OKLAHOMA GEOLOGICAL SURVEY

Governor Lee Cruce, State Superintendent R. H. Wilson,
President Stratton D. Brooks, Commission.

D. W. Ohern, Director.

BULLETIN NO. 15.

PART I.

DIRECTOR'S BIENNIAL REPORT TO THE GOVERNOR OF OKLAHOMA, 1912.

PART II.

MINERAL PRODUCTION OF OKLAHOMA FROM 1901 TO 1911.

By D. W. Ohern.

NORMAN
December, 1912.

PART I.

DIRECTOR'S BIENNIAL REPORT

TO THE

GOVERNOR OF OKLAHOMA.

CONTENTS.

CONSTITUTIONAL PROVISION.

The Constitution of Oklahoma provides for the establishment of the Survey. Section 37 of Article 5 reads:

The legislature shall provide for the establishment of a State Geological and Economic Survey.

ESTABLISHMENT OF SURVEY.

In accordance with the constitutional provision, the first Legislature of Oklahoma established the Survey by the following bill:

Senate Bill Number 75.

An Act

To authorize a Geological Survey of the State, provide for a Geological Commission, and define the powers and duties of the same. Be it Enacted by the People of the State of Oklahoma.

Section 1. There is hereby created a bureau, to be known as the "Oklahoma Geological Survey", which shall be under the direction of a commission, to be known as the State Geological Commission, composed of the Governor, the President of the State University, and the State Superintendent of Public Instruction.

Section 2. The said Commission shall serve without compensation, but shall be reimbursed for actual and necessary expenses incurred in the performance of their official duties, said Commission shall have general charge of the bureau, and shall appoint as director of the survey, a geologist of established reputation, who may, with the approval of the Commission, appoint such assistants and employees as may be necessary to carry out the provisions of this Act. The director, assistants and employees shall receive such salaries, or compensations as may be determined by this Commission.

Section 3. The said bureau shall have for its object and duties the following:

First: A study of the geological formations of the State with special reference to its mineral deposits, including oil, coal, gas, asphalt, gypsum, salt, cement, stone, clay, lead, iron, sand, road building material, water resources and all other mineral resources.

Second: The preparation and publication of bulletins and reports accompanied with the necessary illustrations and maps including both general and detailed descriptions of the geological structure and mineral resources of the State.

Third: The consideration of such other scientific and economic questions as, in the judgment of the Commission shall be deemed of value to the people.

Section 4. The Director shall present to the Governor a biennial report, ready for printing, showing the progress and conditions of said bureau, together with such other information as the Com-

mission may deem necessary: Provided, that the Commission shall have authority to print and to distribute said report.

Section 5. All materials collected, having served the purpose of the bureau shall be deposited in the State Museum: Provided, that duplicates may be distributed to the various educational institutions of the State under such regulations as the Commission shall formulate.

Section 6. In order to carry out the provisions of this Act, it shall be lawful for all persons employed by the bureau to enter and cross all lands within the State: Provided, that in so doing, no damage is done to private property.

Section 7. Until suitable laboratories, libraries and testing apparatus are provided by the State for prosecuting the work of the survey, said survey shall be located at the State University. The Commission shall enter into arrangements with the Board of Regents of the State University for the use, by members of the staff of the survey, of such rooms, laboratories, libraries and apparatus as may be necessary for the carrying on of such work.

Section 8. The sum of fifteen thousand ($15,000) dollars or so much thereof as may be necessary, is hereby appropriated out of the funds in the State Treasury, not otherwise appropriated, to provide for the payment of actual expenses of the Commission, and for other expenses authorized by them, and for the salaries or other compensation of the director, assistants or other employees.

Section 9. For the preservation of the public peace, health, and safety, an emergency is hereby declared to exist by reason whereof this Act shall take effect and be in force from and after its passage and approval.

GEORGE W. BELLAMY, President of the Senate.
WM. H. MURRAY, Speaker of the House of Representatives.

Approved May 29, 1908.

C. N. HASKELL, Governor of the State of Oklahoma.

ORGANIZATION

This bill was approved by the Governor, May 29th, 1908. The Commission met at the call of the Governor July 25, 1908, and the organization of the Survey was accomplished.

The Governor, C. N. Haskell, the State Superintendent of Public Instruction, E. D. Cameron, and the President of the State University, A. Grant Evans, met in the Governor's office.

Upon motion of E. D. Cameron, seconded by A. Grant Evans, Governor C. N. Haskell was elected President of the State Geological Commission.

The State Superintendent, E. D. Cameron, was elected Secretary of the Commission, and the President of the State University, A. Grant Evans, was elected Executive Officer. Upon motion, the Secretary was directed to purchase a substantial record book and to make a record of all actions of the Commission therein.

On motion, Chas. N. Gould, a geologist of established reputation, and now acting as Professor of Geology at the State University, was elected Director of the Geological Survey.

The following resolutions were adopted:

That the Executive Officer be empowered to certify to the State Auditor, the amount of money required to pay the salaries of the Director and other expenses as may be authorized by the Commission.

That the Executive Officer be empowered to arrange with the Board of Regents of the State University for such rooms, laboratories, libraries, and testing apparatus as may be necessary for the work of the Survey, as provided in Section seven of the Act establishing the Survey.

That the President of the Commission make known to the Director of the United States Geological Survey, in Washington, and to heads of the Geological Surveys in the neighboring states the organization of the Oklahoma Geological Survey, and to ask their official aid and co-operation.

That the Director of the Survey be authorized in the name of the Commission, to solicit the friendly aid and co-operation of all the citizens of Oklahoma, and particularly all teachers, and other professional men of the State.

That in conformity with Article three of Section three of the Act establishing the Commission, the Executive Officer is authorized on the advice of the Director to appropriate such funds of the Survey as he may think wise to the investigation of zoological and botanical problems of the State.

That the Executive Officer is authorized to apportion the funds of the Survey, to approve the appointment of assistants and other employees and to see that the instructions of the Commission are faithfully carried out.

At the same meeting of the Commission the following general instructions were given to the Director of the Survey:

To proceed to ascertain the relations existing between the different rock formations at or near the surface of the earth in Oklahoma and to prepare reports properly illustrated, setting forth these facts.

To answer all reasonable inquiries relative to the mineral resources of the State and prepare reports outlining their distribution.

To collect, name, and arrange a collection of specimens illustrating the geology and mineral resources of the State.

To assist the colleges and high schools in making collections of geological and mineralogical specimens.

To disseminate, as widely as possible, particularly by correspondence and public addresses, correct ideas as to the occurrence, origin, and relation of rocks, minerals and ores.

To answer all reasonable inquiries relative to the mineral resources of the State.

To examine, upon petition of fifty freeholders, properly certified by the county clerk, lands upon which valuable mineral resources may be thought to exist.

To analyze free of cost, such specimens as in the opinion of the Director, may be thought to contain valuable minerals or which would further the work of the Survey.

To prepare a schedule of prices to be charged by the chemist of the Survey for analysis made of such material, as is not analyzed on the authority of the Director.

To co-operate with the United States Geological Survey, other bureaus of the United States Government and other State Surveys, whenever benefit will accrue to the State.

The Director was also given special instructions as follows:

Begin immediately to investigate the location and accessibility of various building stones of the State, including limestone, marble, sandstone, granite, gabbro, gypsum, and porphyry, with pressure tests to determine the availability of all this stone for the construction of public buildings.

Begin immediately to investigate the location and availability of all stone, clay and other minerals of the State, suitable for the construction of roads, with ample tests to determine the relative value of the different materials in the construction of roads.

Begin immediately to investigate as fully as possible the oil and gas field of Oklahoma. Also to prepare and present to the Commission, reports fully illustrated setting forth the facts relating to these subjects.

APPROPRIATIONS FOR 1910 AND 1911

The second legislature, which met in 1909, passed the following bill providing funds for the maintenance of the Survey until June 30th, 1911.

Senate Bill No. 318

An Act

Making an appropriation to pay the expenses of the Oklahoma Geological Survey, for the fiscal year ending June 30th, 1910, and June 30th, 1911. Be it Enacted by the People of the State of Oklahoma:

Section 1. That there is hereby appropriated out of any money in the state treasury, not otherwise appropriated, the sum of thirty-four thousand six hundred fifty ($34,650.00) dollars, or so much thereof as may be necessary to pay the expenses of the Oklahoma Geological Survey for the fiscal years ending June 30, 1910, and June 30, 1911, and the State Auditor shall issue warrants upon the

State Treasurer for such portion thereof as may be found to be due upon the auditing of the respective claims in favor of the persons to whom such claims are allowed. Provided, that all claims and accounts against the State shall be itemized and sworn to as true and correct, and shall bear the approval of the Director of the Oklahoma Geological Survey, before being audited.

Section 2. The appropriation for the Oklahoma Geological Survey shall be apportioned as follows:

Salaries	For the fiscal year ending June 30, 1910;	June 30, 1911.
Director	$2,500.00	$2,500.00
Assistant Director	1,500.00	1,500.00
Chemist	1,200.00	1,200.00
Draftsman	900.00	900.00
Two stenographers	1,200.00	1,200.00
Laborer	480.00	480.00
	$7,780.00	$7,780.00
Office and incidental expenses.		
Commission expense	$ 100.00	$ 100.00
Stationary, blanks and note books	225.00	225.00
Filing cases	125.00	125.00
Postage	300.00	300.00
Express	75.00	75.00
Freight	200.00	200.00
Chemicals and reagents	300.00	400.00
Testing road material	225.00	250.00
Photography	250.00	200.00
Lithographic work	350.00	300.00
Scientific apparatus	350.00	450.00
Typewriter	90	
Traveling expenses for Director and assistant	800.00	800.00
	$3,390.00	$3,425.00

Special investigations for gold, silver, copper, lead, zinc, and other metals, $4,000.00 per annum.

Printing reports.	For the fiscal year ending June 30, 1910;	June 30, 1911.
Bulletin No. 5, mineral resources of the Arbuckle Mountains	$ 450.00	
Bulletin No. 6, preliminary report on coal	600.00	
Bulletin No. 7, preliminary report on asphalt	525.00	
Bulletin No. 8, preliminary report on Portland cement rock	500.00	
Bulletin No. 9, report on lead and zinc		$ 450.00
Bulletin No. 10, report on clay and shale		650.00

Bulletin No. 11, report on gypsum		425.00
Bulletin No. 12, report on salt		375.00
Director's biennial report		300.00
	$ 2,075.00	$ 2,200.00
	$ 17,245.00	$ 17,405.00
Grand total		$ 34,650.00

Approved except as to "Special investigations gold and etc., $4,000 per annum," which $8,000 is disapproved.

C. N. HASKELL, Governor.

APPROPRIATIONS FOR 1912 AND 1913.

Provision for maintenance of the Survey for 1912 and 1913 was made in the General Appropriation Bill.

Senate Bill No. 517.

An Act

Making general appropriations for the expenses of the Executive, Legislative and Judicial Departments of the State, and for the interest on the public debt, for the fiscal years ending June 30th, 1912, and June 30th, 1913.

Geological Survey.

	For the fiscal year ending June 30, 1912:	June 30, 1913.
Office and incidental expenses	$ 3,000.00	$ 3,000.00
Printing	2,400.00	2,400.00
Field work	3,000.00	3,000.00
Cooperative work with U. S. Geological Survey and other Federal bureaus	3,000.00	3,000.00
Salary of Director	2,500.00	2,500.00
Salary of assistant director	1,500.00	1,500.00
Salary of chemist	1,200.00	1,200.00
Salary of clerk	480.00	480.00
Salary of two stenographers	1,200.00	1,200.00
Salary of laborer	600.00	600.00
Total	$18,800.00	$18,800.00

Approved March 25, 1911.

LEE CRUCE, Governor of the State of Oklahoma.

PERSONNEL OF STAFF.

The personnel of the staff of the Survey from the time of its organization to the present is as follows:

Director, Chas. N. Gould, July 25, 1908, to October 7, 1911. D. W. Ohern, October 7, 1911, to the present.

Assistant Director, L. L. Hutchison, September 1, 1908, to November 11, 1910. L. C. Snider, November 11, 1910, to the present.

Field Geologist, C. W. Shannon, September 6, 1911, to the present.

Chemist, L. C. Snider, July 1, 1909, to November 11, 1910. Frank Buttram, November 11, 1911, to the present.

Draughtsman, Frank Gahrtz and Leo Gorton have served intermittently.

Assistant Geologists, D. W. Ohern, Chas. H. Taylor, Chester A. Reeds, J. W. Beede, and others have served as occasion required.

Chief Clerk, Miss Louise S. Taylor, August 1, 1911, to the present.

Stenographer, M. A. Cox, May 19, 1910, to the present. Several others have served as occasion demanded.

Field Assistants: Pierce Larkin, Frank A. Herald, C. C. Clark, H. A. Everest, Key Wolf, John Bennett, W. J. Cross, E. L. DeGolyer, T. R. Corr, Ben C. Belt, E. Z. Carpenter, H. G. Powell, W. J. Hazeltine, J. C. Thompson, T. F. Eyerly, C. W. Hamilton, Lloyd Maxwell, A. C. Reeds, Robt. H. Wood, John Herald, J. B. Newby, Fred Capshaw, John A. Newby, Glenn C. Clark, Robt. E. Garrett, M. L. McCance, B. H. West, and Burr McWhirt have done service in the field under the direction of trained men.

OFFICES.

The law creating the Survey provides that:

Until suitable laboratories, libraries and testing apparatus are provided by the State for prosecuting the work of the Survey, said Survey shall be located at the State University. The Commission shall enter into arrangements with the Board of Regents of the State University, for the use, by members of the staff of the Survey, of such rooms, laboratories, libraries and apparatus as may be necessary for the carrying on of such work.

At present the Survey has quarters in one of the temporary frame buildings of the University. The work is seriously handicapped by lack of adequate facilities, especially laboratories. All the rooms now being occupied are very cold in winter and excessively hot in summer, so that the staff cannot work in comfort.

WORK OF THE SURVEY.

Field Work.

Since the establishment of the Survey in 1908, field investigations have been carried on practically without interruption. The work of 1908, 1909, and 1910 has been included in the Director's report for the biennium 1908 to 1910.

Work of 1911.

During the summer of 1911 several parties were in the field

making investigations on the mineral resources and geology of the various parts of the State.

D. W. Ohern, then Assistant Geologist of the Survey, had a party in the vicinity of Chelsea, Centralia, Welch, Bluejacket, and Vinita. Detailed survey of an area embracing approximately 1,000 square miles was completed. Special attention was devoted to the study of oil, gas, building stone, road material, Portland cement materials, coal, and clays. This work was carried on under cooperative agreement between the United States and Oklahoma Geological Surveys, and the report will be published by the United States Geological Survey. It will be ready for distribution in a few months.

Prof. Chas. H. Taylor conducted investigations on the building stone and other mineral resources of the Wichita Mountains. This work also was carried on under a cooperative agreement. The report has already gone to press and will soon be ready for distribution by the United States Geological Survey.

Chester A. Reeds continued the study of the geology and mineral resources of the eastern part of the Arbuckle Mountains. Special attention was devoted to building stone, asphalt deposits, and the possibilities of the occurrence of lead, zinc, gold, and silver. The data collected by Mr. Reeds will be embodied in various reports now in preparation by the Survey, a special report having already been issued on the mineral resources of the Arbuckle region.

Prof. J. W. Beede, of the University of Indiana, spent the entire summer in studying the Redbeds of the State. These beds underlie practically all of the western half of our State and very little is known as to their nature and possible mineral deposits. The Survey is particularly anxious to learn as much as possible regarding these beds, especially as to the probabilities of their containing oil and gas at depths; little being known of the underground waters of the Redbeds special study was given to this phase of the subject.

Work in 1912.

Dr. Beede continued his study of the Redbeds of Oklahoma, devoting special attention to Logan and Payne counties. The several deep wells that are being drilled in the area were visited and logs of the same studied in order that additional light might be thrown upon the possibilities of the ocurrence of oil and gas and on the nature and extent of the water bearing horizons.

Mr. Robt. E. Garrett devoted two months to the study of the Ponca City oil and gas field. The field work is complete and a report which is now in process of preparation will be ready for the public very shortly. It is to be hoped that this report will be of high value to land owners and to the oil and gas men of the State.

Mr. L. C. Snider, Assistant Director of the Survey, assisted by Jerry B. Newby, devoted several weeks to the study of the geology

in the vicinity of Wagoner and Pryor Creek. The geology here is closely related to that of the lead and zinc field near Miami but is much more complex and demands careful and detailed work. No report will be issued at present but the work will be pursued again next season.

The larger part of the summer of 1912 was devoted by Mr. Snider, assisted by Mr. Newby, to the study of gypsum deposits oi the western part of the State. The gypsum industry felt very severely the depression of 1911 and the early part of 1912 and the Survey shall make a special effort to help give this industry the place it should have in the commerce of our State. A special and detailed report of the gypsum deposits of the State is being prepared by Mr. Snider and will be issued about April, 1913.

From November, 1911, to July, 1912, Mr. Frank Buttram, Chemist of the Survey, made a detailed study of the glass sand deposits of the State. The report of Mr. Buttram's work has just come from the press. It will be in order to make special mention of the fact that during his field and laboratory investigations Mr. Buttram discovered a large number of highly valuable deposits of glass sand in various parts of the Arbuckle Mountains and contiguous territory to the southward and eastward. These deposits are not now utilized, all the glass factories of the State importing their raw products from other states. It is believed that these factories will deem it profitable to utilize the Oklahoma glass sand and every reasonable inducement will be offered to this end. There is no reason why the glass sand industry should not be a very important one in the State.

One of the important lines of investigation of the Survey has been carried on by C. W. Shannon, who is employed by the Survey on a per diem basis, for the investigation of the coal deposits. This work was begun more than two and a half years ago by Mr. Hutchison, then Assistant Director of the Survey, but work, of course, was discontinued at the termination of his connection with the Survey. Mr. Shannon has made remarkable progress in the work, has visited every mine in the coal area, and has studied carefully the coal outcrops. Very little attention was devoted to the geology of the coal region owing to the fact that this work had already been done, mostly by the United States Geological Survey, but supplemented by that of the Oklahoma Geological Survey. Samples of coal were collected from all principal mines under conditions and specifications laid down by the United States Geological Survey and the Federal Bureau of Mines. Accurate calorimetric and chemical tests are being made in the laboratory of the Survey of every sample collected. This work is now going on and it is hoped that the report will be ready for distribution by February 1, 1913.

In addition to the systematic work carried on in the manner above mentioned, more or less detailed studies were made of several localities with the view to obtain data relating to local mineral

deposits and geology, for the benefit of citizens in the several communities. This work was done directly for the benefit of the citizens and written reports submitted, hence no further report will be made.

As the work of the Survey has developed it has become apparent that one of the largest fields of investigation is that of the water resources of the State. During 1911 and 1912 a vast number of inquiries reached the office regarding the availability of water suitable for domestic use and for agricultural purposes. Only a limited amount of work of this nature has been done within the State and that which has been carried on has been under the auspices of the United States Geological Survey and the Reclamation Service. There is urgent need of immediate, specific information on the underground and the surface water, including composition, on the amount of water available, and on the porosity of the soil. Recommendations on this line of investigation will be found below in another connection. A limited amount of work has been done on water resources, but available funds have been totally inadequate to justify the undertaking of systematic investigations. As occasion presented itself, information on the water resources was carried on during the progress of the investigations of mineral resources, and the Survey now has a considerable amount of very valuable data relating to this subject. It is believed that this line of work should be pushed as rapidly and systematically as circumstances will permit.

Educational Work.

During the summer of 1912 a new departure was made in the work of the Survey. After consultation with the members of the Survey Commission and with the promised cooperation of a large number of the leading educators of the State, the Director and Field Geologist of the Survey gave a series of lectures at each of our State Normal schools. The several members of the Survey staff, in pursuit of geological investigations, readily obtain a vast amount of other valuable information which, it is believed, no one else in the State is in a position to secure. It is considered that this knowledge is really the possession of the State and should be communicated to its citizens. The lectures given at the several Normal schools dealt with the geography, physical features, mineral deposits, and natural history of the State. I cannot speak too highly of the earnest cooperation and kindly support afforded the Survey in the undertaking, especially by the presidents of the Normal schools. Reports which have reached this office lead to the belief that this work was very highly profitable. The State Superintendent of Public Instruction was kind enough to say that he also had received very encouraging reports of this work. It is hoped that circumstances will permit this work to be continued during the next summer.

Another line of educational work has also been undertaken by the Survey. There are now available no ready sources of information on the mineral resources and natural history of the State suitable for use by teachers and students in the public schools. On approval of the Commission, the Survey has undertaken a study of the physiography of the State, the work to be done and publication written by the Director of the Survey. This report will be specially adapted to teachers and students in the high schools, and will be mailed free to such as may be able to use it.

The Commission also directed that a study of the trees of the State be begun at once. This work is already well advanced, being carried on by Mr. Shannon. A vast amount of information has been secured by him while in pursuit of his other work and without detriment to the same. The preparation of a report on the trees of Oklahoma is a vast undertaking and it is not to be hoped that a report will be ready before the close of 1913. This paper also will be adapted to use by the average citizen of the State, but it will be especially suited to use in the schools.

Furthermore, Mr. Snider is preparing a bulletin on the minerals found in Oklahoma. This also will be elementary in character and adapted for use in high schools and by farmers and other laymen.

High School Collections.

The work of supplying high schools of the State with representative mineral collection has been continued. A large number of these schools now have these collections and it is believed that this work is highly profitable.

Until the publication of the report on the Physiography of the State, a preliminary physiographic map has been issued by the Survey and is being distributed to the teachers of physiography and geography without charge, postage only being requested.

The educational work of the Survey is gaining gradually throughout the State through the various economic publications of the Survey. These publications, being prepared and issued at the expense of the State, rightly belong to the people and it is believed that no charge should be made for them. They are therefore supplied upon request to all teachers and students, and excellent results are being obtained by their use in the schools.

Public Lectures.

The several members of the Survey staff have given lectures before commercial clubs, public schools, and other institutions of the State and before popular audiences. This work is regarded as educational. That the people are very desirous of knowing of the mineral resources of the State is made very apparent by the very kindly way in which these lectures have been received, and by

the interest manifested in them. Commercial clubs and high schools in particular seem to appreciate, and profit greatly by, this line of work. It is hoped that circumstances will permit these lectures to be carried on on a larger scale next year.

Cooperative Work.

The Legislature in 1911 appropriated $3,000 to be used for cooperative work with the United States Geological Survey, that institution to allot the same amount to the work. It gives me pleasure to say that the United States Government has done vastly more than its share. The importance of this work will justify my entering into some detail.

Under cooperative agreement accurate topographic maps are being made of the Vinita, Claremore, Nowata, and Hominy quadrangles. These quadrangles, it will be observed, lie in the oil districts. The reason for doing the work in that region is that accurate topographic maps are absolutely essential for working out the geology of oil and gas fields. This Survey allotted $1,000, or one-third of the cooperative fund, to the topographic work. By agreement entered into by the Director of the United States Geological Survey and the Director of the Oklahoma Geological Survey, each institution was to allot $1,000 to the work. The United States Geological Survey, however, has spent probably four or five times the amount agreed upon. In addition to this, the Federal Survey will engrave and publish the maps without any charge whatever to the State.

The remaining $2,000 of the cooperative fund was allotted for geologic work. During 1911, $500 was allotted to Prof. Taylor for work on the mineral resources, particularly the building stone, of the Wichita Mountains. Seven hundred fifty dollars was allotted to D. W. Ohern, then Assistant Geologist to the Survey, for work in the Vinita quadrangle. The same amount was allotted to Carl D. Smith, for work in the Claremore quadrangle.

During 1912, $1,500 of the cooperative fund was allotted to Robert H. Wood for investigations in the Hominy quadrangle in the vicinity of Cleveland and Tulsa. Five hundred dollars was allotted to cooperative work in Tillman, Comanche, Stephens, Jefferson, and Carter counties. This work is to be carried on under the direction of Mr. Munn, an oil and gas expert on the United States Geological Survey. The remaining $1,000 was used for making an accurate topographic map of the Hominy quadrangle.

In this connection it will be in order to say that in addition to the cooperative work, the United States Geological Survey is doing a vast amount of independent work in the State. Several years ago, a geologic survey was made of a considerable area in the coal region of the eastern part of the State. The publication of the reports was delayed by numerous difficulties over which the Federal Survey had no control. These reports, however, are now being

pushed to completion and will without doubt be issued at an early date. The people of the State keenly appreciate the interest that the United States Government is taking in the investigation of our mineral resources and surely we cannot ask more than is already being done for us.

Good Roads.

The Survey is devoting special attention to the study of road materials of the State. It is believed that the time is not far distant when there will be an enormous demand for good road materials that will be easily accessible in the various parts of the State. A report has already been issued on Road Materials, but this deals only in a preliminary way with the subject, and investigations are being continued.

In addition to investigations of road materials, the Survey has taken special pains to spread good roads propaganda, realizing that the well being and advancement of our State depends in a very large measure on ease and rapidity of intercommunication. The building of roads comes, of course, under another department of the State, but this Survey has cooperated in every way possible and to the extent of its ability in the work of improving our highways.

CONSERVATION.

It has become very apparent to the members of the Staff in pursuing field investigations that Oklahoma is wasting her natural resources. This is especially true of our coals. Mr. Shannon, who as already noted, has made a detailed study of the coals, reports to me that there is an enormous waste now going on. It is not easy to determine what is the cause of this waste, but that it is vastly greater than need be is apparent to the most casual observer. A high percentage of slack results in the mining of the coal and a great deal is left in the mine to support the roof. Much of the slack is of course utilized as steam coal, but some companies are unable to dispose of it at a profit, with the result that it is thrown on the dump and we simply put a burden upon the shoulders of future generations when we permit this waste to go on. This subject will be again referred to under the heading of recommendations.

While it may not seem to be within the province of the Survey to enter into the study of our trees and forests, yet the growth, existence, and preservation of our trees and forests is so intimately connected with geology that it is not an easy matter to separate the two. Our forests, as our coal, are being wasted. This is partly because of gross wantonness on the part of those who have to deal with the forests, but it seems to be due more to ignorance than to wantonness. There is no doubt, whatsoever, in my mind, but that the State should take more drastic steps to preserve the trees and the forests of the State. In some of the lumber camps a prodigal

waste of material is going on. Moreover, young trees are not being given the care they deserve. They are exposed to the ravages of fire and pests such as are usually consequent upon the removal of the best timber of the forests.

In additon to the waste of coal and forests we are also wasting our birds. This may seem at first thought a trivial subject, but in the educational work of the Survey above noted, it has been learned that the people of the State, as a whole, know very little of the economic value of our birds. A large number of them feed wholly or in part upon insects. These same insects prey upon our crops, our fruit trees, our shade trees, and our forests. It is questionable whether this can be remedied by law. It seems rather that it must be solved wholly by the broadest kind of education and enlightenment of the people, and this kind of work should be carried on on a larger scale than it is at present.

PUBLICATIONS.

Below is a list of the publications of the Survey:

Bulletin No. 1. Preliminary Report of the Mineral Resources of Oklahoma.
Bulletin No. 2. Rock Asphalt, Asphaltite, Petroleum, and Natural Gas in Oklahoma.
Bulletin No. 3. Geology and Mineral Resources of the Arbuckle Mountains.
Bulletin No. 4. Coal of Oklahoma.
Bulletin No. 5. Structural Materials of Oklahoma.
Bulletin No. 6. Director's Biennial Report and Brief Chapters on Twenty Oklahoma Minerals.
Bulletin No. 7. Clays and Clay Industries of Oklahoma.
Bulletin No. 8. Road Materials and Road Conditions of Oklahoma.
Bulletin No. 9. Lead and Zinc in Oklahoma.
Bulletin No. 10. Glass Sand in Oklahoma.
Bulletin No. 11. Gypsum in Oklahoma. (In preparation).
Bulletin No. 12. Mineral Waters in Oklahoma. (In preparation).
Bulletin No. 13. Volcanic Ash in Oklahoma. (In preparation).
Bulletin No. 14. Asphalt in Oklahoma. (In preparation).
Bulletin No. 15. Director's Biennial Report and the Mineral Production of Oklahoma from 1901 to 1911.

Circular No. 1. Origin, Scope, and Purpose of the Oklahoma Geological Survey. (Edition exhausted).
Circular No. 2. Brief Statement of the Geological History of Oklahoma.
Circular No. 3. Oklahoma Among the Southern States.

Booklet. Resources of Oklahoma in a Pocket Book.

The problem of the manner of distribution of publications by the Survey is one which cannot be solved easily and readily. The United States Geological Survey distributes most of its publications free to citizens of the United States, not even requiring postage. This is true also of some of the State Geological Surveys, but by no means is it true of all. Some find it expedient to sell publications at a moderate price, others find it quite necessary to do so in order that the work of the Survey may be maintained. It has been found, however, that the public as a whole will not secure publications when a price is put upon them, even if that price be nominal. Moreover, the tax payers of various states maintain the Surveys. This is particularly true of this Survey, and it is believed that when the people pay for a work, that they should have the benefit of that work without additional cost. Therefore, this Survey has adopted the policy of sending publications free to the public and especially to citizens of the State. As each publication is issued, notice is given far and wide through the press that the publication is ready for distribution. In this way a vast number of the people are reached and the reports thus go into the hands of the people who can profit by them. In most cases the amount of postage is requested, but this is not insisted upon.

Believing that through the medium of the schools of the State the public at large can be readily informed of our mineral resources, publications of the Survey are sent free to all the higher educational institutions and to the high schools of the State.

The Survey also sends its publications free to other similar institutions receiving in return the publications of those institutions. In this way the State obtains practically all the literature necessary for carrying on the work of the Survey and at the same time no direct expenditure of funds is demanded. The publications thus received in exchange become the property of the State.

EXPENDITURES.

The tax payers of the State maintain the work of the Survey and should therefore know what disposition is made of the funds. It would, however, be out of place here to give an itemized statement of disbursements. Such accounts have been filed with the Governor of the State, the State Superintendent of Public Instruction, and the President of the State University. These lists of expenditures are open for public inspection.

RELATION OF THE SURVEY TO THE PUBLIC.

In the prosecution of its work the Survey has been impressed with the fact that a considerable number of people conceive that the Survey exists and is maintained, first, to save certain individuals the trouble and especially the expense of doing their own work, and, secondly, to give official approval of, and support to, wild,

ethereal schemes for "getting rich quick." In some instances promoters have falsely represented that the Survey has officially examined their projects and pronounced them sound. In other cases certain individuals and members of loosely constructed concerns have represented themselves having at some time or other been officially connected with the Survey, hoping thereby to gain that prestige that seems to attach itself to official functions in general. Furthermore, samples are continually being sent in to the office for analyses or assays, some of which give promise of possessing value, but by far the greater number are just common rocks.

To judge how much of such work should be done and yet do justice both to the State and to her citizens, is not easy. Each member of the staff of the Survey tries to keep prominently before him two ideas: That this institution was created and is being maintained by and for the good of the people of the State, and again, that the tax payers' money is not to be abused and thrown away in pursuit of foolish projects. Under existing conditions the only course to pursue is to let the merits of each case determine what action shall be taken. Experience has shown conclusively that the entire time of the staff would be consumed and the State's funds foolishly spent if every petition requested be granted and every service sought be performed.

In declining to perform service when there is little or no hope that results will be encouraging or promising, possibly the Survey has not done strict justice in every instance. Nevertheless, action in each individual case has been according to the best judgment of the Survey and it is hoped that, in all, the work has been the very best possible for all concerned.

The purpose of the Survey is, first, to investigate the mineral resources of the State, including sources of water and power, and to study her physical features and her manifold forms of life; and, secondly, to put in such form as may be readily comprehended by the lay as well as by the trained, such information as has been obtained.

RECOMMENDATIONS.

For convenience, recommendations for legislation will be embodied in a compact form. Before entering into the discussion of recommendations I may say that matters, which at the beginning of the history of the Survey were overlooked or regarded lightly, have now come to be considered as of very high importance to the welfare and progress of the people of the State. The recommendations have been studied very carefully and given the closest scrutiny and consideration.

Investigation of Water Resources.

As already noted the Survey has received a vast number of requests for information on water suitable for irrigation and domestic purposes. No systematic work of this kind has yet been undertaken by the State. The United States Geological Survey and the Reclamation Service have made preliminary investigations in certain parts of the State, but there is now available very little information that is definite and specific and in such form that it can be readily understood and used by the average citizen. It is recommended, therefore, that the State undertake, at the earliest possible moment, a systematic and thorough study of the waters of the State, both surface and underground, and in addition that a study be made for reservoir sites for irrigation waters and of the nature of the surface soil in various parts of the State.

I feel that I cannot be too urgent in this matter. With the exception of building stone, clay, gypsum, and volcanic ash, we have no great mineral deposits in the western part of our State, but we do have unlimited wealth in the soil. But the soil has now only a small part of the value it would possess if an adequate supply of water for irrigation were at hand and there is no doubt whatsoever but that this is one of the most important lines of investigation now confronting the people of the State. Should it be deemed advisable on the part of the law makers to enact legislation relative to irrigation, the greatest caution should be used. It would be an extremely easy matter to expend hundreds of thousands of dollars on irrigation without result. It will not be speaking disparagingly to say that the Reclamation Service of the United States Government has found that a vast amount of money has been spent on irrigation without returns. This should be expected in such a vast undertaking. In our own State procedure should be with caution but I firmly believe that if the problem is attacked in a business like and conservative manner that western part of our State which is now seriously hampered by lack of good water can be made one of the most productive parts of our nation. That the soil possesses fertility is demonstrated by the abundant production when there is ample rainfall or small irrigation projects.

Already several irrigation projects on a small scale have proved irrigation to be feasible and highly profitable. One of these is at Olustee, in Jackson County. One only need visit this vicinity to be convinced of the practicability of irrigation in western Oklahoma. At other places farmers irrigate in a limited way by pumping by windmills. There is, without doubt, a considerable amount of water beneath the surface that is suitable for irrigation and a considerable amount of surface water is well adapted to the same purpose. There is no doubt, on the other hand, that a great deal of our underground water is highly alkaline and totally unfit for agricultural purposes. The same is true of some of the surface water, hence the need of extreme caution in procedure in this line of work.

In addition to the lack of water suitable for irrigation, there is

also need of good boiler water. Railroads, manufacturing concerns, and others write to this Survey asking assistance in finding water which can be used in boilers, but in few cases can we give assistance that is of value. The manufacturing industries should be aided in every conceivable way and material assistance can be rendered them by the State by supplying accurate information on sources of boiler water.

It is perfectly apparent that water adapted for irrigation is, broadly speaking, adapted to boiler use, although this is not always true. The two lines of investigation, however, can be easily pursued at the same time.

Whether investigations regarding water resources be carried on by the Survey or by some other department of State is a matter of very little concern to me personally. The point is that some state department should undertake the work at the very earliest possible date.

Mineral Exhibit at the Panama Exposition.

I would recommend, in the second place, that proper measures be enacted looking toward an exhibit of the State's mineral resources at the Panama Exposition at San Francisco in 1915. It will be remembered that at the St. Louis Exposition, in 1904, the State's mineral resources were admirably represented. I was not in the State at that time and did not entertain any idea of coming here, but I learned a great deal of the enormous wealth of the State through the exhibit at St. Louis, and there is no doubt whatever that the people of the State profited greatly by that exhibit. The same will be true if an exhibit will be installed at the Panama Exposition. Since 1904 our mineral resources have been developed in an astonishing manner and we have discovered mineral deposits which were not dreamed of at that time. The State therefore is in position to install a much better exhibit than it was at that time.

After consultation with the members of the Commission, the work of collecting material for the exhibit was begun in the summer of 1912. Such procedure was however anticipating, but the work of collecting materials was carried on along with the regular work of the Survey and in such manner as not to interfere with the same. The task was begun early so that, should the people of the State see fit to install an exhibit, the work could be done gradually and therefore at a very small cost to the tax payers. Collecting material for such an exhibit requires time rather than money. The Survey is now in touch with all the mineral producers of the State and they are already manifesting a keen interest in the proposed exhibit, and the Survey feels confident of the cooperation of every mineral producer. There is no apparent reason why the State, with a reasonable outlay of funds, should not obtain immense profits by an exhibit at the Panama Exposition.

A Law Giving Certain Rights to Employees of the United States Geological Survey.

The law creating the Geological Survey gave to its employees the right to enter and cross all lands of the State, provided that in so doing no damage is done to private property. Inasmuch as the United States Geological Survey is doing a vast amount of both cooperative and independent work in the State, its employees should have the same right. Only occasionally does one who is doing geological work meet with any objection on the part of land or other property owners. Usually, by the exercise of a reasonable amount of courtesy, discretion, and tact, the employees of the Survey can readily obtain such information as is desired, but occasionally eccentric characters are met with who would seem to take particular pleasure in obstructing the work. I would therefore, recommend that a simple law be passed giving to the employees of the United States Government the right to enter and cross all lands within the State, provided, that in so doing no damage is done to private possessions.

The Coal Industry.

The coal industry of the State is not prosperous and beyond controversy the interests of the people of Oklahoma are suffering severely under present conditions. As to the cause of such conditions much has been said on the various phases of the subject. It is best that simple facts be stated here, facts which any one may obtain for himself.

High grade domestic lump coal retails in the towns and cities of the central part of the State at $8.00 per ton during most of the year. A comparable coal mined and sold in Indiana and Illinois under conditions similar to those of Oklahoma retails at $3.00 to $3.75, less than half the price of Oklahoma coal.

In 1910 the average price of coal f. o. b. mine in the various states in the Mississippi Valley was as follows:

Oklahoma	$2.22
Iowa	1.75
Texas	1.67
Missouri	1.69
Kansas	1.61
Arkansas	1.56
Colorado	1.42
New Mexico	1.29
Illinois	1.14
Indiana	1.13
Average in United States	$1.12

In 1911 the average price in Oklahoma was $2.05. These figures speak for themselves, needing but little comment. The mine price of Oklahoma f. o. b. mine coal, is just about 100 per cent above the

average for the United States. In 1910 it was higher by 20 per cent than in any other state east of the Rocky Mountains.

In the last decade the production of coal in Oklahoma has shown no net increase. The production in short tons is:

1903	3,517,388
1904	3,046,539
1905	2,924,427
1906	2,860,200
1907	3,642,658
1908	2,948,116
1909	3,119,377
1910	2,646,226
1911	3,074,242

These figures are the latest published by the United States government. A worse record has been made by not one of the important coal producing states as is shown by tables similar to the above. The output of coal in the United States doubles every ten years.

The percentage of slack in Oklahoma mines is very high. No accurate figures however are at hand to show the percentage in this and in other states. The United States government says the percentage of slack in Oklahoma coal has doubled in 15 years. It is estimated that in Indiana the slack is 30 to 45 per cent and in Oklahoma 25 to 55 per cent, while in Texas only 15 per cent results.

At present all slack in Oklahoma is sold but at a very low price, about 90 cents a ton. This necessitates raising the price on the coarser or domestic coals.

There are but few machines used in coal mining in Oklahoma, only about 1 per cent of the coal being mined by machinery. Texas, Colorado, Kansas, Missouri, Arkansas, Iowa, Illinois, and Indiana have machines in some mines at least.

In Oklahoma miners are permitted to shoot from the solid. This practice has been condemned by the best coal men and has been abandoned in nearly every state except Oklahoma and Arkansas. Consumers complain that Oklahoma lump coal is badly shattered in mining and disentegrates so freely on handling that a considerable additional amount of slack results.

The miner in Oklahoma is paid on the mine run basis. This practice prevails practically only in this State and in Arkansas.

In an analysis of the coal situation in Oklahoma the fact that the coal has to compete with a great abundance of cheap gas must not be overlooked. This has without doubt been a very important factor in keeping the output of coal at its present low level, but it is a striking fact that as the available gas supply has increased the price of coal has risen. If the small production of coal were due exclusively to competition with gas one would expect a decrease in the price of coal or at least no advance.

The general advance in the cost of living also should not be

neglected. The miners must of necessity be paid an amount comparable to cost of living. A study of the situation shows the miner is not getting the benefit of the high price of coal. On the other hand the operators in Oklahoma cannot be said to be doing a satisfactory business.

In 1910 the miners in Oklahoma worked on an average only 144 days, the lowest of all the states in the Union except Arkansas. The small number of working days was due in part to the strike. But during 1911 although there was no strike the average number of days the miner was active was only 156, just about half the possible number. The average for the United States was 217 during 1910, putting Oklahoma 33 per cent below the average.

The average tonnage per man per day in Oklahoma was 2.13 in 1910, lower than in any other state except Missouri and Michigan. The tonnage for 1911 was 2.2 per man per day, a very low average.

The freight rates on coal afford another interesting study. The rate from McAlester to Oklahoma City for example, is $1.35 for 125 miles. In Illinois and Indiana for example the rate for a comparable distance is about 50 cents. These facts do not need comment.

It appears therefore that the whole coal industry is in such condition that the State should make careful inquiry into the cause or causes of the abnormal situation.

PART II.

THE MINERAL PRODUCTION OF OKLAHOMA FROM 1901 TO 1911

CONTENTS.

INTRODUCTION.

In a new country such as Oklahoma, it is to be expected that the development of certain mineral industries follow closely the increase in population and the consequent general growth of business. This is particularly true of those industries which supply building material, fuel, and power. But the increase of the value of the whole of Oklahoma's mineral output since 1901 has been so rapid that it has been deemed advisable to give to the public data of production in compact and tabulated form.

Furthermore, the Survey receives many inquiries regarding the demand for mineral products in the State. It is believed that some, at least, of these queries can be best answered by providing inquirers with condensed printed information.

Again, in Oklahoma as elsewhere, it is often difficult for the general public to obtain brief and satisfactory information as to what is transpiring in the State's mineral world. Moreover, the press of the State in particular and the trade journals in general frequently inquire for statistics and other information on the State's mineral output and mineral resources.

It is with the idea of meeting these several demands that the present brief paper has been prepared. Data for the years 1901 to 1910 inclusive are taken largely from the various publications of the United States Geological Survey. Those for 1911 are from records in the office of this Survey and were collected in cooperation with the United States Geological Survey. In most cases where estimates are given it will be found that data for two or more products or states has been combined by the Federal Survey. This is done when not more than three producers report from the state, in order to conceal figures of individual producers.

Probably few, if any, states can show a more marked advance in the amount and value of mineral products during the last decade than Oklahoma. With but a modest output in 1901 valued at $4,552,555 the advance has been steady but so rapid as to be little short of phenomenal. The total value in 1911 was $42.760,808, an increase of 839 per cent over 1901, an average yearly gain of about 83 per cent. It can hardly be expected that this rate will continue, but that there will be a steady increase seems certain.

COAL.

The history of the coal production in Oklahoma presents some features which are absent from the histories of the development of other mineral industries in the State. The earliest recorded coal production in Oklahoma (then Indian Territory) was in 1880 when the total was 120,947 tons. From that time until 1903 the increase in production was steady but very marked. In 1904 it decreased somewhat in spite of the prosperous conditions which prevailed in general throughout the country. The decrease was due largely to

the enormous quantities of cheap fuel oil thrown on the market in the Texas oil field in that year.

Since 1903 there has been a net loss in the coal output of the State, although in 1907 the amount increased to 3,642,658 tons, the largest amount ever put out in the State in a single year. In considering the coal industry in this State through the last nine years it should not be forgotten that the coal has been brought into the sharpest competition with cheap fuel oil from Texas and Oklahoma, and also with cheap gas in our own State. This condition has, without doubt, militated strongly against the development of our coal industry. It is thought, however, by many dealers and operators that the mining methods play a very important role in retarding the development of the coal industry. The total yearly output and value of coal in this State from 1880 to 1911 is shown in the following table:

Quantity and value of coal produced in Oklahoma, 1880-1911.

Year.	Quantity (short tons).	Value.
1880	120,947	
1881	150,000	
1882	200,000	
1883	350,000	
1884	425,000	
1885	500,000	
1886	534,580	
1887	685,911	
1888	761,986	
1889	752,832	
1890	869,229	
1891	1,091,032	$1,897,037
1892	1,192,721	2,043,479
1893	1,252,110	2,235,209
1894	969,606	1,541,293
1895	1,211,185	1,737,254
1896	1,366,646	1,918,115
1897	1,336,380	1,787,358
1898	1,381,466	1,827,638
1899	1,537,427	2,199,785
1900	1,922,298	2,788,124
1901	2,421,781	3,915,268
1902	2,820,666	4,265,106
1903	3,517,388	6,386,463
1904	3,046,539	5,532,066
1905	2,924,427	5,145,358
1906	2,860,200	5,482,366
1907	3,642,658	6,253,367
1908	2,948,116	5,976,504
1909	3,119,377	6,253,367

1910	2,646,226	5,867,947
1911	3,074,242	6,291,494

COKE.

The history of the coke industry offers about the only example known to me of a mineral industry in our State failing after once well begun. In 1905 the coking industry was thriving but from that time until 1908 there was a steady decline in the output, due seemingly to a lack of demand for the product. Since 1908 the State has manufactured no coke.

At one time there were five coke plants in the State, one located each at Howe, Alderson, Henryetta, Krebs, and Chant. These five plants had constructed a total of 536 ovens of which 50 were built as late as 1908. All are now idle. This discontinuance of the manufacture of coke seems to be due to several causes. First, the ovens were constructed for handling slack coal. The demand of this kind of coke was never great and, declining, necessarily carried the industry with it. Another chief cause was that in several parts of the State gas as a cheap and convenient fuel was offered for the factories and smelters. The coke industry evidently suffered as a result. Furthermore, it seems to be true that from 1905 to 1908 the demand for slack coal for steaming purposes experienced a steady increase which caused a marked rise in the price of that product. This also had its effect on the coke industry.

The following table shows the amount and value of the coke production from 1901 to 1908:

Quantity and value of coke produced in Oklahoma, 1901-1908.

Year.	Quantity (short tons).	Value.
1901	37,374	$154,834
1902	49,441	202,921
1903	49,818	227,542
1904	44,808	209,165
1905	54,781	199,424
1906	49,782	204,205
1907	19,089	82,447
1908	2,994	13,473 *(e)*

(e) Estimated.

The value of the coke output in Oklahoma, in 1908, is not given in the statistics of the United States Geological Survey in as much as there were less than three producers in the State.

It is considered very probable that when the development of the gas fields has reached and passed its maximum that the demand for coke will increase and that the industry will be rejuvenated.

OIL.

The first oil reported in Oklahoma was in 1891 when 30 barrels

was the total. The increase in the output was not marked during the next decade, for only 10,000 barrels were marketed in 1901. In 1902, however, the total advanced to 37,000 barrels and in 1903 to 138,911 barrels. With 1904, when 1,366,748 barrels were produced, the real development began, the increase for the next eight years being phenomenal, and the output reaching in 1911 the enormous total of 56,069,637 barrels. In 1908 and 1909 the State held first rank in amount of production. The following table shows the production, value, and average price of oil in the State during the last 11 years:

Production, value, and average price of oil, 1901-1911.

Year.	Barrels.	Total value.	Average price per barrel.
1901	10,000	$ 7,125	$0.712
1902	37,100	32,940	.888
1903	138,911	142,404	1.025
1904	1,366,748	1,325,745 (*e*)	.97 (*e*)
1905	6,466,200	3,524,122	.545 (*e*)
1906	1,803,600 (*e*)	8,000,000 (*e*)	.443 (*e*)
1907	43,524,128	17,213,524	.402
1908	45,498,765	17,694,843	.386
1909	47,859,218	17,428,990	.364
1910	52,028,718	19,922,660	.383
1911	56,069,637	26,451,767	.470

(e) Estimated.

The present outlook for the oil industry in the State is very promising. During the early part of the present year the price began to advance and by the middle of the year had increased to 70 cents per barrel, a price never before attained since the State became a prominent producer. The increase in the price stimulated drilling. During the entire year there has been active drilling in the proved territory, the results in most cases being all that could be desired. The discovery of a deeper sand in the Cleveland field has made that pool one of the most important in the State. Individual wells with an initial production of 10,000 barrels have already been reported. The Cushing field is one of the latest surprises. Successive wells show this field to be destined as one of prominence in the State. Discovery of gas at Coalgate, Ada, and Duncan materially extends the oil and gas fields of the State. Recent reports of developments at Gotebo are encouraging. Of seven wells so far completed all are reported to be productive of oil or gas. As a whole the indications are that the production and value of oil during this year (1912) will far exceed that of last year.

NATURAL GAS.

Oklahoma entered the list of natural gas producers in 1902. During that year a small amount was produced from a few wells

at Red Fork in the Creek Nation for domestic purposes. The succeeding year witnessed, on November 26, the bringing in of the first gas well in the Osage Nation. This was at Pawhuska. In the same year the first well was brought in at Lawton, Comanche County, and a small gasser was put down near Newkirk, Kay County, in an endeavor to find oil. The Red Fork wells continued with a small production. From the beginning of 1904 the development was rapid. At the close of that year there were about 45 gas wells in Oklahoma, although only 24 were being utilized. During the same year gas was piped into Tulsa, Bartlesville, Ochelata, Pawhuska, and Red Fork for domestic purposes. The first gas used in the State for manufacturing, so far as the writer is aware, was by a brick plant at Red Fork in 1904. During 1905 and 1906 the development was phenomenal. The Gotebo field was added to the list. In the northeastern part of the State pipe lines were constructed to such distant towns as Muskogee and Wagoner. By the close of 1907 there were 315 producing gas wells reported in the State. Although many were shut in awaiting market, the State advanced in that year to seventh place in the value of gas produced. One smelter at Bartlesville began to use gas late in the same year while Ardmore and Oklahoma City were added to the list of consumers.

Notwithstanding the lack of market for gas, 374 wells were productive at the close of 1908 and the State mounted to fifth place in production and seventh in value of gas. The price at that time was ridiculously low, ranging from 1½ to 15 cents per 1,000 cubic feet.

Early in 1909 the United States Supreme Court annulled the state law prohibiting the pipage of gas out of the State. This annulment was followed by spectacular development over the entire field as now defined. There was a mad rush of gas companies into the field, each intent on securing the lion's share of the gas. The amount and value of the product mounted rapidly from that time, and in 1911 the value reached a total of $6,731,770.

There is much talk and rumor about the failure of the gas supply of the State. It is failing. So is the coal supply. That some of the best gas fields have passed their zenith there is no doubt. Nor is there any doubt that new fields are being developed and new gas wells brought in constantly. At the close of 1910 there were 502 productive wells in the State according to the figures of the United States Geological Survey. During 1911, 364 new wells were brought in, an average of one a day. In the first eight months of 1912, 267 wells were added to the list.* Adding we have:

Productive December 31, 1910	502
Drilled during 1911	364
Drilled January-August, 1912	267
Total productive	1133

*Figures from the Petroleum Gazette.

This is assuming that none have been abandoned since January 1, 1911. It is admitted that some of those included in the above list probably have not capacity enough to count seriously in the industry. Even then, these figures show that there is no cause for alarm.

The following table shows the value of gas in Oklahoma from 1902 to 1911:

Value of gas in Oklahoma, 1902-1911.

Year.	Value.
1902	$ 360
1903	1,000
1904	49,665
1905	130,137
1906	259,862
1907	417,221
1908	860,159
1909	1,806,193
1910	3,490,704
1911	6,731,770

ASPHALT.

Prior to 1903 limited quantities of asphalt had been produced in what was then Indian Territory. The production was somewhat small and the demand very restricted by reason of the fact that very little paving was being done in the Southwest as it was at that time. Beginning, however, with 1903 the production has advanced steadily although not as rapidly as conditions might lead one to expect. In 1903 the total output was valued at $28,150 and in 1910 at $65,244. On account of the limited number of producers in 1911 the writer is not at liberty to disclose the figures for that year although it must be understood that there was a substantial increase in that year over 1910.

In view of the enormous quantities of rock asphalt and the purer varieties, such as gilsonite and grahamite, found in the State the annual output is very small. Competition with oil asphalt from the refineries and with the imported Trinidad asphalt has served to prevent what might be called normal development of the Oklahoma deposits. A few years ago, moreover, the experts of one of the large importing companies published a statement to the effect that Oklahoma asphalts are not well adapted to paving. This ridiculous statement has served only to lead municipalities and cities in the Southwest to inquire into the subject for themselves. Anyone who will inspect carefully the streets of Ardmore will be at once convinced that the statement above referred to rests on a financial rather than a scientific basis. Now that the deposits of asphalt in Oklahoma are well known and inasmuch as several quarries are operating on a somewhat extensive scale, it is believed that the future of Oklahoma asphalt is assured.

The value of natural asphalt of all kinds in Oklahoma from 1903 to 1911, inclusive, is as follows:

Value of asphalt in Oklahoma, 1903-1910.

Year.	Value.
1903	$28,150
1904	37,516
1905	27,790
1906	18,461
1907	20,770
1908	23,820
1909	48,130
1910	65,244

STONE.

Granite.

The granite industry of the State is but in its infancy. Much of the product is put on the market as building stone and necessarily the demand for this, as for any other building stone, is controlled by general industrial conditions. Consequently the output in 1908 shows plainly the effect of the financial panic of 1907 and the figures for 1911 exhibit the depression of the market consequent upon the drought which prevailed throughout the Southwest in that and the immediately preceding years. At present, with the return of the Southwest to its normal financial status, this industry is recovering rapidly and a fair increase in the output seems assured.

Nearly the entire output of granite of the State comes from the Wichita Mountains. The Survey, under cooperative agreement with the United States Geological Survey, has prepared a detailed report on the granites and special consideration is given to granite for monuments. The Wichita Mountain granites are admirably adapted for monumental purposes and no more superior articles are put on the market. In spite of this fact New England and even imported granites are being sold in abundance in this State, the purchasers paying therefor fancy prices in the belief that a superior product is being obtained.

The value of the output of granite in the State for the past 11 years is as follows:

Value of granite in Oklahoma, 1901-1911.

Year.	Value.
1901	$12,000 (*e*)
1902	11,970
1903	9,030
1904	32,082
1905	20,720
1906	18,847

1907	24,550
1908	23,239
1909	67,584
1910	102,566
1911	20,244

(c) Estimated.

Sandstone.

The sandstone industry in this State has passed through many vicissitudes. Beginning in 1901 with a modest production valued at approximately $5,000, it increased to $24,200 in 1902. The next two years saw a marked falling of in the value of the output, only $2,995 worth of material being put out in 1904. From that time, however, until 1910 the increase in the output was gradual but not marked. The widespread financial depression of 1910 was disastrous to the building and stone industries and this one suffered the common fate, only $19,801 worth being put out in that year. In 1911, however, the value of the output quickly rose to $90,971. The subjoined table shows the value of the output for the years 1901 to 1911, inclusive:

Value of sandstone in Oklahoma, 1901-1911.

Year.	Value.
1901	$ 5,000 (e)
1902	24,200
1903	6,500
1904	2,995
1905	15,112
1906	40,861
1907	43,403
1908	57,124
1909	59,855
1910	19,801
1911	90,971

(e) Estimated.

The sandstone industry in Oklahoma has never been prominent, but the rock is widely distributed throughout the State and in numerous places is well exposed for quarrying and conveniently situated for transportation. With the marked tendency toward the erection of firm buildings, construction of good foundations, and lasting culverts manifest throughout the Southwest, there should be a steady increase in the output of sandstone in Oklahoma.

Limestone.

In no year since 1901 has the value of the output of limestone in the State fallen below that of the preceding year. During the period 1901 to 1911 it increased from $32,497 to $594,664, a net gain of nearly 1800 per cent. That this rate of increase will be continued is hardly to be hoped for, but that there will be a very substantial gain year by year seems well assured. This is made evident by the fact that the greater part of the value of limestone comes from crushed rock for ballast and concrete work and it is but reasonable to expect that consumption for these purposes will increase steadily with the building and improving of railroads, the progress of concrete construction work and the building of macadam roads. Some interesting comparisons of the amounts of crushed limestone produced by several states for road making show that Oklahoma is slow to begin actual construction of good roads. The following table shows the value of limestone used in constructing roads in several states during 1910:

New York	$1,804,838
Ohio	1,314,192
Illinois	954,409
Indiana	551,021
Missouri	530,669
Oklahoma	20,983

It is highly probable that the good roads propaganda spread over the State in the last few years will have the effect very early of starting actual active construction. Once well begun this work will make a heavy demand for crushed rock. Moreover, limestone for building in Oklahoma has been but little in demand until very recently. With the installation of a large modern plant at Bromide and continuance of operation at other quarries, the present year (1912) will doubtless see a marked increase in the value of this product. The following table shows the value of the output of limestone for all purposes from 1901 to 1911:

Value of limestone in Oklahoma, 1901-1911.

Year.	Value.
1901	$ 32,497
1902	50,541
1903	56,140
1904	101,516
1905	168,924
1906	171,983
1907	189,568
1908	257,066
1909	450,055
1910	509,344
1911	504,664

Marble.

The marble deposits of the State are, so far as known, very restricted, being confined to a few exposures of the St. Clair marble in the vicinity of Marble City, Sequoyah County. Here the Western Marble Company opened a quarry and in 1907 did a fair amount of

business. No reports were received from the company for 1908, 1909, and 1910, but it was in operation. This company being the only producer in the State, the Survey is not at liberty to disclose the value of the output of 1911. The company's affairs, however, seemed to be very prosperous, when early in 1912 it went out of business. It is improbable, under the circumstances, that the plant will long remain idle. The value of the output in 1911 is included in the chart under "other products."

LIME.

Beginning with a very small output in 1902 the lime industry has been slowly developed in Oklahoma. At the close of 1911 there were 8 plants in the State, one in each of the following counties: Atoka, Coal, Comanche, Delaware, Dewey, Johnston, Nowata, and Pawnee. In 1911, however, only those in Coal, Comanche, Delaware, and Johnston counties reported any production. The number of producers is such that the figures for that year are concealed, the value of the production being included in the chart under "other products." Several of the plants reported as just getting under way at the beginning of 1912.

Limestone admirably suited for the production of lime is located in the coal and gas regions of the State as well as elsewhere. The good quality of the limestone, the convenient fuel, together with a marked advance in the Southwest of building and other industries which require lime, will, it is believed, engender considerable activity in the lime industry. Some of the plants which reported no output in 1911 state that the operations will be carried on during 1912. The plants which operated during 1911 had a fairly good business, better, in fact, than might have been expected in view of the general trade conditions in the Southwest.

The following table shows the value of lime production in Oklahoma from 1902 to 1910:

Value of lime in Oklahoma, 1902-1911.

Year.	Value.
1902	$ 25
1903	4,800
1904	3,194
1905	4,650
1906	4,850
1907	5,000(*e*)
1908	5,500(*e*)
1909	6,000(*e*)
1910	9,700

PORTLAND CEMENT.

There are two Portland cement plants in operation in Oklahoma, one at Dewey in Washington County and the other at Ada in Pontotoc County. Both began operation in 1906. The former has a capacity of 3,000 barrels and the latter 2,600 barrels daily. In 1910 construction was begun on a plant at Hartshorne which was to have a capacity at the outset of 2,000 barrels, but plans were laid to increase the capacity to 10,000 barrels. Unfortunately the plant was begun during the severe financial stringency of 1910 and the company was not able to complete its plant. It is highly probable though that with the return of normal financial conditions, the plant will be completed and placed in operation.

The production of Portland cement in Oklahoma dates from 1908. The data of the production are combined by the United States Geological Survey with those of Texas; hence only estimates can be made of the value of Portland cement in Oklahoma, and the figures below given are to be taken as such.

With the continued increase in the cost of lumber and with the price of production of clay products and building stone at what seems to be a minimum, and, further, with the increase in building operations throughout the Southwest in general, the cement industry in Oklahoma has a very promising future. The raw materials and fuel being in close proximity, cost of production is kept at a minimum. This minimum, however, could be reduced if prices of coal were all that could be desired. The plants in Oklahoma are enabled by the low cost of production and by the high merit of the product, to compete successfully with other mills to the northward in Kansas and to the southward in Texas.

The following table gives estimates of the value of Portland cement in Oklahoma from 1908 to 1910. The figures for 1911 cannot be disclosed inasmuch as there are but two producers in the State:

Value of Portland cement in Oklahoma, 1908-1911.

Year.	Value.
1908	$462,000
1909	608,000
1910	888,000

GYPSUM.

There are 10 gypsum plants in Oklahoma. Conditions of quarrying the raw product are very favorable by reason of the small amount of overlying materials and the great thickness of the gypsum and gypsite beds. In the early development of the industry in this State transportation facilities were poor and the price of, and freight rates on, fuel were high. Nevertheless, the value of gypsum products increased from $66,031 in 1901 to approximately $451,000, the maximum in 1910, the value of the output in 1911 falling to $293,203. The decrease in value was due to the severe drought which prevailed in the entire Southwest. At present the industry is rapidly approaching its normal status, but it is hardly to be ex-

pected that it will attain prominence under present conditions. The raw product and the fuel are widely separated. Gas is not being piped to the mills and the scattered position of the individual mills together with the great demand for gas closer to the gas fields renders the early construction of gas mains to the gypsum plants very improbable. Furthermore, as already noted, the mine prices of, and freight rates on, coal are so much higher in Oklahoma than in other states where similar geographic, geologic, and commercial conditions obtain that the Oklahoma producers cannot reach the territory that properly belongs to them. Even in the face of these obstacles, however, the output in the State will continue to increase and the territory and trade will continue to expand.

The following table shows the value of gypsum products in Oklahoma from 1901 to 1911:

Value of gypsum products in Oklahoma, 1901-1911.

Year.	Value.
1901	$ 66,031
1902	111,215
1903	234,521
1904	190,245
1905	200,000(*e*)
1906	356,000(*e*)
1907	404,000(*e*)
1908	288,000(*e*)
1909	370,000(*e*)
1910	451,000(*e*)
1911	293,203

(e) Estimated.

CLAY PRODUCTS.

At the beginning of the period covered in this brief sketch the clay industry already had a good beginning in the then Oklahoma and Indian territories. Up to the present Oklahoma has put out no pottery or terra cotta, all her clay products consisting of brick and tile; in fact one may go farther and say that the output is composed almost entirely of brick. This being the case, it follows that the development of the brick industry should keep pace with building operations of the new state. As the population of the State advanced and especially after the cities and towns sprang up there became a very sharp demand for brick for paving and construction purposes. The figures in the table below show a steady increase in the value of the output from 1901 to 1908. With the admission of the State into the Union there was rapid development in every direction, and especially in building. This explains the marked increase of the value of the output in 1909 over that of 1908, the increase being nearly 100 per cent in a single year. With the advent of the financial depression in 1910 and 1911 the production, as was

to be expected fell off, only $756,639 worth of materials being manufactured in 1911. During 1912 there was a reaction and the industry recovered rapidly. There is wide demand for paving brick, as well as for common builders and for face brick in the State. Reports received from the various plants so far in 1912 indicate a very healthful condition in the trade and it is believed that from now henceforth the industry will improve rapidly.

It is a striking fact that Oklahoma puts out no pottery. Tests of the clay of the State show that some of the clays at least are well adapted for pottery purposes. With good supplies of fuel available and with the clay conveniently located with regard to transportation, it is but a question of time until the pottery industry is begun within the State.

The following table shows the value of clay products in Oklahoma from 1901 to 1911:

Value of clay products in Oklahoma, 1901-1911.

Year.	Value.
1901	$322,284
1902	403,649
1903	534,977
1904	531,024
1905	596,299
1906	540,901
1907	664,512
1908	562,929
1909	1,032,314
1910	920,921
1911	756,639

SAND AND GRAVEL.

Sand and gravel are widely distributed in Oklahoma. In the beds of the several large streams that cross the State from west to east are vast amounts of sand which, in many places, is clean and well adapted for building purposes. Glass sand, moreover, is very abundant and of extraordinarily high grade, but up to this time none whatsoever has been placed upon the market. In the Wichita and Arbuckle mountains and in the Ozark region in the northeastern part of the State good gravel deposits are abundant. In spite, however, of the abundance of our sands and gravels, development did not begin until 1904 when a very small production with an estimated value of $5,000.00 was obtained. From that time to 1910 the value of the output of these materials increased with remarkable rapidity, reaching a maximum of $186,977 in 1910. Final statistics are not at hand for the production in 1911, but it is considered highly probable that there was a slight decrease in that year over 1910. With the wide demand for building sands in the State there is no reason why the common sands should not be developed rapidly.

The Survey has just issued a report on glass sand and during the coming year without doubt this material will be opened up and placed on the market. There is a wide demand for gravel, especially for concrete work, and inasmuch as concrete construction of all kinds will continue and probably increase, it is to be expected that the gravel industry will attain unto considerable dimensions in the near future. The Survey is beginning a detailed study of the sands and gravels of the State and a report on these deposits will be issued at an early date.

The following table shows the value of sand and gravel in Oklahoma from 1904 to 1911:

Value of sand and gravel in Oklahoma, 1904-1911.

Year.	Value.
1904	$ 500
1905	17,937
1906	8,000
1907	22,506
1908	35,971
1909	185,812
1910	186,977
1911	180,000

LEAD AND ZINC.

Inasmuch as lead and zinc occur together in Oklahoma, it is best to consider the two under one head. Statistics of production extend back only to 1907, although the Quapaw lead and zinc district in Ottawa County was opened up in 1903. Even prior to that time a limited amount of these metals seems to have been placed on the market but no statistics are at hand regarding the amount and the value of production.

There are but two productive areas now known within the State, the first one centering around Miami and lying wholly in Ottawa County and the other in the Arbuckle Mountains in Murray County. The Ottawa County field has been producing since 1903 and from this field nearly all production in Oklahoma has been obtained. The output at first was very small, partly owing to the fact that the region was unknown and partly also because of local mining conditions. From 1907 to 1909 the output increased markedly, reaching a maximum in the latter year. During 1910 and 1911 the production decreased, partly because of the financial stringency generally prevalent over the Southwest, but perhaps more because of the low price of lead and zinc.

In the Arbuckle Mountains the production in 1909 was limited, being confined to the region southwest of Davis, but 1910 witnessed a fair increase in the amount of ore shipped. It is reported that at present operations are not being carried on in the Davis district.

Since 1909 there has been considerable prospecting at Ravia in Johnston County, but so far as known very little ore has been obtained and operations have ceased.

The following tables show the value of lead and zinc in Oklahoma since 1907, the figures for 1911 being estimated:

Value of lead in Oklahoma, 1907-1911.

Year.	Value.
1907	$ 42,824
1908	118,356
1909	195,048
1910	158,840
1911	150,000

Value of zinc in Oklahoma, 1907-1911.

Year.	Value.
1907	$ 84,842
1908	210,090
1909	324,864
1910	248,076
1911	240,000

During the early part of 1912 valuable new discoveries of lead and zinc ores were reported from the Miami district. The lower of the two runs in the older part of the district is being opened up extensively and is proving up to expectations. These two factors combined with the increased price of the metals indicate that the output for 1912 will show a marked improvement in the industry.

SALT.

The salt industry in Oklahoma has never been extensive and at present it is in a less prosperous condition than it was six years ago when it reached its prime. The most of the production so far has come from Harmon and Blaine counties. There are valuable salt springs widely distributed through the west-central and western parts of the State, but the waters have been utilized profitably only to a very limited extent. The Survey has now in preparation a report dealing with the salt resources of the State and it is hoped that valuable aid will be rendered this industry. There is no reason why salt should not be an important article of commerce in the State. Kansas, whose salt occurs in a manner similar to that in which it is found in Oklahoma, produces nearly a million dollars worth of salt each year. With proper business methods it is believed that our salt industry should be just as important as that of Kansas.

The following table shows the production of salt in the State from 1901 to 1910. In 1911 only three producers reported and hence the figures for that year are not published, the amount being included under "other products."

Value of salt in Oklahoma, 1901-1910.

Year.	Value.
1901	$5,986
1902	7,562
1903	2,070
1904	1,961
1905	2,145
1906	4,965
1907	910
1908	900
1909	900
1910	881

MINERAL WATER.

Only recently has any serious attempt been made to exploit the mineral waters of the State. Prior to 1906 not more than two springs reported production in any one year. The number increased to twelve in 1909, fell to four in 1910, but rose again to twelve in 1911. The springs and wells reported at various places as producing mineral waters are as follows:

Altus Water Company	Altus
Sulphur Bromide Well	Sulphur
Bromide Springs	Bromide
Brown Sulphur Springs	Granite
Comanche Mineral Wells	Comanche
Works Excelsior Wells	Comanche
Germicide Wells	Wagoner
Guthrie Well	Guthrie
"Hercules" and "Sooner"	Guthrie
Kalium Wells	Faxon
Lewis Lithia Wells	Oklahoma City
Sand Springs Water Company	Sand Springs
Sand Springs	Sand Springs
Shannoan Springs	Chickasha
Beech Wells	Sulphur
Bromide and Eaton Wells	Claremore
Claremore Radium Wells	Claremore
Green Well	Chelsea
Harper Artesian Bromide Wells	Sulphur
Nowata Radium Well	Nowata
Old Government Springs	Enid
Osage Spring	Tulsa
Tulsa Crystal Spring	Tulsa
Zylite Water Company	Oklahoma City
Crystal Water Company	Oklahoma City

In prospecting for oil and gas in Oklahoma the drill often encounters mineral water, not a few of the present wells having been discovered in this manner. Many are artesian, especially in the

Arbucle Mountains and in the northeastern part of the State. It is considered probable that the demand for the waters from these wells will increase and that the industry will be a valuable one to the State. The figures of production since 1906 are as follows:

Value of mineral waters in Oklahoma, 1906-1911.

Year.	Wells reporting.	Value.
1906	3	$ 7,744
1907	4	7,345
1908	9	52,779
1909	12	35,194
1910	4	4,950
1911	12	14,290

OTHER PRODUCTS.

In publishing statistics of mineral production the United States Geological Survey as noted above has adopted the policy of concealing statistics where not more than three producers report in any state. This Survey pursues the same policy. Concealment is effected by combining the statistics of two or more states, or, in the case of state reports, of two or more products. In Oklahoma values other than those given above amount to a considerable sum. In the chart in this report footnotes are given showing what the figures for each year represent. No data are available prior to 1905.

VALUE OF MINERAL PRODUCTS OF OKLAHOMA, 1901-1911.

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911
Coal	$ 3,915,268	$ 4,265,106	$ 6,386,463	$ 5,532,066	$ 5,145,358	$ 5,482,366	$ 7,433,914	$ 5,976,504	$ 6,253,367	$ 5,867,947	$ 6,291,494
Petroleum	7,125	32,940	142,402	1,325,745	3,524,122	(e) 8,000,000	17,513,524	17,694,843	17,428,990	19,922,660	26,451,767
Natural Gas	.....	360	1,000	49,665	130,137	259,862	417,221	860,159	1,806,193	3,490,704	6,731,770
Asphalt	.....	.....	28,150	37,516	27,790	18,461	20,770	23,820	48,130	65,244	(a) .....
Granite	(e) 12,000	11,970	9,030	32,082	20,720	18,847	24,550	23,239	67,584	102,566	20,244
Sandstone	.....	24,200	6,500	2,995	15,112	40,861	43,403	57,124	59,855	19,801	90,971
Limestone	32,497	50,541	56,140	101,516	168,924	171,983	189,568	257,066	450,055	509,344	594,664
Marble	.....	.....	.....	.....	.....	.....	16,805	.....	.....	.....	(a) .....
Lime	.....	.....	4,800	3,194	4,650	4,850	5,250	.....	(e) 6,000	(e) 9,000	(a) .....
Cement	.....	.....	.....	.....	.....	.....	.....	(e) 424,971	(e) 713,832	(e) 1,029,954	(a) .....
Gypsum	66,031	111,215	234,621	190,245	(e) 191,878	(e) 356,441	(e) 421,024	(e) 288,000	(e) 400,000	(e) 451,000	293,203
Clay Products	322,284	403,649	534,977	531,024	596,299	540,901	664,512	562,929	1,032,314	920,921	756,639
Sand and Gravel	.....	.....	.....	(e) 500	(e) 3,000	(e) 8,000	22,506	35,971	185,812	186,977	180,000
Lead	.....	.....	.....	.....	.....	.....	42,824	118,356	195,048	158,840	173,250
Zinc	.....	.....	.....	.....	.....	.....	84,842	210,090	324,864	248,076	256,158
Salt	5,986	7,562	2,070	1,961	2,145	4,965	910	(e) 900	(e) 900	881	(a) .....
Mineral Water	.....	.....	.....	.....	(e) 5,000	7,744	7,345	52,779	35,194	4,950	14,290
Other Products	.....	.....	.....	1,000	.....	3,000	.....	.....	.....	.....	(b) 906,358
TOTAL	$ 4,361,191	$ 4,907,543	$ 7,406,153	$ 7,809,509	$ 9,835,135	$14,918,281	$26,908,968	$26,586,751	$29,008,138	$32,988,865	$42,760,808

(e) Estimated.
(a) Included in "Other Products."
(b) Includes asphalt, marble, lime, cement, and salt.