MISSOURI
BUREAU OF GEOLOGY
AND MINES

BIENNIAL REPORT *of the* 300

STATE GEOLOGIST

TRANSMITTED BY THE

BOARD OF MANAGERS OF THE BUREAU
OF GEOLOGY AND MINES TO THE
FIFTY-FOURTH GENERAL
ASSEMBLY, 1927

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DIRECTOR AND STATE GEOLOGIST
ROLLA, MISSOURI

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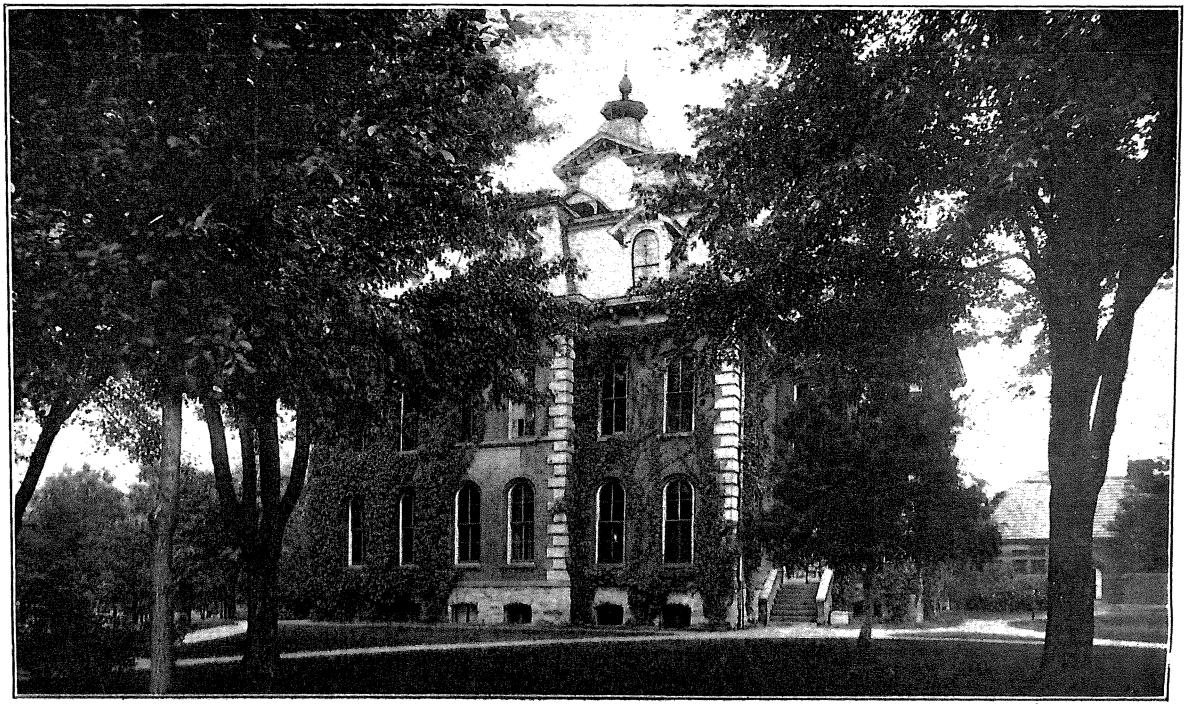

HEADQUARTERS MISSOURI BUREAU OF GEOLOGY AND MINES, ROLLA, MO.

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LETTER OF TRANSMITTAL

To the President, Sam A. Baker, and the Honorable Members of the Board of Managers of the Bureau of Geology and Mines:

Gentlemen:—I have the honor to submit herewith a brief report covering the work of the Bureau of Geology and Mines for the years 1925 and 1926.

In addition the report contains a brief outline of the value of the output of the mineral industry during 1924 and 1925. As a separate report issued as an appendix to this Biennial there is now in press the stream flow records determined by the Water Resources Branch during the past five years.

Respectfully submitted,

H. A. BUEHLER,
State Geologist.

CHAPTER I.

WORK OF THE BUREAU OF GEOLOGY AND MINES DURING 1925 AND 1926.

The following report briefly outlines the work of the Bureau of Geology and Mines during the past biennial period.

When first established by the 35th General Assembly, the activities of the Department were restricted to geological and mining investigations which had for their purpose the development of the mineral resources.

At that time and up to 1900, the annual value of mineral products in the State did not average $15,000,000.00 per year, and Missouri although having great potential mineral wealth, did not rank with the chief mineral producing states. In 1925, with a mineral output valued at approximately $90,000,000.00, there are at least three individual mineral industries in the State having a greater value of output than the total yearly mineral production prior to 1900. The production of lead ore alone has a value of more than twice the yearly average; clays and clay products about twice, and Portland cement, the manufacture of which did not start until after 1900, more than equals the value of the entire State output at that time. Without doubt, the systematic investigations of the Bureau have been an important aid in this development. Its reports and maps are valuable guides to prospecting.

Prior to 1907, only a few scattered topographic maps had been made by the State Bureau where these were especially needed for geological investigations. The United States Geological Survey had mapped a number of areas in addition to their old reconnaissance sheets, which were only of general value. The 44th General Assembly however, established a definite policy of making a complete and accurate topographic map of the State in cooperation with the Federal Survey, and a separate appropriation was made for this work. This cooperative agreement has continued during each succeeding biennial period until, at the present time, approximately one-fourth of the area of the State has been covered by accurate maps. This division is under the

general supervision of the State Geologist, the field work being done by the engineering staff of the Federal Survey. The cost of the field and office work is apportioned on an equal basis, the Federal Bureau matching the appropriations made by the State. As the value of these maps has become better known, the request for additional areas has increased until at present the Bureau cannot cover many areas demanded, for water power and flood control investigations, State Highway location, and the various mining industries. This branch has become an important part of the work of the Bureau.

During the past few years the importance of developing the possible water powers of the State has been brought forcibly to the front by the almost universal use of electricity. Recurring disastrous floods along many streams in various parts of the State have impressed the need of detailed knowledge covering the amount of water that must be cared for in order to predicate adequate flood control, and lessen the frequent useless loss of crops valued at millions of dollars.

The 51st General Assembly placed under this Bureau the task of obtaining information covering the development of possible water powers and the determination of factors important in flood control. A separate appropriation was made to cover the investigations. The work has since been carried on in cooperation with the United States Geological Survey, which department has established one of its district engineers at Rolla, the State headquarters. The Federal Bureau bears approximately one-third of the total expense of office and field work.

Prior to establishing gaging stations under this act, very little information was available regarding the actual flow of any of the major streams of the State. In order to determine the water power possibilities, accurate records must be had showing the daily flow of the stream. The value of these records increases with time, as both the minimum and maximum discharge is of the greatest importance. Some idea of the value of the data already obtained is indicated by the fact that at the time the State started obtaining records but one major hydro-electric power plant was in operation, with a maximum rated capacity of 16,000 horse-power. At the present time the Federal Power Commission has issued power permits covering the Osage, Gasconade, White (above Forsyth dam), Current, and Black rivers, and the applications indicate installations approximating a total of

500,000 horse-power. The total cost of construction is estimated at about $60,000,000.00. Several hundred thousand dollars have already been spent by hydro-electric companies in these investigations, which have only been made possible by the records already obtained by the State Survey. The value of the results will increase as continuous records are obtained in the future.

APPROPRIATIONS.

The work of the Department at the present time includes three fundamental engineering branches, the appropriations for which are made under the following heads:

(1) Geology and Mining,
(2) Topographic mapping,
(3) Water Power and Flood Control.

Succeeding legislatures during the past three biennial periods have appropriated practically the same sums to carry on the work of the Department; the material increase being an appropriation by the 53rd General Assembly of $10,000.00 for large scale mapping of the important river systems of the state for water power and flood control data. Due to the lack of funds in the state treasury, this appropriation was withheld. Of the total appropriations $25,000.00 was withheld during the present biennium. This reduction materially decreased the activities of the Bureau and restricted its field work.

The following tabulation indicates the funds requested of the 53rd General Assembly for each branch; the amount appropriated; and the final amount available:

	Geology and mining.	Topographic mapping.	Water power and flood control.	River maps.
Amount requested.....	$88,060.00	$45,000.00	$20,000.00	$10,000.00
Amount appropriated.....	68,300.00	30,000.00	20,000.00	10,000.00
Amount available.....	58,300.00	25,000.00	20,000.00	None

The appropriation for geology and mining includes all geological field work, office supervision, equipment, traveling expenses, and printing of geological reports and maps. Due to the reduction of $10,000.00 in this appropriation over the preceding biennium, two members of the staff were discontinued, and

several reports were not published although the field data was available. Some of the investigations started during former biennial periods were temporarily abandoned. The reduction of $5,000.00 in topography also reduced the Federal Survey appropriation a like amount, making a total reduction of $10,000.00 in available funds. Field mapping was curtailed accordingly. The water power and flood control appropriation was the same as in former biennial periods and the work was carried on as previously. The river mapping fund was withheld in toto, and no work inaugurated along this line.

PERSONNEL.

The following members of the staff and those engineers supplied through cooperative agreement with the Federal Geological Survey have been employed on the various investigations of the Bureau during the past two years. In addition there have been a number of temporary employees in each branch.

GEOLOGY AND MINING.

Permanent Staff:

H. A. Buehler, State Geologist,
W. F. Pond, Geologist,
J. M. Thiel, Geologist,
H. S. McQueen, Geologist,
H. W. Mundt, Chemist,
C. O. Reinoehl, Draftsman and Instrumentman.
Jean I. McCaw, Clerk,
E. E. Hawkins, Janitor.

Summer Field Parties:

C. L. Dake, Potosi Region.
Josiah Bridge, Eminence Region.
E. B. Branson, Mississippian formation, Boone and Callaway counties.
J. S. Williams, Mississippian formations.

WATER POWER AND FLOOD CONTROL.

H. C. Beckman, District Engineer.
V. L. Austin, Assistant Engineer.
W. A. Werner, Assistant Engineer.

TOPOGRAPHY.

C. L. Sadler and party, Topographic engineer.
F. L. Whaley and party, Topographic engineer.
J. B. Leavitt and party, Topographic engineer.
J. M. Rawls and party, Topographic engineer.
J. L. Saunders and party, Topographic engineer.
C. R. Fisher and party, Topographic engineer.
W. R. Broaddus and party, Topographic engineer.
F. W. Hughes and party, Topographic engineer.

COOPERATION.

Many State and Federal departments have problems touching the activities of this Bureau. It is the policy of the Board of Managers of the Geological Survey to cooperate with all other departments having similar problems in order that duplication may be avoided and assistance rendered where possible. Cooperation was carried on during the last biennial period with the following State and national bureaus:

(1) With the United States Geological Survey:
  (a) In studying the geology of the Ozark region.
  (b) In topographic mapping.
  (c) In surface water supply investigations.

(2) With the United States Bureau of Mines in collecting complete statistics covering the mineral production of the State.

(3) With the United States Census Bureau in gathering statistics covering the manufactured products derived from mineral production.

(4) With the United States Weather Bureau of St. Louis in maintaining gaging stations and reporting flood conditions on Missouri streams.

(5) With the State Board of Health in providing sanitary city water supplies and in determining bacteriological content of surface streams and springs.

(6) With the State Penal Board in determining the possibilities of opening a coal mine in Callaway County, and in establishing the quantity and quality of clay available at the Boonville Reformatory and near the State Penitentiary.

(7) With the Eleemosynary Board in analyzing waters to determine their character for boiler use.

(8) With the State Fair Board in maintaining a mineral and forestry exhibit at the State Fair.

(9) With the State Museum Commission in collecting and installing exhibits.

(10) With the State Park Commission in surveying Round Spring State Park.

(11) With drainage districts, corporations and cities in maintaining gaging stations for the purpose of determining run-off and water supply.

(12) With the Ceramic Engineering Department of the Missouri School of Mines and the Missouri Refractories Association in studying the clay resources and making laboratory tests.

In addition to the above direct cooperative efforts, the State Geologist is ex-officio member of the State Highway Commission and State Museum Commission, and considerable time is devoted to these duties.

PUBLICATIONS.

The following reports and maps have been issued during the past biennial period. Due to the reduction in the appropriations available, additional publications in large part completed have not been issued. These volumes and maps should be published as soon as possible, as this is the important method of getting data to those interested. The various volumes are in constant demand and many of the older reports are out of print.

State Geological Map:

A revised edition of the State geological map has been issued which shows the region of outcrop of the older Cambrian formations of Southeast Missouri. This revision is important in indicating more closely the geology of the disseminated lead district and the Barytes district of Southeast Missouri.

State Base Map:

A second edition of the base map has been issued. In this edition the river systems have been amplified, all important drainage ditches shown, and additional elevations above sea level indicated. It is the most accurate map ever published of the State.

State Drainage Map:

This map shows the principal river systems and the area drained by each. It is an important map in the investigations covering water power development and flood control.

Vernon County Report and Geological Map:

A detailed geological report has been issued covering Vernon County. The volume contains a description of the oil field near Richards, and a discussion of the bituminous sandstones occurring in the southeastern portion of the county. These are without doubt the most extensive deposits of bituminous sands in the State. Recent diamond drilling has shown several million tons available, and the Bureau is now cooperating in an investigation as to the suitability of this rock for highway purposes. The report contains a map showing a dome-like anticline in the northwestern part of the county in the vicinity of Amos, which was surveyed to show the general structure of the region favorable for drilling for oil and gas. A number of undeveloped shales have been tested, the results being given in the economic chapter.

Water Power and Flood Control Records:

The complete data covering the daily flow records of the various rivers of the State is in press as an appendix to the Biennial Report. Records for the past five years and all previous data is included. The complete analyses of 210 samples of water taken from the various rivers and springs are given in extended tables. These indicate the chemical character of the surface waters throughout the State.

Map Showing Plastic, Flint, and Diaspore Clay Districts:

A map showing the location of the Plastic fire clay region of Callaway, Audrain and adjoining counties and the Flint and Diaspore clay district of the northern Ozark region has been issued as a white print for distribution to the clay manufacturers. This map shows the geological relations of the types of clays mentioned and indicates the areas in which new deposits may be found as well as outlining those parts of the region in which deposits do not occur. It is the first map to show the location of the Diaspore clays which are unique in being the only deposits of this character mined in the United States. This clay will assay 75 per cent alumina, and is used in the manufacture of refractories and high grade fire brick.

County Topographic Maps:

County topographic maps covering Caldwell and Perry counties are in press. Additional maps covering DeKalb, Clinton, Buchanan, Andrew and Holt counties have been placed under contract for publication.

FIELD INVESTIGATIONS.

In addition to the major geological field investigations, members of the staff have answered requests in all parts of the State where information is asked concerning the possibility of developing certain types of mineral deposits. This service is considered an important branch of the work and such requests are answered as soon as possible.

Cooperative work has taken much time of various members of the staff. During the past two years we have undertaken the examination of all drill cuttings derived from wells being drilled for municipal water supply. By carefully examining the material the porous or open nature of the ground can be shown and the depth to which casing should be set, determined. By this means the entrance of surface waters can be eliminated and a sanitary water supply assured. It is also possible to advise the driller at what depths important water-bearing horizons may be expected, and many wells that would otherwise be abandoned as failures have been brought in through this advice. The work is carried on in cooperation with the State Board of Health. In taking samples of the waters of the various rivers and springs of the State for mineral analysis, a sample was also collected for the bacteriological laboratory of the Health Board and tested for bacteria. Some two hundred samples were thus collected; the results indicate that many springs and rivers are badly contaminated and cannot be used for public water supply without careful treatment.

At the request of the State Penal Board, the Bureau investigated the pocket coal deposits north of Missouri River in Callaway County. As the result of this investigation, a property was leased and a production of from fifty to one hundred tons per day produced for the use of the Penitentiary. In order to find employment for additional men, the clay deposits in the vicinity of the Penitentiary were investigated and areas were drilled, with help furnished by the institution, on State Farms Nos. 1 and 2. Sufficient clay was found to warrant a brick industry and a small

plant was leased in the outskirts of Jefferson City. There is sufficient clay available near the institution to establish a real industry within its walls. The clays at the Boonville Reformatory were drilled out, tested, and found in sufficient quantity to warrant the rebuilding of the brick plant at that institution.

At the request of the consulting engineer to the Eleemosynary Board, the water supply at each of the State institutions under the direction of that board was analyzed for the purpose of determining the most economic method of treatment for boiler purposes. Comparatively costly chemical softening compounds can be replaced by cheaper crude chemicals.

In connection with work on the State Highway Commission, an examination was made of certain quarries north of Missouri River.

During the latter part of the biennial period a large scale topographic map was prepared covering Round Spring State Park and surrounding territory. The Fish and Game Commissioner has requested similar maps of all the State Parks, but funds for this work were not available. The same condition prevailed covering requests for topographic maps by the State Highway Department in areas where road location is extremely difficult.

At the present time the Bureau is making a study of the asphaltic sandstone in Vernon County in cooperation with a Sand Company, in an endeavor to determine its suitability for road construction. This company has signified its willingness to construct test roads under supervision of the State Highway Department, in order to determine the character of pavement it will produce. Drilling has shown that a large tonnage of this sandstone can be obtained without an excessive cost for the removal of overburden.

In connection with the studies being made relative to the various water power permits, members of the staff have examined drill cores covering the geology of dam sites and examined the immediate regions for fractures, faults, caves or other openings that might result in excessive leakage.

Approximately two weeks each year is taken by one member of the staff in installing and supervising the mineral exhibit comprising the Department of Forestry and Mining at the State Fair. The exhibit includes samples of the various minerals produced in the State, and affords an excellent opportunity of exhibiting the wide range of mineral products.

The cooperative and incidental work of the Survey in making field examinations has been more extended than during any former biennial period and has demonstrated the value of close association with the various State and Federal departments.

Due to the restricted appropriation, geological field work was centered largely on those investigations in progress at the beginning of the biennium.

Joplin Office:

The Bureau has maintained a branch office at Joplin during recent years, and one member of the staff has headquarters in offices courteously furnished by the Joplin Chamber of Commerce. During the past two years much development work has been carried on in this district, and the geological records of the office have been available for consultation while such work was in progress. The mapping of the geology on large scale maps has been virtually completed, the western portion of the district being covered by nine township maps on a scale of four inches per mile. The district extends from the Kansas line eastward to Springfield, and the work of this office includes the entire southwestern part of the State.

Clay Deposits:

The value of the products of the clay industry has increased each year until today it stands second only to the production of lead ore. With the further development of the various clay deposits this mineral industry will soon lead all others in the State. The former report covering the clays of the State is long since out of print, and the constant demand for information regarding the geology of the various districts has made it imperative that a detailed investigation be made of the entire industry.

This work has been started and to date covers the Flint-Diaspore and east central plastic fire clay districts; two of the most important areas in Missouri. The field work showing the location of the various deposits, has been transferred to a map and is ready for publication. At the urgent request of clay manufacturers a preliminary edition of this map has been issued as a white print, and distributed to each of the clay manufacturers, and made ready for public distribution. The map shows the geological relation of the Flint-Diaspore deposits, and indicates the constant relation of these to the Pennsylvanian sandstones and shales of the northeast Ozark region. So constant is this relation that the map is invaluable in showing the possible productive area. North of Missouri River the flint clays extend up

to the southern boundary of the Coal Measures, where the plastic fire clays occur. No Diaspore clay has been found north of the river. The plastic fire clay deposits of Audrain, Callaway and adjoining counties have been shown on this map. In recent years this district has assumed first importance as a clay manufacturing center in the State. A brief report covering the area mapped is being prepared for publication.

The field work covering the geology of the clay deposits should be extended as rapidly as possible to the St. Louis district; to the area of Southeast Missouri where chinaware and ball clays are being produced; to the kaolin deposits of Cape Girardeau and Bollinger counties and throughout the northwestern half of the State, where there are extensive deposits of sewer pipe, brick and tile clays largely undeveloped.

The Ceramic industry is rapidly becoming our most important mineral industry. It is not confined to any particular part of the State, but on the contrary, deposits of value occur in almost every county.

Marble Quarries:

Up to the present time the Bureau has not published a report on the marble industry of the State, although in recent years the production of marble has increased rapidly and the Missouri product is being shipped to every state in the union. The quarry report, which was published before Missouri stone was used for interior decoration, did not discuss this important branch of the industry, centered at Phenix, Greene County; Carthage, Jasper County; and Ozora, Ste. Genevieve County.

During the past field season the quarries at Phenix, Carthage and in Ste. Genevieve County were examined preliminary to making a detailed study of the marble industries and the geological formations from which stone of this character might be obtained. It has not been possible to keep an assistant on this work continually because of other duties. It is planned, however, to continue the work early in the coming biennial period.

Mississippian Series:

The season of 1925 was devoted to a study of the material collected in the former biennial period, and no work was done on this investigation in 1926. The correlation of this series should be continued until the work is finally completed.

Potosi-Eminence-Ozark Region:

Summer field parties have continued the study of the correlation of the formations in the Ozark region, and additional areas have been mapped on the Edge Hill and Exchange quadrangles. The Decaturville area in Camden County is probably one of the most complex in the Upper Mississippi Valley. The formations which stand at vertical and highly inclined attitude, are apparently badly faulted and small areas of formations have been found in this region that apparently do not occur at any other point in the northwest flanks of the Ozark uplift. This work of correlation throughout the Ozark region is highly important and should be continued until the difficult stratigraphic problems are solved.

A considerable area was mapped south of Cape Girardeau, in Cape Girardeau County. The region is traversed by heavy faulting, which has an important bearing on the economic conditions along the southern portion of the quarry belt bordering the Mississippi River. By indicating the structural conditions it is possible to operate without encountering the badly fractured areas.

Chemical Analyses:

In addition to the routine testing and analyses of samples of ores, rocks, and drill cuttings, the chemist to the Bureau has completed 210 analyses of river and spring waters taken from the principal rivers and springs of the State. Also an elaborate series of analyses of clays was made in order to determine whether it is possible to improve some of the Burley clays of the Diaspore district and make a more refractory product. This investigation is still under way and the laboratory still has a large number of samples from the plastic fire clay district for analysis.

In connection with the clay investigation, the Bureau has entered into cooperation with the Ceramics Department of the School of Mines and the Missouri Refractories Association in testing the various samples of clay collected in our field work. This cooperation will be mutually beneficial, as it supplies the Bureau with the service and advice of expert ceramists, and will bring out additional possibilities of undeveloped clays investigated by the Bureau.

There has been no further work done on the Iron Mountain-Pilot Knob iron ore region. The Boone-Callaway County report has been delayed by the absence of the authors during the summer season. The report is being written.

TOPOGRAPHIC MAPPING.

The cooperative agreement with the United States Geological Survey covering topographic mapping has been continued throughout the biennial period. The Federal Survey appropriates a sum equal to the State funds, and furnishes trained engineers to do field work. Under this agreement approximately one-fourth of the State has been covered on a scale of one-inch per mile.

The Shell Knob quadrangle in Stone and Barry Counties, the Exchange and Cardareva quadrangles in Shannon and Reynolds Counties, and the Annapolis quadrangle in Iron and Madison Counties, were completed and sketching is under way on the Twelve Mile sheet in Wayne and Madison Counties.

Much attention was given to primary traverse during the latter part of the biennial period. Traverse was run through Madison, Bollinger and Wayne counties, completing an area of eight quadrangles. In Crawford and Washington counties the Steelville and Berryman sheets have been covered by traverse, and during the latter part of the year the Fulton and Mexico areas were covered preparatory to extending traverse throughout Audrain, Callaway and Montgomery counties during the coming season. During the period the Meramec Spring sheet, and practically all of the sheets of Northwest Missouri mapped during the previous biennial periods were engraved. Areas have now been completed covering Perry, Caldwell, Clinton, DeKalb, Buchanan, Andrew and Holt counties, and county maps are being prepared as rapidly as possible. Caldwell and Perry counties are now in press.

WATER RESOURCES INVESTIGATIONS.

The work of the Bureau during the biennial period relating to the water resources of the State has consisted principally of a continuation of the stream flow investigations for use in water-power, flood-control, drainage and water-supply developments. Work has also been done in making chemical analyses of samples of water taken from the principal streams in order to determine their suitability for domestic and industrial water supplies.

The stream flow investigations have been carried on, as in the past, in cooperation with the Water Resources Branch of the United States Geological Survey, which organization contributed $7,300.00 to the work during the biennial period. Eight new gaging stations were established at the request of cooperating parties, who are paying a part of the cost of the work. Three stations were discontinued. At this time fifty-eight gaging stations are being maintained on the principal streams of the State. At each station a local resident reads a gage once or twice a day to determine the height of the water. The engineers make occasional measurements of the flow, or discharge, of the stream in terms of cubic-feet per second, prepare rating curves and tables showing the flow for any gage height, and then compute from the daily gage heights the flow for each day of the year.

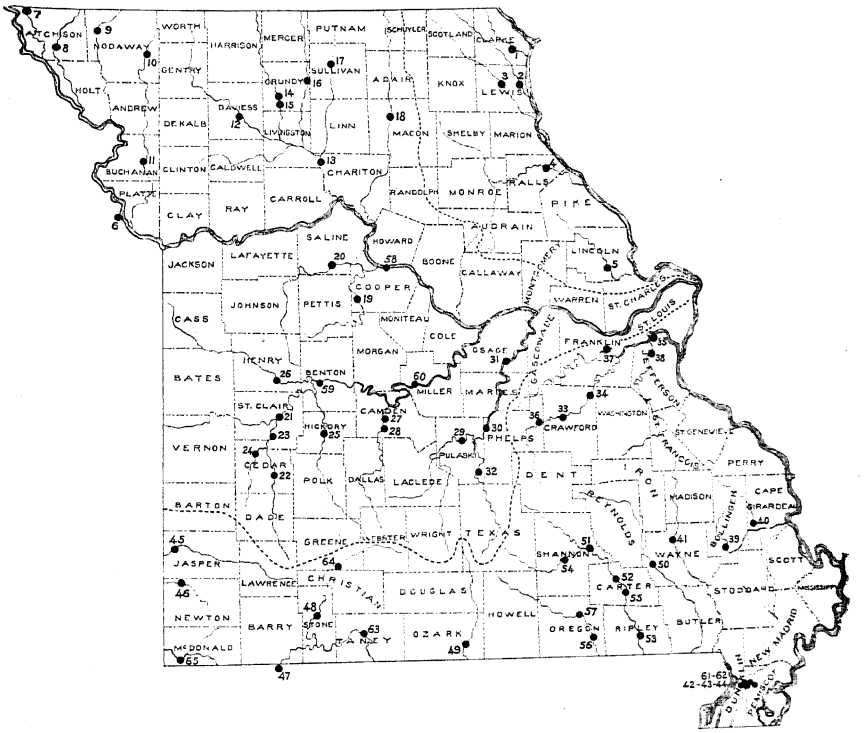
The accompanying map shows the location of the gaging stations which have been maintained during this and the two preceding biennial periods. The records of daily flow collected at these stations during 1921 to 1926, together with the records collected by the United States Geological Survey during 1903 to 1906, by the Engineering Experiment Station of the University of Missouri during 1912 to 1920, and by the Mississippi River Commission and United States Army Engineers on Mississippi River at places along the Missouri line, are being published under separate cover in an appendix to this report. The appendix also gives the results of measurements of the flow of 60 of the larger springs of the State and a statement of the measured drainage areas of 650 streams.

During the biennial period the Bureau has received numerous requests for stream flow records for use in planning water-power, flood-control, drainage, and water-supply developments.

The records have served as the basis for planning water power developments exceeding 500,000 horse power as follows:

On Osage River the Missouri Hydro-Electric Power Company has obtained final license from the State and the Federal Power Commission to build a dam 4 miles above Bagnell in Miller County. The dam will be about 95 feet high and will create a lake having a length of 96 miles and an area of 86 square miles. The plant will have a capacity of about 125,000 horsepower. Some preliminary construction work has already been done.

Missouri Bureau of Geology and Mines. Biennial Report, 1925-1926, Plate III.



Bureau of Geology and Mines, H. A. Buehler, State Geologist,
Map showing location of Gaging Stations, 1926.

On Current River the same company has obtained a preliminary permit from the Federal Power Commission for the construction of two or more dams between the mouth of Jacks Fork and Doniphan, and is now developing plans for them. The total capacity of the proposed plants is about 100,000 horse-power.

On White River the Empire District Electric Company has obtained a preliminary permit and has applied for final license to build a hydro-electric plant about 7 miles above Branson. The application of the company for a license states that a dam about 190 feet high is contemplated and that the plant will have an installed capacity of about 220,000 horse-power.

On Gasconade River the Central Missouri Power & Water Company has preliminary permits for the construction of three hydro-electric plants between Jerome and Rich Fountain. Surveys for the projects have been made. The total capacity of the proposed plants is about 100,000 horse-power.

On Black River a preliminary permit has been issued to Willis H. Meredith for the construction of a dam 3 miles above Leeper in Wayne County, which is intended to serve for the development of electrical power and to reduce floods along the lower stretches of the river. Surveys for the project have been made. The tentative plan is to install a plant which will develop about 30,000 horse-power.

The total capacity of these proposed plants exceeds 500,000 horse-power and their estimated cost exceeds $60,000,000. That the construction of these projects would be a great benefit to the State in the way of extending the use of electrical service, stimulating manufacture, and creating of the Ozark region a wonderful pleasure-resort district that would be visited each year by many thousands of pleasure seekers, is so obvious as not to require discussion. The stream flow records which are being collected serve as the basis for the design and financing of these projects and in a large measure determine their feasibility. Without such records the projects would not be given serious consideration.

The records of flow collected by the Bureau have had important uses in connection with drainage and flood-control work during the biennial period. The records collected in cooperation with the Little River Drainage District were used by engineers

of the district in planning the additional drainage improvements which the District constructed during 1925 and 1926 at a cost of about $4,000,000.

During September, 1926, heavy floods occurred on all streams in the State north of Missouri River. Many thousands of acres of land were flooded and the crops destroyed, parts of several towns were inundated, and traffic was suspended on several railroads. The losses incurred exceed a million dollars. Similar floods have occurred in the past at intervals of only a few years. The records of these floods which were collected by the Bureau have been requested by engineers for use in designing improvements to the streams to prevent such losses in the future. These records show the magnitude and frequency of the floods and thus supply the information which is necessary to design the proposed channel improvements and levees of the proper size to carry the floods. Without this fundamental information the plans would have to be based largely upon estimates which would probably result in costly errors.

The stream flow records have also been used during the biennial period in locating municipal water supplies. At the request and with the cooperation of the Springfield City Water Company, a gaging station has been maintained on James River to determine the adequacy of that stream to supply the future needs for water of the City of Springfield. The records of other streams have been used in making studies of proposed water supplies for other smaller towns.

The State Highway Commission has used the stream flow records in determining the area of waterways to be provided in some of the new bridges for the State Highway System.

During the biennial period, various private and public agencies contemplating the use and development of the streams for water power, flood-control, drainage, water-supply, and other purposes, have shown their interest and appreciation of the work by contributing $3300, in order that the work might be expanded. The following list gives the names of those who cooperated and shows the number of gaging stations they helped to maintain during a part, or for the entire biennial period:

Little River Drainage District	7
Missouri Hydro-Electric Power Co	5
Ozark Power & Water Co	3
Central Missouri Power & Water Co	2
United States Weather Bureau	2

United States Army Engineers..... 1
Ozark Utilities Co..... 1
Electric Utilities Co..... 1
Empire District Electric Co..... 1
Willis H. Meredith..... 1
Springfield City Water Co..... 1
Chicago Great Western Railroad..... 1
Mo. Game & Fish Department..... 1

Total..... ... 27

At the time this report goes to press these parties are cooperating in maintaining 25 of the 58 gaging stations.

In order to be able to furnish the information requested by municipalities, industrial concerns, and others, regarding the quality of the surface waters of the State and in compliance with the legislative act (S. B. No. 372), providing for the water resources investigations, a systematic survey of these waters was made by the Bureau during 1925 and 1926. About 210 samples of river and spring water from different parts of the entire State were collected and analyzed in the chemical laboratory of the Bureau. The results of these analyses furnish the necessary information to determine the suitability of the waters for domestic use, boiler feed, laundering, and various other industrial processes. The results of these analyses are published in an appendix to this report.

The recent floods in the northern part of the State with the consequent heavy damage to crops and other property have revealed a class of work for which there is a great need, but for which no funds have been available. This relates to preliminary topographic surveys of the streams from which general plans can be made for improvements to protect the adjoining lands from overflow.

Losses from floods in the State have been very large and have occurred repeatedly at intervals of only a few years. The damage caused by the floods of September, 1926, alone exceeded a million dollars. These losses should not be permitted to go on indefinitely. Measurements of the flow of many streams at flood stage made by the Bureau show that in most places the greater part of the water is carried by the regular channel and only a small part by the overflow section. Although the area of the overflow may be much greater than the area of the main channel, yet the velocity in the over-

flow area is relatively small; consequently the amount of water carried by the overflow section is only a small part of the total. This is due to the fact that the flow of water in the overflow section is usually greatly retarded by trees, brush, crops and weeds. The carrying capacity of the channels of most streams subject to overflow can be very materially increased by dredging new straight channels to replace the crooked natural channels. The measurements of flow that have been made on streams that were straightened by dredging show definitely that the carrying capacities of these channels gradually increase through erosion caused by the much higher velocities. After a few years the amount of water that can be carried by these channels is considerably greater than at the time the improvement is made.

Sections of some of the streams in the northern part of the State have been improved by dredging new channels and building levees along them. The damage caused by the floods of September, 1926, in these sections was relatively much less than in the unimproved sections of the streams. In fact, improving one section of a stream usually intensifies the flooding in the lower unimproved sections, as the water is then carried down more rapidly from above. The logical way to improve a stream is to take it as a whole. Piece-meal work not only is less effective for the sections improved, but makes the conditions worse for the unimproved sections downstream.

The continued recurrence of heavy flood losses on these streams is not warranted on economic grounds. The improvement of these streams as entire units would be greatly facilitated by a system of topographic surveys which could be used for making the preliminary plans for the improvements and for determining the benefits that would be derived and probable cost. Such surveys can be made very economically by the Bureau of Geology and Mines by the plane table method, as has been demonstrated by the surveys that have been made of parts of the Gasconade and Current rivers.

APPROPRIATION REQUESTED.

The foregoing pages briefly outline the activities of the Bureau during the past biennial period. Many of the geological investigations are still in progress and data covering other surveys are in constant demand.

In order that the work may keep pace with the urgent needs, the Board of Managers requests the following appropriation for each department:

Geology and Mining	(for salaries of permanent and temporary employees, field and traveling expenses, equipment, chemicals, stationery, engraving maps, and printing reports).	$91,300.00
Topographic Mapping	(for making topographic maps in co-operation with the U. S. Geological Survey, the latter to meet the State appropriation dollar for dollar).....	45,000.00
Water Power and Flood Control	(for engineers' salaries, office expenses, equipment, traveling and field expenses, etc.) (The U. S. Geological Survey appropriates $6,750.00 in co-operation).....	20,000.00
	(For large scale mapping of rivers to determine water power and flood control possibilities).	10,000.00
		$166,300.00

The above amounts are virtually the same as requested two years ago, and the appropriations are based on requests and needs of the Department. Under the Geology and Mining appropriation there are reports and maps practically available for publication that have not been issued, due to the lack of funds. These reports and maps are the results of the field work done by members of the staff. They are the important connection in getting the data to the investor and public and should be published at an early date. At the present time there are, virtually completed, geological maps of Lawrence, Boone, and Callaway counties, and nine large township maps covering the Joplin mining region, also geologic maps covering the Potosi region in Washington County, and the Eminence region in Shannon

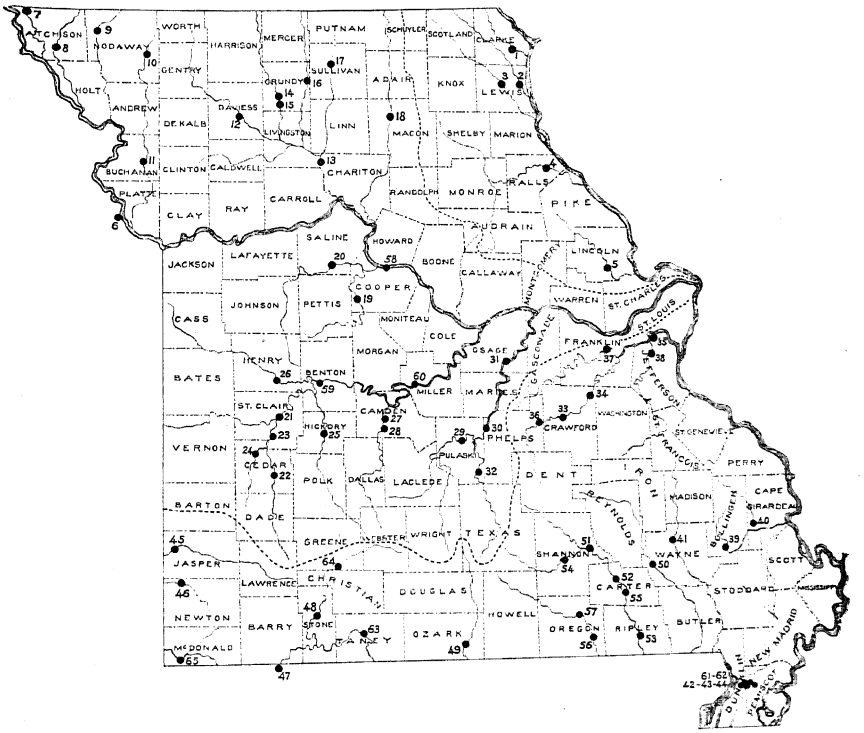
County. Geological reports covering Ste. Genevieve, Boone, Callaway and Lawrence counties are prepared, also manuscript covering the Eminence-Potosi regions, with correlations covering the general stratigraphy of the Ozark region.

The demands for areal topographic mapping have far exceeded our ability to comply. In addition to quadrangles in Southeast Missouri needed for geological work, many quadrangles have been requested along the Osage, Gasconade, White, Current and Eleven Point rivers, by companies interested in the development of water power possibilities. The State Highway Department has requested maps in several areas for highway location, and the clay manufacturers ask that a large area in Callaway, Audrain and adjoining counties be mapped at an early date. These are direct requests from industries needing the maps. There are many not so urgent, but where the maps are needed. Under the present appropriation we cannot meet even the urgent request of the industries.

There has been no increase in the request for water power and flood control investigations; the present appropriation covers the cost of the organization as operating at present.

The request for river mapping is the same as for the past biennial period. The 53rd General Assembly appropriated $10,000.00 for this work, but because of lack of funds the entire amount was withheld. In the proper development of our water powers large scale maps are necessary. The recent floods in North Missouri have drawn attention to the vast destruction of crops by floods. Such destruction can be, to a large extent, controlled by proper drainage. Large scale maps of the more important rivers are necessary for complete study.

Missouri Bureau of Geology and Mines. Biennial Report, 1925-1926, Plate III.



Bureau of Geology and Mines, H. A. Buehler, State Geologist,
Map showing location of Gaging Stations, 1926.

MINERAL PRODUCTION OF MISSOURI.

During 1923 to 1925 the mineral industry in Missouri experienced a rapid recovery, production in 1925 reaching nearly $90,000,000, almost as much as in the war-year of 1917 when a record of over $91,000,000 was made. And this new peak was reached in spite of a loss, since 1917, of over $16,000,000 in zinc ore and $5,500,000 in coal production. As compared with the recent low year of 1921, only five years ago, of $52,000,000, the present production is 42 per cent greater. Lead and zinc increased nearly 300 per cent, clay products and cement 75 per cent, limestone 80 per cent, marble 230 per cent, sand and gravel 350 per cent, lime 60 per cent, and raw clay 55 per cent. These are all in the million dollar class of production.

New records were set in clay products at $18,544,117; cement at $14,155,795; limestone at $4,085,883; marble at $1,439,604; sand and gravel at $3,595,187; lime and hydrated lime at $1,860,244 and $750,710 respectively and in tonnage of barytes at 101,056 short tons.

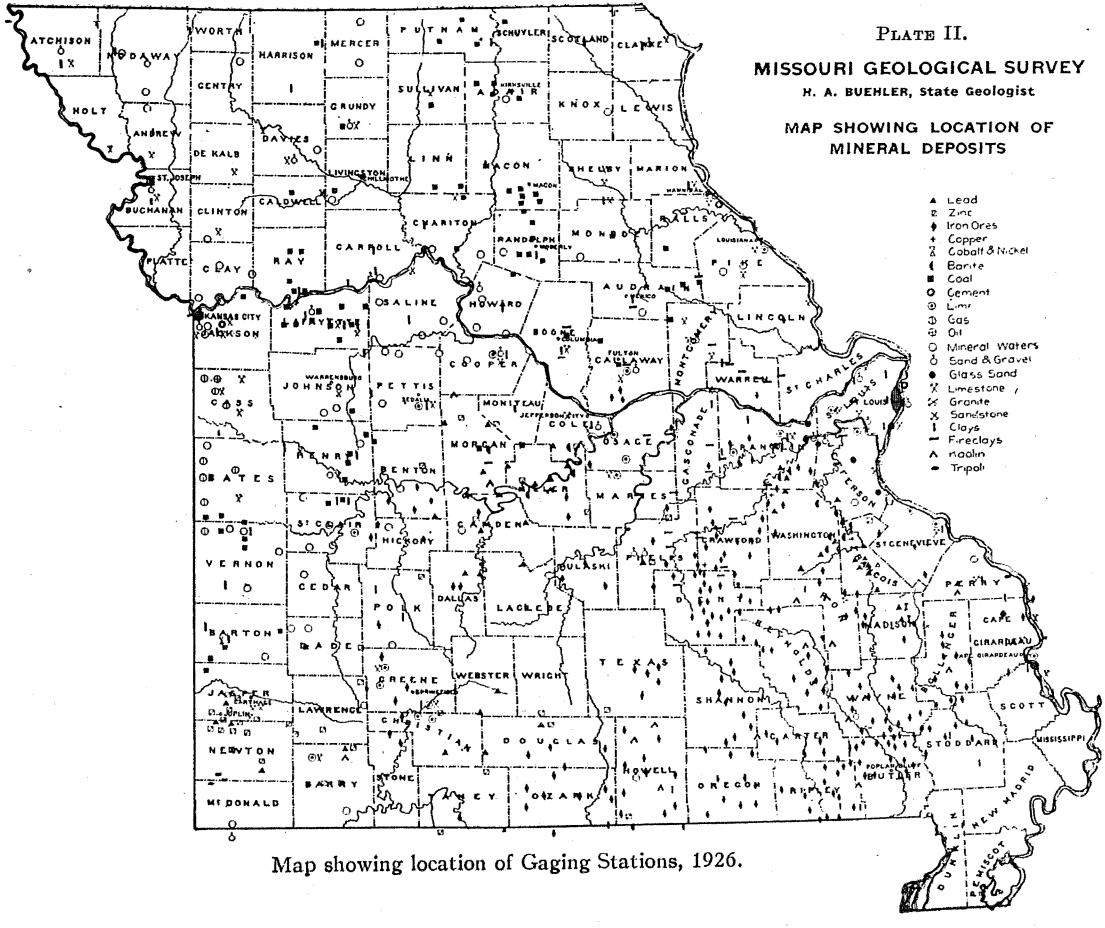
The table on page 28 gives a summary of the production from 1917 to 1925, inclusive. In the discussions which follow, the term "ton" means a short ton of 2,000 pounds.

The statistics were collected in cooperation with the United States Geological Survey, the United States Bureau of Mines and the United States Bureau of Census. In all cases where there are less than three producers the figures are concealed to avoid revealing the production of any individual.

VALUE OF MINERAL PRODUCTION OF MISSOURI, 1917-1925.

Commodity.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.
Lead ore	$34,038,976	$21,988,567	$12,107,731	$20,284,921	$11,825,280	$14,934,548	$19,692,318	$25,037,380	$32,125,281
Zinc	17,708,604	5,473,483	2,429,235	2,142,564	491,365	952,411	1,403,365	1,010,059	1,488,593
Coal	13,755,864	17,126,498	12,766,366	22,230,000	13,915,500	11,153,000	11,575,000	8,154,000	8,281,000
Clay products	10,328,374	9,198,184	11,016,333	17,443,458	10,579,034	11,552,982	18,509,937	16,826,511	18,544,117
Cement	8,248,007	7,132,470	9,264,017	10,980,453	8,034,540	10,457,557	13,237,141	13,515,267	14,155,795
Limestone	1,679,677	1,359,755	1,759,129	2,776,936	2,269,457	2,409,202	3,173,622	3,624,089	4,085,883
Marble	227,520	238,111	360,287	616,550	627,729	816,098	1,085,122	1,229,160	1,439,604
Sand and gravel	1,101,745	772,753	873,333	1,356,352	1,018,325	1,063,370	2,007,529	2,053,436	3,595,187
Lime	1,435,914	1,376,046	1,333,085	1,735,002	1,169,391	1,402,337	1,830,937	1,711,180	1,860,244
Lime, hydrated	(c)	201,737	402,620	584,283	487,169	551,187	674,848	642,995	750,710
Clay	1,386,338	1,192,996	1,004,033	1,413,189	938,135	1,238,622	1,624,789	1,441,457	1,463,880
Chats	214,007	135,319	206,353	167,028	259,571	306,252	431,884	520,269	399,002
Barytes	391,373	393,738	640,398	1,013,570	217,913	421,568	629,097	604,390	749,927
Copper	99,649	142,683	300,799	278,307	17,749	107,649	29,776	23,948	1,718
Mineral waters	57,175	38,478	39,641	50,892	45,670	40,149	38,145	30,000	32,000
Tripoli	90,293	81,728	8,926	(a)	(a)	(a)	(a)	(a)	(a)
Iron ore	134,906	270,337	223,144	230,827	169,516	244,928	247,975	405,622	(a)
Granite	58,241	54,523	(a)	114,663	81,389	85,093	83,804	108,084	137,348
Silver	50,747	46,939	101,249	121,130	69,902	212,656	145,361	69,475	57,538
Sandstone	6,862	(a)	(d)	(a)	(d)	(a)	(a)	(d)	(d)
Natural gas	8,230	5,548	3,000	2,600	2,130	780	3,000	3,000	3,100
Pottery	(a)	(a)	20,817	31,084	89,657	96,513	94,985	95,936	77,090
Miscellaneous (b)	33,051	98,489	118,184	169,680	4,484	21,062	130,427	132,875	327,289
Totals	$91,056,173	$67,674,136	$54,978,580	$83,743,489	$52,224,249	$58,018,949	$76,649,062	$77,239,133	$89,575,306

(a) Included in miscellaneous.
(b) 1917 includes pyrite, petroleum, pottery, cobalt, nickel, and tungsten.
1918 includes potash, pottery, pyrites, sandstone and miscellaneous stone.
1919 includes pyrites, granite, potash and petroleum.
1920-1922 includes pyrites, tripoli, potash, petroleum, sandstone and miscellaneous stone.
1923 includes mineral waters, petroleum, sandstone and tripoli.
1924 includes asphaltic sandstone, miscellaneous stone and tripoli.
1925 includes iron, ground silica, miscellaneous stone and tripoli.
(c) Included under lime.
(d) No production.



Map showing location of Gaging Stations, 1926.

ASPHALTIC SANDSTONE.

Although a small production of asphaltic sandstone was reported in 1924 from Vernon County, the deposits have not been opened on a commercial scale, and as far as known there was no output during the past year. The various companies organized to develop the deposits are evidently yet in the experimental stage.

Much attention has been given the deposits especially in Vernon County and a rather extensive campaign of diamond drilling has shown several million tons of available rock which can be won without the removal of an excessive amount of overburden.

Other than diamond drilling in Cedar County no development work has been reported on similar deposits in Cass, Barton and Lafayette counties.

During the biennial period the Bureau has published a detailed geological report covering Vernon County (Vol. XIX), in which the deposits are described. Brief descriptions of the deposits throughout Southwest Missouri are given in Vol. XV, the Sand and Gravel Resources of Missouri. In addition the Bureau has made analyses of typical samples and drill cores which show the sandstone to carry from 5 to 10 per cent bitumen; composed approximately of 75 per cent petrolene and 25 per cent asphaltine. The results check in general former analyses made in the Survey laboratories. Plans are at present being made to lay certain test pieces of road to determine the suitability of this material in highway construction.

BARYTES.

In 1924 the production and value of crude barytes continued at practically the same high rate as in 1923, being 77,189 tons valued at $604,390 and in 1925 increased over 30 per cent to 101,056 tons with a value of $794,927. This is a record tonnage, being the first year in which it has been over 100,000, and the value is exceeded only by 1920 when the record average high price per ton of $10.17 was paid. The average price per ton has increased only slightly in the last three years, as shown by the table below, to $7.87 in 1925.

This average price is slightly below the market price as quoted in the Engineering & Mining Journal, the first week of each month, owing to the quotations being the price paid jobbers whereas the production reports are mostly sales by miners to jobbers. The sustained high production has been due to a steady demand which has been fostered by the firm market for lithopone and ground barytes in the paint and rubber industries. Production has continued at a high rate in 1926 and although there was a slight drop in the quotations in the late spring the market has been firm and demand sustained at about $8.00 per ton.

Missouri again leads in State production and value as shown by the following figures taken from the Mineral Resources pamphlets published by the United States Geological Survey:

CRUDE BARYTES SOLD BY PRODUCERS IN THE UNITED STATES IN 1925.

	Tons.	Value.	Per cent.	Av. value per ton.
Missouri	101,056	$794,927	40.7	$7.87
Georgia	65,936	475,618	27.9	7.22
Tennessee	47,012	345,038	20.3	7.35
Other states	14,059	87,514	5.1	6.25
Totals	228,063	$1,703,097	100.0	$7.47

Barytes is mined in Missouri chiefly by individual "tiff diggers" who take a lease on a piece of land and pay a royalty or who dig the ore at a stated price per ton, the proprietor marketing the ore. Small shafts are dug, the ore being found in the residual clay, usually concentrated near the bed rock. After drying it is shaken in rockers to remove the clay and hauled to market. In recent years two steam shovels and washing plants have been installed in the district.

Barytes is refined for use by grinding, washing, leaching with acid to remove iron, again washed and sized. Its principal use is in lithopone, a mixture of about 70 per cent barium sulphate and 30 per cent zinc sulphide, which is used extensively as an inside paint and as a filler in rubber goods, linoleum, oil cloth, window shades, paper, etc. Refined barytes is also used as a pigment in inside paints and as a filler in the same goods in which lithopone is used. Barytes has also recently come into use in the

manufacture of Titanox, an intimate mixture of barium and titanium compounds, which has uses similar to those of lithopone. About 90 per cent of the refined barytes sold is manufactured in Missouri. The average price per ton is around $23.00.

The tables below give the figures on production, and the producers of barium products in Missouri:

BARYTES—TABLE OF PRODUCTION, 1907–1925.

Year.	Number producers reporting.	Stock on hand Dec. 31.	Shipments, tons (short).	Value.	Average per ton.
1907	.....	.....	44,039	$163,459	$3.69
1908	.....	.....	16,319	56,768	3.48
1909	.....	.....	34,815	119,818	3.44
1910	.....	.....	25,431	85,624	3.32
1911	.....	.....	21,500	81,380	3.79
1912	.....	.....	24,530	117,035	4.77
1913	.....	.....	31,131	117,638	3.75
1914	.....	.....	33,317	117,738	3.53
1915	.....	.....	39,113	158,597	4.05
1916	.....	.....	58,407	365,111	6.25
1917	.....	.....	59,046	391,363	6.62
1918	.....	.....	49,094	393,738	8.02
1919	.....	8,090	73,247	640,398	8.74
1920	70	3,154	99,654	1,013,570	10.17
1921	68	10,136	25,200	217,913	8.64
1922	61	5,202	66,421	421,568	6.35
1923	85	6,111	81,701	629,097	7.70
1924	70	2,222	77,189	604,390	7.83
1925	83	4,919	101,056	794,927	7.87

PRODUCERS OF REFINED BARYTES IN MISSOURI.

Ground Barytes:

C. P. DeLore Co., St. Louis, Mo.
National Pigments & Chemical Co., St. Louis, Mo.
Point Milling & Manufacturing Co., Mineral Point, Mo.

Barium Chemicals:

Titanium Pigment Co. (Inc.), Carondelet Sta., St. Louis, Mo.

PRODUCTION OF BARYTES IN MISSOURI, BY COUNTIES, FOR 1922-1925.

County.	1922.		1923.		1924.		1925.	
	Quantity sold.	Value.	Quantity sold.	Value.	Quantity sold.	Value.	Quantity sold.	Value.
Cole	475	$2,612	(a)	(a)	(a)	(a)	2,778	$23,714
Jefferson	1,187	6,890	2,467	$20,003	1,740	$12,074	3,745	29,647
St. Francois	637	4,593	521	3,682	435	3,053	2,027	15,657
Washington	53,136	338,218	62,987	484,307	56,288	443,221	84,211	660,693
Other counties (b)	791	4,517	785	6,068	1,644	13,011	1,967	15,415
Undistributed	10,195	64,738	14,941	115,037	17,082	133,031	6,328	49,801
Totals	66,421	$421,568	81,701	$629,097	77,189	$604,390	101,056	$749,927

(a) Cole included with other counties in 1923 and 1924

(b) Other counties include Franklin, Miller and Morgan in 1922; Cole, Franklin, Miller and Morgan in 1923; Benton, Cole, Franklin, Hickory and Polk in 1924; Franklin, Hickory and Morgan in 1925.

PRODUCERS OF CRUDE BARYTES.

Producer.	Location of mine.
BENTON COUNTY—	
Basic Chem. Mfg. Corp., Alton, Ill.	Cole Camp
Westerman Bros., Weaubleau	Cole Camp
COLE COUNTY—	
O. S. Reaves	Henley
National Pigments & Chemical Co., St. Louis	Henley
Ozark Mining & Milling Co.	Henley
Cole County Producing Co.	Henley
FRANKLIN COUNTY—	
J. H. Johnson	Morrelton
Wm. Casey	St. Clair
Salor Mines, Inc., C. A. Wolley, Manager	St. Clair
HICKORY COUNTY—	
Mill Creek Mining Co.	Cross Timbers
Tom Sanders	Hermitage
Dody, Allen & Hardy	Weaubleau
Westerman Bros.	Weaubleau
Wright Bros. & Tipton	Wheatland
JEFFERSON COUNTY—	
Lessees of Taussig land	Frumet
Joshua Cole	Blackwell
G. F. Engledow	Blackwell
W. A. Jones	Melzo
C. P. DeLore, St. Louis	Vineland
Valle Mining Co.	Vineland
W. E. Bernhardt	Vineland
Mat Luebbers	DeSoto
MILLER COUNTY—	
P. M. Ritchie	Tuscumbia
Central Mo. Mineral Co., St. Louis	Tuscumbia
MORGAN COUNTY—	
Arthur J. Adams, Omaha, Neb.	Versailles
E. Jobe	Rocky Mount
Geo. H. Hubbard	Versailles
Versailles Barytes Co., Ltd.	Versailles
POLK COUNTY—	
Westerman Bros., Weaubleau	Bolivar
ST. FRANCOIS COUNTY—	
Mrs. L. Aly	Blackwell
Estate of A. D. Politte	Blackwell

PRODUCERS OF CRUDE BARYTES—Continued.

Producer.	Location of mine.
ST. FRANCOIS COUNTY—Continued.	
T. F. Boyer	Blackwell
Edward Flick	Blackwell
L. E. Cole	Blackwell
R. B. Cole	Blackwell
Cole & Brown	Blackwell
William Perkins	Desloge
Ode Engledow	Blackwell
J. R. Politte	Blackwell
Clarence Bess (W. C. Ashburn Est.)	Bonne Terre
C. E. Boyer	Blackwell
WASHINGTON COUNTY—	
F. A. Clancy	Baryties
Mrs. Lizzie Aubuchon, Tiff	Baryties
John Degonia	Baryties
P. Coleman	Baryties
Gratz & Stocking, DeSoto	Baryties
F. F. Boyer	Blackwell
Washington Land & Mining Co., St. Louis	Bliss
James Donald	Blackwell
Ode Engledow	Blackwell
C. E. Short	Blackwell
Aubuchon Mining Co., St. Louis	Cadet
John O. Long & Son	Cadet
M. E. Rhodes	Cadet
Adolph Portell	Cadet
Mrs. Mary Portell	Cadet
Anthony Recar	Cruise
Geo. W. Cook	Fertile
H. T. Henry	Fertile
McGready & Cole (L. E. Cole), Blackwell	Fertile
James Pashea, Fletcher (buyer)	
C. A. Stocking, DeSoto	Fletcher
Richwoods Dev. Co., DeSoto	Fletcher, Richwoods
A. E. Stocking, DeSoto	Fletcher, Richwoods
St. Joseph Lead Co., Bonne Terre	Hopewell
D. N. Baker	Mineral Point
Mrs. Agnes M. Boas	Mineral Point
Arthur Dale	Mineral Point
Eagle-Picher Lead Co., Chicago	Mineral Point
Mike Higgins	Mineral Point
M. F. Higgins, Potosi	Mineral Point
John Wallace	Mineral Point
Edgar Gard	Mineral Point
P. E. Walton & Bros.	Mineral Point
Joe Patashnick	Mineral Point
Point Milling and Mfg. Co.	Mineral Point, Baryties
P. C. Walton & Bros	Mineral Point

PRODUCERS OF CRUDE BARYTES—Continued.

Producer.	Location of mine.
WASHINGTON COUNTY—Continued.	
Mrs. M. J. Waugh	Mineral Point
E. F. Cordia Land & Lumber Co., St. Louis	Potosi
Mrs. Ermine Hutchison	Potosi
Pierce & Stocking, DeSoto	Richwoods, Fletcher
Theo. Walther, DeSoto	Richwoods
George Aly	Vineland
George Wallace & Geo. Carr	Belgrade
National Pigments & Chem. Co.	Cadet
C. P. DeLore	Cadet
C. J. Daniels	Mineral Point
C. M. Wells	Mineral Point
C. B. Groves	Old Mines
J. W. Settle & Co.	Old Mines
White & Bros.	Old Mines
Murphy & Allen	Old Mines
T. F. Blount	Potosi
Hugh McGregor	Potosi
S. E. Missouri Lead Co.	Potosi
Benj. A. Wood	Potosi
Rev. Clark Martin	Potosi
J. W. Towl	Potosi
Evans & Russell	Potosi
E. M. Dearing	Potosi
C. C. Rose & H. O. Hollow	Richwoods
C. A. Johnson	Richwoods
Steve Kelso	Richwoods
Mrs. S. C. Coleman	Racola
Bust Bros	Tiff
Thurman & Banta	Tiff

CEMENT.

The production of Portland cement in Missouri has continued showing an increase each year since 1921, setting a new record in both quantity and value although there has been a nearly even decline in the price per barrel, as shown by the table below. Cement has now become the third mineral product in value, being exceeded only by lead and by clay products. The cause for this steady increase may be found in the sustained building activity and the increasing use of cement in road building. The State continues to be fourth in rank, being exceeded only by Pennsylvania, California and Michigan.

The number of kilns in use remains constant at 39, but the sizes have increased so that the minimum is now 108 by 6½ feet, the maximum remaining at 240 by 12 feet. An average of about 2600 people are employed in the industry in Missouri.

In 1924 the celebration of Joseph Aspdin's invention of Portland cement took place. A brief history of the development of the industry may be found in "Cement in 1924" published by the United States Bureau of Mines and sold by the Superintendent of Documents at Washington, D. C., for five cents.

The consumption of cement in Missouri is about 48 per cent of the production, the excess being shipped to nearby states which are without plants or which have a deficiency in production. The Missouri plants are strategically located, being on the State boundaries and so on the edge of other states in which the industry is less developed, such as Illinois, Nebraska, Arkansas, Kentucky and Mississippi.

The following tables give the figures on production and the list of manufactures:

PRODUCTION OF PORTLAND CEMENT, 1916-1925.

Year.	Barrels.				Price per barrel.
	Stock on hand Jan. 1.	Manufactured.	Sold.	Value.	
1915	.....	4,646,771	4,628,484	$4,007,679	$0.866
1916	.....	5,178,021	5,732,001	6,333,567	1.105
1917	.....	5,882,240	5,800,988	8,248,007	1.435
1918	404,624	4,738,596	4,515,695	7,132,470	1.579
1919	676,552	5,216,347	5,496,164	9,264,017	1.686
1920	160,123	6,017,517	5,605,952	10,980,453	1.96
1921	571,688	4,446,091	4,375,712	8,034,540	1.84
1922	640,932	6,170,633	6,239,144	10,457,557	1.68
1923	636,625	7,305,997	7,143,883	13,237,141	1.85
1924	774,922	7,871,621	7,711,206	13,515,267	1.77
1925	921,165	8,331,751	8,168,165	14,155,795	1.73

Stock on hand Dec. 31, 1925—1,084,751 barrels.

PORTLAND CEMENT PLANTS IN MISSOURI.

Firm name.	Material used.a	County.	Town.
Atlas Portland Cement Co....	ls. & sh.....	Ralls.....	Hannibal.
Marquette Cement Mfg. Co...	ls. & clay.....	Cape Girardeau....	Cape Girardeau.
Alpha Portland Cement Co...	ls. & clay.....	St. Louis.....	Continental.
Missouri Portland Cement Co.	ls. & sh.....	St. Louis.....	Prospect Hill.
Missouri Portland Cement Co.	ls. & sh.....	Jackson.....	Sugar Creek.

a ls. = limestone; sh. = shale.

CLAY AND CLAY PRODUCTS.

The production and value of clay mined in Missouri in 1924–1925, while showing a slight decrease in value over the record year of 1923, nevertheless points to a very active and satisfactory condition in this industry. The value of clay mined in 1925 shows a slight increase over 1924 and from the activity shown in 1926 the total value of the raw clay mined should be as great as in each of the two years mentioned.

Considerable interest has been manifested by the clay-working industries during the past two years in the prospecting and development of areas for immediate production and in the development of reserve supplies.

Attention has been focused chiefly on the fire clays of the central part of the State. The Flint, Burley and Diaspore deposits of the central Ozark region have been given serious consideration, and as a result the tonnage output of Diaspore clay, 15,177 tons, valued at $102,064, establishes a new record for this type of clay. With the depletion of available reserves near the present centers of production, operators have gone over other parts of the field and several large deposits have been opened. This is particularly true of the area north of Rolla, where several new pits have been opened, one of which has become an important producer.

Drilling operations have been pushed in other parts of the field and the diamond core drill has been used to some extent for the first time.

The area of plastic semi-flint clays lying north of Missouri River and particularly developed in Audrain, Callaway, and Montgomery counties has also been under consideration and new deposits have been opened during the last two years. Diamond core drilling has been found to be particularly adapted to this part of the state, the method not only procuring representative samples but also keeping particles of limestone and shale in the overburden from becoming mixed with clay. Drilling has been in progress near Montgomery City, near Vandalia, at Mexico and in the Fulton district, and a considerable tonnage of high-grade material has been blocked out.

While the fire clays have attracted the most attention during the last two years, other types of clays have been produced and the deposits extended. Production of the high-grade ball clays used in the manufacture of dinner-ware, tile and other high-grade clay products has been continuous from the Poplar Bluff, Butler County district. The deposits are extensive and field work has suggested that other deposits will be found with prospecting. The uses of these clays are being extended and an increase in tonnage may be expected.

There has been no production of the white residual kaolins from Bollinger County in the last two years. Some kaolin, however, has been produced in Morgan County and used for special purposes.

The extensive shale deposits of the Pennsylvanian or Coal Measure formations have been worked in many parts of the state for use in the manufacture of brick, hollow tile, sewer pipe and other heavy clay products. Clays suited to the manufacture of common brick and hollow tile are being used from the Tertiary formations in Southeast Missouri.

The bulk of the tonnage of raw clay mined is manufactured into clay products by the company mining the material. Consequently the value is not reported in the state total.

The statistics and value of production for clay mined from 1915 to 1925 are given below. A list of producers of clay is also given.

The outstanding developments in the clay working industries in the last two years have been confined particularly to the fire brick industry. The development of high-grade refractories and improvements in burning have been notable. The continuous type of kiln is being adopted in many parts of the fire-brick producing area, particularly in the St. Louis district, and in the Audrain County field. This type of kiln claims many advantages,

chief among which may be noted the saving of fuel, reduction of labor, decrease in period of burning, and a higher grade and more uniform final product. The kilns are part of a unit assembly and the process, from the grinding of the raw material to the final product is a continuous one.

The Diaspore clays have been the subject of considerable research and high-grade super-refractories have been produced and are being satisfactorily used in many industries, particularly in the lining of lime and Portland cement kilns.

The activity in the building industry has stimulated the manufacture of common brick and hollow tile, and the other branches of the clay-working industries have experienced, in general, satisfactory conditions during the biennial period.

Missouri ranks second in the manufacture of fire brick, and sewer pipe, third in the production of raw or prepared clay, fifth in drain tile and architectural terra cotta, and commands a high position among the states of the Union in the manufacture of common and vitrified brick, and other clay products.

The production and value of clay products in this state and a list of the producers and class of ware burned are given below.

VALUE OF CLAY PRODUCTS, 1922-1925.

Product.	1922.	1923.	1924.	1925 (*b*)
Fire brick	$4,698,064	$7,553,898	$7,354,048	$7,431,975
Sewer pipe	2,349,130	2,605,922	2,825,623	(*c*)
Common brick	1,393,673	2,469,561	1,802,833	2,397,724
Face brick	1,057,354	1,074,989	1,165,734	1,428,726
Hollow building tile or block	379,348	517,196	448,713	557,349
Drain tile	83,611	70,855	96,796	50,960
Pottery	96,513	94,985	95,936	(*c*)
Miscellaneous (*a*)	1,591,802	1,547,959	3,132,764	6,754,473
Totals	$11,649,495	$18,604,919	$16,922,447	$18,621,207

(*a*) "Miscellaneous" includes vitrified brick, enameled brick, architectural terra cotta, tile other than drain tile, silica brick, clay gas retorts, stove lining, wall coping, high alumina brick, flue lining, segment blocks, refractory cement and raw or prepared clay.

(*b*) Statistics for 1925 are incomplete and subject to revision.

(*c*) Included with "miscellaneous" in 1925.

CLAY MINED AND SOLD, 1914-1925.

Year.	Fire Clay.									
	Plastic.		Flint.		Diaspore.		Miscellaneous. *c*		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1914	203,755	$432,786	*a*	.....	*b*	.....	5,426	$30,917	209,181	$463,703
1915	303,432	604,777	*a*	.....	*b*	.....	4,953	36,263	308,385	641,040
1916	254,865	436,441	179,675	$501,708	*b*	.....	3,963	48,575	439,583	988,884
1917	491,674	1,306,721	*a*	.....	*b*	.....	5,593	79,617	497,267	1,386,338
1918	365,339	942,547	87,453	159,105	*b*	.....	11,654	91,444	464,446	1,192,996
1919	217,905	804,376	121,928	177,750	*b*	.....	1,552	21,907	341,385	1,004,033
1920	329,563	1,130,266	111,165	266,814	*b*	.....	8,256	16,109	448,984	1,413,189
1921	159,831	627,289	95,963	302,485	*b*	.....	989	8,361	256,783	938,135
1922	259,011	711,087	137,470	406,637	13,384	$109,229	12,263	11,669	412,128	1,238,622
1923	338,010	1,252,003	142,584	301,474	10,617	54,450	4,586	16,862	495,797	1,624,789
1924	376,328	1,175,847	68,392	199,688	9,252	47,407	5,598	18,515	459,570	1,441,457
1925	340,870	1,138,664	91,015	201,728	15,177	102,064	5,944	20,624	453,006	1,463,880

a Fire clay not divided in 1914, 1915 and 1917.
b Diaspore clay not separated before 1922.
c Includes kaolin, stoneware clay and clay for miscellaneous uses.

PRODUCERS OF CLAY IN MISSOURI, 1924-1925.

Operator.	Type of clay mined.	Location.
AUDRAIN COUNTY—		
Farber Fire Brick Co.	Plastic fire clay	Farber.
A. P. Green Fire Brick Co.	Flint fire clay, plastic fire clay	Mexico.
Walsh Fire Clay Products Co.	Plastic fire clay	Vandalia.
Mo. Fire Brick Co.	Plastic fire clay	Vandalia.
BOLLINGER COUNTY—		
Frederick E. Bausch	Kaolin	Glenallen.
American China Clay Co., Samson Plaster Board Co	Kaolin	Lutesville.
J. A. Berry	Kaolin	Glenallen.
BOONE COUNTY—		
Edwards Brick Co.	Plastic fire clay	Columbia.
BUTLER COUNTY—		
Missouri Clay Mining Co.	Ball clay	Poplar Bluff.
CALLAWAY COUNTY—		
A. P. Green Fire Brick Co.	Flint and Plastic fire clay.	Fulton.
COLE COUNTY—		
J. K. Anderson	Kaolin	Centertown.
CRAWFORD COUNTY—		
Laclede-Christy Clay Products Co.	Diaspore, burley and flint fire clay	Hofflin.
FRANKLIN COUNTY—		
Laclede-Christy Clay Products Co.	Diaspore clay, flint fire clay	Beaufort and Leslie.
F. A. Toelke	Flint fire clay, diaspore and burley clay	Gerald.
Western Fire Brick Co.	Flint fire clay	Gerald.
Evans & Howard Fire Brick Co.	Flint fire clay	Gerald.
Hydraulic-Press Brick Co.	Flint fire clay	Johnson Spur.
General Chemical Co.	Flint fire clay	Gerald.
GASCONADE COUNTY—		
Campbell & Lichte	Flint fire clay	Bland.
Chas. E. Sassman	Flint and plastic fire clay.	Ditman.
A. P. Green Fire Brick Co.	Diaspore clay	Swiss.
Decker & Lacy	Flint fire clay	Canaan.
Evans & Howard Fire Brick Co.	Flint fire clay	Owensville.
General Chemical Co.	Flint fire clay	Owensville.

PRODUCERS OF CLAY IN MISSOURI, 1924-1925—Continued.

Operator.	Type of clay mined.	Location.
GASCONADE COUNTY—*Continued.*		
General Refractories Co.	Flint fire clay, diaspore clay	Owensville.
Chas. Brown	Flint fire clay	Rosebud.
Laclede-Christy Clay Products Co.	Flint fire clay, diaspore and burley clay	Canaan, Owensville & Rosebud.
Hydraulic Press Brick Co.	Flint fire clay	Rosebud.
Gasconade Clay Products Co.	Flint fire clay	Rosebud.
Louis Heidel	Flint fire clay	Rosebud.
John Wehmeyer	Flint and plastic fire clay	Rosebud.
Dewitt Terrill	Flint fire clay, diaspore and burley clays	Owensville.
Hydraulic Press Brick Co.	Flint fire clay	Rosebud.
F. A. Toelke	Flint fire clay; diaspore clay	Rosebud.
Gasconade Clay Co	Flint fire clay	
Owensville Fire Clay Co.	Flint fire clay	Owensville.
L. A. Haines		Canaan.
R. H. Nieman		Hermann.
HENRY COUNTY—		
James W. Edwards	Stoneware clay	Calhoun.
J. E. Guthridge	Stoneware clay	Calhoun.
JACKSON COUNTY—		
Builders Brick & Mfg. Co.	Miscellaneous clay	
Lyle Rock Co.		Kansas City.
Haydite Co.		Kansas City.
JOHNSON COUNTY—		
Johnson County Brick & Tile Co.	Brick and tile clay	Knobnoster.
LINCOLN COUNTY—		
Walsh Fire Clay Products Co.	Flint fire clay	Whiteside.
MARIES COUNTY—		
General Chemical Co.	Flint fire clay	Belle.
Evans & Howard Fire Brick Co.	Flint fire clay	Belle.
J. Heck	Flint fire clay	Belle.
Laclede-Christy Clay Products Co.	Diaspore, flint fire clay	Belle.
H. H. Heck	Flint and diaspore clay	Belle.
Willoughby and Jones	Flint fire clay	Belle.
General Abrasive Co.	Diaspore clay	Belle.
General Refractories Co.	Diaspore, burley clay	Belle.
MILLER COUNTY—		
C. P. Tellman	Kaolin, flint fire clay	Marys Home.

PRODUCERS OF CLAY IN MISSOURI, 1924-1925—Continued.

Operator.	Type of clay mined.	Location.
MONTGOMERY COUNTY—		
Supreme Fire Clay Co.	Flint fire clay	Jonesburg.
Hydraulic Press Brick Co.	Flint fire clay	New Florence.
Laclede-Christy Clay Products Co.	Plastic fire clay	Wellsville.
Wellsville Fire Brick Co.	Plastic fire clay	Wellsville.
Parker-Russell Mng. & Mfg. Co.	Flint and plastic fire clay	Wellsville.
Ed. McCullough	Flint and plastic fire clay	Jonesburg.
New Florence Fire Brick Co.	Plastic fire clay	New Florence.
MORGAN COUNTY—		
Geo. H. Hubbard	Kaolin	Versailles.
W. S. Dickey Clay Mfg. Co.	Flint fire clay	Versailles.
OSAGE COUNTY—		
H. H. Heck Clay Co.	Kaolin, flint fire clay, diaspore	Belle.
Laclede-Christy Clay Products Co.	Diaspore and flint fire clay	Belle.
General Chemical Co.	Flint fire clay	Belle.
J. O. Heck	Flint fire clay	Belle.
A. P. Green Fire Brick Co.	Diaspore	Chamois.
Evans & Howard	Flint fire clay	Chamois.
PHELPS COUNTY—		
Gray Bros.	Flint, diaspore and burley clay	St. James.
ST. LOUIS COUNTY—		
Missouri Fire Brick Co.	Plastic fire clay	Cheltenham, St. Louis.
Laclede-Christy Clay Products Co.	Plastic fire clay	Christy, Cheltenham, St. Louis.
Geo. W. Gittins Clay Products Co.	Plastic fire clay	Clayton.
Frederick E. Bausch	Plastic fire clay	Clayton.
Evans & Howard Fire Brick Co.	Plastic fire clay	Overland.
Volz Fire Clay Co.	Plastic fire clay	Clayton.
Glencoe Clay Co.	Flint and plastic fire clay	Glencoe.
Murray & Siems	Flint and plastic fire clay	Oakhill.
Walsh Fire Clay Products Co.	Plastic fire clay	St. Louis.
St. Louis Vitrified & Fire Brick Co.	Plastic fire clay	Maryland Hts.
Mound City Roofing Tile Co.	Miscellaneous clay	St. Louis.
ST. LOUIS CITY—		
Mutual Press Brick Co.	Miscellaneous clay	Shrewsbury.
Cheltenham Fire Clay Co.	Plastic fire clay	St. Louis.
Grand View Fire Clay Mines	Plastic fire clay	St. Louis.
Highlands Fire Clay Co.	Flint and plastic fire clay	St. Louis.
Parker-Russell Mng. & Mfg. Co.	Plastic fire clay	St. Louis.

PRODUCERS OF CLAY IN MISSOURI, 1924-1925—Continued.

Operator.	Type of clay mined.	Location.
WARREN COUNTY—		
Aug. Hummel	Flint and plastic fire clay.	Truesdale.
Walsh Fire Clay Products Co	Flint and plastic fire clay.	Truesdale and Jonesburg.
Aluminum Flake Co	Flint fire clay	Truesdale.
Joseph Good		Truesdale.
Christian Fahrmeyer		Warrenton.

PRODUCERS OF CLAY PRODUCTS, 1924-1925.

Operator.	Name of product.	Location of works.
AUDRAIN COUNTY—		
Farber Clay & Mining Co	Fire brick	Farber.
A. P. Green Fire Brick Co	Fire brick	Mexico.
Western Stove Lining Co	Stove lining	Mexico.
Walsh Fire Clay Products Co.	Fire brick	Vandalia.
Mexico Brick and Fire Clay Products Co		Mexico
BARTON COUNTY—		
Universal Brick & Tile Co.	Common brick	Oskaloosa.
Oskaloosa Brick Co		Oskaloosa.
Venetian Brick Co		Oskaloosa.
BATES COUNTY—		
W. S. Dickey Clay Mfg. Co	Drain tile	Rich Hill.
BOLLINGER COUNTY—		
American China Clay Products Co.		Lutesville.
BOONE COUNTY—		
Edwards Brick Co	Face brick; common brick; hollow building tile	Columbia.
BUCHANAN COUNTY—		
Coates Brick & Tile Co		St. Joseph.
St. Joseph Pressed Brick Co	Common brick; hollow building tile or block	St. Joseph.
Moorehead Brick & Tile Co	Common brick; hollow building tile or block	St. Joseph.
CALLAWAY COUNTY—		
Fulton Fire Brick Co	Fire brick	Fulton.

PRODUCERS OF CLAY PRODUCTS, 1924-1925—Continued.

Operator.	Name of product.	Location of works.
CAPE GIRARDEAU COUNTY—		
Cape Girardeau Press Brick Co.	Common brick	Cape Girardeau.
Kasten & Schmuke Press Brick Co.	Common brick; face brick.	Jackson.
CARROLL COUNTY—		
Carrollton Brick and Tile Mfg. Co.	Common brick	Carrollton.
CASS COUNTY—		
Harrison Brick and Tile Co	Face brick; hollow building tile or block	Harrisonville.
CHARITON COUNTY—		
Brunswick Brick and Tile Co	Common brick; drain tile; hollow building tile or block	Brunswick.
COLE COUNTY—		
Mo. State Board Penal Institutions.	Common brick	Jefferson City.
COOPER COUNTY—		
Missouri State Reformatory	Common brick	Boonville.
FRANKLIN COUNTY—		
Washington Dry Pressed Brick Works	Common brick	Washington.
GASCONADE COUNTY—		
Korff Bros. Brick Mfg. Co	Common brick	Rosebud.
HENRY COUNTY—		
W. S. Dickey Clay Mfg. Co	Drain tile; hollow building tile or block; sewer pipe; wall coping; segment blocks	Deepwater.
HOWARD COUNTY—		
Fayette Brick and Tile Co	Common brick; drain tile; hollow building tile or block; fire brick	Fayette.
JACKSON COUNTY—		
Hydraulic Press Brick Co.	Face Brick	Kansas City.
Builders Brick and Mfg. Co.	Common brick	Kansas City.
W. S. Dickey Clay Mfg. Co.	Sewer pipe; hollow building tile block; wall coping; miscellaneous	Kansas City.
Lyle Brick Co.	Common brick	Kansas City.
B-V Brick Co.	Common brick	Vale.

PRODUCERS OF CLAY PRODUCTS, 1924-1925—Continued.

Operator.	Name of product.	Location of works.
JACKSON COUNTY—*Continued.*		
Kansas City Brick Co.	Common brick; face brick; hollow building tile or block	Vale.
Norton Brick and Tile Co.		Kansas City.
Fredericksen Floor and Wall Tile Co.	Floor tile	Independence.
Ballou Brick Co.		Kansas City.
Kansas City Terra Cotta and Faience Co.	Architectural terra cotta	Kansas City.
JEFFERSON COUNTY—		
Festus Pressed Brick Co.	Common brick	Festus.
JOHNSON COUNTY—		
Johnson County Brick Co.	Common brick; face brick.	Knobnoster.
LAFAYETTE COUNTY—		
Higginsville Brick & Tile Co.	Common brick; hollow building tile or block	Higginsville.
LINCOLN COUNTY—		
Magruder Tile Factory	Drain tile	Winfield.
LIVINGSTON COUNTY—		
Shale Hill Brick & Tile Co	Drain tile; hollow building tile or block	Utica.
MONTGOMERY COUNTY—		
New Florence Fire Brick Co.	Fire brick	New Florence
Wellsville Fire Brick Co	Fire brick	Wellsville.
MORGAN COUNTY—		
W. S. Dickey Clay Mfg. Co.	Fire brick	Versailles.
PIKE COUNTY—		
Philip Schurfeld	Common brick; drain tile; hollow building tile or block	Louisiana.
RANDOLPH COUNTY—		
Moberly Paving Brick Co.	Common brick; brick for paving and other uses	Moberly.
ST. LOUIS COUNTY—		
Alton Brick Co	Common brick; face brick; hollow building tile or block	Maryland Hts.
Evans & Howard Fire Brick Co.	Fire brick	Clayton.
Continental Brick Co.	Common brick	Continental.

PRODUCERS OF CLAY PRODUCTS, 1924-1925—Continued.

Operator.	Name of product.	Location of works.
ST. LOUIS COUNTY—*Continued.*		
Wm. H. Warmann	Common brick	Eden.
St. Louis Vitrified & Fire Brick Co.	Fire brick	Maryland Hts.
Excelsior Press Brick Co.	Common brick	Brentwood.
Jacob Maes	Common brick	Luxemburg.
Missouri Pressed Brick & Imp. Co.	Common brick	St. Louis.
Walsh Fire Clay Products Co.	Fire brick	St. Louis.
Mutual Press Brick Co.	Common brick	Shrewsbury.
American Press Brick Co.	Common brick	Wellston.
ST. LOUIS CITY—		
Missouri Fire Brick Co.	Fire brick	Cheltenham.
Blackmar & Post Pipe Co.	Sewer Pipe	St. Louis.
Evans & Howard Fire Brick Co.	Drain tile; sewer pipe; fire brick	St. Louis.
Hydraulic Press Brick Co.	Common brick; vitrified brick for paving and other uses; fire brick; face brick; enameled brick; hollow building tile or block	St. Louis.
Laclede-Christy Clay Products Co.	Sewer pipe; hollow building tile or block; clay gas retorts; fire brick; miscellaneous	St. Louis.
Mitchell Clay Mfg. Co.	Fire brick	St. Louis.
Mound City Roofing Tile Co.	Roofing tile	St. Louis.
Parker-Russell Mng. & Mfg. Co.	Hollow building tile or block; fire brick; clay gas retorts; silica brick	St. Louis.
Progress Press Brick & Machine Co.	Common brick; face brick.	St. Louis.
St. Louis Terra Cotta Co.	Architectural terra cotta	St. Louis.
H. H. Schweer Brick Co.	Common brick	St. Louis.
Superior Press Brick Co.	Common brick; face brick.	St. Louis.
Winkle Terra Cotta Co.	Architectural terra cotta	St. Louis.
Walsh Fire Clay Products Co.	Fire brick	St. Louis.
SCOTT COUNTY—		
Post Bros. Tile Co.	Drain tile	Commerce.
Illmo Pressed Brick Co.	Common brick	Illmo.
STODDARD COUNTY—		
Dexter Brick & Tile Co.	Common brick	Dexter.
VERNON COUNTY—		
Norman Clay Tile Co.	Hollow building tile or block	Nevada.
H. Pohl	Common brick; face brick.	Nevada.

PRODUCERS OF POTTERY, 1924-1925.

Operator.	Name of product.	Location.
ST. LOUIS COUNTY—		
Missouri Pottery & Supply Co.	Red earthenware	St. Louis.
St. Louis Pottery & Mfg. Co.	Red earthenware	St. Louis.
National Lead Co.	Corroding pots	St. Louis.
SHELBY COUNTY—		
J. B. Cluskey	Stoneware	Lakenan.
STODDARD COUNTY—		
Evans Pottery	Stoneware and yellow and Rockingham ware	Dexter.

COAL.

Coal production in Missouri in 1923 recovered slightly to 3,403,151 tons valued at $11,575,000 although the average price per ton at the mines dropped to $3.40. In 1924, owing to a highly competitive market and over-production in nearby states, production slumped to 2,480,880 tons valued at $8,154,000 or $3.29 per ton. This is the lowest total value since 1915. In 1925 the price per ton dropped still further to $3.08 but the production increased to 2,694,215 tons, giving a value of $8,281,000. Production during 1926 has been at a higher rate owing partly to a shortage in Great Britain and the figures for this year should show a considerable recovery.

The failure of the coal industry to continue in development along with the increase of other industries may be laid to overproduction, unsettled labor conditions and increasing competition of oil fuel. Oil has become a competitor not so much in actual replacement of coal in old plants, as in displacement in new plants. It has been shown in an article by members of the United States Geological Survey in Coal Age, Jan. 15, 1925, by comparing the normally prosperous years of 1918 and 1923, that in comparing the heating value and consequently the power producible, the consumption of coal has fallen off about 3 per cent, while that of oil and natural gas has increased 91 per cent. The consumption of coal is still far ahead of oil and gas, but in those five years the ratio dropped from about 6 to 1, to nearly 3 to 1, gross consumption of coal falling off slightly in the interval.

Barton County with its large steam-shovel mines continues to lead in output, Ray, Lafayette and Bates following in that order. Barton, Bates and Henry counties, in which operations are mainly by steam-shovel, produced 43 per cent of the coal with 21 per cent of the men, even though the average number of days worked by them was not above the average for the state. Average tons per man per day for the entire state was 3.08; for Barton County, 8.96, and for Barton, Bates and Henry, 6.71.

As shown by the county table of production, coal in Missouri is extensively mined from Barton County to Adair and from Audrain to Platte County. The fields are scattered over the north-western third of the state and there is hardly a county underlain by the "Coal Measures" but what has mines for supplying local trade at least.

The following tables compiled by the United States Geological Survey and the United States Bureau of Mines give detailed figures on production, number of employees, days employed and a list of producers:

COAL PRODUCED IN MISSOURI, 1919-1925.

County.	1919.	1920.	(a) 1921.	1922.	1923.	(a) 1924.	(a) 1925.
Adair	517,910	777,986	527,804	221,703	251,783	154,295	188,828
Audrain (including Ralls in 1925)	16,683	18,626	10,538	17,526	15,959	16,920	22,300
Barton	887,174	965,757	726,347	658,092	704,090	739,854	947,844
Bates	57,050	115,621	39,690	147,047	119,934	207,847	263,710
Boone, Chariton, Moniteau and Callaway (b)	18,416	18,950	16,128	13,557	12,200	19,338	15,527
Caldwell, Clay, Dade and Platte	(c) 68,119	(c) 86,617	91,646	88,113	95,292	99,625	(d)
Callaway	51,010	58,462	32,191	41,255	26,602	(l)	28,389
Chariton	2,908	(d)	(d)	(e)	(e)	(e)	(e)
Cooper, Howard, Moniteau, Morgan and Pettis	(f) 21,970	29,300	4,514	(g)	(k)	(k)	(k)
Dade	6,324	6,342	(h)	(h)	(h)	(k)	(k)
Grundy, Harrison and Schuyler (i)	31,728	23,080	11,654	(i) 31,259	12,210	10,191	11,565
Henry	136,872	203,200	95,279	115,374	115,094	111,731	66,458
Johnson	77,958	45,434	15,240	44,201	58,500	(d)	(k)
Lafayette	651,193	885,569	540,421	416,383	511,277	326,497	355,419
Linn	99,991	142,290	89,747	53,807	27,964	21,829	15,739
Macon	384,846	720,227	473,985	352,137	571,350	181,598	60,766
Putnam	37,973	30,867	13,921	(d)	12,869	8,547	15,737
Randolph	320,835	422,903	324,836	158,692	233,529	138,224	113,752
Ray	408,148	578,694	476,117	423,881	518,633	408,202	449,931
Vernon	47,978	74,771	42,026	30,648	7,824	(d)	(d)
Other counties (d)	69,567	61,869	19,537	53,657	19,102	36,182	138,250

COAL PRODUCED IN MISSOURI, 1919-1925—Continued.

County.	1919.	1920.	(a) 1921.	1922.	1923.	1924.	1925.
Small mines	65,145	103,000	(k)	75,418	88,939	(k)	(k)
Tons	3,979,798	5,369,565	(a) 3,551,621	2,924,750	3,403,151	2,480,880	2,694,215
Value	$12,766,366	$22,230,000	$13,915,500	$11,153,000	$11,575,000	$8,154,000	$8,281,000
Average value per ton	$3.21	$4.16	$3.92	$3.81	$3.40	$3.29	$3.07

(a) Exclusive of product of wagon mines. (b) 1919-1921, 1925 Boone only, Chariton given elsewhere; production reported from Moniteau in 1922 only; Callaway in 1924 only. (c) Production for Dade given separately. (d) Other counties include Franklin, Ralls and St. Clair in 1919; Chariton, Ralls and St. Clair in 1920; Chariton, Franklin, Ralls and St. Clair in 1921; Franklin, Lincoln, Putnam, Ralls and St. Clair in 1922; Cass, Lincoln, Ralls and St. Clair in 1923; Johnson, Ralls and Vernon in 1924; Caldwell, Chariton, Clay, Cooper, Platte, St. Clair and Vernon in 1925. (e) Grouped with Boone and Moniteau. (f) No production in Morgan for 1919. (g) No production reported from Cooper, Howard, Morgan and Pettis; Moniteau given with Boone and Chariton. (h) Production for Dade given with Caldwell, Clay and Platte. (i) Not including Schuyler in 1919-1921. (k) No production reported. (l) Included with Boone, etc., in 1924.

COAL PRODUCED IN MISSOURI IN 1923

County.	Loaded at mines for shipment (net tons).	Sold to local trade and used by employees (net tons).	Used at mines for steam and heat (net tons).	Total quantity (net tons).	Total value.	Average value per ton.	Number of employes.			
							Underground.		Surface.	Total.
							Miners, *a*.	All others.		
Adair	238,846	5,883	7,054	251,783	$744,000	$2.96	369	116	49	534
Audrain	5,558	10,314	87	15,959	62,000	3.88	38	14	6	58
Barton	658,822	6,913	38,355	704,090	2,221,000	3.15	87	14	693	794
Bates	114,245	1,839	3,850	119,934	318,000	2.65	99	23	96	218
Boone and Chariton	.....	12,150	50	12,200	38,000	3.11	32	8	6	46
Caldwell, Clay, Dade and Platte	60,517	32,277	2,498	95,292	358,000	3.76	189	54	22	265
Callaway	6,800	19,602	200	26,602	110,000	4.13	46	14	7	67
Grundy, Harrison and Schuyler	3,284	8,426	500	12,210	66,000	5.41	51	12	5	68
Henry	107,600	5,669	1,825	115,094	318,000	2.76	19	3	95	117
Johnson	56,075	1,458	967	58,500	206,000	3.52	49	20	30	99
Lafayette	470,938	23,796	16,543	511,277	1,985,000	3.88	757	303	101	1,161
Linn	5,126	22,674	164	27,964	150,000	5.36	140	66	19	225
Macon	550,348	10,909	10,093	571,350	1,767,000	3.09	764	223	64	1,051
Putnam	12,869	.....	.....	12,869	48,000	3.71	85	24	11	120
Randolph	222,612	6,517	4,400	233,529	796,000	3.41	306	70	38	414
Ray	474,054	41,110	3,469	518,633	2,048,000	3.95	1,126	357	109	1,592

Vernon	7,478	212	134	7,824	21,000	2.68	35	8	9	52
Other counties *b*	17,164	1,698	240	19,102	52,000	2.72	25	6	40	71
Totals, excluding wagon mines	3,012,336	211,447	90,429	3,314,212	$11,308,000	$3.41	4,217	1,335	1,400	6,952
Wagon mines served by rail	88,939	.....	.....	88,939	267,000	3.00	.....	.....	.....	.....
Grand totals	3,101,275	211,447	90,429	3,403,151	$11,575,000	$3.40	.....	.....	.....	.....

a Includes also loaders and shot-firers.
b Cass, Lincoln, Ralls, and St. Clair.
The number of active mines in 1923 was 149.

COAL PRODUCED IN MISSOURI IN 1924. *a*

(Exclusive of product of wagon mines.)

County.	Net tons.				Value.		Number of employes.				Average number of days worked.
							Underground.		Surface.	Total.	
	Loaded at mines for shipment.	Sold to local trade and used by employes.	Used at mines for steam and heat.	Total quantity.	Total.	Average per ton.	Miners *b*	All others.			
Adair	123,193	26,082	5,020	154,295	$474,000	$3.07	218	111	24	353	138
Audrain	3,921	12,877	122	16,920	69,000	4.08	36	13	4	53	264
Barton	702,690	5,440	31,724	739,854	2,170,000	2.93	33	10	636	679	122
Bates	198,220	2,002	7,625	207,847	518,000	2.49	103	22	102	227	146
Boone, Chariton and Callaway	600	18,738	.....	19,338	65,000	3.36	43	8	7	58	176
Caldwell, Clay and Platte	51,279	45,590	2,756	99,625	472,000	4.74	194	79	24	297	182
Grundy, Harrison and Schuyler	2,050	7,904	237	10,191	52,000	5.10	40	12	6	58	151
Henry	101,300	9,605	826	111,731	322,000	2.88	21	3	99	123	192
Lafayette	277,635	39,163	9,699	326,497	1,238,000	3.79	865	273	101	1,239	124
Linn	2,699	19,027	103	21,829	104,000	4.76	72	18	12	102	111
Macon	170,533	9,519	1,546	181,598	559,000	3.08	594	159	59	812	101
Putnam	8,547	.....	.....	8,547	26,000	3.04	47	9	5	61	89
Randolph	128,289	6,070	3,865	138,224	446,000	3.23	328	55	37	420	144

Ray.....	363,639	41,504	3,059	408,202	1,529,000	3.75	993	277	132	1,402	146
Other counties *c*....	34,560	781	841	36,182	110,000	3.04	62	19	12	93	135
Totals.....	2,169,155	244,302	67,423	2,480,880	$8,154,000	$3.29	3,649	1,068	1,260	5,977	135

a Note that the coal statistics of the Geological Survey for a given year include only the mines that had an output in that year. Many mines that operated in 1923 produced no coal in 1924; moreover, many of the mines that did produce in 1924 worked for a short time only. The number of active mines of commercial size in Missouri was 127 in 1924.

b Includes also loaders and shot-firers.

c Johnson, Ralls and Vernon.

COAL PRODUCED IN MISSOURI IN 1925.[1]

(Exclusive of product of wagon mines.)

County.	Net tons.				Value.		Number of employes.				Average number of days worked.
	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total.	Average per ton.	Underground.		Surface.	Total.	
							Miners, loaders, and shot-firers.	All others.			
Adair	172,388	11,299	5,141	188,828	$477,000	$2.53	212	93	30	335	190
Audrain and Ralls	16,201	6,056	43	22,300	67,000	3.00	58	17	8	83	155
Barton	920,604	5,329	21,911	947,844	2,654,000	2.80	67	15	597	679	154
Bates	253,914	8,346	1,450	263,710	583,000	2.21	111	20	143	274	183
Boone	.....	15,488	39	15,527	55,000	3.54	26	7	5	38	184
Caldwell, Chariton, Cooper and Platte	18,597	16,175	1,474	36,246	176,000	4.86	113	17	16	146	129
Callaway	.....	28,324	65	28,389	104,000	3.66	78	21	29	128	163
Clay	28,120	22,576	342	51,038	210,000	4.11	120	27	14	161	173
Grundy, Harrison and Schuyler	5,694	5,521	350	11,565	48,000	4.15	30	11	5	46	165
Henry	60,035	5,594	829	66,458	178,000	2.68	24	4	59	87	188
Lafayette	304,598	42,539	8,282	355,419	1,269,000	3.57	723	224	85	1,032	155
Linn	5,065	10,534	140	15,739	71,000	4.51	71	12	8	91	151
Macon	44,542	16,064	160	60,766	197,000	3.24	131	43	16	190	141
Putnam	10,201	5,536	.....	15,737	47,000	2.99	75	19	9	103	78

Randolph.....	100,523	10,691	2,538	113,752	343,000	3.02	238	73	22	333	148
Ray.....	396,765	50,456	2,710	449,931	1,669,000	3.71	917	304	116	1,337	189
St. Clair and Vernon..	47,395	571	3,000	50,966	133,000	2.61	.....	.....	51	51	167
Totals.....	2,384,642	261,099	48,474	2,694,215	$8,281,000	$3.07	2,994	907	1,213	5,114	166

[1]These figures relate only to active mines of commercial size that produced coal in 1925. The number of such mines in Missouri was 154 in 1925.

Methods of mining in 1925: The tonnage undercut by hand was 322,215; shot off the solid, 136,180; cut by machines, 912,004; mined by stripping, 1,202,201; not specified, 121,615.

Size classes of commercial mines in 1925: There were 6 mines in Class 2 (100,000 to 200,000 tons) producing 26 per cent of the tonnage; 9 in Class 3 (50,000 to 100,000 tons) with 26.1 per cent; 38 in Class 4 (10,000 to 50,000 tons) with 36.3 per cent; and 101 in Class 5 (less than 10,000 tons) producing 11.6 per cent.

LIST OF PRINCIPAL COAL PRODUCERS IN MISSOURI.

	General office.	Location of mines.
ADAIR COUNTY—		
Arctic Coal & Mining Co	Novinger	Novinger.
Big Creek Coal Co	Kirksville	Kirksville.
Joe Blackwith & Sons	Connellsville	Connellsville.
Kansas City Midland Coal & Mining	Novinger	Novinger.
Riverside Coal Co	Youngstown	Youngstown.
Spring Creek Coal Co	Novinger	Novinger.
City of Kirksville	Kirksville	Kirksville.
Moyer Bros	Novinger	Novinger.
F. D. Scott	Novinger	Novinger.
Stahl Coal Co	Stahl	Stahl.
AUDRAIN COUNTY—		
Big Four Coal Co	Farber	Farber.
Eagle Coal Corporation	Vandalia	Vandalia.
Martinsburg Coal & Mining Co	Martinsburg	Martinsburg.
Midway Coal Co	Vandalia	Vandalia.
Vandalia Coal Co	Vandalia	Vandalia.
BARTON COUNTY—		
Ardath Coal Co	Mulberry, Kan	Ardath.
Bainter Coal Co	Liberal	Liberal.
Carney-Cherokee Coal Co	76 West Monroe St., Chicago, Ill	
Clemens Coal Co	Pittsburg, Kan	Mindenmines.
Domestic Fuel Co	Globe Bldg., Pittsburg, Kan	Ardath.
Ellsworth Coal Co	Pittsburg, Kan	Mindenmines.
LeComte & Norton Coal Co	Mindenmines	Mindenmines.
Liberal Coal & Mining Co	Liberal	Liberal.
Minden Coal Co	Joplin	Mindenmines.
Modern Coal Co	Mulberry, Kan	
L. J. Morgan Coal Co	Pittsburg, Kan	
Mulberry Coal Co	Globe Bldg., Pittsburg, Kan	
Petentler Coal Co	Mulberry, Kan	
Pittsburg & Midway Coal Mng	Pittsburg, Kan	Midway.
Pittsburg, Oskaloosa Coal Co	Pittsburg, Kan	Oskaloosa.
United States Coal Co	206 Commerce Bldg., Pittsburg, Kan	
BATES COUNTY—		
Bates Coal Mining & Merc. Co	Rich Hill	Rich Hill.
Blue Jay Coal & Mining Co	4319 Independence Ave., Kansas City, Mo	
D. H. Coal Co	Amsterdam	Amsterdam.
Donaldson & Ryan Coal Co	Rich Hill	Rich Hill.
J. F. Klaner Coal Co	Pittsburg, Kan	

LIST OF PRINCIPAL COAL PRODUCERS IN MISSOURI—Continued.

	General office.	Location of mines.
BATES COUNTY—*Continued.*		
N. & S. Coal Co	Pittsburg, Kan.	
Peacock Coal & Dev. Co.	Warrensburg	
Ritchie Coal Mining Co	Rich Hill	Rich Hill.
Ruchaber Coal Co	Sprague	Sprague.
Schooley Coal Co	Foster	Foster.
Standard Coal Co.	Pleasanton, Kan.	
Worland Coal Co	Worland	Worland.
D. H. Arbogast Coal Co	Foster	Foster.
J. H. Roberts	Foster	Foster.
BOONE COUNTY—		
Allen Coal Co	Manchester, Ky.	
Blackfoot Coal Co (W. R. Prather.)	Columbia	Columbia.
Clarke-Lane Coal Co	Columbia	Columbia.
DeMasters Coal Co	Columbia	Columbia.
Smarr & Algoe	207 North 8th St., Columbia	Columbia.
CALDWELL COUNTY—		
Caldwell Coal Co	Hamilton	Hamilton.
CALLAWAY COUNTY—		
Capitol City Coal Co	Jefferson City	
Central Missouri Coal & Mng. Co.	Jefferson City	
Department of Penal Institutions	Jefferson City	Holts Summit.
J. F. Reed	Fulton	Fulton.
Simmons Coal Co	321 W. 6th Ave., Fulton	Fulton.
Trigg-Crowson Coal Co.	Fulton	Fulton.
Clint M. Nickelson	Stephens	Stephens.
CHARITON COUNTY—		
Chariton County Coal & Coke Co.	Marceline	Marceline.
Shater & Teter	Prairie Hill	Prairie Hill.
CLAY COUNTY—		
Fairplay Coal & Dev. Co	Box 730, Excelsior Springs.	Excelsior Springs.
Missouri City Coal Co	Missouri City	Missouri City.
Mosby Block Coal Co	Mosby	Mosby.
COOPER COUNTY—		
E. L. Barlow	Boonville	Boonville.
DADE COUNTY—		
Bishop Bros.	Lockwood	Lockwood.
FRANKLIN COUNTY—		
Anaconda Coal & Mining Co.	Morrellton	Morrellton.

LIST OF PRINCIPAL COAL PRODUCERS IN MISSOURI—Continued.

	General office.	Location of mines.
GRUNDY COUNTY—		
Trenton Mining Co	Trenton	Trenton.
HARRISON COUNTY—		
Melbourne Coal & Mining Co	Melbourne	Melbourne.
HENRY COUNTY—		
Anaconda Coal Co	Clinton	Clinton.
Clinton Coal Co	Clinton	Clinton.
John Hurst Coal Co	Deepwater	Deepwater.
Lewis Coal Co	Lewis Station	Lewis Station.
W. D. Reese	Deepwater	Deepwater.
Reliance Coal Co	Clinton	Brownington.
Standard Coal Co c/o Harry England.	Deepwater	Deepwater.
Tebo Coal Co	Clinton	Clinton.
Lee Feaster & Bros	Clinton	Clinton.
C. A. McKinley Coal Co	Clinton	Clinton.
Prairie Hill Coal Co	Deepwater	Deepwater.
W. H. Rusk	Deepwater	Deepwater.
Russell Hill Coal Co	Deepwater	Deepwater.
JOHNSON COUNTY—		
Bowen Coal & Mining Co	Windsor	Windsor.
Bristle Ridge Coal Co	Warrensburg	Warrensburg.
LAFAYETTE COUNTY—		
Atwood Coal Co	Lexington	Lexington.
Edward Aull Coal Co	Commerce Bldg., Kansas City, Mo.	
Carter Coal Co	Wellington	Wellington.
Diamond Coal Co	Corder	Corder.
Dover Coal Mining Co	Dover	Dover.
Farmers Fuel Co	Kansas City	Higginsville.
Imperial Coal Co	Corder	Corder.
Laning-Harris Coal & Grain Co	Kansas City	Kansas City.
McGrew Coal Co	Lexington	Lexington.
Napoleon Coal Co	Napoleon	Napoleon.
Joseph Perry & Son	R. R. No. 3, Lexington	Myrick.
Wagener & Nicmeyer	Higginsville	Higginsville.
Western Coal & Mining Co	St. Louis	Myrick.
N. T. Wilcoxen Coal Co	Lexington	Lexington.
Corder Coal Co	Corder	Corder.
Hamilton & Son	Higginsville	Higginsville.
Klondike Coal Co	Mayview	Mayview.
Philip Oliver & Son	Higginsville	Higginsville.
Powell Bros	Higginsville	Higginsville.
Sand Spring Coal Co	Lexington	Lexington.

LIST OF PRINCIPAL COAL PRODUCERS IN MISSOURI—Continued.

	General office.	Location of mines.
LAFAYETTE COUMTY—*Continued.*		
G. P. Rogers	Higginsville	Higginsville.
Emmett Summers	Corder	Corder.
Chas. A. Wezeciona	Higginsville	Higginsville.
C. J. Winfrey	Corder	Corder.
LINN COUNTY—		
Bucklin Coal Co	Bucklin	Brookfield.
Wm. E. Crandall	Brookfield	Brookfield.
Landreth Coal Co	Marceline	Marceline.
Linn County Coal Mining Co	Brookfield	Brookfield.
Marceline Miners Co-operative	Marceline	Marceline.
Schaefer Coal Co	Brookfield	Brookfield.
MACON COUNTY—		
Central Coal & Coke Co	Kansas City	Keota, Ardmore, Bevier, Macon.
Lingo Coal Co	Commerce Bldg., Kansas City.	
Macon Co-operative Coal & Mining	Macon	Macon.
Mulkey Block Coal Co	Macon	Macon.
Pierce-Hess Coal Co	Bevier	Bevier.
Star Coal Co. (E. Frederick)	Bevier	Bevier.
Grant Bros	Macon	Macon.
Roberts Coal Co	Macon	Macon.
Roy Valentine	Macon	Macon.
PLATTE COUNTY—		
Home-Riverside Coal Mines Co	Leavenworth, Kan	
PUTNAM COUNTY—		
Bertha Coal & Mining Co	311 Felix St., St. Joseph.	
Mendota Block Coal Co	Mendota	Mendota.
Mendota Fuel Co	Mendota	Mendota.
Missouri Block Coal Co	Unionville	Unionville.
Maulsby & Carter	Unionville	Unionville.
Smith & Rowland	Livonia	Livonia.
RALLS COUNTY—		
Bondinier & James Coal Co	Perry	Perry.
Clark Coal Co	Perry	Perry.
RANDOLPH COUNTY—		
Black Diamond Coal Co	Huntsville	Huntsville.
Bradley Coal Co	Moberly	Moberly.
Citizens Coal Co	Higbee	Higbee.
Higbee Coal Mining Co	5001 South 38th St., St. Louis	Higbee.

LIST OF PRINCIPAL COAL PRODUCERS IN MISSOURI—Continued.

	General office.	Location of mines.
RANDOLPH COUNTY—*Continued.*		
Marriott Coal Co	Moberly	Moberly.
Mitchell & Lovell Coal Co	Huntsville	Huntsville.
Powhatan Coal Co	Keith & Perry Bldg., Kansas City	Huntsville.
Moberly Fuel & Transfer	Moberly	Moberly.
RAY COUNTY—		
Central Coal & Coke Co	Kansas City	
Clay Coal & Mining Co	Excelsior Springs	Excelsior Springs.
Conrow & Williams	Richmond	Richmond.
Crawford-Wilson Coal Co	Richmond	Richmond.
Crispin Coal Co	Richmond	Richmond.
Elmira Coal Co	Elmira	Elmira.
Fowler Coal & Mining Co	Richmond	Richmond.
Hubbell & Hamilton Coal Co	Richmond	Richmond.
Mercantile Coal & Mining Co	Richmond	Richmond.
Lilly Neal & Co	Camden	Camden.
Ottman & Dickson	Richmond	Richmond.
Pickering Coal Co	Richmond	Richmond, Camden, Swanwick.
Ray County Coal Co	Richmond	Richmond.
Rayville Coal Co	Rayville	Rayville.
St. Joseph Coal Mining Co	Lawson	Lawson.
Schussler Coal Co	Camden	Camden.
Three W. Coal Co	Henrietta	Henrietta.
Ward Coal Co	Richmond	Richmond.
Bates Coal Co	Richmond	Richmond.
Hugh Blair	Rayville	Rayville.
Chenault Coal Co	Richmond	Richmond
Martin Mine	Hardin	Hardin.
Willis Railey Mine	Richmond	Richmond.
Thomas Bros	Orrick	Orrick.
Watson & Valkema	Richmond	Richmond.
SCHUYLER COUNTY—		
Raven Coal Co	Coatsville	Coatsville.
J. O. Filkins	Greentop	Greentop.
F. M. Walters	Coatesville	Coatesville.
VERNON COUNTY—		
J. Smith	Moundville	Moundville.
Lavery Coal Co	Moundville	Moundville.
Garland Coal Co	Garland, Kan	Swart.
C. B. Jenkins Coal Co	Ft. Scott, Kan	Eve.
B-E-L Coal Co	Bronaugh	Bronaugh.
Bainter Coal Co	Bronaugh	Bronaugh.
Moss & Moss	Nevada	Walker.

COBALT AND NICKEL.

These metals formerly had a considerable production at the plant of the Missouri Cobalt Company near Fredericktown where a complex sulfide ore of cobalt, nickel, copper, lead and iron was mined. Similar ores are known in neighboring regions. They occur at the contact between the basal Lamotte sandstone and the overlying Bonneterre dolomite where the contact laps against the granite or porphyry knobs. This is the only area in the United States which has produced nickel and one of two which have produced cobalt. At the present time the potential production of both cobalt and nickel is in excess of the demand, the larger deposits in Canada and elsewhere fully supplying the market.

Cobalt is used as a pigment in the arts and ceramics, in high speed tool steels and in stellite, a cobalt-chromium acid-resisting alloy employed in cutlery, surgical instruments and the chemical industry. Nickel is used in high-speed tool-steel alloys, plating and in storage batteries.

COPPER.

There are no mines producing copper in Missouri at present. All of the metal reported is derived from the disseminated lead mines in southeast Missouri. Some of it is saved in milling as a middling table product and some goes into the matte in smelting the lead.

Small deposits of copper ores have been worked in the past in Ste. Genevieve, Franklin and Shannon counties and considerable production was derived from the complex sulfide ores of Madison County. Interest in the new discoveries at the Sutton Mine near Eminence, as reported two years ago, has continued but no commercial production has been reported.

IRON ORE.

Iron ore production in 1924 was greater than any year since 1909 and the value the greatest since 1890, although there were only four producers—The Iron Mountain Company at Iron Mountain the Southern Acid & Sulphur Company at their

Ruepple Mine in Franklin County, mining hematite; the Granite Bend Mining & Development Company, near Keener, and the Iron Hill Ore Company at Barrett, Wayne County, mining limonite. All but the Southern Acid & Sulphur Company operated mills or washing plants.

In 1925 the production was cut nearly 50 per cent and both limonite plants ceased to operate. Iron Mountain was shut down most of the time for remodelling. Unsettled market conditions owing to the re-organization of the St. Louis Iron & Coke Company have depressed the demand for iron ore. With the renewed activity of that company and the blowing-in of their second blast furnace, it is expected that activity will be renewed in the iron mining industry in Missouri.

The following table shows the production and value for 1908 to 1925:

PRODUCTION OF IRON ORE IN MISSOURI, 1908-1925.

Year.	Total tons (long) shipped.	Value.	Average price per ton.	Hematite (red ore) tons.	Limonite (brown ore) tons.
1908.....	98,414	$218,182	$2.22	77,400	21,014
1909.....	89,954	210,853	2.35	67,391	22,563
1910.....	78,341	168,697	2.47	55,832	22,509
1911.....	72,810	153,716	2.11	57,201	8,214
1912.....	42,120	92,996	2.20	39,721	3,756
1913.....	37,134	93,628	2.26	33,709	5,645
1914.....	37,554	75,696	2.02	32,054	5,500
1915.....	40,290	99,853	2.47	35,145	5,145
1916.....	34,914	116,484	3.34	27,568	7,346
1917.....	38,776	134,906	3.48	26,866	12,042
1918.....	71,968	270,337	3.76	55,955	16,013
1919.....	53,626	223,144	4.16	44,867	8,759
1920.....	50,825	230,827	4.54	41,154	9,671
1921.....	36,431	169,516	4.65	(a)	(a)
1922.....	58,320	244,928	4.28	57,038	1,282
1923.....	54,348	247,975	5.15	(a)	(a)
1924.....	79,847	405,622	5.08	(a)	(a)
1925.....	(a)	(a)	(a)	(a)	(a)

(a) Figures not given to conceal individual production.

PRODUCERS OF IRON ORE IN MISSOURI.

Operator.	Name of mine.	Kind of ore.
BUTLER COUNTY—		
Granite Bend Mining and Mercantile Co.	Keener (Luke)	Secondary limonite.
CRAWFORD COUNTY—		
Cherry Valley Iron Co.	Cherry Valley	Red hematite.
Sligo Furnace Co.	Walker	Red hematite.
DENT COUNTY—		
Ozark Iron Ore Mining Co.	Hawkins Bank	Red hematite.
Jas. A. Green & Son	Hawkins Bank	Red hematite.
FRANKLIN COUNTY—		
Southern Acid & Sulphur Co.	Ruepple	Red hematite.
IRON COUNTY—		
Pilot Knob Iron Co.	Pilot Knob	Red hematite.
OSAGE COUNTY—		
Iron Exploration Co.	Miller	Hematite & limonite.
PHELPS COUNTY—		
L. G. Bronson		Red hematite.
ST. FRANCOIS COUNTY—		
Iron Mountain Co.	Iron Mountain	Red hematite.
STODDARD COUNTY—		
Mississippi Valley Iron Co.	Puxico	Secondary limonite.
WAYNE COUNTY—		
Iron Hill Ore Co.	Barrett	Secondary limonite.

LEAD ORE.

Production of lead ore concentrates increased in 1924 and 1925 to a tonnage nearly equal to the war-time output and in Southeastern Missouri the total crude ore hoisted and tonnage of concentrates was greater than ever before. The average price for both southeastern and southwestern Missouri was also set at a new record in 1925.

The mill of the Annapolis Lead Company was practically destroyed by a cyclone in 1925 and was rebuilt late in 1926. Considerable exploratory diamond drilling has been done in areas underlain by favorable formations to the south and east of the

producing district, in Ste. Genevieve, St. Francois and Madison counties. Extensive drilling has also been carried on in the producing district to extend known ore bodies or complete the proving of probable ore. The St. Louis Smelting and Refining Company has sunk a 750-foot shaft on the Pim tract, the deepest shaft in the district. Drilling campaigns have also been prosecuted in the Decaturville, Camden County and Crooked Creek, Crawford County, areas. In both of these regions the Bonneterre formation, in which the ores of Southeast Missouri are found, outcrops or is present near the surface.

Near Linn Creek lead has been found in cherty zones of the Gasconade dolomite. Up to the present time this cherty horizon has not been put in production. The ore occurs rather bunchy in chert having a thickness of from one to three feet. This bed occurs between heavy limestone strata which carry only small amounts of ore. Some production has been made from typical circle deposits in this region.

Near Red Bird, Gasconade County, recent drilling is reported to have encountered both lead and zinc. The extent of the strike has not been determined.

The following tables, taken from publications of the United States Geological Survey and the United States Bureau of Mines, give the statistics of the industry:

PRODUCTION OF LEAD IN MISSOURI IN 1923-1925.

District.	1923.				1924.				1925.			
	Galena.		Carbonate.		Galena.		Carbonate.		Galena.		Carbonate.	
	Quant. (short tons).	Value.	Quant. (short tons).	Value.	Quant. (short tons).	Value.	Quant. (short tons).	Value.	Quant. (short tons).	Value.	Quant. (short tons).	Value.
SOUTHWESTERN MISSOURI:												
Alba, Neck City	86	$7,144	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ash Grove	16	960	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Carthage and Carl Jct. (a)	5	400	.....	.....	.....	.....	.....	.....	25	$2,600	.....	.....
Duenweg, Porto Rico	74	6,100	3	$180	11	$1,100	.....	.....	385	45,162	.....	.....
Granby	596	50,273	.....	.....	336	29,192	.....	.....	473	48,435	.....	.....
Joplin and Smithfield (b)	829	69,338	116	8,120	1,391	144,862	165	13,200	1,169	130,733	277	$23,510
Oronogo	449	38,311	.....	.....	260	25,374	.....	.....	184	19,210	.....	.....
Spring City, Beef Br	90	7,650	77	5,340	.....	.....	.....	.....	.....	.....	.....	.....
Spring City, Spurgeon, Seneca and Racine (c)	33	2,640	.....	.....	215	20,119	115	8,852	254	27,749	109	9,581
Stark City and Wentworth (d)	10	800	.....	.....	14	1,360	2	144	.....	.....	.....	.....
Thoms Station	.....	.....	.....	.....	.....	.....	.....	.....	28	3,242	.....	.....
Waco	139	10,663	.....	.....	189	19,956	.....	.....	151	14,526	.....	.....
Webb City, Carterville and Prosperity	551	45,746	.....	.....	285	31,375	.....	.....	492	57,669	.....	.....
Other counties (e)	48	4,020	.....	.....	17	2,027	.....	.....	22	2,422	.....	.....
	2,926	$244,045	196	$13,640	2,718	$275,365	282	$22,196	3,183	$351,748	386	$33,091
SOUTHEASTERN MISSOURI	259,320	19,434,633	.....	.....	292,604	24,739,819	.....	.....	314,530	31,740,442	.....	.....
	262,246	$19,678,678	196	$13,640	295,322	$25,015,184	282	$22,196	317,713	$32,092,190	386	$33,091

(a) Carl Junction in 1925 only.
(b) Smithfield in 1925 only.
(c) Racine in 1923 only; Spring City in 1924 and 1925 only.
(d) Wentworth in 1923 only.
(e) Hickory and Christian in 1923; Christian in 1924; Barry, Hickory and Ozark in 1925.

TENOR OF CRUDE LEAD ORE AND CONCENTRATES IN SOUTHWESTERN MISSOURI, 1921-1925.

	1921.	1922.	1923.	1924.	1925.
Total crude ore, short tons	243,300	727,300	784,000	459,100	662,200
Total lead concentrates in crude ore, per cent	0.73	0.31	0.4	0.65	0.54
Lead content of crude ore, per cent	0.57	.23	.3	0.49	0.41
Average lead content of galena concentrates, per cent	78.4	75.7	7.56	76.1	76.8
Average lead content of carbonate concentrates, per cent	58.8	56.1	60.2	60.0	60.0
Average value per ton:					
Galena concentrates	$50.15	$69.44	$83.40	$101.31	$110.51
Carbonate concentrates	32.76	56.36	69.60	78.71	85.73

VALUE AND TENOR OF LEAD ORES, 1910-1925.

Year.	All Missouri.		Southeast Missouri only.				
	Total concentrates.	Total value concentrates.	Total crude ore.	Galena concentrates in crude ore.	Lead in crude ore.	Average lead in concentrates.	Average value per ton concentrates.
1910	248,058	$11,286,750	3,693,523	5.7 %	3.5 %	62.3 %	$44.35
1911	258,240	12,469,460	3,974,712	5.5	3.7	67.3	46.94
1912	256,838	11,948,358	4,064,366	5.3	3.35	67.1	45.01
1913	255,723	11,444,935	4,250,800	5.15	3.45	67.2	43.63
1914	279,854	11,143,104	4,718,300	5.27	3.56	67.6	38.96
1915	312,567	14,579,361	5,067,800	5.47	3.62	66.5	45.89
1916	347,869	24,172,965	5,467,500	5.60	3.68	65.66	67.47
1917	345,513	34,038,976	5,887,900	5.03	3.47	66.70	98.01
1918	287,983	21,988,567	5,532,600	5.01	3.39	66.8	75.53
1919	237,428	12,107,731	4,301,930	5.32	3.65	68.4	50.46
1920	247,205	20,284,921	4,803,630	5.04	3.35	66.6	81.72
1921	282,122	11,825,280	5,058,800	5.54	3.60	65.0	41.87
1922	273,381	14,934,548	5,152,400	5.26	3.50	66.5	54.48
1923	262,246	19,692,318	5,314,900	4.88	3.21	65.9	74.94
1924	295,322	25,015,184	6,059,700	4.83	3.26	67.6	84.55
1925	317,713	32,092,190	6,209,800	5.06	3.43	67.6	100.91

LIME.

Although there was a little less demand for lime in 1924, the production in 1925 increased sufficiently to again set a record with a total of 273,348 tons valued at $2,610,954. Practically all the lime burned in Missouri is high calcium, the only magnesian lime plant being the Washington Lime Kiln Company at Washington, which has a field kiln run intermittently. The rock formations used include the Burlington, Spergen and Kimmswick formations, all of which are very pure and uniform, provided the chert in the Burlington be excluded. In consequence of this remarkable purity the Missouri lime is in great demand for use in the various chemical industries, about two-thirds of the output being so used as shown by the tables below. This is in contrast with the average for the United States where only about 40 per cent of the lime manufactured goes into chemical use. It is this demand for high grade chemical lime which enables Missouri to occupy third or fourth place among the states in total production. Over two-thirds of the production is shipped to other states and although there is a small importation the net export is nearly 55 per cent. Nearly all neighboring states have deficiencies in production and although the consumption in most of them is small there is a considerable market, Illinois alone having a deficiency of about 180,000 tons.

Of the 16 plants operating in the state, 9 have hydrators and of the 10 principal producing companies only 3 are without hydrating equipment. There are 89 kilns, of which 79 were reported in operation, 33 burning coal, 24 wood, 1 oil, 1 gas, 16 producer gas and 4 both coal and wood.

In the table showing the uses to which Missouri lime is put the item "other" chemical is large owing to the great diversity of uses and the necessity of concealing output of less than three producers. The industries to which this lime goes are in general order of consumption—calcium carbide, insectides (spray), gas and by-product coke, calcium acetate, purification of mineral and animal greases, bleaching powder, acetic acid, soaps, glue works, silica and sand lime brick and alkali works.

PRODUCTION AND VALUE OF LIME, 1914-1925.

Year.	Lime.			Hydrated lime.		
	Quantity. (tons).	Value.	Average value per ton.	Quantity (tons).	Value.	Average value per ton.
1914.....	155,630	$686,051	$4.40	19,960	$93,414	$4.68
1915.....	135,901	547,025	4.21	(a)	89,417	(a)
1916.....	199,260	956,300	4.81	24,647	128,903	5.24
1917.....	234,936	1,435,914	6.48	32,120	219,600	6.88
1918.....	166,795	1,376,046	8.25	34,942	345,754	9.90
1919.....	141,504	1,333,095	9.42	39,245	402,620	10.26
1920.....	157,126	1,735,002	11.04	51,987	584,283	11.24
1921.....	113,291	1,169,391	10.32	45,903	487,169	10.61
1922.....	147,960	1,402,337	9.48	56,024	551,187	9.84
1923.....	182,503	1,830,937	10.03	63,823	674,848	10.57
1924.....	182,814	1,711,180	9.36	60,651	642,995	10.60
1925.....	202,058	1,860,244	9.21	71,290	750,710	10.50

OUTPUT, VALUE AND USES OF LIME BURNED IN 1923-1925. (a)

Use.	1923.		1924.		1925.	
	Quantity. (tons).	Value.	Quantity. (tons).	Value.	Quantity. (tons).	Value.
Building chemical.....	80,806	$789,085	82,051	$797,665	94,910	$881,105
Paper mills.....	13,668	125,147	9,879	95,317	15,766	174,265
Tanneries.....	4,200	44,953	1,600	17,510	3,291	31,936
Metallurgy.....	13,024	124,070	34,534	297,766	34,553	281,596
Water treating..	36,851	381,920	41,786	418,246	32,267	321,527
Other.....	97,777	1,040,610	73,615	727,671	92,561	920,525
Totals.....	246,326	$2,505,785	243,465	$2,354,175	273,348	$2,610,954

(a) Including hydrated lime.

PRODUCERS OF LIME IN MISSOURI.

Producers.	Location.
FRANKLIN COUNTY—	
Washington Lime Kiln Co	Washington.
GREENE COUNTY—	
*Ash Grove Lime & Portland Cement Co	Ash Grove and Gallaway.
*The Marble Head Lime Co	Springfield.
JEFFERSON COUNTY—	
Glencoe Lime and Cement Co	Byers, Glen Park.
LAWRENCE COUNTY—	
*Peirce City Lime Co	Peirce City.
MARION COUNTY—	
*The Marblehead Lime Co	Hannibal.
PIKE COUNTY—	
Marblehead Lime Co	Louisiana.
RALLS COUNTY—	
*Bluff City Lime & Stone Co	Hannibal.
ST. CLAIR COUNTY—	
Osceola White Lime Co	Osceola.
STE. GENEVIEVE COUNTY—	
Arrowhead Manufacturing Co	Brickeys.
*Peerless White Lime Co	Ste. Genevieve.
*Ste. Genevieve Lime and Quarry Co	Ste. Genevieve.
*Western Lime Works	Ste. Genevieve.
Bluff City Lime and Stone Co	Ste. Genevieve.
ST. LOUIS COUNTY—	
*Glencoe Lime and Cement Co	Mincke, Glencoe.
Centaur Lime Co	Glencoe.

*Produces hydrated lime also.

MANGANESE.

The principal use for manganese is in the iron and steel industry. The ores are classified under three headings—manganese ore containing 36 to 40 per cent manganese, ferruginous manganese ore containing 15 to 35 per cent manganese and 25 to 35 per cent iron, used in the manufacture of spiegeleisen, and manganiferous

iron ore containing 5 to 15 per cent manganese. There is little call for the last named type unless a steady production of several carloads per day can be maintained.

Small deposits of manganese ore are known in several counties in southeastern Missouri. They are usually low grade, occasional pockets of richer ore being found. There have been no shipments in recent years.

MINERAL PAINTS.

Ochres, which are usually low grade, clayey, iron ores ranging in color from buffs through brown to deep reds, are frequently found in connection with iron ores in the Ozarks. They sell for a little more than the iron ores but may be difficult to mine unless near the surface, owing to caving of the soft ore. There has been an intermittant production in Phelps County during the last two years, the output being utilized largely for mortar colors.

The largest production of mineral paints is from lead and zinc ores. The production figures for those minerals are reported under lead and zinc.

MINERAL WATERS.

Mineral springs and mineral waters from wells are present over most of Missouri in great variety. The number of them which are exploited commercially is comparatively few although most of them are appreciated and used locally, people sometimes coming from considerable distances to drink the water.

Excelsior Springs in Clay County and Eldorado Springs in Cedar County are the best known of the Missouri watering places and are well equipped with hotels, baths, and drinking fountains. The following lists show the producing springs or wells and their distribution and the production by years:

PRODUCTION OF MINERAL WATERS, 1910-1925.

Year.	Value.
1910	$96,488
1911	86,747
1912	81,114
1913	84,316
1914	74,793
1915	83,363
1916	109,814
1917	57,175
1918	38,478
1919	39,641
1920	50,892
1921	45,670
1922	40,149
1923	38,145
1924	30,000
1925	32,000

MINERAL SPRINGS REPORTING PRODUCTION IN 1923-1925.

Proprietor.	Name of spring.	Location.
BARRY COUNTY—		
Radium Springs Corp	Radium Springs	Seligman.
CEDAR COUNTY—		
Mrs. Isaac C. Holmwood	Aperient Well	Eldorado Springs.
W. C. Masters	Eldorado Laxative Well	Eldorado Springs.
Mrs. M. A. Musick	Musick Mineral Well	Eldorado Springs.
CLAY COUNTY—		
Excelsior Saline Water Co	Excelsior Saline	Excelsior Springs.
Natrona Springs Water Co	Natrona Wells	Excelsior Springs.
Excelsior Springs Mineral Water & Bottling Co	Regent, Siloam, Soterian, Sulpho-Saline	Excelsior Springs.
Salt Sulphur Water Co	Salt Sulphur Well, White Sulphur Springs	Excelsior Springs.
.....	Claymount Spring	Randolph.
COOPER COUNTY—		
E. A. Windsor	Chouteau Springs	Boonville.
JACKSON COUNTY—		
Crystal Spring Water Co	Crystal Spring	Kansas City.
Cusenbary Mineral Water Co	Cusenbary	Mt. Washington.

MINERAL SPRINGS REPORTING PRODUCTION IN 1923-1925—Continued.

Proprietor.	Name of spring.	Location.
JEFFERSON COUNTY—		
Bokert Springs Mineral Water Co..	Bokert Springs.....	DeSoto.
LAWRENCE COUNTY—		
Paris Springs Bottling Co.....	Chalybeate.....	Paris Springs.
MERCER COUNTY—		
David Walker.....	Grand River Mineral.....	Mercer.
J. S. Haymaker.....	Haymaker.....	S. Lineville.
NODAWAY COUNTY—		
Wm. Reed.....	Morris Mineral Well.....	Burlington Jct.
PIKE COUNTY—		
National Mineral Water Co.....	Bowling Green.....	Bowling Green.
The Bowling Green Sanitarium Mineral Water Co.....	BB., Epzo, Fonzo.....	Bowling Green.
Amos & Margaret Turner.....	Hornet.....	Bowling Green.
ST. LOUIS CITY—		
Belcher Water Bath & Hotel Co...	Belcher Artesian Well....	St. Louis.
ST. LOUIS COUNTY—		
Florian J. Stepan.....	Old Orchard Mineral Springs.....	Webster Groves.
SALINE COUNTY—		
Missouri Mineral Water Co.....	Sweet Springs.....	Sweet Springs.

NICKEL.

See "Cobalt and Nickel."

PETROLEUM AND NATURAL GAS.

Missouri, though underlain by large areas of rocks which are favorable to the accumulation of oil and gas, has not yet produced a commercial sized pool of either. Much drilling has been done, but little of it has been guided by structural mapping. This Bureau has published reports on the general possibilities in the state in Vol. XVI, 2nd series, and on the Trenton formations in northeastern Missouri in Vol. XVIII, 2nd series, showing the succession of the formations and the general structure together with the detailed structure of certain type areas.

At present there are 20 to 30 wells in western Missouri yielding small amounts of gas or oil for household consumption and in the past there have been a few local gas fields furnishing small city supplies for a few years. These are now all abandoned. Careful geological work and well directed drilling should, however, locate other fields in the future.

Cuttings from wells are examined by this Bureau to determine the horizons and oil possibilities and reports made to the owners or drillers. In order to make these correlations accurate samples of cuttings should be sent every five feet and in continuous succession from the top of the hole. Little can be done with single samples. The Survey has records and samples from several thousand wells all over the state and is in a position to give the best available advice on horizons.

PYRITES.

Pyrites or "sulphur ore" is used in the manufacture of sulphuric acid. In past years many thousand tons were mined in Missouri for this purpose but since the development of the pure native sulphur deposits along the Gulf Coast there has been little demand for pyrites excepting at a very low price. Large deposits near a railroad and capable of being mined at low costs can still be marketed in St. Louis.

Pyrites is found in the Ozark region as filled sink deposits, in places with only a thin capping of leached iron ore, in other deposits at the base of the hematite ores. There has been no production in recent years.

SAND AND GRAVEL.

The output of sand and gravel increased in both 1924 and 1925, the latter year setting new record figures for both quantity and production and the average price per ton being exceeded by that of 1920 only. The increase in 1925 was 35 and 75 per cent in tonnage and value respectively. Most classes of sands and gravels reported an increase in value per ton in 1924 and 1925. Those which were lower in price in 1924—paving sand and gravel, molding sand and railroad ballast—showed, with the exception of the last named, a corresponding decrease in output. In 1925

molding sand increased in price and value over 1924, but was still below 1923. Building sand, building gravel, paving sand and paving gravel each amount to about 20 per cent of the total of both quantity and value.

Sand and gravel are dredged from the Mississippi and Missouri and from most of the streams in the Ozark region. In the northwestern part of the state where the shaley "Coal Measures" are the country rock, the rivers are loaded with silt and mud, and excepting for small pockets in the glacial drift, gravel and coarse sand are lacking. Consequently those materials must be imported into the northern interior and the western counties south of Kansas City.

The following tables of production, use and producers is not quite complete, owing to many small producers in the southern part of the state not reporting. The figures are, however, comparable from year to year.

OUTPUT AND VALUE OF SAND AND GRAVEL FOR 1924-1925.

	1924.		1925.		
	Quantity. (Short tons.)	Value.	Quantity. (Short tons.)	Value.	Average price per ton.
Building sand....	832,536	$467,874	1,147,903	$806,541	$0.70
Building gravel...	852,538	498,086	975,056	696.957	.71
Paving sand.....	616,278	285,483	1,136,791	751,287	.66
Paving gravel....	597,304	277,810	1,120,160	727,140	.65
Glass sand.....	161,604	225,963	165,200	252,271	1.53
Molding sand....	73,155	49,733	86,680	71,651	.83
Engine sand.....	3,296	2,802	23,541	17,397	.75
Other sands (a)...	126,744	100,245	156,801	116,100	.74
Railroad ballast..	817,745	145,440	711,473	155,843	.22
Totals.....	4,081,200	$2,053,436	5,523,605	$3,595,187	$0.65

(a) Includes grinding and polishing and other sand in 1924; grinding and polishing, fire or furnace and other sand in 1925.

PRODUCTION OF SAND AND GRAVEL, 1911-1925.

Year.	Quantity (short tons).	Value.	Average value per ton.
1911	3,605,912	1,042,674	$0.29
1912	3,682,280	1,083,704	.29
1913	4,126,126	1,109,233	.27
1914	3,528,678	1,020,903	.29
1915	2,889,211	675,684	.23
1916	3,643,205	877,634	.24
1917	2,274,072	1,101,745	.48
1918	1,743,616	772,753	.44
1919	1,665,295	873,333	.52
1920	1,909,314	1,356,352	.71
1921	1,539,073	1,018,325	.51
1922	1,970,345	1,063,370	.54
1923	3,719,243	2,007,529	.54
1924	4,081,200	2,053,436	.50
1925	5,523,605	3,595,187	.65

LIST OF SAND AND GRAVEL PRODUCERS, 1924-1925.

Operator.	Name of product.	Location.
ATCHISON COUNTY—		
Jas. M. Whitham	Building sand, railroad ballast, gravel	Rockport.
Wm. Sly		Fairfax.
Marvin O. Holloway	Building sand	Rockport.
Eilert Corp	Building sand	Rockport.
BOLLINGER COUNTY—		
Lutesville Sand & Gravel Co.	Paving and building sand, gravel	Lutesville.
Missouri Pacific Railway	Railroad ballast, gravel,	Lutesville.
Taylor-Lutes Sand and Gravel Co.	Paving sand and gravel, railroad ballast	Lutesville.
Madison Co. Sand & Gravel Co.	Paving sand and gravel	Fredericktown.
BUCHANAN COUNTY—		
Chicago, Burlington & Quincy R. R. Co	Railroad ballast	St. Joseph.
Pioneer Sand Co	Building sand, paving	St. Joseph.
BUTLER COUNTY—		
Randles Sand & Gravel Co	Building and paving sand, gravel	Poplar Bluff.
Energy Coal & Supply Co	Building and paving sand, gravel	Poplar Bluff.

LIST OF SAND AND GRAVEL PRODUCERS, 1924-1925—Continued.

Operator.	Name of product.	Location.
CAPE GIRARDEAU COUNTY—		
Cape Girardeau Sand Co	Building sand	Cape Girardeau.
Edw. Hely Estate	Paving and engine sand	
CLARK COUNTY—		
Sherwood Sand Co	Building sand, paving sand, gravel	Kahoka.
COLE COUNTY—		
Jefferson City Sand & Gravel Co.	Building sand	Jefferson City.
State Highway Commission	Paving gravel	Jefferson City.
COOPER COUNTY—		
Missouri River Sand & Gravel Co.	Building sand, paving sand, gravel	Boonville.
FRANKLIN COUNTY—		
The St. Louis Material & Supply Co	Building sand, gravel	Moselle and Pacific.
J. W. Glaser	Molding sand, furnace sand	Pacific.
W. W. Goran	Molding sand	Pacific.
Tavern Rock Sand Co	Glass sand, molding sand	Grays Summit.
D. E. Williams Sand Co	Glass sand, molding sand	Pacific.
Macks Creek Sand & Clay Co	Molding sand	
Denton Sand and Gravel Co	Building sand and gravel	Pacific.
HOWARD COUNTY—		
Glasgow Sand Co	Building and paving sand	Glasgow.
JACKSON COUNTY—		
Stewart Sand Co	Building, molding, engine and paving sand	Kansas City.
Woods Bros	Building and paving sand	Kansas City.
JASPER COUNTY—		
Independent Gravel Co	Grinding and polishing, fire or furnace, engine, and paving sand, building and paving gravel, railroad ballast	Webb City.
Odell-Daly Material Co		Webb City.
JEFFERSON COUNTY—		
Pittsburgh Plate Glass Co	Glass sand	Crystal City.
Hematite Sand & Gravel Co	Building sand, gravel	Hematite.
American Silica Sand & Mining Co	Molding sand, glass sand	Herculaneum.
Silica White Sand Co	Molding sand, grinding and polishing sand	Silica.
Denton Sand & Gravel Co	Building and paving sand and gravel	Pacific.

LIST OF SAND AND GRAVEL PRODUCERS, 1924-1925—Continued.

Operator.	Name of product.	Location.
JEFFERSON COUNTY—*Continued.*		
Missouri Silica Mng. & Mfg. Co.	Molding sand	St. Louis.
LEWIS COUNTY—		
Keokuk Sand Co.	Building and paving sand, and building and paving gravel	LaGrange.
Missouri State Highway Dept.	Paving gravel	LaGrange.
LIVINGSTON COUNTY—		
E. C. Johnson	Paving gravel	Chillicothe.
LINCOLN COUNTY—		
Northeast Missouri Sand and Gravel Co.	Paving sand and gravel	Silex.
MADISON COUNTY—		
Madison County Sand & Gravel Co		Fredericktown.
MARION COUNTY—		
Lawson Sand Co.	Building, engine, and paving sand	Hannibal.
MERCER COUNTY—		
Chicago, Rock Island and Pacific Railway	Railroad ballast	Princeton.
MILLER COUNTY—		
C., R. I. & P. R. R.	Building gravel, railroad ballast	Hoecker.
NEW MADRID COUNTY—		
John Kurtz		New Madrid.
OSAGE COUNTY—		
C., R. I. & P. R. R. Co.	Railroad ballast	Argyle.
PEMISCOT COUNTY—		
Caruthersville Sand and Gravel Co	Building and paving sand, paving gravel	Caruthersville.
Missouri Sand and Gravel Co.	Paving sand, building gravel	Caruthersville.
PETTIS COUNTY—		
Sedalia Gravel Co.	Building and paving gravel	Sedalia.
PHELPS COUNTY—		
Little Piney Sand & Gravel Co.	Building sand, gravel	Newburg.
Gasconade Sand & Gravel Co.	Paving sand, building gravel	Arlington.

LIST OF SAND AND GRAVEL PRODUCERS, 1924-1925—Continued.

Operator.	Name of product.	Location.
PIKE COUNTY—		
Louisiana Sand & Gravel Co....	Building sand, gravel.....	Louisiana.
Northeast Missouri Sand and Gravel Co.....	Paving gravel.....	Bowling Green.
Chicago & Alton R. R.....	.....	Louisiana.
C. E. Goodman.....	Paving gravel.....	Louisiana.
D. D. Weaver.....	Paving gravel.....	.....
ST. CHARLES COUNTY—		
Tavern Rock Sand Co.....	Glass sand.....	Klondyke.
St. Charles Sand & Material Co..	Building and paving sand.	St. Charles.
Moreno-Burkham Const. Co....	.....	St. Louis.
ST. LOUIS COUNTY—		
Missouri Portland Cement Co...	Gravel, building sand.....	Drake.
Tavern Rock Sand Co.....	Glass sand, molding sand.	Pacific.
Meramec Portland Cement and Material Co.....	Building sand, gravel.....	Sherman.
St. Louis Material & Supply Co..	Building sand, gravel....	.....
Alpha Portland Cement Co.....	Gravel.....	Valley Park.
Ed. E. Squier Co.....	.....	Pacific.
Missouri Pacific Railway Co.....	.....	Jedsburg.
ST. LOUIS CITY—		
John W. Allen & Son.....	Molding sand.....	St. Louis (Carondelet).
Meramec Portland Cement & Material Co.....	Molding sand.....	St. Louis.
Missouri Portland Cement Co...	Building sand.....	St. Louis.
St. Louis Material & Supply Co..	Building sand, building and paving gravel.....	St. Louis.
W. W. Ruprecht.....	Building sand.....	.....
STODDARD COUNTY—		
S. E. Newhouse.....	.....	Dexter.
M. J. Williams.....	Paving gravel.....	Dexter.
Halleck and Hill.....	Paving gravel.....	.....
St. Louis and San Francisco Railroad Co.....	Railroad ballast.....	.....
WASHINGTON COUNTY—		
Missouri Pacific Ry. Co.....	Railroad ballast, sand....	Savoy.
WAYNE COUNTY—		
Missouri Pacific Ry. Co.....	Railroad ballast.....	Leeper.

LIST OF SAND AND GRAVEL PRODUCERS, 1924-1925—Continued.

Operator.	Name of product.	Location.
WORTH COUNTY—		
J. C. Harris	Building sand	Sheridan.
Henry Ray	Building sand, paving sand, gravel	.....
Kansas City Southern Railway	Railroad ballast	.....

SILVER.

The lead ore concentrates from the southeastern Missouri lead belt average about one ounce of silver per ton of concentrates. This is too small an amount to be saved for itself or to be paid for in the ores but in the process of refining through which some of the lead is put, silver, along with the impurities, becomes concentrated and is, from time to time, recovered.

The production being irregular is not representative of the year's output. The decrease in amount during the last three or four years indicates that less of the lead is being refined.

While there has been some prospecting of the silver-tungsten quartz veins of northwestern Madison County, no production has been reported to date.

There follows the yearly production of silver in Missouri since 1919:

PRODUCTION OF SILVER IN MISSOURI, 1919-1925.

Year.	Ounces.	Value.
1919	90,401	$101,249
1920	111,128	121,130
1921	69,902	69,902
1922	212,656	212,656
1923	177,270	145,361
1924	103,694	69,475
1925	86,340	57,538

STONE.

The production of stone has shown a marked increase during the biennial period; in fact this industry has shown a consistent growth each year since 1917. In value it has more than trebled since that date. The total value as shown on the accompanying table in 1925 exceeded $6,000,000, each class of material, except sandstone, recording a decided increase.

The following table shows the value of production for the years 1910 to 1925:

PRODUCTION OF STONE IN MISSOURI, 1910-1925.

Year.	Limestone.	Marble.	Granite.	Sandstone.	Chats.	Total.
1910....	$2,360,604	(a)	$120,663	$39,389	$243,048	$2,673,704
1911....	2,179,767	(a)	139,070	19,748	225,540	2,564,125
1912....	2,373,725	(a)	97,776	15,004	408,510	2,895,015
1913....	2,486,020	(a)	42,484	10,195	304,331	2,843,030
1914....	2,160,958	(a)	77,971	3,588	340,616	2,583,133
1915....	2,049,772	(a)	85,624	10,104	346,358	2,491,858
1916....	1,990,419	156,942	80,390	14,991	433,645	2,676,387
1917....	1,679,677	227,520	58,241	6,862	214,007	2,186,307
1918....	1,359,755	238,111	54,523	(b)	135,319	(c) 1,787,708
1919....	1,759,029	360,287	(b)	(d)	206,353	(e) 2,325,669
1920....	2,776,936	616,550	114,663	(b)	167,028	(c) 3,675,177
1921....	2,269,457	627,729	81,389	(d)	259,571	3,238,146
1922....	2,409,202	816,098	85,093	(b)	(f)306,252	(c) 3,593,183
1923....	3,173,622	1,085,122	83,804	(b)	(f)431,884	(c) 4,795,370
1924....	3,624,089	1,229,160	108,084	(d)	520,269	5,473,613
1925....	4,085,883	1,439,604	137,348	(d)	399,002	6,058,874

(a) Included in limestone.
(b) Not given, less than three producers.
(c) Not including sandstone.
(d) No production.
(e) Not including granite.
(f) Revised.

LIMESTONE.

The increased use of limestone has been almost entirely in concrete and road making, showing the great effect of the large State road building program and of the sustained activity in building on the industry. Very little dimensional limestone for building is reported as the Carthage and Phenix quarries are classed as marble producers. Missouri is abundantly supplied

with stone for crushing with the exception of certain counties in the north-central and extreme northwestern parts where the Coal Measures are lacking in heavy bedded limestones. The table of producers shows how well distributed the production is.

VALUE OF LIMESTONE PRODUCED ACCORDING TO USES, 1922-1925.

Purpose.	1922	1923	1924	1925
Rough construction	$11,271	$11,125	$4,333	$19,920
Dressed building	161,626	.....	.....	.....
Rubble	323,887	273,111	394,687	405,948
Riprap	137,713	331,680	347,758	262,592
Railroad ballast	135,930	100,955	125,070	80,516
Concrete and road making	1,354,582	2,165,653	2,433,438	3,003,754
Flux	41,319	51,157	80,921	(a)
Glass factories	46,757	40,646	46,760	(a)
Agriculture	36,122	42,285	16,690	54,668
Miscellaneous (b)	159,995	157,010	171,432	258,485
Totals	$2,409,202	$3,173,622	$3,624,089	$4,085,883

(a) Less than three producers, concealed under "miscellaneous."

(b) Includes paper mills, lime burners, paving and curbing, sugar factories, whiting filler for asphalt, rubber, and paint, and other uses.

PRODUCERS OF LIMESTONE IN MISSOURI, 1924-1925.

Firm.	Type and uses of stone.	Location of quarry.
ANDREW COUNTY—		
Newell & Stewart	Agricultural, road metal, riprap, concrete, railroad ballast, rubble	Amazonia.
St. Joseph Quarries Co	Road metal, concrete, riprap	Savannah.
Wyeth Stone Co	Concrete	Wyeth.
BATES COUNTY—		
G. E. Hertz	Concrete, road metal	.....
John Rooks	Concrete, road metal	.....
BOONE COUNTY—		
J. N. Fellows	Riprap, concrete, road metal, rubble	Columbia.
Spencer-Whitlow Co	Concrete, rubble, agricultural, road metal	Columbia.
U. S. Engineer Office	Riprap	Wilton.

PRODUCERS OF LIMESTONE IN MISSOURI, 1924-1925—Continued.

Firm.	Type and uses of stone.	Location of quarry.
BUCHANAN COUNTY—		
Metropolitan Paving Co	Concrete, road metal	St. Joseph.
Reinert Bros. Const. Co	Riprap, concrete, rubble, railroad ballast, agricultural, road metal	St. Joseph.
The Buchanan Co. Quarry Co	Concrete, road metal	St. Joseph.
Heumader Quarry Co	Road metal, concrete	St. Joseph.
CALLAWAY COUNTY—		
Oscar L. Taylor	Rough building	Fulton.
Missouri Limestone Co	Road metal, concrete, agricultural	Auxvasse.
CAPE GIRARDEAU COUNTY—		
Tri-Cities Stone Co	Riprap, concrete, agricultural, road metal	Illmo.
Edward Hely	Concrete, railroad ballast, road metal, agricultural.	Cape Girardeau.
The Arnold Stone Co	Riprap	Neely's Landing.
Oscar F. Barrett	Riprap	Neely's Landing.
CLARK COUNTY—		
L. W. Lewis Sons		Dumas.
CLAY COUNTY—		
S. H. Atwood & Son	Concrete, riprap, road metal	South Liberty.
C. Atwood	Railroad ballast	South Liberty.
Consolidated Crushed Stone Co.	Concrete, road metal	Smithville.
Clay County Crushed Rock Co.	Concrete, road metal	
CLINTON COUNTY—		
J. H. Anderson	Rubble, concrete, road metal	Lathrop.
Maley & Rixey	Rubble, concrete road metal	
COLE COUNTY—		
Missouri State Penitentiary	Rough building, rubble, riprap, concrete, road metal	Jefferson City.
Pope Construction Company	Concrete, road metal	Jefferson City.
U. S. Engineer Office	Riprap	Osage City.
Edw. S. Ramsey	Concrete, road metal	Jefferson City.
Graff & Klug	Road metal, concrete	Jefferson City.
J. W. Keeney	Road metal, concrete	Jefferson City.
COOPER COUNTY—		
U. S. Engineer Office	Riprap	Arrow Rock.
F. Stretz & Sons	Concrete, road metal, agricultural	Boonville.

PRODUCERS OF LIMESTONE IN MISSOURI, 1924-1925—Continued.

Firm.	Type and uses of stone.	Location of quarry.
COOPER COUNTY—*Continued.*		
S. J. White Stone Co	Concrete, riprap, road metal, agricultural	Blackwater.
Mo., Kan. & Texas Ry. Co	Railroad ballast, riprap	Sweeney.
Blackwater Stone Co	Concrete, road metal	Blackwater.
Missouri State Reformatory	Concrete, road metal	Boonville.
DAVIESS COUNTY—		
Blankenship Bros	Concrete, road metal	Pattonsburg.
Consolidated Crusher Co	Concrete, road metal	Gallatin.
FRANKLIN COUNTY—		
U. S. Engineer Office	Riprap	Berger.
City of Washington	Concrete, road metal	Washington.
L. G. Krull	Concrete, road metal	Washington.
GREENE COUNTY—		
Phoenix Marble Co	Concrete, rubble, road metal	Phoenix.
Greene County	Road metal, concrete	Springfield.
Horton Stone Co	Road metal, concrete	Springfield.
Marblehead Lime Co	Lime, road metal, concrete, railroad ballast	Springfield.
Springfield Special Road District	Concrete, road metal	No. Springfield.
Quarry Products Co	Concrete, road metal, agricultural	Springfield.
Stigall Construction Co	Road metal, concrete	Springfield.
Missouri Crushed Stone Products Co	Road metal, concrete, riprap	Springfield.
HARRISON COUNTY—		
Bethany City Quarry	Concrete, road metal	Bethany.
Allhands & Davis	Concrete, road metal	Eagleville.
Rand Construction Co	Concrete, road metal	Bethany.
HOLT COUNTY—		
Whitmer Mill & Stone Co	Concrete, road metal	Oregon.
Joseph Shanks	Concrete, road metal	Oregon.
HOWARD COUNTY—		
U. S. Engineer Office	Riprap	Glasgow.
JACKSON COUNTY—		
U. S. Engineer Office	Riprap	Eton.
W. M. Spencer	Concrete, road metal, riprap, rubble, agricultural.	Independence.
Beyer Crushed Rock Co	Concrete, road metal	Kansas City.
Belt Line Crusher Co	Miscellaneous	Dodson.
Atlas Investment Co	Concrete, road metal	Kansas City.

PRODUCERS OF LIMESTONE IN MISSOURI, 1924-1925—Continued.

Firm.	Type and uses of stone.	Location of quarry.
JACKSON COUNTY—*Continued.*		
Halpin-Dwyer Construction Co..	Concrete, road metal.....	Kansas City.
Kansas City Park Quarries.....	Concrete, road metal.....	Kansas City.
Lyle Rock Co.....	Rubble.....	Kansas City.
Frank J. O'Hearn.....	Rubble.....	Kansas City.
Kansas City Railways Co.....	Concrete, road metal.....	Kansas City.
W. C. Mullens Construction Co..	Concrete, road metal.....	Kansas City.
The Phelps Stone & Supply Co..	Concrete, road metal.....	Kansas City.
M. F. Sullivan.....	Rubble.....	Kansas City.
Norton Rock Co.....	Concrete, road metal.....	Kansas City.
Swenson Construction Co.....	Concrete, road metal rubble.....	Kansas City.
Kansas City Board of Public Welfare.....	Concrete, road metal, rubble.....	Leeds.
Jas. O'Connor & Son.....	Concrete, road metal, rubble.....	Kansas City.
W. A. Ross Construction Co....	Concrete, road metal.....	Independence.
McTernan-Halpin Const. Co....	Concrete, road metal.....	Kansas City.
H. J. Nichols Crusher Co.....	Concrete, road metal.....	Kansas City.
American Rock Crusher Co.....	Concrete, road metal.....	Kansas City.
Thompson Bros.....	Concrete, road metal, rubble.....	Kansas City.
Atlas Rock Co.....	Concrete, road metal.....	Kansas City.
Frank Flinn Constr. Co.....	Concrete, road metal.....	Kansas City.
Findley Marlborough Realty Co.	Rubble.....	Kansas City.
National Building Materials Co..	Concrete, road metal.....	Kansas City.
K. C. Quarries Co.....	Concrete, flux, railroad ballast, road metal.....	Leeds, Kansas City.
E. H. Bradbury.....	Concrete, road metal.....	Kansas City.
John Twyman.....	Rough construction, concrete, road metal.....	Mt. Washington.
JASPER COUNTY—		
Carthage Marble & Bldg. Stone Co.....	Dressed building, flagging, rubble, riprap, and for sugar factories.....	Carthage.
Carthage Marble & White Lime Co.....	Dressed building, curbing, rubble, and for sugar factories.....	Carthage.
Carthage Crushed Limestone Co.	Whiting, concrete, flux, glass factories, agricultural, miscellaneous....	Carthage.
Consolidated Marble & Stone Co.	Rubble, sugar factories...	Carthage.
The Ozark Quarries Co.....	Rubble, curbing, flagging, paving.....	Carthage.

PRODUCERS OF LIMESTONE IN MISSOURI, 1924-1925—Continued.

Firm.	Type and uses of stone.	Location of quarry.
JASPER COUNTY—*Continued.*		
Independent Gravel Co.	Whiting, concrete, flux, glass factories, agricultural, miscellaneous, road metal, concrete, railroad ballast	Carthage.
Spring River Stone Co.	Dressed building, flagging.	Carthage.
F. W. Steadley & Co	Rough building, flagging.	Carthage.
Chas. Shull & H. T. Oltman	Concrete, road metal	Sarcoxie.
Highway Stone Co.	Concrete, road metal, railroad ballast	.....
JEFFERSON COUNTY—		
Glencoe Lime & Cement Co.	.....	Glen Park, Byers.
Peter McLoon & Co.	Flux, glass factories, riprap, road metal, agricultural	Barnhart.
Cedar Hill Lime Co.	Flux	Barnhart.
JOHNSON COUNTY—		
State of Missouri	Concrete, road metal	.....
LAFAYETTE COUNTY—		
Diamond Coal Co.	Concrete, road metal	Corder.
M. P. Wegener	Concrete, road metal	Higginsville.
LINCOLN COUNTY—		
Crystal Carbonate Lime Co.	Riprap, whiting, concrete, road metal, flux, glass factories, agricultural, miscellaneous	Elsberry.
MARION COUNTY—		
Geo. A. Bronham	Concrete, road metal	Hannibal.
Marblehead Lime Co.	Concrete, road metal, riprap, flux, railroad ballast, agricultural	Hannibal, White Bear.
Central Crushed Stone Co.	Concrete, agricultural, flux, road metal	Hannibal.
MONITEAU COUNTY—		
U. S. Engineer Office	Riprap	Lupus, Sandy Hook
MONTGOMERY COUNTY—		
W. B. Dixon	.....	New Florence.
NEWTON COUNTY—		
T. C. Hatler	Concrete, road metal	Neosho.

PRODUCERS OF LIMESTONE IN MISSOURI, 1924-1925—Continued.

Firm.	Type and uses of stone.	Location of quarry.
OSAGE COUNTY—		
U. S. Engineer Office	Riprap	Chamois.
Fred Schimmle		Rich Fountain.
PIKE COUNTY—		
Marblehead Lime Co	Riprap, railroad ballast, concrete, road metal	Louisiana.
PLATTE COUNTY—		
Park College	Riprap, rough building, paving	Parkville.
W. D. Houser	Riprap	Weston.
Kansas City Quarries Co	Concrete, road metal	
RALLS COUNTY—		
Bluff City Lime & Stone Co	Concrete, road metal	Hannibal.
G. B. & R. R. Walton	Concrete, road metal, agricultural	
Lynch-McDonald Const. Co	Rough const., road metal, concrete, agricultural	
RAY COUNTY—		
Pea Ridge Stone Co	Concrete	Richmond.
ST. CHARLES COUNTY—		
Kansas City Bridge Co	Riprap	St. Charles.
Weldon Springs Lime Co	Riprap, concrete, agricultural, road metal	Weldon Springs.
ST. CLAIR COUNTY—		
Osceola Lime Co	Concrete, road metal, agricultural, miscellaneous	Osceola.
STE. GENEVIEVE COUNTY—		
Peerless White Lime Co	Fluxing, sugar factories, glass factories, miscellaneous	Mosher.
Ste. Genevieve Lime & Qy. Co	Fluxing, sugar factories	Ste. Genevieve.
Arnold Stone Co	Riprap	Ste. Genevieve.
Missouri-Illinois R. R	Riprap	
Cliffdale Quarry & Mfg. Co	Glass factories	Brickeys.
McLoon-Ste. Genevieve Limestone Co	Riprap, flux, glass factories	Mosher.
ST. LOUIS COUNTY—		
Geo. H. Knoche	Rough building, roadmaking	Fern Ridge.
John C. Heins	Riprap, roadmaking	Florissant.
Florissant Construction Co	Railroad ballast	Florissant.
Glencoe Lime & Cement Co	Roadmaking, fluxing	Glencoe, Mincke, Carondelet.
Henry E. Heintz	Roadmaking	Jefferson Barracks.

PRODUCERS OF LIMESTONE IN MISSOURI, 1924-1925—Continued.

Firm.	Type and uses of stone.	Location of quarry.
ST. LOUIS COUNTY—*Continued.*		
Wm. F. Ruprecht	Rough constr., riprap, concrete	.....
Edward Kassebaum	Roadmaking	Mattese.
Albert Bussen	Riprap, railroad, ballast	Quarantine.
Jas. F. Rothwell	Rubble, riprap, roadmaking, miscellaneous	Vigus.
Sinclair Quarry & Constr. Co.	Rubble, riprap, roadmaking, paint grinders	Vigus.
Lamb Construction Co	Rough building, riprap	University City.
J. & W. Dillon	Riprap	Jefferson Barracks.
U. S. Engineer Office	Riprap	Spanish Lake, Florissant.
New Jamestown Quarry Co	Concrete, road metal, agricultural	Spanish Lake.
John Steffen Bros	Rough building, concrete, road metal, riprap	Nursery.
Grant Road Quarry Co	Rubble, riprap, road metal, concrete	.....
Rock Hill Quarry & Const. Co.	Curbing, flagging, paving, rubble, road metal, concrete, agricultural	Webster Groves.
ST. LOUIS CITY—		
Bambrick Bros. Constr. Co	Rubble, roadmaking	St. Louis.
Big Bend Quarry Co	Rubble, riprap, concrete, road metal, miscellaneous	Maplewood.
T. E. Cavanaugh	Rubble, concrete, road metal	.....
Eyermann Construction Co	Rubble, roadmaking	St. Louis.
Fehlig Construction Co	Concrete, rubble, road metal	St. Louis.
Fruin-Bambrick Constr. Co	Concrete, road metal, rubble, asphalt, dust	St. Louis.
Hoffman Bros. Constr. Co	Rough building, riprap, roadmaking, concrete, road metal	St. Louis.
St. Louis Workhouse Quarry	Riprap, roadmaking	St. Louis.
Tower Grove Quarry & Constr. Co	Riprap, roadmaking, concrete, road metal	St. Louis.
Union Quarry & Constr. Co	Rubble, concrete, road metal	St. Louis.
Independent Quarry Constr. Co.	Rubble, concrete, road metal, riprap	St. Louis.
Clayton Quarry Co	Rubble, concrete, road metal, riprap	St. Louis.
West St. Louis Quarries Co	Road metal, concrete	St. Louis.

PRODUCERS OF LIMESTONE IN MISSOURI, 1924-1925—Continued.

Firm.	Type and uses of stone.	Location of quarry.
SALINE COUNTY—		
U. S. Engineer Office	Riprap	Arrow Rock.
State Highway Dept	Road metal, concrete	.....
Tri-City Stone Co	Riprap, road metal, concrete	.....
WARREN COUNTY—		
U. S. Engineer Office	Riprap	Bernheimer.
Mo. State Highway Dept	Road metal, concrete	.....

MARBLE.

The marble industry in Missouri has continued to show a healthy progressive growth during the past biennium. While there are at present only three localities producing marble in Missouri, these three yield a variety of both decorative and monotone marbles. The "Gray" marbles marketed from Carthage and Phenix under a variety of names, are all known throughout the country for their pleasing background as used in panelling, partitions, columns and floors. The Ste. Genevieve "Golden Vein" and "Rose" are rapidly becoming equally popular for their warm colors and unique veining.

Investigations started by this Survey indicate that the Mississippian limestones are capable of taking a polish not only where quarried at Carthage and Phenix, but throughout their extent through the middle of the State and into the northeastern counties. The Ste. Genevieve marbles unfortunately seem to be confined to a comparatively small area near Ozora.

The Missouri Marble Quarries Company has opened a quarry in the Plattin formation two miles west of Rush Tower. Several ledges about four feet thick have been developed along a greatest length of 250 feet and many blocks quarried. No production has been reported and the quarry is closed at present.

The Joplin Marble Quarries Company has opened a new quarry three miles south of Joplin in the bluff on the south bank of Shoal Creek. The blocks are lowered onto a car on the bottomlands and pulled across the creek to the shop, with which a spur

from the Missouri Pacific Railroad connects. The quarry is at a lower horizon of the Burlington limestone than the Carthage quarries and samples polished are darker colored than the Phenix and Carthage marbles.

Following is a table of uses of Missouri marbles and a list of recent producers:

PRODUCTION OF MARBLE ACCORDING TO USES, 1921-1925.

	1921.		1922.		1923.		1924.		1925.	
	Quantity, cubic feet.	Value.	Quantity, cubic feet.	Value.	Quantity, cubic feet.	Value.	Quantity, cubic feet.	Value.	Quantity, cubic feet.	Value.
Rough building, exterior..	83,179	$91,159	(a)	(a)	5,820	$16,625	(a)	(a)	(a)	(a)
Rough building, interior..	67,130	110,217	94,640	$141,668	100,840	152,014	148,390	$246,109	184,360	$263,998
Dressed building, exterior.	24,691	97,141	210,900	299,402	424,300	541,794	346,830	447,034	400,990	511,165
Dressed building, interior.	71,369	251,790	100,840	332,935	118,060	342,446	159,730	447,294	195,990	577,979
Monumental, rough.....	.....	.....	26,290	39,985	.....	.....	25,660	40,505	(a)	(a)
Monumental, dressed....	31,551	77,421	(a)	(a)	20,640	32,243	.....	.....	37,310	83,071
Other uses.....	.....	.....	3,040	2,108	.....	.....	9,490	18,218	3,080	3,391
Totals.....	277,920	$627,729	435,720	$816,098	669,660	$1,085,122	690,100	$1,229,160	821,730	$1,439,604

(a) Included in "other uses."

MARBLE PRODUCERS IN MISSOURI IN RECENT YEARS.

Producer.	Use.	Quarry location.
GREENE COUNTY—		
Phenix Marble Co	Rough and dressed interior and exterior building	Phenix.
JASPER COUNTY—		
Carthage Marble and Building Stone Co	Dressed exterior, rough and dressed interior, rough monumental	Carthage.
Carthage Marble and White Lime Co	Dressed exterior, rough and dressed interior, rough and dressed monumental	Carthage.
Consolidated Marble Stone Co	Dressed exterior, rough and dressed interior, rough dressed monumental	Carthage.
Joplin Marble Quarries Co	Rough building	Joplin.
Ozark Quarries Co	Dressed exterior, rough and dressed interior, rough and dressed monumental	Carthage.
Spring River Stone Co	Dressed exterior, rough and dressed interior, rough and dressed monumental	Carthage.
F. W. Steadley & Co., Inc	Dressed exterior, rough and dressed interior, rough and dressed monumental	Carthage.
JEFFERSON COUNTY—		
Missouri Marble Quarries, St. Louis	Rough exterior and interior	Rush Tower.
STE. GENEVIEVE COUNTY—		
Consolidated Marble Co., Chicago, Ill	Rough exterior and interior	Ste. Genevieve.
Ozora Marble Quarries Co., St. Louis	Rough interior	Ozora.

GRANITE.

Granite outcrops in Missouri in Iron, Wayne, St. Francois, Reynolds, Washington and Shannon counties, but at present is being worked in only the first three named. Paving blocks at 8 to 10 cents apiece represent from one-half to two-thirds of the production and rough monumental and building stone take in most of the remainder. Rubble, riprap, concrete and road metal complete the list of uses.

The Missouri granites and porphyries make very beautiful and strong architectural and monumental stones and warrant a much greater use than is being made at present. The item of cost has led to the use of more easily worked stones but for durability, beauty, retention of polish and finish, and strength, Missouri granite cannot be surpassed.

The general table of stone production a few pages previous gives the figures for granite in recent years.

GRANITE PRODUCERS IN MISSOURI IN RECENT YEARS.

Name.	Purposes used for.	Quarry location.
IRON COUNTY—		
Iron County Red Granite Co....	Rough monumental.....	Graniteville.
A. J. Sheahan Granite Co.....	Rough monumental, paving blocks, riprap, road-making.....	Graniteville.
J. H. Brod Granite Co.....	Monumental.....	Graniteville.
ST. FRANCOIS COUNTY—		
Alexander Hanson.....	Paving blocks, curbing, riprap.....	Doe Run.
A. G. Asplof.....	Paving blocks, rubble....	Syenite.
J. G. Milne.....	Rough monumental.....	Syenite.
C. B. Scott.....	Rough monumental, paving blocks, road metal..	Farmington.
WAYNE COUNTY—		
P. O'Keefe.....	Paving blocks, riprap, concrete.....	Kerrigan.
Granite Bend Mining & Merc. Co.	Paving blocks, riprap, concrete.....	Kerrigan.

SANDSTONE.

There has been no production of sandstone in Missouri during the past biennium. The Warrensburg sandstone has been quarried to a considerable extent in the past as is shown by the large openings near the city. There is at present no production though the equipment still remains at some of the quarries and stone can be quarried should the demand be renewed.

CHATS.

The crushed rock in the large piles of mine tailings in the lead and zinc districts of Southeast and Southwest Missouri are known as chats. They are in considerable demand for highway, railroad and concrete construction. Those from the Joplin district are largely chert, while those from Southeast Missouri are mostly dolomite. Since most of the chats for railroad use are shipped from dumps purchased outright by the railroads, an arbitrary value of twenty-five cents per ton is used. The tonnage is compiled from rail shipments reported by the different railroads and non-rail sales estimated by the largest dealer.

UTILIZATION OF CHATS IN MISSOURI, 1909-1925.

Year.	Railroad use (tons).	Commercial use (tons).	Total.	Value.
1909	355,901	472,934	828,835	$124,325
1910	1,009,533	610,789	1,620,322	243,048
1911	865,011	638,592	1,503,603	225,540
1912	1,911,705	811,698	2,723,403	408,510
1913	1,231,005	797,884	2,028,889	304,333
1914	1,687,331	583,440	2,270,771	340,616
1915	1,713,884	595,307	2,309,191	346,379
1916	2,268,370	622,600	2,890,970	433,646
1917	1,010,620	416,096	1,426,716	214,007
1918	627,335	274,794	902,129	135,319
1919	827,700	548,057	1,375,757	206,353
1920	448,211	665,311	1,113,522	167,028
1921	585,680	606,643	1,730,473	259,571
1922 (*a*)	455,755	769,254	1,225,009	306,252
1923 (*a*)	1,064,050	663,487	1,727,537	431,884
1924	1,411,318	669,757	2,081,075	520,269
1925	964,897	631,112	1,596,009	399,002

(*a*) Revised.

TRIPOLI.

Tripoli is a porous siliceous stone. It is quarried near Seneca and Racine, Newton County, some of the production coming from the Oklahoma side of the State line. The stone is easily worked and is used for filters, polishing powders, fillers, in dusting foundry castings, etc. While normally white, it is often colored delicate tints of pink and buff by small quantities

of iron which do not affect its other qualities. There are only two producers—the American Tripoli Company and the Independent Gravel Company, both of Joplin, Mo., hence the figures on production cannot be given. Most of the tripoli is ground and sized before being sold and although the demand is relatively small the industry has shared in the general prosperity of the country.

ZINC.

The production of zinc ore in Missouri has ranged between one and one and one-half million tons in the last few years. The margin of profit is small and the production sensitive to the market price as is shown by the lowered output in 1924 when the price of concentrates dropped to below $40 during the summer. The price of lead concentrates also plays an important part as many of the mines are dependent on the lead content of the ore to keep them going.

The depletion of the richer ore bodies and the relatively few new discoveries in the Kansas-Oklahoma field, combined with a fairly stable and profitable market for lead and zinc concentrates, have resulted in a greater interest being shown in the older Southwest Missouri district during the past two years.

Southeast of Joplin, on the Missouri Lead & Zinc Company land, the Admiralty Zinc Company has drilled out several ore bodies and are now getting ready to mine them. West of Joplin, in the West-Joplin sheet-ground field, C. F. Dike and associates have acquired the fee to a large acreage. The drilling on this acreage has developed extensive sheet-ground ore deposits which are being held for future development. The Vantage Mining Company is at present drilling acreage they have under lease, adjoining the Dike acreage to the south and east.

Further west in the old Central City district, the Goldenrod Mining and Smelting Corporation have developed a rich ore body of shallow zinc ore. To the south of them the Howe Mining Company has put up a mill to concentrate the ore from the shallow lead ore body they have developed. In the Thoms Station field, the Admiralty Zinc Company developed and mined out an ore body. This mill was dismantled and rebuilt at their newly developed mine at Bellville. Rakowsky and Naething have prospected a large acreage in the Thoms Station field and

the ore bodies discovered by their drilling are now being developed by the Grasselli Mining Company. Adjoining acreage has been drilled by the M. & H. Zinc Company of Missouri and ore bodies discovered north of the Pocohontas and on the Napoleon ground. The Napoleon ground was mined during the past year.

The Kansas Explorations, Inc., have continued drilling their extensive acreage, notably near the old Lehigh Camp, Smithfield, north and east of Carl Junction, north of Jasper County line, in Barton County and north of Oronogo. Their Isherwood mine near Smithfield was mined out the early part of last year, but dirt from newly developed ore bodies to the north and west is being put through the Isherwood mill.

The Waco camp continued to produce a large tonnage of zinc ore and prospecting for new ore bodies was and is still being done. The older mines are nearly depleted at present. The Gascho mine was reopened this year by the Universal Exploration Company and is now being mined. The St. Louis Smelting and Refining Company following a thorough drilling, is now sinking one shaft and deepening another to tap a lower run of ore shown by their drilling. The Barnsdall Zinc Company is developing an ore body on their Lease No. 14, Rakowsky and Naething are now drilling a large acreage which has so far not been thoroughly drilled.

Considerable prospecting has been done in the old Alba-Neck City camp by various companies, but as yet no active mining development has been under way.

At Oronogo, the old Oronogo Circle and Oronogo Mutual and adjoining acreage is being prospected by Rakowsky and Naething with the aim of developing new sheet-ground ore bodies.

At Duenweg, A. J. Burnham has developed and is mining a rich lead ore body. The Federal M. & S. Company have drilled a great number of holes on their large acreage at and near Duenweg and have discovered new sheet-ground ore bodies and extended some previously known sheet-ground deposits. No active mining has been done to date, although two shafts are being sunk. South of Duenweg the old Clear-Peacher mine has been more or less active. This property has changed ownership several times during the past two years.

In Newton County, the Federal M. & S. Company leased a large acreage and drilled more or less on all of it. At Granby they are mining at the Klondike, Mascot-Homestake and the Crabapple. During the past year they have done considerable drilling in the old Spring City Camp. At Wentworth, the Eagle-Picher Lead Company is mining the old Navy Bean and south of Peirce City they are mining shallow sheet-ground ore at their Bryceville mine.

There is considerable interest in the possibilities for new ore bodies in the Aurora district, although no active drilling campaign is under way.

During 1925 the Pierson Creek district southeast of Springfield was drilled for new gumbo ore runs or extensions of old runs by the M. & H. Zinc Company of Missouri, but without success.

The following tables are taken or adapted from reports of the United States Bureau of Mines:

PRODUCTION OF ZINC IN MISSOURI, 1923-1925.

	1923.				1924.				1925.			
	Sphalerite.		Silicate and Carbonate.		Sphalerite.		Silicate and Carbonate.		Sphalerite.		Silicate and Carbonate.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Alba, Neck City	179	$5,737			69	$2,572						
Ash Grove			33	$660								
Aurora					8	320	23	$600				
Carthage and Carl Junction (*a*)	142	5,309			445	15,889			171	$6,929		
Duenweg, Porto Rico	120	4,800	308	7,685	152	4,346	9	260	413	20,657	450	$14,000
Granby	553	21,252	2,865	77,110	154	5,572	1,006	24,084	1.000	49,095	954	29,296
Joplin and Smithfield (*b*)	1,281	50,116	518	13,858	852	32,834	330	8,447	8,541	456,262	390	12,100
Oronogo	2,537	69,584			164	6,630	35	653	127	4,126	2	55
Spring City, Beef Branch			20	400								
Spring City, Spurgeon, Seneca							50	1,250			428	13,023
Springfield					156	6,240						
Spurgeon, Seneca, Racine			5	110								
Stark City, Wentworth			18	309								
Thoms Station									1,275	58,666		
Waco	27,096	1,138,637			20,812	886,993			12,211	679,956		
Webb City, Carterville, Prosperity	248	7,658			449	13,369			157	6,489		
Wentworth									43	2,408		

Hickory and Christian counties..	.....	.....	7	140	.....	.....	.....	.....	.....	.....	.....	.....
Barry, Hickory and Ozark counties.....	.....	.....	.....	.....	.....	.....	.....	.....	2,249	134,131	45	1,400
Totals.....	32,156	$1,303,093	3,774	$100272	23,261	$974,765	1,453	$35,294	26,187	$1,418,719	2,269	$69,874

(*a*) Carl Junction in 1925 only.
(*b*) Smithfield in 1925 only.

TENOR OF CRUDE ZINC ORE AND CONCENTRATES PRODUCED IN MISSOURI, 1923-1925.

	1923.	1924.	1925.
Total crude ore, short tons	784,000	459,100	662,200
Total zinc concentrates in crude ore, per cent	4.58	5.38	4.34
Zinc content of crude ore, per cent	2.65	3.20	2.54
Average zinc content of sphalerite concentrates	60.0	60.7	60.8
Average zinc content of silicate and carbonate	38.6	39.3	38.2
Average value per ton—			
Sphalerite concentrates	$40.52	$41.91	$54.18
Silicate and carbonate	26.57	24.29	31.24

PRODUCTION OF ZINC ORE IN MISSOURI, 1909-1925.

Year.	Sphalerite.			Carbonate and Silicate.			Total value.
	Quantity short tons.	Value.	Average price per ton.	Quantity short tons.	Value.	Average price per ton.	
1909	229,023	$9,445,826	$41.20	28,525	$677,213	$23.74	$10,123,039
1910	232,841	9,342,139	40.15	23,826	561,803	23.58	9,903,942
1911	217,812	8,680,559	39.81	20,119	447,420	23.76	9,157,979
1912	244,986	12,346,922	50.45	22,172	641,881	28.95	12,988,803
1913	225,850	9,180,960	43.10	21,531	483,463	22.45	9,664,423
1914	189,765	7,351,726	38.65	19,648	415,185	21.13	7,766,911
1915	241,111	18,382,520	76.23	25,412	1,243,458	45.00	19,625,978
1916	277,176	22,878,215	82.60	26,894	1,350,381	50.21	24,228,596
1917	231,588	16,453,629	70.80	30,986	1,254,975	40.50	17,708,604
1918	95,555	4,899,347	51.30	17,816	574,136	32.23	5,473,483
1919	51,813	2,108,382	40.69	11,741	320.853	27.33	2,429,235
1920	39,431	1,805,561	45.80	9,494	337,003	35.50	2,142,564
1921	19,490	490,731	25.18	60	634	10.57	491,365
1922	27,844	888,494	31.91	3,008	63,917	21.25	952,411
1923	32,156	1,303,093	40.52	3,774	100,272	26.57	1,403,365
1924	23,261	974,765	41.91	1,453	35,294	24.29	1,010,059
1925	26,187	1,418,719	54.18	2,269	69,874	30.80	1,488,593

PUBLICATIONS OF THE BUREAU OF GEOLOGY AND MINES.

The following is a complete list of the publications issued by the present Bureau of Geology and Mines and former Geological Surveys. The reports of the second series are given first, since some of these are still available for distribution. A majority of those listed under the headings of Former Surveys are exhausted. The volumes available are distributed free upon receipt of transportation charges. A flat rate of twenty-five cents is charged to cover cost of packing and transportation. The Biennial Reports are sent at a uniform charge of 10 cents. All publications sent to foreign countries go at the rate of two ounces for one cent.

The reports may be obtained upon application to H. A. Buehler, State Geologist, Rolla, Missouri.

Vol. No.
2nd series.

I. *Geology of Miller County, by E. R. Buckley, A. F. Smith and S. H. Ball, xvi + 207 pp., XVIII pls., including geologic map, 56 figs. 1913.
Describes the topography, general geology, and mineral resources of Miller County, Mo.

II. The Quarrying Industry of Missouri, by E. R. Buckley and H. A. Buehler, xv + 371 pp., LIX pls., including geologic map of Missouri. 1904.
Discusses properties, geology, distribution and laboratory tests of Missouri granites, rhyolites, limestones and sandstones and describes the quarries from which they are obtained.

III. The Geology of Moniteau County, by F. B. Van Horn, ix + 104 pp., XIII pls., including geologic map, 25 figs. 1905.
Describes the topography, general geology and mineral resources of Moniteau County, Mo.

IV. Geology of the Granby Area, by E. R. Buckley and H. A. Buehler, viii + 120 pp., XLII pls. ,including general geologic, topographic and outcrop, 3 figs. 1906.
Describes the general geology, occurrence of lead and zinc ores of the Granby Area in Newton County, Mo., and discusses the genesis of the ores of southwestern Missouri.

V. *Public Roads, their improvement and maintenance, by E. R. Buckley, xiii + 124 pp., XXX pls. 1907.
Contains specifications for building roads, directions for their construction, improvement and upkeep, a chapter on road materials, etc.

VI. The Lime and Cement Resources of Missouri, by H. A. Buehler, xvi + 255 pp., XXXVI pls., including a geologic map of Missouri, showing location of lime and cement plants. 1907.
Discusses properties, manufacture and production of lime and cement, the distribution of lime and cement resources by counties, including analyses and a chapter on the geological formations of Missouri and their composition.

VII. The Geology of Morgan County, by C. F. Marbut, xiv + 97 pp., XIX pls., including a geologic map of Morgan County, 19 figs. 1908.
Describes the topography, general geology and mineral resources of Morgan County, Mo.

VIII. *The Geology of Pike County, by R. R. Rowley, xiv + 122 pp., XX pls., 13 figs., geologic map of Pike County. 1908.
Describes the topography, general geology, mineral resources and paleontology of Pike County, Mo.

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*Edition exhausted.

Vol. No.
2nd series.

IX. *Geology of the Disseminated Lead Deposits of St. Francois and Washington counties, by E. R. Buckley, 2 pts.; pt. 1. xvi + 259 pp., pls. I-XXXIX, 10 figs.; pt. 2, pls. XL-CXXI, including a general geologic map of southeastern Missouri. 1909.
Discusses location, history, production, physiography, general geological history, structure, mines, ores, genesis of the ores of southeastern Missouri, with a chapter on barite and galena in the Potosi formation.

X. *The Iron Ores of Missouri, by G. W. Crane, xvi + 434 pp., XLVII pls., 29 figs., and geologic map of Missouri showing the location of the iron deposits. 1912.
Discusses the history, development, production, types and distribution of Missouri iron ores and general geology and physiography of the ore-bearing district.

XI. *The Coal Deposits of Missouri, by Henry Hinds, xi + 503 pp., XXIII pls., 97 figs., and maps of the Clinton, Calhoun, Lexington, Bevier, Huntsville and Richmond quadrangles and geological map of Missouri. 1912.
Describes briefly the Pennsylvanian series in Missouri and discusses in detail the mode of occurrence, coal industry, the distribution by counties, analysis, and tests of Missouri coal.

XII. The Geology of the Rolla Quadrangle, by Wallace Lee, xii + 111 pp., X pls., 17 figs., topography and geologic maps of the Rolla Quadrangle. 1913.
Describes the topography, physiographic history, general geology and mineral resources of the Rolla Quadrangle in Phelps and Dent counties, Mo.

XIII. *The Stratigraphy of the Pennsylvania Series in Missouri, by Henry Hinds and F. C. Greene, with a chapter on Invertebrate paleontology by G. H. Girty, 500 + pp., XXXII pls., 5 figs. 1915.

XIV. The Geology of Jackson County, by W. E. McCourt, assisted by M. Albertson and J. W. Bennett. 158 pp., XIX pls., including geologic maps and cross sections. 1917.
Describes topography, general geology and mineral resources of county and includes brief discussion of history and settlement.

XV. The Sand and Gravel Resources of Missouri, by C. L. Dake. 250 pp., XLVII pls., including a large number of maps. 1918.
Discusses nature and uses of sand and gravel, types found in Missouri and the Geology of Missouri sands and gravels. A large number of screen tests and analyses are contained in the report.

XVI. The Occurrence of Oil and Gas in Missouri, by Malcolm E. Wilson. 1922.
Discusses the oil and gas possibilities of Missouri.

XVII. *The Devonian of Missouri, by E. B. Branson, J. S. Williams, V. O. Tansey and G. A. Stewart, x + 279 pp., A-H + 71 pls., 10 figs. 1922.
Describes the distribution of the Devonian formations in Missouri and gives detailed descriptions and synonomy of the paleontology. Of interest chiefly to geologists.

XVIII. Structural Reconnaissance of the Mississippi Valley Area from Old Monroe, Missouri, to Nauvoo, Illinois, by Frank Krey, 86 pp., 18 pls. 1924.
This report (in co-operation with the Illinois Geological Survey) gives detailed descriptions of structural conditions in the area as a guide to oil prospecting.

XIX. The Geology of Vernon County, by F. C. Greene and W. F. Pond, ix + 152 pp., 14 pls., 13 figs., geological map of Vernon County. 1926.
Describes the geology and mineral resources of Vernon County.

XX. The Water Resources of Missouri, by H. C. Beckman (in press).
Describes the stream flow of Missouri rivers and contains 206 chemical analyses of surface waters, also state map showing area of drainage basins.

*The Oil and Gas Possibilities of the Belton Area, by Malcolm E. Wilson.
Describes geology and geologic structure in southwest Jackson and northwest Cass counties. A pamphlet containing 39 pp., III pls., including geologic structure map. 1918. (Incorporated in Vol. XVI, 2nd series.)

*Mineral Resources of Missouri, by H. A. Buehler. A pamphlet of 36 pp., about one-half being illustrations. Brief paragraphs on the distribution of the mineral resources of the state.

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*Edition exhausted.

Biennial Reports.

These reports describe the work of the Bureau and contain a chapter on the mineral production of the state with statistics for the previous two years. Starting with the report to the 52nd General Assembly they also contain an account of the investigation of the water resources of the state with records of stream flow.

	Postage.
*Biennial Report of the State Geologist to the 42nd General Assembly, by E. R. Buckley, 83 + 3 pp., VIII pls. 1903	10c
Biennial Report of the State Geologist to the 43rd General Assembly, by E. R. Buckley, 56 pp., III pls. 1905	10c
Biennial Report of the State Geologist to the 44th General Assembly, by E. R. Buckley, 57 pp. 1907	10c
Biennial Report of the State Geologist to the 45th General Assembly, by H. A. Buehler, 59 pp. 1909	10c
Biennial Report of the State Geologist to the 46th General Assembly, by H. A. Buehler, 68 pp., VI pls. 1911	10c
*Biennial Report of the State Geologist to the 47th General Assembly, by H. A. Buehler, 54 pp., III pls. 1913	10c
Biennial Report of the State Geologist to the 48th General Assembly, by H. A. Buehler, 62 pp., IV pls. 1915	10c
Biennial Report of the State Geologist to the 49th General Assembly, by H. A. Buehler, 75 pp., I pl. 1917	10c
*Biennial Report of the State Geologist to the 50th General Assembly, by H. A. Buehler, 117 pp., IV pls. 1919	10c
Biennial Report of the State Geologist to the 51st General Assembly, by H. A. Buehler, 87 pp., IV pls. 1921	10c
Biennial Report of the State Geologist to the 52nd General Assembly, by H. A. Buehler, 133 pp., V pls., 1 map. 1923	10c
*Biennial Report of the State Geologist to the 53rd General Assembly, by H. A. Buehler, 143 pp., IV pls. 1925	10c
Biennial Report of the State Geologist to the 54th General Assembly, by H. A. Buehler, 108 pp., III pls. 1927,	10c

Maps.

Base Map of Missouri, compiled in co-operation with the United States Geological Survey. Shows elevations of towns. Unmounted	15c
Geological Map of Missouri, 1922	25c
Joplin District township maps: scale, 4 inches to the mile, T. 27 to 29, R. 32 to 34, inclusive, 1922. Each	10c
Ste. Genevieve County Geological Map, 1922	25c
Caldwell County Topographic Map, 1926 (in press)	20c
*Lawrence County Topographic Map, 1922	20c
Livingston County Topographic Map, 1924	20c
Perry County Topographic Map, 1926 (in press)	20c
Platte County Topographic Map, 1914	20c
Ste. Genevieve County Topographic Map, 1922	25c
Topographic Maps of various quadrangles. Each	10c

(An index map will be sent on request.)

Former Surveys.

The following is a list of publications of this Bureau up to the publication of volume 13, 1st series. In this list the publications of the Survey are arranged in the order in which they were transmitted for publication. *Editions exhausted.

1. **Report of a Geological Reconnaissance* of that part of the State of Missouri adjacent to the Osage River, made to William H. Morell, chief engineer of the State, by order of the Board of Internal Improvement, by Henry King, M. D. Geologist. (Senate Journal, Appendix, 1st Session, 11th General Assembly, pages 506-535.) Jefferson City, 1840.
2. **First and Second Annual Reports* of the Geological Survey of Missouri, by G. C. Swallow, State Geologist, 448 pages, 17 plates, 18 sections, 26 figures and 5 maps, 8 vo. cloth. Jefferson City, December, 1855.
3. **Third Report of Progress* of the Geological Survey of Missouri, by G. C. Swallow, 3 pages. Jefferson City, December, 1856.
4. **Fourth Report of Progress* of the Geological Survey of Missouri, by G. C. Swallow, 8 pages. Jefferson City, December, 1858.
5. **Fifth Report of Progress* of the Geological Survey of Missouri, by G. C. Swallow, 13 pages. Jefferson City, December, 1860.
6. **Geological Report of the Southwestern Branch of the Pacific Railroad, State of Missouri*, by G. C. Swallow, xvii + 93 pp., 2 pls., fold map. St. Louis. 1859.

*Edition exhausted.

7. **Annual Report of the State Geologist* of the State of Missouri, by Albert D. Hager, 23 pages. Jefferson City, December, 1870.
8. **Report of Geological Survey* of the State of Missouri, 1855-1871, by G. C. Broadhead, F. B. Meek and B. F. Shumard, 327 pages, 29 illustrations and 9 maps, 8 vo. cloth. Jefferson City, March, 1873.
9. **Preliminary Report on the Iron Ores and Coal Fields* from the field work of 1872, by R. Pumpelly, A. Schmidt, G. C. Broadhead and W. B. Potter, 671 pages, 190 illustrations and an atlas with 14 large sheets, 8 vo. cloth. Jefferson City, April, 1873.
10. **Report of the Geological Survey* of the State of Missouri, including field work of 1873-1874, by G. C. Broadhead, 794 pages, 91 illustrations and an atlas of 15 sheets, 8 vo. cloth. Jefferson City, August, 1874.
11. **Industrial Report on Lead, Zinc and Iron*, together with notes on Shannon county and its copper deposits, by Chas. P. Williams, Ph. D., Acting State Geologist, 199 pages and 11 illustrations, 8 vo. cloth. Jefferson City, December, 1876.
12. **Bulletin No. 1.* By Arthur Winslow, G. E. Ladd, A. E. Woodward and G. Hambach, 85 pages and 2 sketch maps. Jefferson City, April, 1890.
13. **Bulletin No. —.* A Bibliography of the Geology of Missouri, by F. A. Samson, 76 pages, 810 titles. Jefferson City, December, 1890.
14. **Bulletin No. 2.* By G. E. Ladd and A. E. Woodward, 101 pages, 4 plates, 3 sections and 2 sketch maps. Jefferson City, December, 1890.
15. **Biennial Report of the State Geologist*, transmitted to the 36th General Assembly, Arthur Winslow, State Geologist, 53 pages, 2 diagrams. Jefferson City, January, 1891.
16. **Bulletin No. 4.* A description of some Lower Carboniferous Crinoids from Missouri, by S. A. Miller, 40 pages and 5 plates. Jefferson City, February, 1891.
17. **Bulletin No. 5.* By Erasmus Haworth and G. E. Ladd, 86 pages, 5 plates and 5 figures. Jefferson City, July, 1891.
18. **A Preliminary Report on the Coal Deposits of Missouri*, by Arthur Winslow, 226 pages, 131 illustrations and 1 map, 8 vo. cloth. Jefferson City, November, 1891.
19. **Vol. II. A Report of the Iron Ores of Missouri*, by F. L. Nason, 366 pages, 8 plates, 62 illustrations and 1 map, 8 vo. cloth. Jefferson City, December, 1892.
20. **Vol. III. A Report on the Mineral Waters of Missouri*, by Paul Schweitzer, including notes of A. E. Woodward, 256 pages, 33 plates, 11 figures and 1 map, 8 vo. cloth. Jefferson City, December, 1892.
21. **Biennial Report of the State Geologist*, transmitted to the 37th General Assembly, Arthur Winslow, State Geologist, 37 pages, 3 diagrams. Jefferson City, January, 1893.
22. **Vol. IV. Paleontology of Missouri (Part I)*, by C. R. Keyes, 271 pages, 32 plates and 9 figures, 8 vo. cloth. Jefferson City, June, 1894.
23. **Vol. V. Paleontology of Missouri (Part II)*, by C. R. Keyes, 266 pages, 24 plates and 2 figures, 8 vo. cloth. Jefferson City, June, 1894.
24. **Vol. VI. Lead and Zinc Deposits (Part I)*, by Arthur Winslow, 287 pages, 12 plates and 71 figures, 8 vo. cloth. Jefferson City, July, 1894.
25. **Vol. VII. Lead and Zinc Deposits (Part II)*, by Arthur Winslow, 383 pages, 29 plates and 268 figures, 8 vo. cloth. Jefferson City, July, 1894.
26. **Vol. VIII. Annual Report with Accompanying Papers*, by C. R. Keyes, 395 pages, 30 plates, 16 figures and 1 map, 8 vo. cloth. Jefferson City, December, 1894.
27. **Biennial Report of the State Geologist*, transmitted to the 38th General Assembly, C. R. Keyes, State Geologist, 60 pages. Jefferson City, January, 1895.
28. **Vol. IX. Reports on Areal Geology (Sheets 1-4)*, by C. R. Keyes, A. Winslow, C. H. Gordon, Erasmus Haworth and F. L. Nason, 430 pages, 22 plates, 53 figures, 3 folio plates and 4 maps, 8vo. cloth. Jefferson City, April, 1896.
29. **Vol. X. Surface Features of Missouri and Bibliography*, by C. R. Keyes, C. F. Marbut and J. E. Todd, 533 pages, 22 plates and 24 figures, 8 vo. cloth. Jefferson City, June, 1896.
30. **Vol. XI. Clay Deposits*, by H. A. Wheeler, E. M., 622 pages, 39 plates, 15 figures and 2 maps, 8 vo. cloth. Jefferson City, November, 1896.
31. **Biennial Report of the State Geologist*, transmitted to the 39th General Assembly, C. R. Keyes, State Geologist, 63 pages, 7 plates and 2 figures. Jefferson City, December, 1896.
32. **Vol. XII. Areal Geology (Sheets 5-10)*, E. M. Shepard, C. F. Marbut, and G. C. Broadhead, edited by C. F. Marbut, 656 pages, 13 plates, 39 figures and 6 maps, 8 vo. cloth Jefferson City, December, 1898.
33. **Biennial Report of the State Geologist*, transmitted to the 40th General Assembly, by John A. Gallaher, State Geologist, 68 pages. Jefferson City, December, 1898.
34. **New Year Announcement of the Bureau of Geology and Mines*, by J. A. Gallaher, State Geologist, 27 pages. Jefferson City, January, 1900.
35. *Vol. XIII. Preliminary Report on the Structural and Economic Geology of Missouri*, by John A. Gallaher, State Geologist, 260 pages, 65 plates, 9 sections and 6 figures, 8 vo. cloth. Jefferson City, September, 1900. (Weight, 46 ounces.)
36 **Biennial Report of the State Geologist*, transmitted to the 41st General Assembly, by Leo Gallaher, Act. State Geologist, 55 pages. Jefferson City, January, 1901.

*Edition exhausted.

FINANCIAL STATEMENT FOR 1925 AND 1926°—SUPPORT FUND

1925

H. A. Buehler	$5,214.38
W. F. Pond	3,084.52
J. M. Thiel	2,604.32
J. I. McCaw	1,200.00
Office	1,466.20
H. S. McQueen	2,709.06
C. O. Reinoehl	1,822.02
H. W. Mundt	1,963.31
C. L. Dake	1,007.09
J. Bridge	935.67
I. A. Keyte	333.30
E. E. Hawkins	1,013.57
J. S. Williams	472.00
R. B. Rutledge	221.40
E. M. Shepard	117.60
P. N. Moore	13.10
C. T. Orr	24.50
E. S. Gatch	13.60
Hugh Stephens Ptg. Co	43.31
F. C. Kerr	247.50
A. A. Smith	100.00
Total	$24,606.45

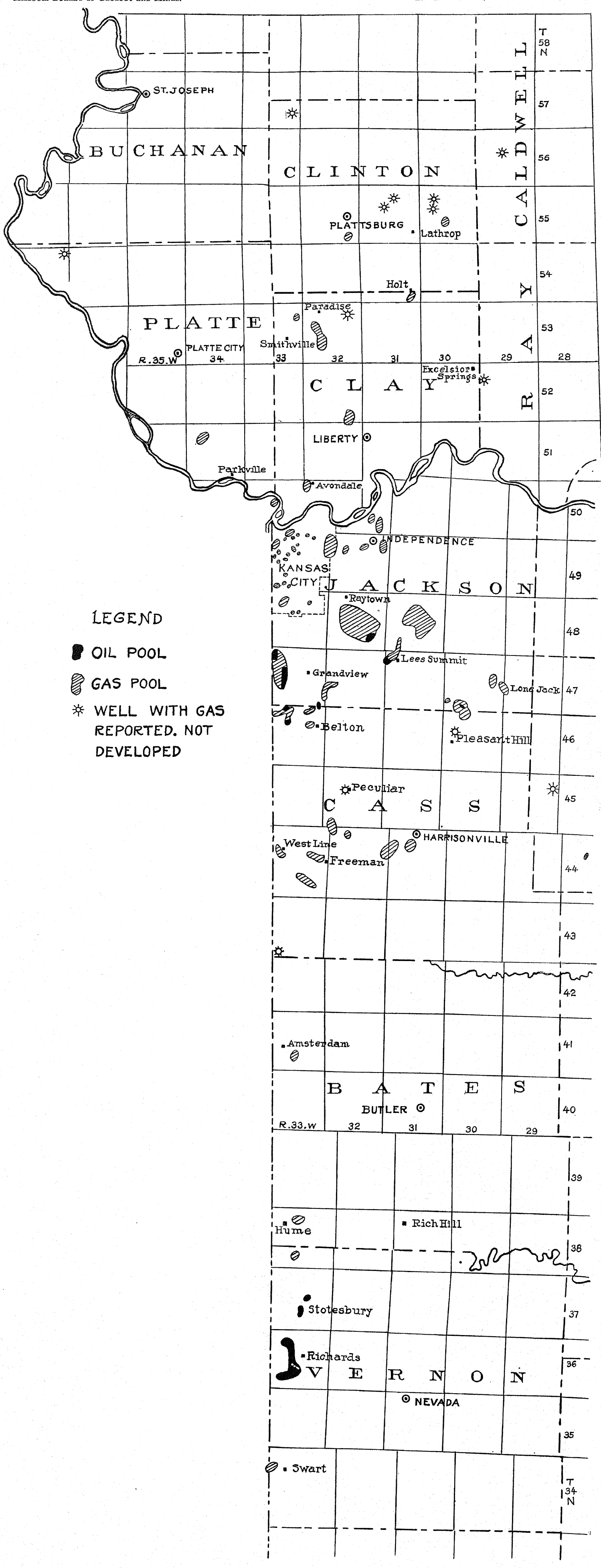
1926

H. A. Buehler	$5,286.92
W. F. Pond	3,247.76
J. M. Thiel	3,042.05
J. I. McCaw	1,200.00
Office	1,912.20
H. S. McQueen	2,661.54
C. O. Reinoehl	1,753.70
H. W. Mundt	2,275.00
C. L. Dake	1,000.72
J. Bridge	529.55
H. R. McCaw	400.00
Underwood Typewriter Co	69.53
Ruth Glass Co	60.00
L. T. Hudson Motor Co	459.70
Mound City Engraving Co	129.50
Navigator Instruments Co	135.00
A. Hoen & Co	3,115.00
Bemis Bag Co	113.21
E. M. Shepard	58.73
E. E. Hawkins	1,080.00
E. B. Branson	278.70
Hugh Stephens Ptg. Co	1,078.54
Total	$29,887.35

FINANCIAL STATEMENT FOR 1925 AND 1926—WATER POWER FUND

1925

H. C. Beckman	$1,855.95
V. L. Austin	1,586.65
W. A. Werner	217.86
W. S. Frame	1,234.82
W. D. Turner	791.47



LEGEND

OIL POOL

GAS POOL

WELL WITH GAS REPORTED. NOT DEVELOPED

Map of western Missouri showing oil and gas pools. Scale 1:500,000 (about eight miles to one inch).

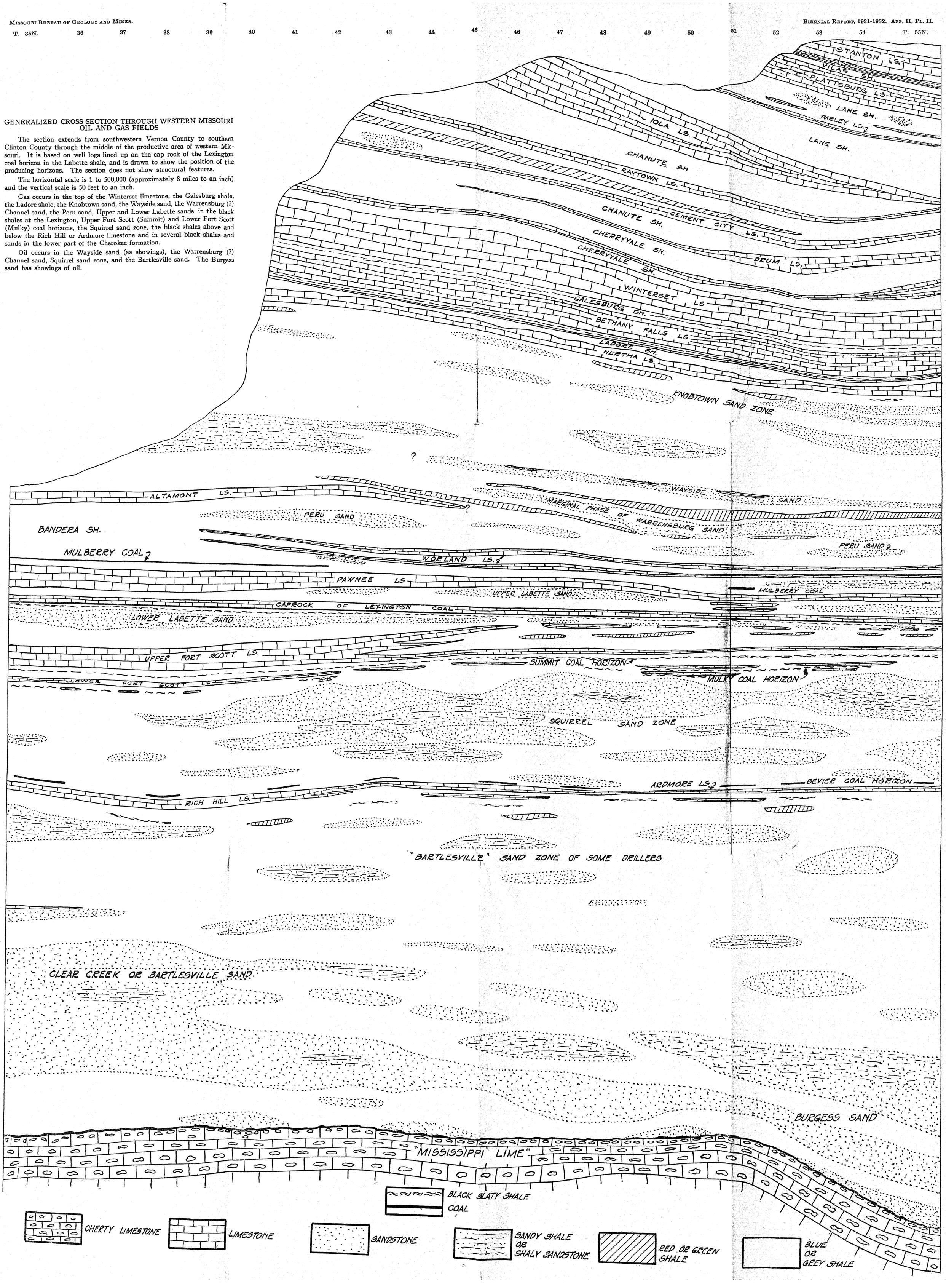
GENERALIZED CROSS SECTION THROUGH WESTERN MISSOURI OIL AND GAS FIELDS

The section extends from southwestern Vernon County to southern Clinton County through the middle of the productive area of western Missouri. It is based on well logs lined up on the cap rock of the Lexington coal horizon in the Labette shale, and is drawn to show the position of the producing horizons. The section does not show structural features.

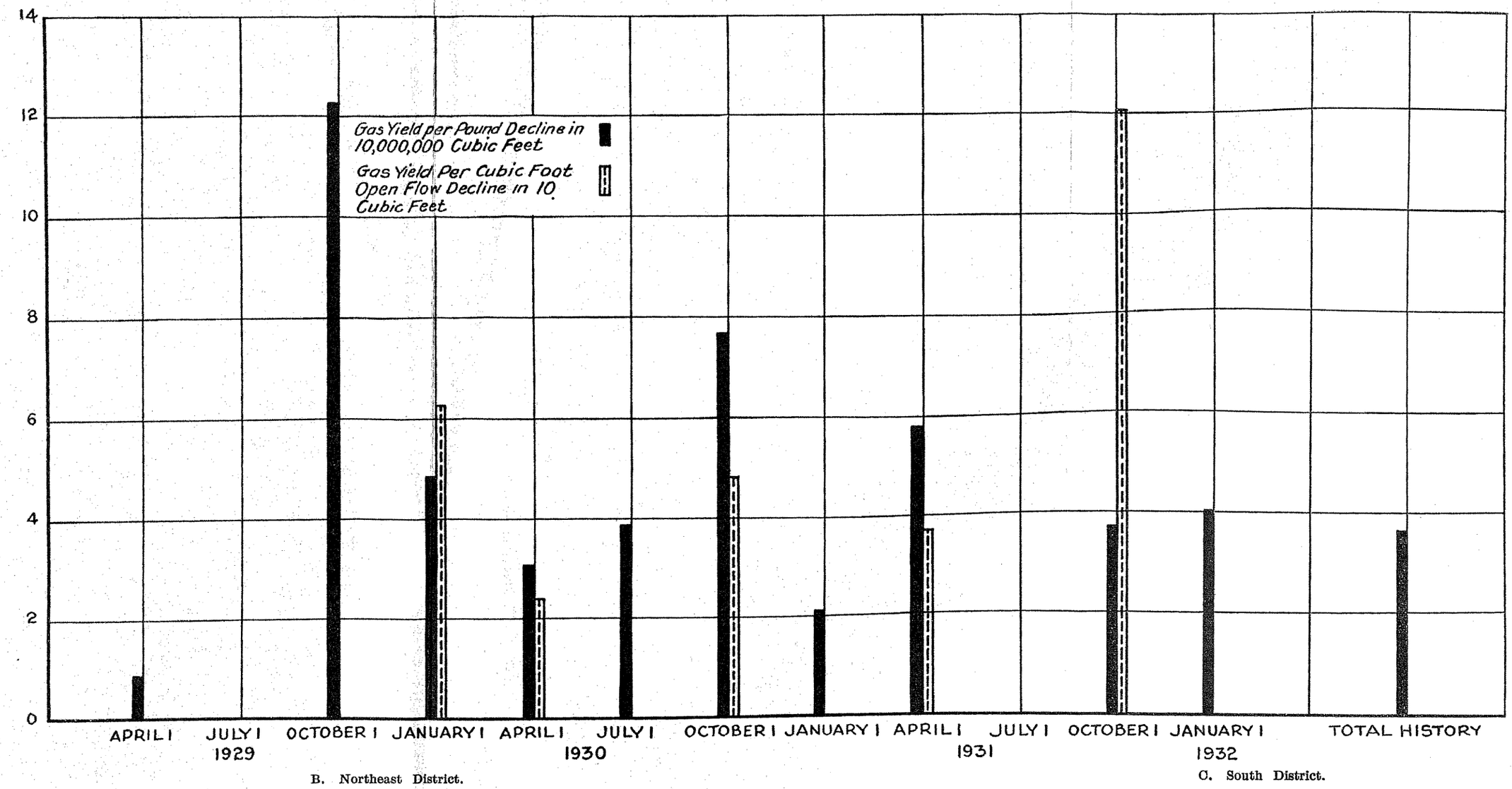
The horizontal scale is 1 to 500,000 (approximately 8 miles to an inch) and the vertical scale is 50 feet to an inch.

Gas occurs in the top of the Winterset limestone, the Galesburg shale, the Ladore shale, the Knobtown sand, the Wayside sand, the Warrensburg (?) Channel sand, the Peru sand, Upper and Lower Labette sands in the black shales at the Lexington, Upper Fort Scott (Summit) and Lower Fort Scott (Mulky) coal horizons, the Squirrel sand zone, the black shales above and below the Rich Hill or Ardmore limestone and in several black shales and sands in the lower part of the Cherokee formation.

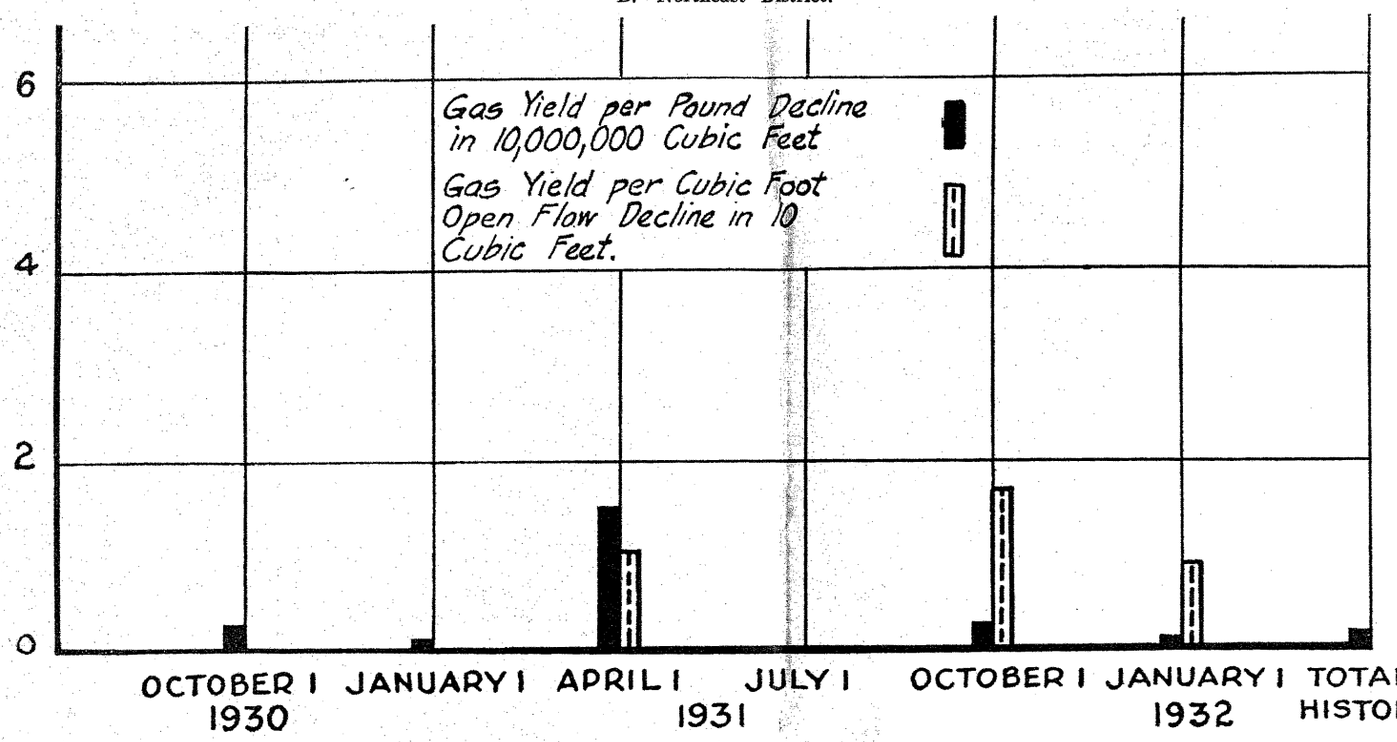
Oil occurs in the Wayside sand (as showings), the Warrensburg (?) Channel sand, Squirrel sand zone, and the Bartlesville sand. The Burgess sand has showings of oil.



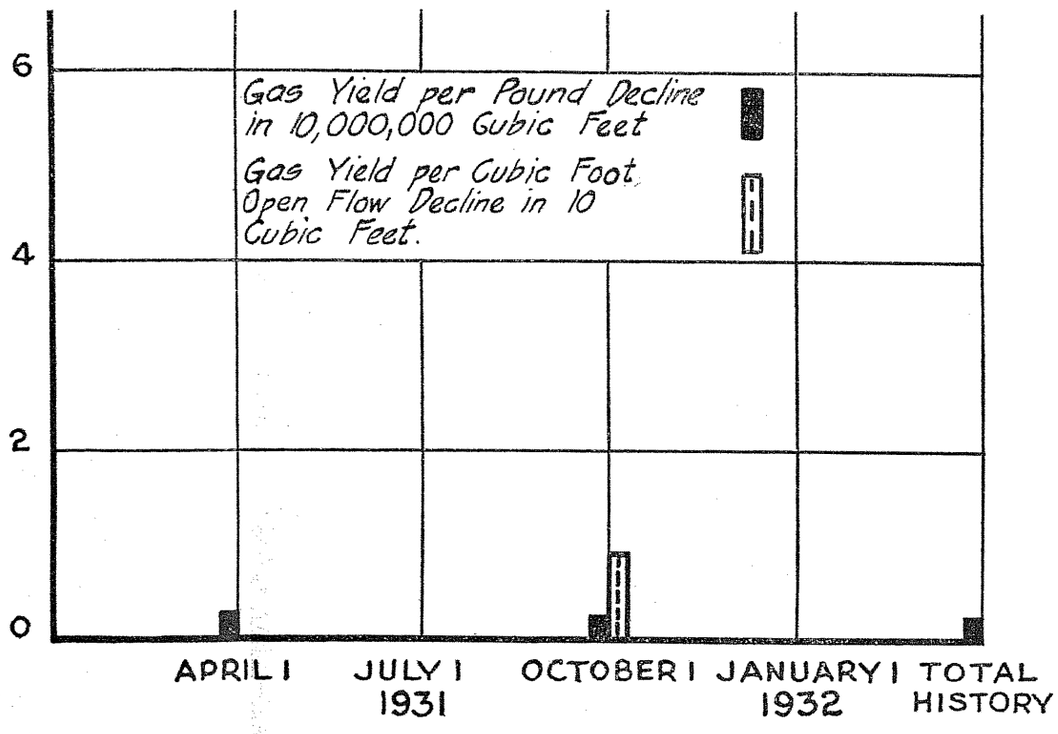
A. West District.



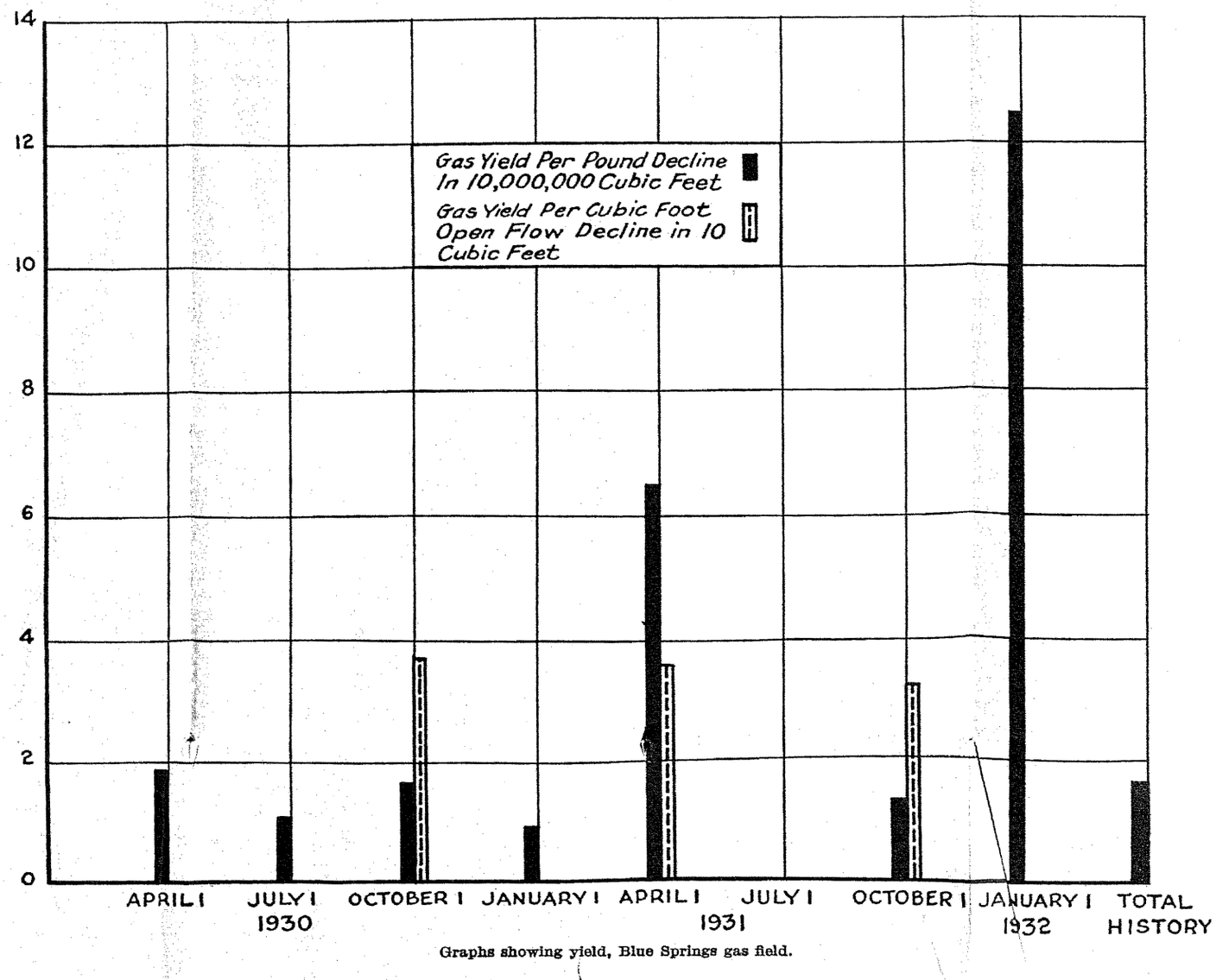
B. Northeast District.



C. South District.



D. East District.



Graphs showing yield, Blue Springs gas field.

FINANCIAL STATEMENT FOR 1925 AND 1926—WATER POWER FUND

1925—Continued.

Gage Readers	$2,715.67
Gilbert Young	125.00
R. L. Harrison	150.00
M. Murphy	34.67
Walter H. York	100.00
J. E. Hayes	56.33
W. A. Simmonds	77.50
Total	$8,945.92

1926

H. C. Beckman	$3,452.28
V. L. Austin	2,422.58
W. A. Werner	1,870.45
W. D. Turner	573.30
Gage Readers	2,270.50
Total	$10,589.11

FINANCIAL STATEMENT FOR 1925 AND 1926—TOPOGRAPHIC FUND

1925

J. B. Leavitt and party	$2,544.09
J. M. Rawls and party	375.00
J. G. Staack	126.67
R. L. Harrison	125.00
F. L. Whaley and party	1,609.32
C. L. Sadler and party	791.67
M. Murphy	48.50
W. R. Broaddus and party	1,484.20
F. W. Hughes and party	3,513.40
R. A. Kiger	133.33
S. R. Archer	53.33
Edw. Tibbott	37.33
W. S. Gehres and party	986.65
F. J. McMaugh	33.33
M. E. Watts	16.00
F. McLaughlin	25.00
C. F. Watson	11.45
Total	$11,914.27

1926

W. R. Broaddus and party	$882.92
F. W. Hughes and party	4,346.11
J. L. Saunders and party	4,707.52
S. H. Moyer	137.39
F. L. Whaley and party	801.73
Total	$10,875.67

° Figures for December, 1926, include only salaries of permanent staff.