after the agricultural use of phosphate of lime was known to the world. But South Carolina, before the war, being in a state of agricultural prosperity, there was, doubtless, less importance attached to this matter than would otherwise have been the case; and, as usual, it was the necessity of effort—the demand for a means of livelihood—which led to the great discovery. By that wonderful

provision of nature which so often awes and impresses us, the aid was given, the supply furnished, when the demand was greatest. The first company organized to excavate the phosphates was the Charleston Mining and Manufacturing Company, which was formed with northern capital, furnished by Messrs. George D. Lewis and Frederick Klett. The first shipment by this company was sixteen tierces, by steamer Falcon, consigned to George D. Lewis, Philadelphia, Pennsylvania. The manufacture of commercial fertilizers, under the chemical superintendence of Dr. St. J. Ravenel, had begun in Charleston shortly before this, using the Navassa phosphate as a source of phosphoric acid. Henceforth, native phosphate was substituted for the Navassa phosphate; and, under Dr. Ravenel's direction, new fertilizer works were put up to utilize the phosphate which was now being mined at home.

OCCURRENCE AND CHARACTER OF THE PHOSPHATE DEPOSIT.

The phosphate deposit occurs in beds or strata of rough masses or nodules, of a size varying from a part of an inch to several feet in diameter, and is associated with numerous fossil bones and teeth. It is found on the bottoms of the shallow creeks and rivers which intersect the coast, and on the low lands which form a belt of country running parallel to and from ten to fifty miles from the seaboard. The beds are from 6 to 20 odd inches in thickness, and the limit of a workable deposit is 8 feet underground or 20 feet under water. The phosphatic nodules are known as "land" or "river" rock, according to the element in which they are found. The average yield of the land deposit is 600 to 800 tons to the acre, and though sometimes occurring in "pockets," that is irregularly, these deposits are remarkably uniform, many contiguous acres often containing a phosphate-bearing stratum at an accessible depth. The "river" rock having been washed into the rivers from the land, has occasionally accumulated in thicker beds than the original deposit of land rock. The "river" rock is obtained by dredging, chiefly in the Bull, Stono, and Coosaw Rivers; the "land" rock is dug mainly in the section of country lying between the Ashley and Stono Rivers and Rantowle's Creek. Extensive strata of excellent quality are also known on the banks of the Edisto, and between the Edisto and Ashepoo Rivers, but this deposit has not yet been worked to any extent. About and below Beaufort occur a number of very heavy beds of "river" rock, but generally of lower grade. The "land" rock is lighter in color than that found under water or marsh mud, the former having a yellowish or pale brown color, the latter a dark gray or bluish black. The river rock is considerably harder than that occurring in the land deposit, but either variety may be readily ground to a powder so fine that it floats in air (so called "floats"). Carolina phosphate gives out when rubbed a peculiar fetid odor, the denser it is the more conspicuous the odor, due to the presence of organic matter. It is very porous, some of it being capable of absorbing 15 to 20 per cent of water. The surface of the nodules is frequently indented with holes and cavities naturally filled with clay and sand, which require to be carefully washed out; when the washing is imperfectly performed the phosphate is of lower quality. Carolina phosphate is remarkably uniform in composition, containing on an average from 55 to 61 per cent of tricalcic phosphate, and from 5 to 11 per cent of carbonate of lime. Among its other constituents are silica, oxide of iron, fluorine, sulphuric acid, traces of alumina and magnesia, water, and organic matter.

ORIGIN OF THE PHOSPHATIC DEPOSIT.

The question of the origin of the phosphate of lime in this deposit has as yet received too little study to afford a satisfactory theory. But it awakens such general as well as scientific interest in the minds of all who have seen or heard of the deposit, that it may not be amiss to state briefly the several hypotheses which have been advanced. One of these assumes that the fragments of marl were charged with the sweepings from guano beds formed above them by the congregation there, at some past period, of vast flocks of birds; in this case the bones of the birds should be among the fossils preserved in the deposit, but no such remains have been found. Another theory supposes that as the remains of numerous extinct animals, such as the mastodon, elephant, megatherium, tapir, horse, deer, etc., occur associated with the beds, immense herds of these animals must have collected at one time about shallow salt licks or lagoons, formed during a partial submergence of the coast, in which the nodules of marl were left upon the recession of the sea, and that the phosphoric acid derived from their bones and excrements brought about the change in the marl. It is objected to this theory that the places where the most bones, etc., are found, are not the richest in phosphate, and while it is by no means probable that the nodules were in all, or even in most instances formed where they are at present found, it is difficult to suppose that agencies of such local and restricted character as salt licks could account for the conversion of so great a mass of material, over an area so extensive as that presented by the phosphate formation, and that a similar deposit found at a depth of seventy feet in the artesian well borings at Charleston could not be explained in this way.

The most plausible theory advanced as an explanation of the formation of these nodules is that certain marine organisms or mollusks possess the power of secreting phosphoric acid from sea water, and that through them the marl, and especially the upper strata, became charged with a certain amount of phosphate of lime. That the proportion of the phosphate of lime thus obtained to the whole body of the superficial layers of the marl was afterwards increased; first, by the removal of a considerable amount of carbonate of

lime, rendered soluble by the percolation through it of rain water containing carbonic acid, derived from the decomposition of vegetable matter in the soil overlaying the marl; second, by a well known proneness of phosphoric acid, when diffusely distributed, to concentrate and to give rise to concretionary processes similar to those observed in the flint nodules and pebbles of the English chalk, and in other formations. This theory agrees with the diffused occurrence of phosphate of lime in the superficial layers of the marl, as well as with the fact that the upper layers of the deposits and the outside of the nodules are the richest in phosphate. It substitutes for a local cause a general one, commensurate at once with the wide area occupied by the phosphate rock, and by the phosphatic marls of the South Atlantic seaboard. Such a cause, also, might have been in operation ages ago, when the layers of phosphate rock found in the artesian well borings were forming; and it may be in operation now, as the dredging work of the United States Coast Survey shows that the marls accumulating at the depth of 200 fathoms on the floor of the Gulf Stream, between Florida and Cuba, contain a considerable percentage of phosphate of lime. (See Handbook of State of South Carolina, and Emmons' report to Pacific Guano Company, 1876.)

THE WORKING OF THE LAND DEPOSIT.

Having carefully examined the land for phosphate, its depth, thickness of stratum, etc., a field is selected and drained by means of trenches, technically known as "line pits," dug around the tract and reaching below the level of the rock bed. This field is about 600 yards wide, and made as long as possible for transportation of the rock dug. A tramroad for horse, or steam, is constructed through the midst of the field in its length, and then, commencing at the "line pits" and working in towards the tram, pits measuring 6 by 12 feet, are sunk in long parallel lines. The superincumbent earth is thrown up with shovels behind the men, and the phosphate rock dug out with picks and cast on the untouched ground in front. When trees are in the field they are undermined and thrown over on the side which has already been excavated. The rock is rolled from the pits in barrows and dumped on platforms on the roadside, whence it is loaded into cars for transportation to the washers. The labor on the phosphate fields is performed almost altogether by negroes, sometimes convict labor being employed. Italians have occasionally been imported as laborers, but they have not been found to do the work required as well as the blacks, who alone can stand the hot suns and malaria of the phosphate swamps in Summer. The hands are not generally paid by the day, but by the foot dug, the price being in most mines 25 cents a foot for a pit of 6 by 12 feet, the rolling of the rock inclusive. At this wages they make about $1 a day on the average—sometimes more and sometimes less—according to the character of the land and depth of rock from the surface. Land miners have not considered it profitable to work deposits at a greater depth than eight feet beneath the surface.

The clay, sand, etc., adhering to the rock, which amounts to one half or two thirds of the whole mass, is removed by washing. The crude rock as it comes from the pit is carried to the washers, large, heavy pieces of machinery, worked by steam, and situated near some creek or river where there is an ample supply of water. The rock is here passed first through roller crushers, armed with steel teeth, which break up the larger nodules to a uniform size of not more than four inches in diameter. These then fall into long wooden troughs or tubs resting on a slight incline, through which revolve wooden shafts furnished with iron teeth fixed in the form of a spiral screw. The nodules being forced up the incline against a strong stream of water are rubbed one on the other until cleansed of all clay, etc., and are thrown out at the open end of the tub. After being screened they are then transported to the dry sheds, or dumped outside the washer building. The land deposits are owned by companies or individuals, or are leased upon a royalty for a term of years.

THE WORKING OF THE RIVER DEPOSIT.

The river deposit is now worked principally by dredging, but some years before the shallower creeks were exhausted of rock large quantities of phosphate were raised by "hand picking," "tongsing," and "diving." "Hand picking" was resorted to in such deposits as run dry at low water, and consisted in loosening the nodules by means of the pick and crowbar and throwing them into flatboats to be carried to the shore. "Tongsing" was the term applied to raising such deposits as were too deep to be hand picked, but which were within reach of the oyster tongs. Diving was occasionally practiced by the negroes in Summer, in water six to ten feet deep, to bring up large loose nodules which were too heavy to lift with the tongs. These apparently primitive methods of working answered admirably as long as the deposits were shallow and labor cheap, but it was not long before the more powerful appliances of steam and machinery came into use.

A very large portion of the Carolina phosphate, and by far the largest portion of the river deposits, are now raised by dredging from deep waters, where the nodules lie on the bottom, sometimes covered by a layer of sand and mud several feet in thickness. The dredges heretofore employed have been found to work best in not more than twelve feet of water, twenty feet being the limit. At this depth they are able to tear up the thickest and hardest phosphate beds; and under favorable circumstances as much as 100 tons of rock a day have been raised to the dredge. The dredge, which is the ordinary single machine, empties the mass of nodules, marl, sand, mud, shells, etc., on a floating washer of simpler though similar construction to that employed for washing land rock. The clean rock is loaded into "lighters" or barges, and transported to dry-sheds on shore.

Several efforts have recently been made with specially adapted machines to raise the deposit lying at greater depths and in larger quantity than the ordinary dredge can do, but so far none of these attempts have been successful. At the present time there are two immense dredging machines in progress of construction which are calculated to do more and better work than has yet been done, but these machines are not at work, and no opinion, therefore, can be formed of them. There is no doubt, however, that the more inaccessible deposits will be excavated whenever the demand for phosphate is sufficient to necessitate the supply, and though that day may not yet have arrived, it is not so far distant.

One of the most important operations in the preparation of phosphate rock for market is the drying of it, though it is one which has been much neglected by phosphate miners. The river rock has long been dried for foreign shipment in order to lessen the cost of freight, and to raise the percentage of phosphate of lime in the rock. But land rock, which has been chiefly consumed at home, is seldom dried even now to less than six or seven per cent of water, and contains often as much as ten per cent, the local fertilizer works purchasing the rock wet and drying it as needed.

The most satisfactory method of drying employed so far is the hot-air process, sun drying being too slow and uncertain to be efficacious, and other methods tried having proved too expensive on the large scale. A hot blast of air is forced by a fan through perforated iron pipes into a brick kiln or dry-shed; into these sheds, which hold 500 tons and over, the wet rock is dumped upon the pipes, over which are sometimes laid logs of wood to aid in distributing the heat through the mass. In this way 500 tons can be dried in thirty-six hours to from one to three per cent of moisture. This process would seem to entail a great waste of heat and fuel, but it answers sufficiently well in practice, and as long as wood is cheap is more economical than any other.

The river miners work under charters from the State, which grant them a general right to work a specified territory with any other comers, or under an exclusive right to such territory. In either case they pay a royalty to the State of one dollar for every ton of rock raised.

NUMBER AND NAMES OF COMPANIES MINING PHOSPHATE ROCKS.

The following list gives the names of companies at present engaged in mining land and river rock:

Land Mining Companies.

(1) Charleston Mining and Manufacturing Company. Works on Ashley River, near Charleston.
(2) Gregg's Phosphate Mines. Works on Ashley River, near Charleston.
(3) Pinckney's Phosphate Mines. Works on Ashley River, near Charleston.
(4) Rose Phosphate Mining and Manufacturing Company. Works on Ashley River, near Charleston.
(5) Pacific Guano Company. Works on Bull River.
(6) St. Andrews' Phosphate Mining Company. Works on Stono River.
(7) Wando Phosphate Mines. Works on Ashley River, near Charleston.
(8) Bradley's Phosphate Mines. Works on Rantowle's Creek, near Charleston.
(9) Drayton & Co.'s Phosphate Mines. Works on Ashley River, near Charleston.
(10) Bolton Phosphate Mines. Works on Stono River, near Charleston.
(11) Chisholm Phosphate Mines. Works on Ashley River, near Charleston.
(12) Fishburne Phosphate Mines. Works on Ashley River, near Charleston.
(13) Pon-pon Phosphate Mines. Works on Edisto River.
(14) Dotterer's Phosphate Mines, Works on Church Creek, near Charleston.

River Mining Companies.

(1) Coosaw Mining Company. Works on Coosaw River, near Beaufort.
(2) Oak Point Mines Company. Works on Wimbee Creek, near Beaufort.
(3) Sea Island Chemical Company. Works on Beaufort River.
(4) Farmers' Phosphate Company. Works on Coosaw River.
(5) Hume Bros. & Co. Works on Beaufort River.

In addition to these the following individuals are mining on a smaller scale on individual rights:

(6) David Roberts. On Wimbee Creek.
(7) J. W. Seabrook. On Morgan River.
(8) J. M. Crofut. On Beaufort River.
(9) J. DeB. & J. Seabrook. On Parrot Creek.
(10) Willis Wilkinson. On Stono River.
(11) J. G. Taylor. On Parrot Creek.

The Land Mining Companies engaged employ a capital of $1,980,000; 1,286 hands, with $363,560 wages. Their products amount to $1,283,830.

The River Mining Companies engaged employ a capital of $525,000; 649 hands, with $259,300 wages. Their products amount to $907,170.

The total capital employed is $2,505,000; number of hands, 1,935; wages, $622,860; products, $2,190,000.

(See Handbook of State.)

Mined and Shipped.

The following table gives the total amount of phosphate rock mined and shipped since the discovery of the South Carolina deposits:

1868–70	20,000 tons.	1879	200,000 tons.
1871	50,000 tons.	1880	190,000 tons.
1872	60,000 tons.	1881	265,000 tons.
1873	90,000 tons.	1882	335,000 tons.
1874	100,000 tons.	1883	355,000 tons.
1875	115,000 tons.	1884	409,000 tons.
1876	135,000 tons.		
1877	165,000 tons.	Total	2,699,000 tons.
1878	210,000 tons.		

Of this amount:

River rock	1,229,170 tons.
Land rock	1,469,830 tons.
Total	2,699,000 tons.

This amount at the very moderate average of $6 per ton has given to the State $16,149,000, of which the State has been benefited by a royalty of $1,229,170.

The cost of production per ton varies. It is estimated at $4 50, including the payment of royalty and other expenses. Upwards of 100,000 tons of crude rock are annually consumed by the fertilizer manufactories of South Carolina.

The value of the phosphate now annually mined is $2,500,000. The royalty paid to the State in 1884 was $153,797 62, being one dollar per ton paid as moved by the marine companies. The taxes levied on the product of the land companies, and the heavy tax on the fertilizer manufacturers, are exclusive of this large amount of revenue.

See Annual Report of *News and Courier*, and View of the (Industrial Life of the State).

No systematic survey determining the extent of these deposits has yet been attempted. The only information on this head comes from prospectors seeking easily accessible rock in localities convenient for shipment. Widely varying estimates as to the quantity of the rock have been ventured. Some have placed it as high as five hundred millions of tons and others as low as five millions. The latter is the estimate of Dr. C. U. Shepard, Jr., who has prepared a map of the region. He traced the deposit over 240,000 acres and estimates the ACCESSIBLE rock as covering only about 10,000 acres. Even this estimated area, at 800 tons per acre, which he gives as an average, should yield 8,000,000 tons. But if we examine a single mining region, as that for instance occupied by the Coosaw Company, we must conclude that he has very greatly underestimated the amount. This company has the exclusive right to a territory of about 6,000 acres in Coosaw River, besides the adjacent marshes yet unexplored. Everywhere the river bottom is covered with rock, which for the most part forms a solid sheet, varying from eight inches to one and one half feet in thickness. Taking the lesser thickness, we have, with a specific gravity of 2.5, after subtracting twenty-five per cent for loss in washing and drying, something more than 1,700 tons to the acre, which would give for the river territory alone belonging to this one company something more than ten millions of tons. And, in effect, this company (which is the only thoroughly equipped river mining company now at work, 1881) consider, in spite of their large plant, that their supply of material is practically unlimited.—[*Handbook of the State.*

COMPETITION FROM OTHER QUARTERS.

But it may be asked is our little State the sole possessor of these phosphate beds, or have we to fear competition from other quarters? The deposits of phosphate rock have been found at various points along the South Atlantic coast, reaching from North Carolina to Florida, and also in Alabama. But these deposits have not yet been sufficiently developed to compete with the South Carolina phosphate, and will probably not come into the market until our deposits are nearly exhausted. There are numerous phosphate deposits in Europe, among which may be mentioned the Spanish phosphorite, the Canadian apatite, the Bordeaux and Nassau phosphates, the English and French coprolites, the Belgian phosphates, the Navassa phosphate, and the guanos of the islands of the Pacific Ocean; but none of these phosphates, though some are much richer than ours, can at present compete with us in accessibility, cheapness, and uniform quality. Occasionally there are rumors of vast deposits being discovered in Russia, in the Pacific islands, etc.; but so far the South Carolina phosphate forms the backbone, so to speak, of the phosphate industry not only of America, but of England. And it should be remembered, moreover, that even should we meet with competition abroad and thus lose the foreign trade in phosphate, which is now very large, our home trade is ever on the increase, and that it is to the Western and Southwestern States of the Union that we should look for our future field of consumption. In this field, at any rate, we need hardly fear competition as long as these deposits can supply the demand.

THE MANUFACTURE OF COMMERCIAL FERTILIZERS.

The gigantic manufacture of artificial manures is based on the treatment of phosphate of lime with sulphuric acid, by which the phosphate of calcium is decomposed, sulphate

of calcium formed, and the phosphoric acid converted into a soluble acid calcium salt (a superphosphate), or else reduced to the free state. The suggestion to act on bones with sulphuric acid was made by Liebig (1840); the utilization of crystalline and fossil phosphates by a similar treatment was the work of Lawes (1843).

The process of manufacturing superphosphate of lime ordinarily employed, which is the one carried out at the fertilizer works near Charleston, is briefly as follows: The kiln dried phosphate rock is ground to powder in mills such as are used for grinding flour, and then treated with sulphuric acid in the proportion of 900 pounds of chamber acid of 49 degrees Beaumé to 1,000 pounds of phosphate. This is performed by machinery in so called "mixing tubs" or "manure mixers," the product being a superphosphate containing ten to twelve per cent soluble phosphoric acid. From the mixer the manure, which is still liquid, is run into storehouses where it is allowed to set. It becomes so hard after a time that it has to be cut down with a pick, and the lumps passed through a disintegrator to reduce them to powder, which is then filled into bags and is ready for shipment. Certain gases are given off during the mixing; these are carbonic acid, fluoride of silicon, hydrochloric acid, and water. Most of these are extremely irritating to the lungs, and injurious to health and vegetation, their perfect removal is a vital necessity, and flues for this purpose are placed above the mixer.

In making most phosphate manures a mixture of ingredients is employed. Either it is desired to produce a manure containing a certain definite percentage of soluble phosphate, or to introduce nitrogen and potash into the manure. To attain the first object, a higher and lower quality of phosphate are mixed together before treating it with acid; for the second object the acid superphosphate is mixed afterwards with ammoniacal matter—dried blood, fish scrap, etc., and German potash salts (kainit, or muriate of potash). The manures resulting from such mixtures are known as "acid phosphate," "dissolved bone," "ammoniated acid phosphate," "complete fertilizer," "ash element," etc.

All the more important fertilizer works near Charleston manufacture their own sulphuric acid; this indeed constitutes one of their most expensive operations. For this purpose sulphur is imported from Sicily, only one of the works near Beaufort using iron pyrites from Spain. Superphosphate of lime supplies to the soil large quantities of phosphoric acid, sulphuric acid, and lime; and in the case of a mixed manure, also nitrogen and potash. In analysis of superphosphates, the phosphoric acid is estimated in three forms, as soluble in water, soluble in citrate of ammonia, and insoluble. The soluble phosphate (by which is meant phosphate soluble in water), consists of monocalcium phosphate with some free phosphoric acid. When applied to the land the soluble phosphate is dissolved by rain, and distributed more or less throughout the surrounding soil. When thus brought in contact with fertile soil, the soluble phosphate is more or less speedily precipitated. This precipitation is brought about either by the carbonate of lime in the soil, or by the hydrated oxide of iron and alumina present. In the first case a more or less insoluble phosphate of lime, and in the second a basic phosphate of iron and alumina are formed. As basic phosphates of iron and alumina are certainly forms of phosphoric acid which can only be slowly appropriated by plants, it is evident that the main effect of soluble phosphate must be yielded within a short time of its application. The insoluble phosphate of the superphosphate was formerly supposed to consist simply of the original phosphate of the material which had escaped the action of the acid; we now know that the insoluble phosphates consist partly and in some superphosphates largely of "reduced" or "reverted" phosphates, that is phosphates which have GONE BACK to the insoluble condition owing to the action of the lime, iron, and alumina. There has lately been much discussion in the agricultural and chemical world as to the manurial value of these reduced and insoluble phosphates as compared with the phosphates soluble in water. It has been argued by some that the manurial value of reduced phosphate must be equal to that of soluble phosphate, because soluble phosphate itself becomes reduced after contact with the soil; and hence they have consented to call at least a part of these reduced phosphates "available" in the soil. Others have gone farther, and maintain that the non-crystalline insoluble phosphate, such as the Carolina phosphates, when ground to an impalpable powder, and composted with vegetable matter producing carbonic acid upon decomposition, or used along with certain liguminous plants as a fallow crop, are equally efficacious as reduced or even superphosphate. They hold that the use of sulphuric acid in the manufacture of superphosphate is not only unnecessary and expensive, but absolutely injurious. The late Dr. St. J. Ravenel, of Charleston, was of this opinion, in which he is confirmed by the views of several distinguished chemists in England, Scotland, France, and Germany, and by practical results in the field, both at home and abroad.

NUMBER OF COMPANIES ENGAGED IN MANUFACTURING FERTILIZERS IN SOUTH CAROLINA.

There are at present engaged in manufacturing commercial fertilizers in South Carolina:

(1) The Atlantic Phosphate Company—capital, $200,000; works located on Ashley River, near Charleston.

(2) The Stono Phosphate Company—capital, $135,000; works located on Ashley River, near Charleston.

(3) The Etiwan Phosphate Company—capital, $300,000; works located on Cooper River, near Charleston.

(4) The Pacific Guano Company—capital, $1,000,000; works located on Ashley River, near Charleston.

(5) The Wando Phosphate Company—capital, $100,000; works located on Ashley River, near Charleston.

(6) The Ashepoo Phosphate Company—capital $50,000; works located on Ashley River, near Charleston.
(7) The Edisto Phosphate Company—capital, $200,000; works located on Cooper River, near Charleston.
(8) The Ashley Phosphate Company—capital, $100,000; works located on Central Wharf, Charleston.
(9) The Wilcox & Gibbs Guano Company; works located on Cooper River, Charleston.
(10) The Hume Bros. Phosphate Company—capital, $500,000; works located on Beaufort River, near Charleston.
(11) The Port Royal Fertilizing Company—capital, $125,000; works located on Battery Creek, near Port Royal.

MANUFACTURED FERTILIZERS SHIPPED.

The following table gives the total amount of fertilizers shipped since 1871:

Shipped From.	1871—Tons.	1872—Tons.	1873—Tons.	1874—Tons.	1875—Tons.	1876—Tons.	1877—Tons.
Charleston	20,487	37,183	56,298	46,302	49,500	47,381	45,766
Savannah	27,447	32,922	56,296	30,895	33,187	33,000	45,591
Port Royal	----------	----------	----------	----------	4,000	12,000	26,000
Totals	47,934	70,105	112,594	77,197	86,687	92,381	117,357

Shipped From.	1878—Tons.	1879—Tons.	1880—Tons.	1881—Tons.	1882—Tons.	1883—Tons.	1884—Tons.
Charleston	52,000	55,000	80,000	100,000	95,000	130,000	143,790
Savannah	61,500	60,000	65,000	110,000	100,000	125,000	70,000
Port Royal	15,000	12,000	26,000	39,245	28,279	25,000	23,094
Totals	128,500	127,000	171,000	249,245	223,279	280,000	236,884

NOTE.—Of the shipments from Port Royal, 11,022 tons were fertilizers manufactured at the works in Beaufort. (See Annual Report of *News and Courier*.)

CONSUMPTION OF FERTILIZERS.

In a compilation by Mr. De Ghequier, Secretary of the Chemical and Fertilizer Exchange of Baltimore, we find:

Total consumption of commercial fertilizers in Southern States	460,000 tons.
Delaware, Eastern States	25,000 tons.
Pennsylvania, New York, New Jersey	90,000 tons.
New England States	40,000 tons.
Western States	20,000 tons.
Total	635,000 tons.

According to this statement it would appear that the South Carolina companies are able to produce at least one third of the whole amount of fertilizers consumed in the United States.

CONCLUSION.

In this sketch, which has necessarily been brief and imperfect, attention has been drawn only to the most remarkable facts in the history, origin, and development of the South Carolina phosphates. Statistics up to date have been given, showing that the phosphate industry has steadily increased in importance every year since the discovery of the deposits, until to-day it constitutes the largest and most successful enterprise in the State. The benefit that has been conferred, not only on the planters of the State and the southern country in general, but also upon the whole agricultural world, by the development of these phosphates, cannot now be computed. For ourselves, it is impossible to realize what we would have done without them, and we dread to think of the day when they will have become exhausted. I venture to say, however, that this last we need not fear; at least for years, even generations to come. And by the time that South Carolina has exhausted her supply, let us hope that the deposits in some of our sister States will have been sufficiently developed, not only to furnish us with phosphates as bountifully as we have done them, but have enough to spare for the rest of the world.

One of the most attractive displays in this department was that of fossils found in the phosphate beds. There were two private collections shown, one by E. Willis and the other by C. A. Scanlan, both of Charleston.

Mr. Willis' collection was displayed in six large table cases. It consisted of large sharks' teeth, vertebræ of mammals and fishes, shells, teeth of elephants, ear bones of whales, and human remains; a great profusion and a very fine collection. I have reason to hope that we shall be able to procure some of these specimens, by exchange, for our State Museum.

Iron ores, rocks, and building stones, street pavement blocks, marbles, and ores were shown in quantity, and a few interesting mineral species, among which I noticed the following: *amethyst*, fine; *asbestus; barite; chromic iron; corundum; dolomite; kaolin and clays; meteoric iron; mica*, fairly good; *ochre; steatite; tourmaline*, green and black.

TENNESSEE.

State, June 1, 1796. Area, 45,600 square miles. Population in 1880, 1,542,359. Capital, Nashville. Floor space in Government Building, 11,812 square feet. The State is divided into 94 counties. The eastern borders of the State are crossed by spurs of the Appalachian Mountains, the highest peaks of which rise 5,000 feet above the sea. From these to the Cumberland Mountains there is a succession of valleys and hilly country, having an average elevation of 1,000 feet. The Cumberland plateau has an area of 5,100 square miles. The Western Tennessee plateau is a great undulating plain, sloping toward the western border and the Mississippi bottoms. The rivers of the State furnish ample water power. Being to a great extent mountainous, it is natural to infer that the State would produce minerals abundantly. This was shown to be the case by the grand mineral exhibit made at the Exposition.

The State is abundantly supplied with coal and iron. The Alleghany coal field extends into Tennessee, with an area of 5,100 square miles. The coal contained in it has been estimated at 42,127,360,000 tons. The Soddy coal mines are in Hamilton County, on the Cincinnati Southern Railroad, twenty-one miles from Chattanooga. In 1882, 2,500,000 bushels were shipped from these mines; 300 men were employed, earning each from $1 to $3 per day. The average selling price was 6½ cents per bushel. The Etna mines are in Marion County, fourteen miles from Chattanooga. The coal is extensively used in the iron furnaces in and about Chattanooga. Coke is largely manufactured. The gross product of coal in Tennessee from 1873 to 1882, inclusive, was 5,126,042 tons.

Iron ores are very abundant. The mineral is hematite, limonite, specular iron, and siderite. Limonite and red fossil ores only, are generally utilized in the manufacture of iron. The ores of iron are practically inexhaustible. In Lawrence County alone they are estimated at 100,000,000 tons. There are now and have been large numbers of iron furnaces in active operation. The product of pig iron in 1882 was 137,602 tons.

I visited the Citico furnace, at Chattanooga, in May, 1885. This is a new and well appointed modern iron furnace which was working well and producing large quantities of iron of excellent quality. It does not materially differ from those at Birmingham, Alabama, or even from the furnace at Clipper Gap in California, except that it is on a much larger scale than the latter.

The ore costs at the furnace $1 50 to $1 75 per load; lime, twenty-five cents per ton; coke, $4 50 per ton. Two and one half tons of ore make one ton of pig iron.

I learned here that it is not necessary to "blowout" a furnace when it is desirable to discontinue the production of iron for a time. A furnace may be "banked," when it will remain in a state of inactivity for thirty or forty

days without injury. The operation is as follows: The blast is slackened and fuel added from time to time, but no ore or limestone flux. This is continued until all the slag and metal is run out. The heat in the stoves is lessened until the blast is cold. The tuyeres are then withdrawn and the holes plugged and cemented air-tight. Fuel is added from above and covered with a layer of dried earth. The furnace can be started again by simply commencing the blast.

GOLD was first discovered in Tennessee on Coca Creek, Monroe County, in 1831. The usual gold excitement followed. The yield was never great. Two dollars per day won by panning was above the average, and the mines were soon abandoned. The total deposits of Tennessee gold and silver in United States Mints to June 30, 1883, was:

Gold	$87,175 12
Silver	7 28
	$87,182 40

The greatest yield was in 1848, when $7,161 worth was taken out.

COPPER was discovered in Tennessee in 1843. In 1847 Mr. Webber, a German, obtained a lease of the ground and commenced shipping ores to Boston. In 1850 Mr. John Caldwell came to Ducktown and commenced mining. Refining works were put up in 1860, and a copper rolling and wire works was erected at Cleveland soon after. The product of copper ingots by the Union Consolidated Company from 1865 to 1873, inclusive, was 8,476,872 pounds.

The Burra Burra Company produced, in 1872, 917,329 pounds of ingot copper.

Zinc and lead ores have been somewhat worked in the State.

Marbles and building stones are found in great abundance. The celebrated Tennessee marble was first found in Hawkins County. Attention was first called to it by a block being sent to the Capitol at Washington. Now the quarries furnish on an average 10,000 cubic feet annually. It is now found in six other counties. In 1881, 80,000 cubic feet were shipped from the quarries of the State.

Roofing slates, *clays*, glass sand, and ochre are among the economic minerals produced in Tennessee. Petroleum is found over a large area, but only a few thousand barrels have been produced.

The collective exhibit made by Tennessee was very fine and extensive. An appropriation was made and the exhibition was official. The economic ores and minerals were shown in abundance, and the exhibit was more conspicuous from the quantity shown than from the number of varieties. The ores and the coal were piled on platforms and tables. It was an important and most interesting display. The most important minerals shown were *coal and coke; phosphatic minerals; calamine; cerussite*, good, a single small specimen; *galena*, fine, but small specimen; *graphite*, rather poor quality; *hematite; kaolin; limonite; magnetite*, very fine; *ochre; pyrolusite*, good; *smithsonite*, fine; *copper ores*, with ingots of metallic copper; *pig iron and manufactured iron; iron ores*, weighing many tons; *silver ores*, inferior quality; *zinc ores and metallic zinc.*

The exhibit of marbles was exceptionally fine. Slabs, vases, ornaments, from the well known mottled Tennessee marble to a light gray homogenous variety slightly clouded. One vertical case was shown containing 48 one-foot slabs, very fine. The whole marble exhibit was on a grand scale. There was shown, also, a black marble burial casket or sarcophagus. Other building stones were shown—granites, porphyries, serpentines, very fine.

TEXAS.

State, December 29, 1845. Area, 327,504 square miles, the largest State in the Union. Population in 1880, 1,591,749. Capital, Austin. Floor space at the Exposition, 18,145 square feet. The State is divided into 174 counties. The surface is generally low or table land. The principal ranges are the Guadalupe, Sierra Hueca, Eagle, Sierra Blanca, and the Apache Mountains. Some peaks reach an altitude of 6,000 feet.

The principal economic minerals of the State are *coal*, *copper*, *gold*, *iron*, *kaolin*, *lead*, *salt*, and *silver*, but none of the mines have been extensively worked. It may be said that the mineral fields of this State are not yet prospected or known.

The collective exhibit made by Texas was large and well arranged. All the products of the State were represented. The State Legislature appropriated $20,000.

The mineral exhibit was quite extensive, and contained many elements of interest. The collection was made by private individuals.

I was informed that the Constitution of Texas specially provides that no money shall be expended for geological surveys. The minerals were partly gathered and arranged by Dr. A. Gregg, of San Saba. At the Exposition they were in the care of Dr. William De Ryee, of Corpus Christi. The specimens that I found the most interesting, were the following: A suite of carboniferous coals from several localities in the State.

One slab, covered with fossils, very fine. A very creditable and interesting exhibit of fossils from various formations. Dr. De Ryee showed me fossil leaves in steatite which, if he is not mistaken in the character of the matrix, is very remarkable.

Of minerals there were shown:

Agate; asphaltum, resembling the best Trinidad, breaking with conchoidal fracture. This mineral is found on the seashore, near Corpus Christi. It washes ashore during storms. Schooner loads are gathered and sold on the ground for $35 per ton; *blende* crystals, fine; *chrysocolla; cuprite; gypsum*, fine; *hematite* (pipe ore) fine; *kaolin; limonite; magnetite; onyx marble*, El Paso; *pyrite; selenite*, fine; *siderite; ores of copper, iron, lead*, and *silver; pig iron; blocks of building stone*—limestones, red granite, freestones, bricks, red, nearly white, and curiously mottled, the latter from Rusk, Cherokee County; fire-bricks, and bricks sawed from a white material resembling volcanic ash.

A beautiful mantelpiece of fossiliferous limestone was on exhibition at the headquarters. The panels were painted by ladies of Austin. The Texas Pacific Railroad made a large exhibition of Texas minerals in their collective exhibit of State resources. Specimens of coal from the Gordon Mine, Eastland; building *stones*, *marbles*, *bricks*, *grindstones*, *pottery ware*, *adobes*, etc., were shown.

VERMONT.

State, March 4, 1791. Area, 10,212 square miles. Population in 1880, 332,286. Capital, Montpelier. Floor space in Government Building, 5,062 square feet. The State is divided into 14 counties. Vermont is named from the principal mountain chain within its borders, the Green Mountains. It was the first State admitted into the Union under the Federal Constitution. The surface is diversified by mountain and valley, elevated plateaus, lakes, and rivers. The mountains rise to a considerable height and extend over a large area, for which reason it would be supposed that

Vermont would be a highly productive mineral State. This, however, it is only to a limited degree. *Building stones, marbles, slates*, etc., are found in the greatest profusion, but metallic ores are rare. *Iron ores, manganese, copper pyrites, clays, steatite*, and even gold, have been found, but the deposits have never been mined to any considerable extent.

The mineral exhibit made by the State of Vermont was very fine. The most showy if not the most important feature was the display of marbles, in which the State is specially rich. The beautiful building in which the headquarters were located was grandly wainscoted with Vermont marbles. There were eight large slabs used for this purpose, each a special and beautiful variety. But these and pavements of tesselated marbles, tiles, and ornamental borders were simple when compared with the imposing Arch of Titus, in Vermont marble and granite, which was erected in front of the headquarters building. This magnificent structure was 18 feet high, 16 feet wide, and 6 feet in thickness through the arch. There were 500 cubic feet of marble and 150 cubic feet of granite used in its construction, and its weight was about 120,000 pounds. The following more detailed description was placed on the arch:

This arch is modeled after the celebrated "Arch of Titus" at Rome, with such modifications as were necessary on account of the materials used and the method of construction.

The bases on either hand, are of Vermont granite, showing all the best varieties produced in the State, at Barre, South Ryegate, St. Johnsbury, and Brattleboro.

The polished columns are of Vermont marble, and include four kinds, viz.: extra dark blue Rutland, Sutherland Falls, East Dorset Italian, and Mountain dark.

The large panels are of blue Rutland and Mountain dark marble; the keystone of blue and white Rutland, polished. The balance of the stock used shows the different grades of Rutland marble—sawed, sand-rubbed, or with coped edges. The tile immediately within the archway is of East Dorset Italian and Isle La Motte.

The entire structure above the granite was contributed by the Producers' Marble Company of Rutland, Vermont, and exhibits the different varieties they are quarrying.

This company is an association of five firms and corporations, and is the largest organization of the kind in America, if not in the world; its members representing a capital invested of over $6,000,000, with a mill capacity of 280 gangs of saws, and 15 rubbing beds, requiring to operate its machinery over 3,500 horse power (steam and water), and an average force of 3,000 men.

The Producers' Marble Company have a large private exhibit of monuments, etc., in the main building, adjoining the dairy exhibit, Section G G, Nos. 59 and 60.

Besides the arch and pavements, were shown a column of Barre granite, highly polished, and blocks and samples of granite from the rough to the most finished examples of the stonecutter's art. This special exhibit was made by Wetmore & Morse of Barre.

There was also shown a small column of serpentine, labeled "*verde antique*." The display of slates was very fine. A set of stationary washtubs, of steatite, was shown, and a great variety of ornamental slabs, vases, large monuments of granite and marbles, photographs of quarries, etc. There were also four cases of minerals and rocks, illustrative of the geology of the State, but I was not enabled to obtain a catalogue of them. Altogether, the mineral exhibit of Vermont was very fine, and to the credit of the State. It is not generally known that gold has been produced in this State; but I find it recorded in the reports of the Directors of the United States Mint that up to June 30, 1883, gold and silver from Vermont had been deposited in that institution, as follows:

Gold	$10,981 27
Silver	43 50
Total	11,024 77

VIRGINIA.

One of the original thirteen States. Area, 45,000 square miles. Population in 1880, 1,512,565. Capital, Richmond. Floor space at Exposition, 10,175 square feet. The State is divided into 99 counties. Virginia is a mineral State, in the broadest sense. There are so many mountains and broken lands that the minerals are brought to view or are within easy access to the prospector, which is not the case in level States.

The mineral resources of Virginia are not fully developed, yet many valuable minerals are known to exist within the State. *Gold*, *silver*, *iron*, *copper*, *lead*, *zinc*, *tin ores*, *coal*, *building stones*, *limestones* and *marbles*, *brick* and *fire clays*, *glass sand*, *graphite*, *manganese*, *gypsum*, *salt*, *pyrites*, *marls* and *fertilizers*, etc., are mined to a greater or less extent. Gold is found in a belt from 15 to 25 miles wide, extending 100 miles or more. There has been considerable mining activity in Fauquier, Culpepper, Spotsylvania, Orange, Fluviana, and Buckingham Counties.

Virginia gold has been deposited in United States Mint to June 30, 1883, as follows:

Gold	$1,707,733 67
Silver	165 01
	$1,707,898 68

Recently, since the value of gold has increased—owing to a reduced production—a renewed activity in gold mining has been developed in Virginia. The following extract from a letter to the *Mining Review* gives important information on this subject:

> Mining lands are cheap in this State and labor is cheap; top hands $1 per day and good miners at from $1 to $1 50 per day. Wood only costs 40 cents a cord and lumber for buildings is delivered on the mine for $10 per thousand feet for all kinds. The climate is first class; no chills or fevers of any kind. The citizens are all good law-abiding people, and we have good schools and churches and a good healthy country. Provisions are plentiful and cheap. Railroads are plentiful, running very near the mines, the C. O. R. R. one side and the Virginia Midland R. R. on the other, with the P. F. P. R. R. on the other and the R. F. P. R. R. the other side. Thus we have everything here for successful mining, including the very necessary article, the metal itself; our ores are running from $5 to $25 per ton. We have plenty of ores, the veins averaging four feet all through the leads.

The mineral exhibit made by Virginia at the Exposition was very fine and comprehensive; 83 counties were represented. All the minerals were classified in the following State subdivisions:

1. Tidewater Virginia.
2. Midland Virginia.
3. Blue Ridge and Piedmont Virginia.
4. Great Valley of Virginia.
5. Appalachian Virginia.

Most of the specimens were collected and arranged by Major Jed. Hotchkiss, Editor of the *Virginias*, of Staunton, and Assistant U. S. Commissioner, aided by an appropriation of only $800. The very full catalogue was first printed in the *Virginias*, and cut out and pasted in a blank book. This was afterward reproduced in the Handbook of Virginia, by Randolph Harrison, the Commissioner of Agriculture, Richmond, 1885, in which much other valuable information may be found.

The catalogue shows the collection to be very extensive; too much so to be described in detail here. The catalogue consisted of sixty-four pages of closely printed matter. There were also many geographical, geological,

and special charts and maps shown. The minerals were placed on terraced tables, and were well displayed. The specimens were all clean and distinctly labeled, and while the selection was not made for beauty, but rather to convey a correct idea of the minerals as they occur in nature, there were many fine and even magnificent specimens of great interest to the scientific mineralogist as well as the technologist. It is to be hoped that the magnificent collection will be placed in some central city in the State, and become the nucleus of a grand State museum.

The minerals were exhibited partly by the Virginia Department of Agriculture, and were partly loaned by individuals or corporations.

Ores and minerals of a like character were often shown in several counties, the object of the collection being to represent the general mineral resources of the State, rather than to make a scientific classification. The most important minerals I observed are embodied in the following list:

Coal and coke; fertilizers—the fertilizers found in the State seem to be tertiary shell marls and greensand; extensive beds of these minerals are stored up by nature for future use; at Evergreen the deposit seems to be 20 feet thick; *asbestus; barite; chalcopyrite; corundum; erubescite; graphite; kaolin; mica; ochre*, good quality; *pyrolusite; argentiferous galena; copper ores; ferro-manganese; gold-bearing quartz; iron ores and pig iron*, in large piles; *manganese ores; concentrated pyrites; tin ore*, Martha D. Cash Mine, Rockbridge County; *zinc ores and bars of metal;* fine model of the natural bridge, a very attractive feature of the Exposition; *bricks; building stones*, a large collection; *china clay; fire clay; glass sand; granite; grindstones and grindstone grits;* hydraulic limestones; limestones; *marbles*, in blocks and slabs; *millstones; mineral waters; slates; whetstones*, etc.

WEST VIRGINIA.

Separated from Virginia, December 31, 1862. Organized a State, June 19, 1863. Area, 23,000 square miles. Population in 1880, 618,457. Capital, Wheeling. Floor space in Government Building, 3,200 square feet. The State is divided into 54 counties. The surface of West Virginia is generally mountainous and resembles Virginia. Minerals are found in abundance, but like those of Virginia their full extent and value still remain unknown. The State did not make a large exhibit at the Exposition. The mineral display was comparatively meager. The collection consisted principally of *blocks of coal, coke, iron ores, limonite* and *hematite, cannel coal*, very fine, *bricks, sewer pipe*, and other similar ware, *terra cotta*, etc.

WISCONSIN.

Territory, July 3, 1830. State, May 29, 1848. Area, 53,924 square miles. Population in 1880, 1,315,497. Capital, Madison. Floor space in Government Building, 6,750 square feet. Wisconsin is a vast plain or plateau, with an elevation of from 600 to 1,500 feet above sea level. The surface is generally undulating. The highest land rises only 1,800 feet. Although there are no great mountain chains in this State there is no scarcity of certain valuable minerals, such as *building stones, iron, zinc*, and *lead ores, clays, mineral waters*, etc. The total production of lead from 1862 to 1873 was 163,422,672 pounds. While gold is said to occur in Wisconsin, it has never been found in paying quantities.

The mineral exhibit at the Exposition was very small and insignificant. There was no appropriation made by the State, and the general exhibit was by individuals. While the mineral exhibit was so meager, it is only

fair to say that the general or collective exhibit of State resources was very fine and ample, which will no doubt be fully described in a State report. The importance of the Wisconsin exhibit may be realized when it is stated that 143 premiums were awarded, in value equal to $5,233, and including 3 gold medals and 15 silver medals.

The following are the most important of the few minerals shown: *blende*, fine crystals; *galena*, fine crystals; *limonite*, very fine, from the Chief Iron Mine, Ashead County; white or *cream colored brick*, very fine; *limestones; lime; iron ores*, Commonwealth Mine; *mineral waters*, etc.

ALASKA TERRITORY.

Has an area of 394,000 square miles. Population in 1880, 33,426. Alaska was not represented in the Exposition, but some of its mineral resources were shown in the government exhibit. The mineral resources of the Territory are not to any great extent known, but sufficiently so to warrant the hope and expectation that Alaska will develop into an important mineral Territory or State.

ARIZONA TERRITORY.

Territory, February 24, 1863. Area, 113,619 square miles. Population in 1880, 40,440. Capital, Prescott. Floor space in Government Building, 3,300 square feet. This Territory is one of the most important mineral regions of the United States. The surface is generally elevated plateaus, and mountains. The principal minerals now worked are *gold*, *silver*, and *copper*, but other valuable economic minerals abound. They will eventually be extracted when conditions change and they are wanted. The vast mineral resources of this Territory are still but comparatively little known, and they will not be fully realized by the present generation.

Gold is found sometimes free, but is generally associated with silver. Silver mines are largely worked. Arizona silver and gold were deposited in United States Mints to June 30, 1883, as follows:

Silver	$13,454,177 32
Gold	3,424,972 71
	$16,879,150 03

The following figures compiled from various sources, although no doubt but roughly approximated, will give a good idea of the importance of Arizona as a producer of the precious metals:

1869, yield of precious metals	$1,000,000 00
1870	800,000 00
1871	800,000 00
1872	625,000 00
1873	500,000 00
1874	487,000 00
1875	750,000 00
1876	1,500,000 00
1879-80	1,401,518 00
1881	8,360,000 00
1882	8,565,000 00
1883	8,183,743 00
	$32,972,261 00

The exhibit of Arizona minerals and ores in the Exposition was large and imposing, consisting as it did of large specimens in very large quantities from all the principal districts and mines of the Territory. There

was, besides, a large collection of views of mining machinery, mining scenes, etc. There were actually tons of ores from sometimes a single mine, conveying the idea of quantity as well as quality. Among the most noticeable exhibits were bars of bullion from the Benson Smelting Works.

The finest specimens were displayed in 22 elegant flat table cases.

Those from the Silver King Mine, which were rich and beautiful, were shown in two special elegant plate glass cases on stands. These specimens were mainly native silver in threads or wires, and in some cases crystallized, and the silver minerals cerargyrite, stephanite, proustite, argentite, etc., with galena and zinc blende, in calcite and quartz. There were many other well known silver mines represented in the table cases.

The Copper Queen made a special exhibit of magnificent ores from the mine, both in cases and on tables. One pyramidal specimen weighed 7,300 pounds.

The Longfellow Copper Mine was also represented by an elegant suite of copper ores in a large special vertical case. In the collection were magnificent specimens of *azurite*, in fine crystals.

Native copper; chalcopyrite, very fine; *calcite*, in fine, large, nearly transparent crystals, on a base of malachite and azurite—a very interesting association. In the same case were displayed ores and copper minerals from the Detroit Copper Mine, at or near the same locality.

A large vertical special case contained the private collection of Charles R. Wores, of Tucson. The specimens numbered 2,500; all were labeled, or rather furnished with numbers which referred to a written catalogue. The collection consisted principally of Arizona ores and minerals, well selected and displayed.

Copper ores, from the United Verde Mine, near Prescott, showed a remarkable association of cuprite, chrysocolla, free gold, and free silver. The ores resembled those found in the Inyo Mountains of California.

The Copper Bottom Mine was represented by ores—one large ingot, and the cooled contents of a slag kettle.

Bullion bars, from Howell Mine, and lead bars (lead bullion), from Tombstone, were also shown.

A special case contained ores and minerals from the Clifton Copper Mines, Pima County, fine bornite and other copper minerals already mentioned. The following information regarding this mine is quoted from the San Francisco *Mining and Scientific Press* of recent date:

THE COPPER MINES AT CLIFTON.

A VERY NARROW GAUGE RAILROAD.

From an extended article in the Deming (N. M.) *Tribune*, describing the mines of the Arizona Copper Mining Company, we make the following extracts: The property now includes the following claims: Coronado Lode, Crown Reef, Copper Crown, Matilda, Horse Shoe, Boulder, Copper Queen, Copper King, Thomson, Worfold, Goodsight, Vicksburg, Sherman, Humboldt, Joy, Yavapai, Detroit, Michigan, Ballyrat, Bartlett, Basset, Clifton, Longfellow, Modoc, Emma, Nora, Arthur, Princess Alice, Cornell, William Grant, Bendigo, Copper Pride, Fairview, Lolo, Cap Bonanza, Lucky Friday, Libbie Annie, Libbie Grant, Oriental, White Hawk, Black Hawk, Southern Cross, Fraction or Dark Horse, C. L. Junction, Peak, Northern Cross, Pyramid, Troy, U. Extension of Clay Mine, Dora, Seven Thirty, Regular, King, Ida, Arizona, Indiana, Richmond, Santa Fe, and Iroquois.

There has been steady progress in the means of transportation for the ores from these mines. At first the ore was taken to the little smelter, on the creek, on the backs of burros; then a wagon road was constructed, after the furnaces had been erected at the river, and large amounts were hauled down in wagons; then, about six years ago, at the suggestion of Captain Davis, a twenty-inch narrow-gauge road was laid up the cañon, first to the Longfellow Mine, and afterward extended to the others. The grade is generally about four per cent, or two hundred feet to the mile, but in several places it is as much as five, and in one or two places six per cent. The first engine was a little four-*ton* fellow, which is now in use on the upper road from the Longfellow around to the Detroit

Company's mines. This was substituted by one weighing eight tons, and a third one of twelve tons was afterward put on. It is really surprising to see the loads which these powerful little machines take up the steep grades, and to note the ease with which they are handled. They stop and start at any point and gain headway rapidly, although the average speed is but eight miles per hour. The cars are wholly of iron, and carry a load of three or four tons. Although the track is so narrow, the cars seem to ride just as steadily as on a broad gauge road. Not an accident has ever occurred to kill or wound a person since the road has been in operation, and this is no doubt largely due to the care exercised by Mr. Arbuckle, the engineer, who has been running the trains ever since the road was built. Although there is but comparatively little load up the grade, except for the Morenci Works, the engines are competent to take up eight or ten loaded cars, or fifteen to twenty empty.

THE INCLINES.

The ore from the several mines is moved down to the main track of the road we have described by means of inclines of varying degrees of pitch, the loaded car going down as the empty car goes up. The incline at the Longfellow is 2,200 feet long, 600 feet through a tunnel, and the elevation gained is 780 feet; at the Metcalf the incline is 1,100 feet long with 500 feet elevation; at the Coronado the incline is 3,320 feet, and the elevation 1,100 feet with a maximum grade of 68 per cent; at the Queen the length is 900 feet. At the Longfellow the four-ton cars are used the same as on the main line, two coming down together, and one loaded and one empty going up. The speed is regulated by powerful brakes at the head of the incline, the cables passing several times around large drums to which the brakes are fitted.

THE SMELTERS.

The plant now consists of three Fraser and Chalmers furnaces, each of 60 tons, and two Pacific Iron Works smelters of 40 tons capacity. As previously stated the water power of the river is utilized, and three turbine wheels are employed of different capacities, according to the work upon them. The principal one drives the Baker blowers, five in number, three number sevens and two smaller ones; another drives the crushers, and still another the pumps. To insure against a scarcity of water or injury to the wheels there is a fine Corliss engine with ample boiler capacity to be used as a substitute in cases of necessity. Benches have been cut in the hillside, which is nearly perpendicular in rear of the works, for the ore bins and chutes, so that the ore, fluxes, and fuels are unloaded from the cars by dumping directly into the bins at the proper level, and these are transferred to their appropriate places by tramways from the chutes to the bins emptying upon the charging floor.

The water is taken from the river about one mile above the works, and is brought through a flume eight feet wide by four feet in depth.

Close by the smelting works a substantial building accommodates the machine shops and repair shops of the company, not yet fully in operation. Recently the entire charge of the machinery has been placed with Mr. W. C. Boylan, who for two years past has been master mechanic of the Arizona and New Mexico Railroad. He is a very competent machinist and has tried his hand successfully at invention. One of his inventions is a steam attachment to clear the locomotive ash box while the train is in motion; another is an equalizer attached to car brakes to prevent the wheels from sliding.

Only two furnaces were in operation at the time of our visit, although three have been in blast most of the time. The production for the preceding week had averaged 13 tons of 98 per cent copper per day.

The total production of the mines was given me as nearly as possible by Mr. Russell, as follows: Under the former ownership between 45,000 and 50,000 tons of ore had been taken out, yielding 7,500 tons, or 15,000,000 pounds of black copper. The production by the present company, to May first, has been 9,000,000 pounds. The present rate of production is between six and seven million pounds annually, which is not quite half the capacity of the works, if they were in full blast. At the present low price of copper, although it is possible to manufacture the copper at a profit, it is not a sufficient inducement to work up the higher grades of ore, and as we have before noted, the object is to make the mine pay its way and to develop the ore bodies so that the production may be increased when the price shall justify it.

The following rare or interesting minerals were noticed and examined: *alabaster*, beautifully translucent; *cerargyrite*, fine, Julius Mine, Globe District; *cerussite*, very fine long needle crystals, Flux Mine, Pinal County; *chalcopyrite*, large specimen, United Verde Mine; *chrysocolla*, coated with drusy quartz; copper, native, Kay Mine; cuprite, very fine; imbolite; fire clay; *free gold* in quartz, Huachuca Mountains, and from other localities; *malachite* (mammillary), quite equal in beauty to the Russian or Australian specimens, from the Copper Queen Mine; *malachite*, in needle crystals, Old Globe Mine; *melaconite* (powdery form), United Verde Mine;

mineral waters; platinum, Hassayampa River; *pyrolusite*, in concretionary shells, Tombstone; *selenite; silicified wood*, blue, red, and yellow variegated, from the petrified forest in Apache County. Large specimens of this beautiful mineral were shown in piles several tons in weight. The Chalcedony Manufacturing Company had machinery in the main building where the petrified wood was cut into beautiful ornamental objects. Some of the natural specimens were very beautiful, and showed fine crystals of quartz and amethyst on a many-colored ground; wire silver, very fine; sphalerite, amber colored and transparent, very fine, Silver King Mine; *vanadinite*, Yuma County; *wulfenite*.

There is a large collection of Arizona ores and minerals in the California State Museum. Nearly all the specimens enumerated above are represented, and many others.

DAKOTA TERRITORY.

Territory, March 2, 1861. Area, 147,490 square miles. Population in 1880, 135,177. Capital, Bismarck. Floor space in Exposition, 10,175 square feet. The general surface of the Territory is undulating, and is a plateau, covered in part by prairie lands. In the southwest are the Bad Lands and the Black Hills, the highest peaks of which are 6,700 feet above sea level. The mineral developments in this territory are yet in their infancy. It is likely that it will become a very productive mineral region. Gold, silver, iron, tin, lead, coal, copper, mica, gypsum, asbestus, salt, and petroleum have been found. Building materials are good and abundant.

The only known gold fields of importance lie in the Black Hills. The gold belt extends through Butte, Lawrence, Pennington, Custer, and part of Fall River Counties. Gold and silver have been and continue to be largely produced. The Territory is credited with deposits in the Mints of the United States to June 30, 1883, as follows:

Gold	$17,283,843 89
Silver	159,844 86
	$17,443,688 75

The general exhibit of Dakota was very extensive and comprehensive. The mineral section was also well supplied with the mineral products of the Territory. The specimens were generally large and fine. In some cases ores from certain mines or districts were shown in large piles. The most important ores, rocks, and minerals are embraced in the following list: *coal* and lignite; *copper ores and bullion; gold ores* from Black Hills; *iron ores*, with columbite in a curious micaceous rock, in which the mica is in flat crystalline plates; concentrated tin ore (cassiterite) and bars of metallic tin; *asbestus; asphaltum* liquid, or *maltha*, resembling that so abundant in California; *cassiterite; galena; gold*, rich specimens; *gypsum*, good; *mica*, some fairly good; *salt; uranite*.

Building stones, magnificent slabs, cubes, and cylinders, exhibited by the Drake Polishing Works, Sioux Falls.

Bricks and brick clay, some red and others white, like the celebrated Milwaukee bricks.

IDAHO TERRITORY.

Territory, March 3, 1863. Area, 90,932 square miles. Population in 1880, 32,610. Capital, Boise City. Floor space in Exposition, 2,160 square feet. The surface of the Territory is generally mountainous, and it is one of the most productive and important mineral localities in the Union, although not yet wholly developed or even prospected.

Gold was first discovered in 1852, by a French Canadian, on the Pend Oreille River. Two years later, 1854, General Lander found gold while exploring for a military road. The historical discovery, however, which led to the rapid settling of the Territory and a large production of the precious metals, occurred in 1858 or 1859. The most noted and productive mining localities are Oro Fino, Florence, Boise Basin, Owyhee, Rocky Bar, Salmon River, Yankee Fork, Wood River, Cœur d'Alene, and Snake River. Gold and silver have been largely produced. The deposits in United States Mints to June 30, 1883, were:

Gold	$25,895,674 07
Silver	1,091,942 76
	$26,987,616 83

The following is taken from a handbook of Idaho, by James L. Onderdonk:

Alturas, Custer, Lemhi, and Shoshone Counties are at present the scenes of most active mining operations. Owyhee and Idaho Counties have been most productive in former years, and still continue to send forth their regular output of precious metals. Each of the last named has plenty of ledges that have never yet been developed. Washington and Kootenai Counties are rapidly coming to the front as ore producers. The remaining counties being chiefly agricultural, their mining interests have as yet attracted comparatively little attention.

The following table shows the estimated production of the precious metals in Idaho since first discovery:

Year.	Amount Produced.	Year.	Amount Produced.
1862	$5,000,000 00	1874	$3,100,447 69
1863	7,448,400 91	1875	1,983,720 27
1864	9,019,704 30	1876	2,267,013 36
1865	12,914,364 25	1877	3,474,787 69
1866	10,001,850 44	1878	2,657,216 91
1867	7,388,064 31	1879	2,553,634 58
1868	3,030,213 56	1880	1,634,637 19
1869	1,613,453 68	1881	4,915,100 00
1870	2,239,190 61	1882	5,500,000 00
1871	2,219,937 94	1883	5,000,000 00
1872	2,675,192 00	1884 (estimated)	6,500,000 00
1873	3,653,605 15	Total production	$106,790,434 84

At the Exposition 192 mines were represented. These included gold, silver, lead, copper, pyrites, and gravel mines.

The collective exhibit was very large and important. The Territorial Government made no provisions aside from the appointing of a Commissioner.

The exhibit was made through the exertions of the Commissioner and private individuals. The minerals were shown in eight special vertical cases, as follows:

No. 1. Wood River ores.
No. 2. Ores and minerals from Alturas, Boise, and Ada Counties.
No. 3. Skylark, Excelsior, Montana, and Silver Wing Mines. Dividends said to be $3,500,000.
No. 4. Copper ores. Washington, Custer, and Lemhi Counties.
No. 5. Ramshorn and Postboy Mines. Output, $2,725,000.
No. 6. Lemhi County Mines. Silver, lead, copper, and iron ores, coal, etc.
Nos. 7 and 8. Contained miscellaneous minerals, ores, including moss agates, lava rock, building stones, mica, very good and largely worked, argentiferous galena, gold ores, silver ores, lead bullion, etc.

Besides the minerals there was shown a fine collection of large photographic views of scenery, mines, metallurgical works, etc.

MONTANA TERRITORY.

Territory, May 26, 1864. Area, 143,776 square miles. Population in 1880, 39,150. Capital, Virginia City. Floor space in Exposition, 4,274 square feet. The surface of Montana is diversified by broad table lands or plains, and mountains. The main chain of the Rocky Mountains crosses the Territory, some peaks of which rise to an altitude of over 12,000 feet. The Territory is rich in minerals; next to California, it has produced more gold than any other State or Territory in the Union. Silver is also found in considerable quantity, with prospect of still greater production.

Gold was discovered in 1852, on Gold Creek, but no extensive mining was done until 1861. The first quartz mill was erected in 1863. Gold mining has been extensively conducted, but of late years the product has generally diminished, which has been the case in all parts of the United States, and generally the world over. The following is the estimated product of the precious metals, gold and silver, in Montana:

1862	$500,000 00	1874	4,000,000 00
1863	8,000,000 00	1875	3,573,600 00
1864	13,000,000 00	1876	4,210,989 00
1865	14,500,000 00	1877	3,963,514 00
1866	16,500,000 00	1878	3,930,146 00
1867	12,000,000 00	1879	4,725,000 00
1868	15,000,000 00	1880	4,900,000 00
1869	9,000,000 00	1881	4,960,000 00
1870	9,100,000 00	1882	6,920,000 00
1871	8,050,000 00	1883	7,800,000 00
1872	6,073,339 00		
1873	5,178,047 00		$165,884,635 00

This estimate, like all others of the precious metals in the United States, is only approximative. No reliable statistics are kept, as in other countries, and such statistics must be always regarded as the opinions of those best capable of estimating. Still, they serve to give an idea of the importance of the gold-producing area of the United States. In Montana the silver yield in later years has greatly exceeded the gold. In 1872 the silver yield was $351,944; and in 1873, $176,500, while in 1883 it was $6,000,000.

Up to June 30, 1883, precious metals from Montana were deposited in the United States Mints as follows:

Gold	$52,952,396 34
Silver	8,037,916 19
	$60,990,312 53

Other valuable metals and minerals abound in Montana, but, as in California, the extraction of gold and silver have generally engaged public attention.

At the Exposition, this Territory made but a small mineral display. The principal minerals shown were ores of *gold, silver, copper, lead, iron, lead bullion*, etc., arranged on two pyramidal tables, over which was a sign, stating that all were from dividend-paying mines. Elsewhere were shown *coal, copper bars*, and *copper matte*, and sundry ores. There was a special case in which a large quantity of rich gold specimens were displayed. Some of the nuggets were very large. Some rich specimens were also shown from

the Atlantic Cable Mine, Cable District, Deer Lodge County. One fine specimen from the Bell Mine showed native silver on erubescite.

NEW MEXICO TERRITORY.

Territory, December 13, 1850. Area, 121,200 square miles. Population in 1880, 119,565. Capital, Santa Fe. Floor space in Exposition, 6,900 square feet. The following extracts are from *Illustrated New Mexico*, by W. G. Ritch, 1883, circulated at the Exposition:

FACE OF THE COUNTRY.

The surface is marked with mesas, valleys, and mountains, foothills, bluffs, cañons, and mountain parks. The mountain ranges, from north to south generally, break into spurs, buttes, and foothills, diminishing in altitude, and graduating into mesas or high table lands.

In the northern part of the Territory the Culebra Range looms up to the east into the Raton Spur, and to the south is known, according to proximity to local towns, as Taos, Mora, and Santa Fe Mountains; to the west is the Conejos and Tierra Amarilla Ranges. Southeast of the old City of Santa Fe and east of the Rio Grande, a broken range runs south, variously known as the Placer Mountains, the Sandia, Manzana, Oscura, Jumanes, Fra Cristobal, Caballo, San Andres, and Organs, the latter crossing the southern border of the Territory near El Paso. To the east of the above range is a series of high table lands reaching to the mesa, known as the Llano Estacado or Staked Plains, and broken by the low mountains and peaks named on the maps as the Gallinas, Jacarillas, Carrizo, Capitan, Sierra Blanca, Guadalupe, Jarilla, Hueco, and Sacramento.

On the west side of the Rio Grande, from the isolated peak near the northern boundary, known as the San Antonio Mountain, another broken range runs south, as follows, and known locally as Petaca, Valles, Jemes San Mateo, Ladrones, Oso, Magdalenas, Socorros, Gallinas, Southern San Mateo, Pinos Altos, Burro, Black and Mimbres Ranges, and the Florida Mountains, near the southern border.

Farther to the west, and near the Arizona line, appears the continental divide, composed of mountains and peaks variously known as Tunicha, Chusca, Zuñi, Datil, San Francisco, Escudilla, Tulerosa, Luera, Mogollon, Pyramid, Stein's, Animas, and Peloncillo.

These mountains, equably distributed as they are, furnish a large water supply, a great amount of timber, and are excellent shelter for stock during storms.

ALTITUDE.

The mesas and table lands in the northern part of the Territory are generally about 6,000 to 6,500 feet above sea level. In the central portion of the Territory the mesas attain an elevation of about 5,000 feet, and in the south about 4,000 feet. The fall of the Rio Grande from the northern border of the Territory to the point where it cuts the New Mexico, Texas, and Chihuahua boundary is about 3,500 feet. The ranges generally rise from 2,000 to 5,000 feet above the mesas and high table lands. Mount Baldy, 18 miles from Santa Fe, is 12,202 feet high. Mount Taylor, in the Sierra San Mateo, is 11,200 feet high. Raton Pass, 7,893 feet; Costillo, 7,774 feet; Tierra Amarilla, 7,455 feet; Taos, 6,950 feet; Cimarron, 6,489 feet; Las Vegas, 6,452 feet; Glorieta, 7,587 feet; Santa Fe, 7,044 feet; Bernalillo, 5,104 feet; Albuquerque, 4,918 feet; Fort Wingate, 7,037 feet; Socorro, 4,655 feet; Silver City, 5,946 feet: Fort Stanton, 5,800 feet; Las Cruces, 3,844 feet; El Paso, Texas, 3,662 feet; Tucson, Arizona, 2,542 feet. Some of the mining camps are at an elevation of from 7,200 to 8,500 feet.

At Kansas City, 849 miles east of Santa Fe, the altitude is 763 feet; Denver, 338 miles north of Santa Fe, 5,240.

WATER-COURSES AND EXTENT.

The Rio Grande is the main river of the Territory. It rises in southwestern Colorado, at an elevation of 11,920 feet; it runs southerly and centrally through the Territory, mainly through a broad valley. Its tributaries are, from the west: The San Andres, the Chama, Jemez, Puerco of the East, Alamosa, Chuchillo Negro, Animas, and Polomas; from the east: Costilla, San Cristobal, Hondo, Taos, Picuris, Santa Cruz, Namba, Santa Fe, Galisteo, Tuerto, and Alamilla.

The eastern portion of the Territory is drained by the Canadian River (Rio Colorado), emptying into the Arkansas River; its tributaries are: Cimarron, Mora, Sapello, Concha, Pajarito, Ute, Revuelta, and Trujillo.

The Pecos River rises in the Santa Fe Range and drains the eastern and southeastern part of the Territory, emptying into the Rio Grande. Its principal tributaries are: Vaca, Tecolote, Bernal, Gallinas, Salado, Yeso, Spring, Hondo, Feliz, Atrasco, Pañasco, Seven Rivers, and Black.

The northwestern part of the Territory is drained by the Rio San Juan, with tributaries as follows: Pinos, Navajo, Animas, La Plata, and Mancos. The Puerco of the West, the Zuñi, and Tulerosa Rivers are in the central west.

The Rio Miembres, Rio Gila, and San Francisco are in the extreme southwest of the Territory.

Numerous small streams, arroyas, and springs are to be found all over the Territory.

MINERALS AND PRECIOUS STONES.

The mineral wealth of New Mexico has been known to exist for centuries. Indeed, the traditions and knowledge existing among the village Indians of Mexico at the date of the conquest by Cortez was of a great people and of great mineral wealth in Aztlan (the white or bright land), as the country far to the north, since named New Mexico, was known early in the sixteenth century. It was less than a decade later than the landing of Cortez that the shipwrecked Cabeza de Baca and party started from the gulf coast, somewhere between the Cities of New Orleans and Galveston, upon the forlorn hope of reaching the settlements of their countrymen in Mexico. During the weary wanderings of this stout hearted and persevering party, they penetrated to the heart of the continent at a point nearly twenty degrees of latitude north of the City of Mexico, and nearly the same distance north of the last settlement of the Spanish colonists. The journey was beset with all the perils and uncertainties of a trackless wilderness inhabited by savage tribes, upon a tortuous route of thousands of miles, occupying five years in traversing. Nothing but the most subtle tact, indomitable will, dauntless courage, and endurance of steel, could have possibly surmounted the difficulties. And not then, we are bound to believe, had the wanderers found less humanity and hospitality than was found as related among a people living in houses, tilling the soil, and possessing provident care and methods of government not to be despised among the more pretentious civilized nations. And thus it was that the first Europeans set foot upon the soil of New Mexico, and gathered information which, when reported to the Viceroy of Mexico, confirmed the wonderful stories and traditions that had previously been related of that "*white and bright land*," and set on foot the expeditions of Niza, Coronado, Ruiz, and Espejo, and gave to the world the first knowledge of the mineral wealth of the country, and that historical significance of which New Mexico and Santa Fe is the seat and center.

Espejo, who is regarded as the more reliable of the early explorers, frequently makes reference to the presence of precious metals. Thus upon or near the lower Rio Grande he speaks of "many mines of silver, which, according to the judgment of skillful men, were very plentiful and rich in metal," and in another paragraph of "abundance of rich metals." At Paola (Bernalillo County), of finding in their towns and houses, "many sorts of metals, whereof some seemed to be very good." At Zia, he says: "They shewed them rich metals, and the mountains also not farre off where they digged them." Of a mine he visited near Zuñi, Espejo says he "tooke out of the same with his own hands exceeding rich metals holding great quantitie of silver." Returning from Zuñi he "found twelve leagues east of Quires (Santo Domingo pueblo near Wallace station, A., T. & S. F. R. R.), a province of Indians called Hubates (old pueblos, Santa Fe County), near mountains full of pine and cedar, who received them peaceably and gave them great store of victuals, informing them also of very rich mines which they found, whereout they got glistening and good metal and therewith returned to the town from whence they came."

That the mines of New Mexico were worked by the Spaniards to a considerable extent is amply attested in old abandoned shafts to be found all along the mountains from the Santa Fe range to the Organs, and elsewhere. They were worked by the Pueblo Indians under duress, from which imposed labors the latter revolted in 1680, drove their oppressors out of the country, and kept control of the same for a number of years. Terms of peace were finally made and the Spaniards returned under stipulations that in their occupation of the country the pursuits of the people were to be confined to agriculture and stock. As a consequence, for many years, mining was wholly abandoned, and but little attention has been given to mining in New Mexico until a comparatively recent date.

Since the American occupation (1846), as reported by the Director of the United States Mint, the net production in precious metals of the mines of New Mexico down to and including 1881, have been in gold, $10,350,000, and of silver, $3,622,000; making a total of $13,972,000.

The real general development of the mineral resources of the Territory only commenced less than five years ago. It was not until geological and mineralogical surveys had been made and reported by the general government, and the coming of railroads and convenient transportation had become an assured fact, that development commenced in real earnest. Sufficient has thus been demonstrated at the beginning of 1883 to clearly establish beyond doubt that new Mexico is one of the richest and most permanent in mineral resources of all the States and Territories. That there are within its borders several mines entitled to rank among the most remarkable and richest in yield in the known world, and that there is still not only a broad and most inviting field for the investment of capital, but that the chances for the prospector are equal or better, if possible, than any of the developed finds that have preceded.

The writer does not hesitate to predict that New Mexico is on the eve of one of the most remarkable seasons of prosperity, as represented in its mineral resources, that has ever fallen to the lot of a mineral-bearing section, and presents the following facts as earmarks of the truth of the statement asserted:

Generally the resources of the Territory consist very largely of not only its mines of precious metals, but likewise of copper, lead, manganese, and iron, besides mica, salt, coal, gypsum, soda, lime, kaolin, cement, sulphur, plumbago, mineral paints, marble, and

building stones. Precious stones, such as turquoise, garnet, moss agate, and emerald, are found. Valuable mining properties are found in every county.

Iron, lead, and coal are practically inexhaustible. The coal fields of Raton and of Colfax County generally, and the San Juan River, near Tierra Amarilla, on the Cerrillos, and on the Rio Galisteo, near Santa Fe, Bernallo, on the line of the Atlantic and Pacific Railroad, near San Antonio, on the Atchison, Topeka, and Santa Fe Railroad, and in Grant, San Miguel, and Lincoln Counties, are immense.

There can be no question as to New Mexico being able to produce vast quantities of minerals, including the precious metals, which are found in nearly every county; 132 mining districts are enumerated in Ritch's Handbook. The total deposits of New Mexico, gold and silver, in United States Mints, to June 30, 1883, were:

Silver	$4,631,710 66
Gold	1,782,773 19
	$6,414,483 85

The total yield, according to H. C. Burchard, Director of the Mint, including 1883, was as follows:

	Gold.	Silver.
To 1881, inclusive	$10,350,000	$3,622,000
1882	150,000	1,800,000
1883	280,000	2,845,000
	$10,780,000	$8,267,000
Total		$19,047,000

These figures show that in New Mexico, as in all other gold and silver producing countries, the gold yield is steadily decreasing, while that of silver is increasing. This has always been the case in new countries since man learned to extract metals from their ores. The physical properties of gold, mentioned elsewhere, cause that metal to be always in the metallic state in nature. Certain geological influences set it free from the rocks in which it was stored, and cause it to collect in placers from which it is quickly gathered when discovered. The source of the gold is then sought, when it is found that silver is more abundant than gold and more easily obtained. This was the case after the conquest of America by Spain. The conquerors, who cared only for gold, found silver in unexpected abundance. The result was a glut of silver after one of gold, the consequences of which are recorded in history.

The mineral exhibit made by New Mexico at the Exposition was ample and even grand. There were large piles of ores on terraced tables from Socorro County, each of which contained from one to two cubic feet. There were 275 of these piles. The ores were *silver*, *iron*, *copper*, and *lead*, with *gypsum*, *salt*, *sand carbonates* (like those of Leadville, Colorado), *magnetite* (loadstone), *baryta*, *hematite*, *fluorspar*, *fire clay*, *etc.*

There were fine blocks of coal, and piles of coke of excellent quality from Bloomsbury, Colfax County, and from Socorro and other counties. The possession of this fuel gives to New Mexico a very great advantage in ore smelting and metallurgy. Limestone suitable for a flux is also abundant.

Lead bullion in large quantities was exhibited by the Smelting Works of the Socorro and the Billings Smelting Works. In this exhibit slabs of fire-proof stone and talc were shown.

A fine specimen of black tourmaline in mica and mica schist was also shown, and views of scenery, towns, hydraulic mining, machinery, etc.

WASHINGTON TERRITORY.

Territory, March 2, 1853. Area, 69,994 square miles. Population in 1880, 75,116. Capital, Olympia. Floor space in Exposition, 2,585 square feet. The mineral resources of this Territory are scarcely known. Gold has been largely produced. The yield to 1868 was estimated by J. Ross Browne at $10,000,000, but this is now thought to be in excess of the reality. Since that date the yield has steadily diminished. In 1883 the yield of both the precious metals is estimated by the Director of the Mint at:

Gold	$80,000
Silver	500
	$80,500

The total deposits of the precious metals in the Mints of the United States to June 30, 1883, were:

Gold	$285,635 21
Silver	681 37
	$286,316 58

Coal, iron, and building stones are found in the Territory. The coal is of a high grade of brown coal or lignite, suitable for many purposes, and is largely mined and exported.

WYOMING TERRITORY.

Territory, July 25, 1868. Area, 93,107 square miles. Population in 1880, 20,789. Capital, Cheyenne. Floor space in Exposition, 3,325 square feet. The surface of the Territory is generally high and mountainous. The mean altitude is 6,450 feet. The Rocky Mountains cross the Territory in a northwest and southeast direction. There is a large area of fertile land in the Territory suitable for agriculture and pasturage.

One of the most interesting features of the Territory is the Yellowstone Geyser region, which has been reserved as a national park. The most valuable minerals found in Wyoming are *coal* and *iron*. *Some* gold has been taken from the mines, but the yield has not been great. Up to June 30, 1883, the deposits in United States Mints were:

Gold	$729,895 57
Silver	11,830 01
	$741,725 58

The coal, which is a good quality of lignite, probably tertiary, is found in extensive fields. It is an excellent fuel for many purposes, but it will not make good coke, and is therefore unsuited for iron smelting. The estimated output of Wyoming coal from 1868 to 1882 inclusive, according to Albert Williams, Jr., was 4,585,594 tons of 2,000 pounds. The following is from a recent mining publication:

WYOMING COAL FIELDS.

These begin from three to thirty-seven miles north of Rattlesnake Hill, whence coal is found for 150 miles to the north. Two miles or so north of section 4, township 32, range 68, is a great belt of lignite coal a little harder than the Colorado, though much like Rock

Spring coal. It extends seventy miles east and west, with the Wind River Mountains as the western boundary, and is well up into Montana. The biggest field is in the northern part of Rattlesnake Basin, where there are fifteen veins, one being ten feet, two five feet, and one four feet thick; all lying on top of one another, while any quantity of veins are two feet thick. This supply, covering so large a territory, seems to be inexhaustible. It of course greatly cheapens the cost of sinking oil wells to have fuel for the boilers right at the doors, and no cost to speak of for hauling. The Colorado and Wyoming Company, a Denver corporation, has already expended $20,000 in developing their oil and coal tract, which embrace 6,560 acres in the Rattlesnake and 640 acres in the Seminole regions.

Wyoming made a splendid collective exhibit at the Exposition, but the mineral section was not large. The following were the most interesting minerals shown:

Coal in large blocks from Rock Springs, Sweetwater County, and from the Alma Mine, Unita County, and from the Carbon Mine; *petroleum shale; alabaster*, or massive gypsum; *carbonate of soda*, crude; *red hematite* (large quantity); *kaolin; mica*, of inferior quality; *moss agate; silicified wood.*

A special case containing minerals from Yellowstone Park Geysers; bottles, horseshoes, and wire baskets incrusted with silica; *amethyst crystals* and *quartz crystals* in *silicified wood*, or casts of logs; *agate chalcedony.* There was a small case containing a hollow cylinder of quartz formed in space left by a decayed branch of a tree. The inside was covered with magnificent quartz crystals. The length of this rare and beautiful specimen was about 14 inches, and the diameter about 10 inches. The rather small mineral collection of Wyoming was beautified and augmented by a fine set of large photographs representing views of scenery, towns, geysers, etc.

The Territories of *Alaska* and *Utah* were not represented, except to a limited extent in the United States Government exhibits. They are both mineral-producing Territories of great importance, both of which could have made fine exhibits if so disposed.

THE UNITED STATES GOVERNMENT EXHIBITS

Occupied a central space in the Government Building, 109,325 square feet. The following general description of this exhibit is from the *Times-Democrat Almanac for 1885:*

THE UNITED STATES EXHIBITS.

The display made by the Government of the United States is the largest and most delightfully instructive ever yet attempted by any nation officially.

The expenditure of the money appropriated by the Government, amounting to $300,000, and the preparation of exhibits, was intrusted to a Board of Commissioners, consisting of Col. S. C. Lyford, War Department; Chas. S. Hill, Department of State; Lieutenant B. H. Buckingham, Navy Department; Wm. F. McLennan, Treasury Department; Hon. A. D. Hazen, Post Office Department; Hon. Ben. Butterworth, Interior Department; Cecil Clay, Department of Justice; Wm. Sanders, Department of Agriculture; and Prof. G. Brown Goode, Smithsonian Institute (including the National Museum and United States Fish Commission).

STATE DEPARTMENT.

The principal feature of the exhibit of the State Department is an immense globe, fifty feet in diameter, upon which is accurately delineated all the geographical and political divisions of the earth, with facts as to their area, population, productions, etc. The globe is so constructed as to be illuminated from within.

Upon large illustrated charts and diagrams is presented to the eye information relative to the production, manufactures, trade, and commerce of each country, and upon other charts are shown the relative distance of the various ports of Central and South America from the various shipping ports of the United States, as compared with the distances of those same ports from those of Europe.

TREASURY DEPARTMENT.

The Treasury Department has a life-saving station upon the shore of Lake Rubio, the crew being provided with all the boats and life-saving apparatus used by them in actual service.

The Bureau of Engraving and Printing is represented by specimens of all work ever done by the Government in that line.

The Mint Bureau exhibits a complete collection of all the coins of all denominations ever issued by the United States.

THE WAR DEPARTMENT

Represents the character of the work of the medical staff of the army in peace and war, by exhibiting every means and appliance used in caring for the sick and wounded or the amelioration of human suffering.

This is done by exhibiting the objects themselves, by models or by drawings and photographs. Ambulances, stretchers, panniers, and other means for transporting the sick and wounded, surgical instruments and appliances, artificial limbs, and everything upon the medical supply tables are displayed, the immense collection contained in the army medical museum having been freely drawn upon to make this exhibit especially interesting to the physician and the student.

The exhibits of

THE INTERIOR DEPARTMENT

Exceed in magnitude, variety, and interest those of all the other departments.

Although by no means the largest, one of the most attractive exhibits is that of the General Land Office.

This consists of a series of about fifty large maps, beautifully executed and handsomely framed, showing the surveys and sale of the public lands from the organization of the Government till now.

A series of large maps shows in colors all the developed mineral areas and specific fields in the United States.

Another series of maps illustrates the advancement, by decades, of the railroad system of the United States from 1830 to 1884.

A series of fifty large water color paintings illustrates pictorially the progress in mining from the most primitive methods—from naked aborigines pounding the gold-bearing quartz with a stone to a view of the ponderous stamp-mills of to-day.

But by far the most valuable feature of this exhibit is the splendid collection of mineral specimens taken since September from the principal mines and quarries in the United States.

THE PATENT OFFICE.

A careful selection of between five and six thousand models has been made from among the millions in possession of the Patent Office, and so arranged as to illustrate the gradual progress in each line of invention from the most primitive process to the perfected machine of to-day.

THE NAVY DEPARTMENT

Illustrates the perils and hardships of Arctic navigation by its display of the Greely expedition. This display includes everything brought back by former expeditions or in possession of the Government, derived from other sources, such as dresses worn by the native Esquimaux and the Arctic explorers, sledges and dog-teams, implements used by the natives in hunting and fishing, etc. Sailors who accompanied the relief party, and who had previously had much experience in Arctic navigation, are constantly in attendance upon this exhibit for the purpose of giving all desired information.

The Bureau of Construction and Repair exhibits models of various vessels of the navy, including those now being constructed. Samples of all the cordage used in the navy, from a ten-inch hawser to the finest twine; blocks and tackle of such ponderous proportions as a Brobdignag might use to pull a mountain from its base to a tiny block that a Lilliput would employ to hoist a fly.

The Naval Observatory shows a full line of astronomical and nautical instruments, chronometers, etc. An astronomical clock, located in the Main Building, is electrically connected with the astronomical clock in the Naval Observatory in Washington, from which it will take its time to a fraction of a second at 12 o'clock daily. This clock is electrically connected with clocks placed in all the buildings on the grounds.

THE AGRICULTURAL DEPARTMENT

In its chemical division illustrates sugar production, more particularly that from the sorghum, or Chinese cane.

A complete sugar laboratory is shown and explained by practical manipulation conducted by an expert, and a full line of sorghum sugars as well as of candy and other manufactures therefrom produced.

THE BUREAU OF ETHNOLOGY

Exhibits many thousand specimens of pottery, stone implements, and shell and bone ornaments recovered from the soil and found in the caves of the ancient cliff dwellers of the cañons of the Colorado and Yellowstone.

THE GEOLOGICAL SURVEY.

A branch of the Interior Department, presents models and dissection of the Comstock, Eureka, Leadville, and other mines, showing their depth, extent, and method of working.

THE SMITHSONIAN INSTITUTE

Having turned over its vast collection to the new National Museum, confines itself to showing its publications, to which will be added a case containing all the scientific publications by the government within the past twenty years, more than 900 volumes. The exhibit of

THE FISH COMMISSION

Is extensive and interesting. The operation of artificial hatching, culture, and distribution of fish is practically exemplified. All the boats, tackle, and apparatus for taking fish, together with an immense series of large photographs and beautifully colored pictures and models, representing to the life every fish that swims, are displayed.

THE NATIONAL MUSEUM

Exhibits, under animal products, the stuffed and mounted skin of every beast, bird, and fish that contributes in any way to the life, comfort, or pleasure of mankind.

In connection with each specimen is placed specimens of every product derived therefrom, and how applied to man's use; such as its flesh for food, its skin, hair, and fur or feathers for clothing, its feathers or scales for ornament, its horns, bones, hoofs, and teeth for their innumerable uses in the arts and manufactures, until every part of the animal economy is shown by its derivative products and their various applications to be finally consumed by all-devouring man.

The mineral exhibit includes all building stones found in the United States, exhibited in four-inch cubes, a natural fracture on one face, a hammered surface on another, and a polished surface on a third.

The department of conchology shows the largest and most beautiful collection of shells ever made, the finest collection in America having been purchased from Prof. R. E. C. Stearns, of California, specially for this exhibit.

This department exhibits for the first time mammoth photographs more than four times the size of any that have ever been made in the world, printed from a single negative upon one piece of paper. The space covered by the photographic print is five by seven feet; when framed, seven by nine feet. They number thirteen, and represent the government buildings at Washington.

THE GEOLOGICAL SURVEY

Furnishes a number of striking models of the more important geologic and topographic features of the Far West. The Grand Cañon of the Colorado, the Yellowstone Park, the Yosemite Valley, and the great mountain districts of the Rocky Mountains are shown; also a number of models of the great mines of Colorado, Nevada, and California, and mammoth transparencies, 150 in number, illustrating chiefly the people and the scenes of the Far West.

THE POST OFFICE DEPARTMENT

Has a model Post Office in the Government Building, where mails are received, dispatched, and delivered at all hours during the continuance of the Exposition. It displays samples of all the mail bags, pouches, and other paraphernalia connected with the mail service. A very attractive feature is a collection, handsomely mounted and framed, of all the postage stamps and stamped envelopes ever issued by the United States, and also of those issued by several foreign governments. A model postal car on the grounds illustrates the method of taking up and delivering mail bags at way stations by lightning express trains.

The mineral collections from the Smithsonian Institution and the National Museum were specially fine. They are fully described in the following catalogue, published by the department:

INTERIOR DEPARTMENT. SMITHSONIAN INSTITUTION—UNITED STATES NATIONAL MUSEUM.

PLAN TO ILLUSTRATE THE MINERAL RESOURCES OF THE UNITED STATES AND THEIR UTILIZATION, AT THE WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXPOSITION OF 1884–1885, AT NEW ORLEANS.

By FRED. P. DEWEY, *Curator of Economic Geology and Metallurgy.*

In the first division of this collection—that of economic geology, or the natural occurrence of materials of economic value—it is designed to exhibit collections illustrating the different kinds and grades of the ores of each metal, and also a few collections of non-metallic minerals of economic importance.

In the second division—that of metallurgy—it is designed to exhibit collections representing the processes for the extraction of the metals from their ores by specimens, where practicable, filling the gaps by means of illustrations and descriptions, and accompanying them by general illustrations and descriptions so as to fully explain these processes.

In making up the ore collection it has been designed to represent all the different varieties of each ore and many of the most prominent mining regions, so as to give a good general idea of the nature of the occurrences of the metals and also their distribution, but it has not been possible to show every occurrence of each variety of an ore, neither has it been possible to represent every mining region.

The Lake Superior copper region is very thoroughly represented, both on account of the value of the mines of this region and as representing the kind of collections it is desirable for the museum to possess to illustrate a region or a mine.

Taking, first, the region, it is represented by three prominent mines showing three different and characteristic occurrences of the ore.

First, the so called Mass mines, which are characterized by the occurrence of large masses of free copper, amounting in some cases to many tons of metal in a single mass, are represented by the Central Mine. Besides these large masses these mines also carry considerable disseminated free copper.

Second, the Amygdaloid mines, which are characterized by the occurrence of the free copper in amygdules, bunches, strings, and sheets from the size of a pin-point up to a few hundred pounds in weight (with rarely a large mass) disseminated in a soft amygdaloid trap-rock, are represented by the Osceola Mine.

The average percentage of copper in the ores from these mines varies from three quarters of 1 per cent to 2 per cent.

Third, the Conglomerate mines, which are characterized by the occurrence of the free copper mostly in strings in a hard conglomerate of ferruginous quartz pebbles, are represented by the Conglomerate Mine. The average percentage of copper in the ores from these mines varies from 4 per cent to 6 per cent.

Taking the Conglomerate Mine, the collection shows, first, the general character of the ore and the inclosing wall rocks; secondly, it shows the occurrence of the ore at various prominent points in the mine which are accurately located; and, thirdly, it shows a section of the rocks over a distance of 631 feet, by specimens taken at suitable distances to show the different characters and changes of the material.

In selecting specimens it has not been designed to take those that are especially handsome or rich, but rather to take such as represent the actual character, occurrence, and value of the ores. In making collections of ores for the National Museum, it is very desirable that some definite and systematic plan of representation of this kind should be adopted, as collections made in this way have far more value for museum purposes than the haphazard collections of showy specimens usually found in such establishments.

COLLECTIONS IN ECONOMIC GEOLOGY.

Gold.

Placer gold, from Virginia, North Carolina, California, Idaho, Montana, Utah, and Oregon.

Gold quartz from Virginia, North Carolina, South Carolina, Georgia, California, and Montana.

Auriferous gravel from California and South Carolina.

Auriferous pyrite from Virginia and Colorado.

Telluride ores—compounds of gold with tellurium from Colorado.

Iridium.

Iridosmine, from California.

Silver.

Native silver with native copper, from the Lake Superior region.

Native silver on sulphide of copper, from Montana.

Wire silver, from Nevada, Montana, Idaho, and New Mexico.

Native silver and horn silver, in sandstone, from Utah.

Horn silver, from Colorado, Utah, Nevada, and New Mexico.

Ruby silver, from Nevada.

Base ores carrying silver (milling ores), from Nevada, Utah, and Montana.

Argentiferous lead ores (smelting ores), from Colorado, Utah, and Nevada.

Tin.

On account of recent discoveries and the general interest attaching to tin, the list of the localities of the occurrence of cassiterite, or the binoxide of tin, has been made as complete as possible, and includes Maine, New Hampshire, Virginia, North Carolina, Alabama, Montana, and the Black Hills of Dakota. The tin ore of San Jacinto, California, is also shown.

With the tin ores are shown bars of tin reduced from the New Hampshire (1840), Virginia, Alabama, Montana, and California ores; also, a collection of Welsh tin plate.

Antimony.

The sulphide ores, from Utah (with metal) and California.

Quicksilver.

Cinnabar, from California.

Lead.

The sulphide ores, from Missouri. (For argentiferous lead ores, see under silver.)

Copper.

Native copper, from Lake Superior region in Michigan, including water-worn or surface specimens; specimens of the mass copper and chips obtained in cutting up the masses in the mine; and specimens showing the disseminated free copper in the rock, both amygdaloid and conglomerate. To these are added specimens illustrating the dressing of the ores.

Sulphide ores, including the sulphides of copper and iron, from Vermont, Maryland, North Carolina, and Missouri, and the sulphide of copper, from Butte, Montana.

Oxidized ores, from Pennsylvania, Virginia, and Arizona.

Bismuth.

The oxidized ores, from Utah.

Nickel and Cobalt.

The sulphide ores from Pennsylvania and Missouri.

Iron.

A collection of ores of over 500 specimens, selected from the collections made by the Tenth Census, under the direction of Professor R. Pumpelly, to illustrate the iron industry of the United States, showing all the different kinds and varieties of iron ore found in this country.

This collection is not intended to show the full occurrence in any one region, but only the prominent varieties of the different regions.

Manganese.

Manganese ore from Virginia and Georgia.

Zinc.

The New Jersey ores, includiug franklinite, zincite, willemite, and calamine.
The silicate and carbonate ores of Tennessee and Virginia.
The sulphide ores of Missouri and Kansas.

Coal.

A collection showing the different varieties of coal from Pennsylvania and Virginia, including anthracite, semi-bituminous, bituminous, splint, and cannel coal; also a large collection illustrating the methods of coal mining, including some large photographs (taken by electric light) of the interior of a coal mine, showing the formation of the coal seam and its peculiarities, together with the men at work. These are the first photographs ever taken of the interior of a coal mine.

Sulphur.

Native sulphur from Nevada.
Iron pyrites from Massachusetts and Virginia.

Besides the above systematic ore collections, some illustrations of ores will be found in the metallurgical collections.

In making up the metallurgical collection it has not been possible to exhibit the production of each metal exhaustively, owing to the small amount of suitable material previously in the department, and to the short space of time available for making new collections.

A few systematic illustrations of metallurgical operations are shown. In making these collections it has been designed to treat a few subjects thoroughly rather than a large number superficially. After suitable consideration a few representative works were selected for illustration, and have been worked up as completely as possible.

Beginning with the ore, as mined, each step in its preparation for smelting is shown, together with the by or waste products of such treatment. To illustrate the smelting operation, the ores, the fuels, the fluxes, and every other material entering into the operation are shown. Following through the process, each product of each operation up to the final product of the works is represented; to these are added, where practicable, illustrations of materials of construction, such as fire-clays, sands, etc. The furnaces and tools are shown by specimens, views, and descriptions. The interest and value of these collections does not lie so much in the specimens themselves as in their being thoroughly connected, and in the kind and amount of information that can be given in regard to them.

In order to be satisfactory the series must be complete, and the information full and accurate. A great deal of time, care, and attention is necessary in making such a collection.

To illustrate the nature and scope of these collections, a single one, that from the Passaic Zinc Works, will be described in detail. These works are located at Jersey City, New Jersey, and use the zinc, iron, and manganese ores from Franklin, Sussex County, New Jersey. They were started in 1854 and have been twice enlarged.

From 1854 to 1875 only oxide of zinc was manufactured; in 1875 the spelter furnaces were added, and in 1884 the spiegel furnace. The works have been in constant operation from the very beginning.

There are 48 furnaces, 6 by 4 feet, making oxide of zinc, arranged in double rows of 8 and 10. There are 12 spelter furnaces arranged in blocks of 4 each. The spiegel plant consists of one 9 feet 8 inches by 37½ feet blast furnace.

The Franklinite ores are treated first in the oxide furnaces for the production of oxide of zinc and the residues, containing iron and manganese, are smelted in the blast furnace for the production of spiegel.

The silicate and carbonate ores are smelted in the spelter furnaces for the production of metallic zinc.

The collection from the zinc furnaces shows:

The franklinite ore, consisting of a mixture of franklinite or protosesquioxide of iron with zinc and manganese replacing the iron, zincite or oxide of zinc, willemite or silicate of zinc, calcite or carbonate of lime, in lumps as mined, from the Buckwheatfield Mine, Franklin, Sussex County, New Jersey.

The same ore crushed ready for the furnace.

The franklinite ore, consisting of a mixture of franklinite or protosesquioxide of iron with zinc and manganese replacing the iron, zincite or oxide of zinc, willemite or silicate of zinc, rhodonite or silicate of manganese, and calcite or carbonate of lime, in lumps as mined, from the Sterling Hill Mine, Ogdensburg, Sussex County, New Jersey.

The same ore crushed ready for the furnace.

The silicate and carbonate ore, consisting principally of calamine or hydrated silicate of zinc with a little carbonate of zinc resulting from decomposition, in lumps as mined, from the Sterling Hill Mine, Ogdensburg, Sussex County, New Jersey.

The same ore after roasting to expel water and carbonic acid.

The roasted ore crushed ready for the furnace.

Anthracite coal used for heating purposes.

Anthracite coal (fine) to be mixed with the ore in making up the charge to reduce the zinc to the metallic state.

The mixed charge of Franklinite ore and coal ready for the oxide furnace.

The mixed charge of silicate and carbonate ore for the spelter furnaces.

The residuum remaining in the oxide furnace after the extraction of the zinc.

The oxide of zinc produced.

The residue remaining in the retorts after the distillation of the zinc in the spelter furnaces.

Blue powder, a by-product consisting of a mixture of metallic zinc and oxide resulting from imperfect condensation of the zinc.

The spelter or metallic zinc produced.

To these are added the fire-clay from Woodbridge, N. J., used for making retorts.

A piece of new retort.

A piece of old retort.

Old retort ground, to be mixed with the clay in making new retorts.

The collection from the spiegel furnaces shows:

The residuum from the oxide furnaces, containing iron and manganese.

Limestone used for flux, from Sing Sing, New York.

Anthracite coal used for fuel.

The slag produced.

Oxide of zinc deposited in the gas-flues.

The Spiegeleisen produced.

The collection of specimens is supplemented by photographic views of the principal points about the works.

COLLECTIONS IN METALLURGY.

Gold.

The extraction of the free gold from the auriferous gravel of California by amalgamation: Collection from the North Bloomfield Mine, Nevada County, California.

The extraction of the free gold from the auriferous pyrite in quartz of Colorado, by stamping and amalgamating: Collection from the Bobtail Mill, Black Hawk, Gilpin County, Colorado.

The extraction of gold from the auriferous mispickel (arsenical pyrites) by roasting and chlorination: Collection from the Del Oro Works, Canada.

The extraction of gold and copper from auriferous copper ores, by the fusion and electrolitic process: Collection from the works of E. Balbach & Son, Newark, New Jersey.

The manufacture of gold leaf: Collection from Hastings & Co., Philadelphia, Pennsylvania.

Silver.

The extraction of silver from base ores by chlorodizing, roasting, and milling (amalgamation): Collection from Ontario Mill, Park City, Summit County, Utah.

The smelting of argentiferous lead ores and the refining of the base bullion (silver and lead): Collection from the Cheltenham Works, Saint Louis County, Missouri.

The refining of base bullion (silver and lead): Collection from the works of E. Balbach & Son, Newark, New Jersey.

Lead.

The manufacture of pig lead and white lead direct from the ore: Collection from the Lone Elm Works, Joplin, Missouri.

Copper.

The smelting and refining of copper by the fusion process: Collection from the Baltimore Copper Works, Baltimore, Maryland, and Saint Genevieve Copper Works, Saint Genevieve, Missouri.

The refining of pig copper: Collection from the Ansonia Brass and Copper Works, Ansonia, Connecticut.

The rolling of copper: Collection of the Ansonia Brass and Copper Works, Ansonia, Connecticut.

Iron.

The smelting of pig iron: Collections from the Crown Point furnace, Crown Point, New York, the Rockwood furnace, Rockwood, Tennessee, and the Missouri furnace, Saint Louis, Missouri.

Steel.

The manufacture of crucible steel: Collection from the Crescent Steel Works, Pittsburgh, Pennsylvania.

The manufacture of Bessemer steel: Collection from the South Chicago Bessemer Works, South Chicago, Illinois.

Zinc.

The smelting of spelter or zinc: Collections from the Glendale Zinc Works, Saint Louis, Missouri, the Joplin Zinc Works, Joplin, Missouri, and the Rich Hill Zinc Works, Rich Hill, Missouri.

Zinc, Iron, and Manganese.

The smelting of spelter or zinc, oxide of zinc, and spiegeleisen from Franklin, New Jersey, ores: Collection from the Passaic Zinc Works, Jersey City, New Jersey.

Coke.

The manufacture of coke at Connellsville, Pennsylvania: Collection from the H. C. Frick coke ovens.

Sulphur.

The manufacture of sulphuric acid from iron pyrites: Collection from the Merrimac Chemical Company, Boston, Massachusetts.

The manufacture of Alloys.

Brass and its utilization: Collection from the Ansonia Brass and Copper Works, Ansonia, Connecticut.

Type metal and its utilization: Collection from the type foundry of Mackellar, Smiths & Jordan, Philadelphia, Pennsylvania.

Babbitt, or anti-friction metals: Collections from Merchant & Co., and Paul S. Reeves, Philadelphia, Pennsylvania.

Solders: Collection from Merchant & Co., Philadelphia, Pennsylvania.

COLLECTION ILLUSTRATING THE PRACTICAL APPLICATION OF NON-METALLIC ORES.

The manufacture of sandpaper: Collection from Baeder, Adamson & Co., Philadelphia, Pennsylvania.

Asbestus and its application: Collection from the H. W. Johns Company, New York.

Abrading and polishing materials: Collections from R. J. Waddell & Co., New York, and Saint Louis Tripoli Company, Saint Louis, Missouri.

The utilization of barites: Collection from Page & Krause, Saint Louis, Missouri.

In the War Department, Medical Department of the United States Army, were shown some remarkable photographs of diatoms, by Colonel J. J. Woodward, as follows: Amphipleura pellucida, magnified 3,500 diameters; Arachnoidiscus, 1,200 diameters; Coscinodiscus, 2,200 diameters; Heliopelta, 1,000 diameters; Navicula rhomboides, 3,000 diameters; Navicula lyra,

1,650 diameters; Pleurosigma angulatum, 800 diameters; section, 6,000 diameters, showing hexagon, another showing beads, one section, 23,000 diameters, very fine; Surirella gema, 3,200 and 4,500 diameters; Triceratium fimbriatum, 1,000 diameters; T. farus, 1,000 diameters.

Dr. George M. Stemberg, F.R.M.S., exhibited splendid photographs of navicula lyra, 1,800 diameters; Triceratum fimbriatum, 1,500 diameters.

DEPARTMENT OF THE INTERIOR.

The General Land Office exhibited two large cases of ores—specimens taken from mines for which patents were applied for. They were from different parts of the United States. Iron ores and other large mineral specimens were placed on pedestals or bracket shelves. Earthy minerals and salt were shown in bottles. In this department was exhibited a large oil painting of Sutter's Mill, and smaller ones of miners working, painted by Eastman, of San Francisco. There were also 12 oil paintings of mining scenes and sections of quartz mines.

The Commissioner of Railroads made a small exhibit of slates, marbles, building stones, coal, iron, etc.

RAILROAD COMPANIES.

A number of railroad companies made exhibits special, or jointly with the States they traverse. These have been generally mentioned in describing the State mineral exhibits. California is much indebted to the Southern Pacific Railroad for the success of the State exhibit; and other States were likewise indebted to local railroad companies. In the Government Building there were two great railroad exhibits that did not occupy State space—the Cincinnati and New Orleans, or Queen and Crescent, and Texas Pacific and the Richmond and Danville and East Tennessee and Georgia. The space occupied by the former was 10,125 square feet, and by the latter, 12,045 square feet.

The Queen and Crescent made a large and comprehensive exhibit of mineral products of the States through which their roads pass. All the exhibits were in exceptionally large quantities, consisting of *marls, phosphatic fertilizers, iron ores, fire and brick clays, limestones, pig iron, coal and coke, manufactured iron, Caen stone, hematite and limonite, building stones, marbles, steatite*, etc.; one mass of iron ore weighing 10,000 pounds from Gadsden, Alabama—an imposing series—but all the minerals were shown also by the respective States.

The Richmond and Danville made an exhibit remarkable alike for the quantities of each mineral shown, the numerous localities represented, and the choice specimens obtained and displayed. The whole collection was well arranged, well labeled, and kept scrupulously clean. The collections were in charge of C. C. McPhail, of Richmond, Virginia, assisted by William Beal, of Murphy, Cherokee County, North Carolina. To these gentlemen I am indebted for much information and for favors shown.

The bulk of the collection was placed on large tables in generous piles. This part of the display consisted of *asbestus; barite; building stones; black band iron ore; corundum; chromic iron; copper ores; chalcopyrite; coal and coke; diatomaceous earth; gold ores*, from many mines; *iron ores; kaolin; limestone; limonite; lead ores; marble; magnetite; molding sands; manufactured iron; nickel ore; ochre; pyrites; pig iron; slate*, etc. The same minerals were also shown in State collections and have been generally described.

The choicer minerals were shown in plate glass table cases, which con-

tained some of the rarest, choicest, and most beautiful specimens shown at the Exposition, among which were the following:

Albite, moonstone, Virginia.
Asbestus, South Carolina.
Beryl, Virginia.
Biotite, crystal in sheet of muscovite; very fine. The biotite was ¾ inch long, clear cut angles. Rabry Mine, Macon County, North Carolina.
Calcite crystals, from Tennessee.
Cassiterite, North Carolina.
Chalcopyrite. Specimen weighed 200 pounds, nearly pure. North Carolina.
Chromic iron, North Carolina. This much resembles the California mineral. Mr. McPhail thinks that 6,000 tons are lying on the dumps in Yancey and Madison Counties.
Coal, Tennessee and Alabama.
Columbite, Virginia.
Copper, native, in cuprite.
Corundum, many fine varieties in special series from North Carolina.
Epidote, fine, North Carolina.
Fluorspar and *Fergusonite*, both from Virginia.
Garnets in fine large crystals, North Carolina.
Genthite, North Carolina.
Gold in many varieties of occurrence. Large nuggets from Pigeon Roost placers, Georgia. In quartz, Dahlonega, Georgia. In beautiful crystals, ochohedrons on wires or threads of gold, Lumpkin County, Georgia. Many specimens of less interest from other southern localities.
Hematite, fine, Alabama.
Hiddenite, North Carolina.
Itacolumite, North Carolina.
Leopardite, very fine, North Carolina.
Marbles in many beautiful varieties from numerous localities. A specially fine exhibit of Tennessee marble, and slabs highly polished from Georgia and Alabama.
Mica, remarkably fine specimens from North Carolina.
Microlite, Virginia.
Monazite, North Carolina.
Pyrophyllite, small crystals on slab, Georgia.
Pyrolusite, from Virginia and North Carolina.
Pyroxene, with chalcopyrite, fine, Dicktown, Tennessee.
Quartz in many beautiful and some rare varieties and *doubly terminated* crystals, North Carolina.
Crystals with many inclosed air globules, very fine, and *crystals* containing rutile crystals or chlorite, North Carolina.
Quartz pseudomorph, called box quartz, fine, North Carolina.
Rutile, very fine lustrous crystals, and the same mineral imbedded in quartz, North Carolina.
Samarskite, North Carolina.
Siderite, fine, North Carolina.
Steatite, used in paper manufactures, North Carolina.
Staurolite in fine crystals, North Carolina.
Tourmaline, black, Georgia and Virginia.
Zircon, North Carolina.

A. E. Foote, of Philadelphia, made a fine display of minerals and scientific publications in the Government Building. The collection was very large, and contained many rare and beautiful specimens, but they had no local interest as they were collected from all parts of the South. All the specimens and books were for sale.

GALLERIES.

There were but few minerals exhibited in the galleries of the Government Building. Near the south central staircase were shown several collections for educational use, placed together and in competition—a reward having been offered for the best and cheapest collection for schools. Centrally in the east gallery, over the Smithsonian headquarters, was Ward & Howell's grand collection of museum material, including many specimens of minerals from various parts of the world—fossils, rocks, ores, and casts and models of rare fossils, relief maps, etc. Ward & Howell, of Rochester,

New York, are dealers in this class of merchandise. They furnish colleges and educational institutions, or will sell a single specimen, if preferred. On the north side the colored people made their special exhibits, including minerals. In this department South Carolina, Louisiana, Colorado, New Mexico, and California had small collections of minerals.

On the south side France made an educational exhibit, in which minerals, rocks, ores, crystals, etc., were shown; also geological maps and publications. In the Connecticut gallery some broken fragments of marble were beautifully painted. In the California woman's department, in the gallery over the California headquarters, a small collection of minerals was shown.

BRICKS AND TERRA COTTA.

Well burned bricks are the most durable and convenient of building material. The old method of hand making has been superseded by costly and complicated machines, which do the labor of many hands, and in proportion, cheapen the product. The brick making machines were in an annex on the west side of the Main Building. I examined them with much interest. Good bricks cannot be made from inferior materials, no matter how good the machine may be. On the other hand, the best of material must be properly tempered and mixed to produce good bricks—this is the duty of the brick machine in the hands of the skilled workman. Fortunately, good clays, suitable for making the best of bricks and terra cotta ware, are common almost everywhere where there is soil. Clay that will make good pressed bricks will make the best quality of terra cotta if the color is no consideration, and similar machines mold the most beautiful designs with great rapidity. This is why this new building material is so cheap and so extensively used in the Eastern States. Some of the brick machines at the Exposition used dry clay, which is prepared by grinding and sifting before being pressed. The Eureka Dry Press Machine makes 2,500 bricks per hour. The pressure employed is equal to 50,000 pounds. The power used to work the machine to advantage is 40-horse power. The bricks are ready for the kiln when they leave the machine. The bricks made are said to be of the best quality.

Chambers & Brother, of Philadelphia, exhibited a machine that thoroughly mixed the material and forced a ribbon of tempered clay from an orifice in the tempering machine, which was cut off into bricks at the rate of 66 per minute. The brick are not so smooth as pressed brick, but more so than those hand made. The machine is guaranteed to make 45,000 brick in 10 hours. It requires a steam engine with a 12-inch cylinder.

J. W. Penfield & Sons, of Willoughby, Ohio, exhibited a machine for making brick, ornamental tiles, clay pipes, and other ware. It somewhat resembled the Chambers machine. By changing the dies, hollow bricks, tubes, or pipe, wedge shaped brick, and ornamental terra cotta can be produced at will. Other machines of less importance were also shown.

Terra cotta in its various forms was a striking feature of the Exposition, both in the Main and Government Buildings. Those in the latter have been generally mentioned. In the Main Building there were many splendid examples, both American and foreign. These cannot be described here in detail, but the exhibit of the Northwestern Terra Cotta Works, of Chicago, deserves at least mention. The display was very large and the work artistic. There were many beautiful figures and designs shown in which I was very much interested.

Terra cotta lumber is a new application of clay in the construction of buildings. A small annex, on the west side of the Government Building,

in the form of a Swiss cottage, contained the joint exhibit of the Gilman Porous Terra Cotta Company of New York City and the Minnesota Terra Cotta Lumber Company of St. Paul, Minnesota.

Terra cotta lumber is a fireproof material. It is made of gritless clay ground and mixed with sawdust, and in that condition prepared by machinery, like that above described, into convenient forms. When dry it is burned in kilns, the sawdust with the clay forming part of the fuel, and in consuming leaves the clay porous and light. It is called lumber because it can be worked with tools and can be nailed to rafters and scantling like common boards. In England it is called "wood-brick," and in Germany "holstein," or wood-stone. This material is made into many forms, as bricks, tiles, shingles, siding, and flooring. These can be laid in walls, or nailed on roofs or sides of houses like common lumber; and buildings so constructed are to a certain extent fireproof. Descriptive catalogues of this manufacture and the brickmaking machines mentioned above, have been placed in the library of the State Mining Bureau, where they may be referred to by those interested.

ERRATA.

Page 16, sixth line from foot of page, for "thrice," read twice.
Page 21, fifteenth line from top of page, for "citizens," read artisans.
Page 27, twenty-first line from foot of page, for "natural," read national.
Page 27, third line from top of page, for "which originally," read originally.
Page 27, tenth line from top of page, for "location," read construction.
Page 49, eleventh line from top of page, for "designated," read designed.
Page 60, nineteenth line from top of page, for "Agalmamolite," read Agalmatolite.
Page 61, second line from top of page, for "Chryotile," read Chrysotile.
Page 67, sixth line from top of page, for "mantlepiece," read mantelpiece.
Page 67, sixth line from foot of page, for "Chalcocite," read Chalcosite.
Page 68, third line from foot of page, for "Alph," read Alpha.
Page 72, twenty-third line from top of page, for "Spalerite," read Sphalerite.
Page 79, fifteenth line from foot of page, for "Sierra, Buttes," read Sierra Buttes.
Page 80, eleventh line from top of page, for "Cambrean," read Cambrian.
Page 80, seventeenth line from foot of page, for "trails," read trials.
Page 82, twenty-seventh line from foot of page, for "foreman," read foremen.
Page 84, eighteenth line from top of page, for "of testing," read and testing.
Page 86, sixth line from top of page, for "gold from," read gold which from.
Page 94, twenty-ninth line from top of page, for "Redwood City Mine," read Redwood City.
Page 95, sixteenth line from top of page, for "while some," read some.
Page 100, twenty-fifth line from top of page, for "Faulknau," read Falkenau."
Page 106, sixteenth line from top of page, for "and in the extraction," read in the extraction.
Page 106, thirty-second line from top of page, for "Sonoma," read Sonora.
Page 138, twelfth line from top of page, for "on such elevations," read of such elevations.
Page 150, twenty-fourth line from top of page, for "wonderous," read wondrous.
Page 162, thirtieth line from top of page, for "placed on," read placed in.
Page 169, sixth line from foot of page, for "purposly," read purposely.
Page 184, second line from top of page, for "was appreciated," read were appreciated.
Page 199, eighteenth line from foot of page, for "liguminous," read leguminous.
Page 201, sixth line from foot of page, for "lime," read limestone.
Page 209, fifth line from foot of page, for "imbolite," read embolite.
Page 219, seventeenth line from top of page, for "is placed," read are placed.
Page 223, first line from top of page, for "chlorodizing," read chloridizing.

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