

**GEORGE C. BRANNER**  
**STATE GEOLOGIST**  
Son of Eminent Scientist Will  
Be Appointed by Govern-  
nor Today.  
May 23, 1928.  
TO TAKE OFFICE JULY 1  
Will Be His Aim to Take Up Father's  
Labors Where He Left Off,  
Says New Official.

George C. Branner of Little Rock, son of the late Dr. J. C. Branner, former geologist of Arkansas, today will be appointed state geologist by Governor McRae. The appointment will be made in accordance with an act that was passed by the last legislature empowering the governor to make the appointment.

Mr. Branner graduated from Leland Stanford University, Palo Alto, in 1915, and later received an advanced degree from the University of Chicago.

In 1911 Mr. Branner was assistant geologist to his father on a scientific expedition to Brazil. He also was associated with his father in 1920 and 1921 in oil development work in Arkansas. Since then he has been a consulting geologist in this state.

Dr. Branner served as state geologist for six years, from 1887 to 1893, and during that time 18 of his reports were published by the state. Forty-one other books and pamphlets of his, dealing with various phases of Arkansas geology, also have been issued. He resigned his position in Arkansas to become head of the department of geology and mining in Leland Stanford University. He won an international reputation as a scientist and during his life it was written that "no one living is probably so well qualified to deal with the problems peculiar to Arkansas." He came to Arkansas from the University of Indiana. He died in California last year.

#### To Take Office July 1.

The appointment of Mr. Branner becomes effective July 1, when he will assume office. There has been no state geologist for the past 12 years, when a law was passed by the state legislature abolishing the office, at the same time conferring on the professor of geology at the University of Arkansas the title of state geologist, ex-officio.

Mr. Branner, who was a first lieutenant during the war, and was commanding officer of Evacuation Ambulance Company No. 9, also attended at Oxford University in England for one term after the armistice was signed. Of his work as state geologist, he said:

"My father did a great work in his profession and what he has written of geology is recognized as authority. I have worked with him and have studied all he has written on the state of Arkansas, and knowing the great value his work to the state has been, it was my aim to pick up his labors where he left off and continue it for the benefit of the state.

"On June 17, 1920, my father, while at Stanford University, made the following outlines to Jim G. Ferguson, commissioner of mines, manufacture and agriculture, of Arkansas:

#### Work Needed in Arkansas.

"I am often asked what is to be done on the geology of the state of Arkansas. It is quite impossible to answer comprehensively in a few words but it may be worth while to mention here some of the subjects that require attention:

"Bring up to date the work on the coal lands and publish the report.

"Report on the petroleum and natural gas resources.

"Report on fertilizers.

"Report on the soils of the state their origin, distribution and treatment.

"Report on the clays, kaolins and Fuller earths.

"Revise and publish the report on the lower coal measures.

"Report on the structural material: including Portland cement.

"Report on the state water supply: including underground waters.

"A comprehensive work on the general geology and geographic history of the state.

"The preparation and publication of a large scale topographic and geological map of the state.

"The work to be done and the order of its doing, however, must depend on some extent on developments as the work progresses."

#### Tribute to Dr. Branner.

Dr. N. F. Drake, consulting engineer, Fayetteville, who worked under Dr. Branner on survey work in Arkansas during 1887, and was a student under him at the Leland Stanford University from 1883 to 1887, said yesterday:

"Dr. Branner's work has been of great value to the state, and he was during his life, and now is, recognized as a great authority on geology.

"The state of Arkansas now receives a great deal of revenue from natural resources, such as oil, coal, bauxite and other ores and clays, and I think study of these is most important, so to develop them and preserve them.

"I also think that outside capital should be encouraged to enter the state with the object in view of developing these natural resources."

Mr. Drake during the past three years has been associated with the State Bureau of Mines.

## Geologist to Seek Fund to Widen Service Democrat. Branner Hopes to Show State's Mineral Re- sources. 1-2-27

Tucked away in a corner of the fourth floor of the capitol building is Arkansas' orphan department, the office of state geologist. But George C. Branner, who holds the title, and has just enough money to pay salaries and buy stamps, is determined to be an orphan no longer, if he can get the budget committee to listen to him when the coming legislature gets into action.

Branner has a vision of a department of importance to the state, and is making his requests for appropriations accordingly. He hopes in the next year to carry out a complete survey of the coastal plain area of Arkansas, which is about half of the state, located generally in the east and south, in order to present accurate information on oil and gas possibilities in that region; to make a complete survey of the gas-bearing lands of the Arkansas river valley; to compile and issue a complete report on the coal resources of the state; and to report on common clays, kaolin, Fuller's earth, building materials and underground water supplies of the state. In addition, he wants to conduct soil surveys and water power surveys, in order that the state may furnish without cost information upon which further agricultural and industrial development may be based.

Branner has worked out in detail the probable cost of the work he wants to undertake. He estimates that a complete survey of the coastal plain area, in which all the south Arkansas fields are located, would cost about \$22,850, including publication of the report. He estimates that another \$15,000 will pay for a similar survey of the Arkansas river valley area, in which gas is now being produced in quantities.

For the present fiscal year Branner has about \$7,500 appropriated by the state. Two years ago the budget committee merely renewed his previous appropriation. Out of it he is able to pay his own salary (\$4,000 a year) and employ a stenographer and a half-time draftsman.

#### Asks \$72,512 Total.

To carry out the work which he has planned for the coming year, Branner will ask for an appropriation of \$72,512.50 for salaries and maintenance for the year 1927-28, and for \$45,112.50 for salaries and maintenance for the year 1928-29.

In the year 1927-28 he wants to spend \$36,310 for salaries, which will pay for the state geologist \$4,000; one assistant at \$400 a month, \$4,800 (for special surveys); one assistant at \$300 a month, \$3,600 (for the special surveys); two assistants at \$250 a month, \$6,000 (one for the special surveys); three assistants at \$150 a month, \$5,400 (all permanent positions); one draftsman at \$130 a month, and one stenographer at \$130 a month, \$3,120 (regular position). For the water power survey he wants permanent positions created for one civil engineer at \$1,800 a year, and assistants at \$720 a year. For the soil survey he wants one chief field man at \$1,800 and one assistant at \$1,320 as permanent employees. Topographic mapping, a co-operative project with the federal government, will cost the state \$3,750, or one-half the salaries and expenses, according to his estimates. For the second year Branner's salary estimate is \$24,910, the reduction being caused by completion of the special surveys.

The maintenance estimate of \$23,202.50 for the first year and \$20,202.50 for the second is composed chiefly of the cost of publication of reports and traveling and field expenses of geologists and engineers.

Mineral development of Arkansas is now producing 11.2 per cent of the total revenue of the state government, Branner declared. In 1925 the state's income (not including counties and cities) from mineral development taxes of various kinds totaled \$2,142,065.18. This total was divided as follows:

Severance tax (excluding timber), \$1,684,920.84; general property tax on oil, gas and mining ventures, \$278,589.40; corporation tax, \$96,990.61; oil and gas permit tax, \$58,925; sand and gravel tax, \$22,639.33; all other mineral taxes, \$61,269.40.

Oil and gas produced 98.16 per cent of the severance tax on minerals; bauxite produced .89 per cent; coal .66 per cent, and all other minerals .29 per cent, according to Branner's figures.

Oil production in the state declined sharply in 1926, and the severance tax receipts naturally declined with it. Exact figures are not yet available.

#### Information Eagerly Sought.

"I get hundreds of letters," Branner said, "asking me for information about possible oil and gas structures in various parts of the state. Usually the writer wants to know about some particular country. I can give him only vague and general information. If we had such a survey of the oil and

gas territory as I am asking authority to make, I could give definite and specific information, which would be of real value to people who want to invest their money here and develop new fields. The same situation exists in relation to other resources of the state which a thorough geological survey would reveal definitely."

Branner is now preparing a new geological map of the entire state, using data obtained from numerous sources, some of which has never been available to the public. He hopes to have it published by the state department of mines, manufactures and agriculture, which has funds available for publications. He is also preparing a map showing the location and extent of anticlines and synclines in north Arkansas, covering the region north of the coastal plain area. This will be valuable, he said, not alone for possible oil and gas information, but for zinc and lead mining. No arrangements have been made for its publication, although his requests of the budget committee will include funds for that purpose.

A small booklet presenting briefly the status of the geological survey work in the state and its needs is now in the hands of the printers and will be available for distribution to members of the legislature.

## STATE'S MINERAL WEALTH DISCUSSED Gazette - 1-19-27

### Geologist Estimates Value of Natural Resources at \$64,000,000.

Arkansas' wealth in its natural mineral resources, many of which no attempt has been made to develop, were graphically explained by George C. Branner, state geologist, to the members of the Science Club at a meeting last night at the Hotel LaFayette.

"The known mineral wealth of Arkansas," said Mr. Branner, "is estimated at more than \$64,000,000. Of this \$50,000,000 is in petroleum, \$5,000,000 in coal deposits, \$4,000,000 in gas and nearly \$2,000,000 in bauxite. There has been an enormous increase in the value of the minerals in the state since 1921, when the oil wells first started producing.

"Mineral properties paid last year, taxes of more than \$2,000,000, or 11.8 per cent of the state income. Most of this came from gas and oils."

#### Water Power Neglected.

"Water power," said Mr. Branner, "is the most neglected natural resource in Arkansas. This is due, mainly, to the fact that there are practically no records of stream flow of the rivers of the state. Data for a period of at least five years and preferably for 10 years is desired by companies interested in developing water power, and we are not in a position to furnish it. There are now established in the state, 10 gauging stations, where records are being taken daily of the rise and fall of the rivers, but it will be several years before these records are of much value.

"Only 900 primary horse-power is being developed on the streams or Arkansas, less than one-half of one per cent of the power available, and only 6,320 secondary horse-power, or about four per cent of the available power, is being developed. This is a distinct loss to the state, as water power is much more economic than any other power."

#### Charts Are Exhibited.

Mr. Branner illustrated his talk with a series of charts with which he showed the geologic construction of the state and briefly traced the probable origin of the territory from Missouri to the Gulf of Mexico.

"There are three distinctive types of rocks in Arkansas," Dr. Branner said, "and this means that we find three distinctive types of minerals. He presented a chart showing the 17 different minerals found in the state and a series of maps showing the location of each of the known mineral deposits.

There were more than 4,000 producing oil wells in Arkansas in 1925, according to Mr. Branner, and all of these are in an area of 77 square miles. In the period from 1921 to 1926 they produced 260,000,000 of barrels of oil, valued at more than \$241,000,000. He estimated that there are 850,500,000 tons of coal available in the state, sufficient to last 350 years, if only 80 per cent is mined. There were 94 coal mines in operation in 1926, he said, and they produced more than one and one-half millions of tons of coal. The known coal fields of Arkansas extend over an area of more than 1,600 square miles.

Bauxite and manganese deposits in the state are very valuable, Mr. Branner said, and he estimated that there are available 45,000,000 tons of bauxite near Benton. There also are large deposits of this ore a few miles from Little Rock, where it is being mined now. Manganese is now being mined near Batesville and is being shipped to Alabama where it is used for hardening steel.

#### Many Mines Suspend.

During the war there were 73 lead and zinc mines operating in Marion county, but most of these have suspended activities. Geologists expect that the lead and zinc mines in the Joplin district will produce only one

third of their present output by 1932, and then prices will be such that Arkansas mines can be reopened.

Four marble quarries are operating in the state and are producing an excellent grade of marble, much similar to the Joplin marble. There are more than 2,200 square miles of marble outcrops in Arkansas, he said. Gray and chocolate colored marble is produced and is used as an exterior building stone.

Although there are large deposits of limestone sand dolomites in the state, practically all of the cement used in construction work is imported. Arkansas is beginning to produce cement in the northern part of the state, he said, but it is being made by the use of Illinois coal.

"Phosphate rock, the basis of valuable fertilizers, is found in large quantities," Dr. Branner said, "but it is not being used on a commercial scale. There are 20,000,000 tons of this rock available for the farmers of the state, if only some one would mine it."

He estimated that there were more than 700,000,000 tons of white chalk, appearing in ranges of from 50 to 100 feet in thickness in the state and that very little of it was being used. He showed maps giving the location of the diamond mines of Arkansas and explained the probable origin of the deposits in which diamonds have been found.

The shale and clay deposits are being overlooked, he declared, for there are only a few brick kilns operating at present. He said that the shale and clay was of good quality for this purpose.

"Only eight per cent of Arkansas has been thoroughly mapped by the geologists," he said, "and there are topographic surveys of only 34 per cent of the state. Sixteen counties have had soil surveys, and work is now in progress in four more.

"It is doubtful if this work will be finished for many years," he continued, "as the business interests of the state which would be most benefited by these surveys, refuse to co-operate with the federal government in financing the work, which would cost but a few cents an acre."

## GEOLOGIST PLANS COMPLETE SURVEY

Ark. Gazette 2-12-27

### Would Bring Up to Date Work Begun by His Father 36 Years Ago.

Gazette 2-12-27.

A complete survey of the natural resources of Arkansas is planned by State Geologist George C. Branner for 1927 and 1928. If the appropriation request presented in the Senate Tuesday by Mr. Branner is approved by the legislature, the geologist will bring up to date the work started more than 36 years ago by his father, the late John C. Branner.

Mr. Branner's program for the two-year period follows:

Prepare a report on the petroleum resources of southern and eastern Arkansas; prepare a report on the petroleum resources of northern and northeast Arkansas; make a complete survey of the common clay, kaolin and Fuller's earth resources; make a survey of the cement, building and road material resources; make a complete survey of the coal resources of the state; prepare a report on the underground water supply; prepare a report bringing up to date the reports on lead and zinc in north Arkansas; continue the geologic map and topographic map program; publication of a chart showing the rock formations; make a complete soil survey; prepare a report on the mineral fertilizers; continue the county soil surveys in co-operation with the United States Department of Agriculture and the University of Arkansas; make a complete report on water power resources and establish gauge stations to obtain an accurate record of the run-off.

For the 1927-28 program, Mr. Branner is asking \$72,512.50, and for the 1928-29 program, \$45,112.50. The requests compare favorably with appropriations made by other states for their geological surveys, according to Mr. Branner.

#### Would Be Valuable Work.

"This work would be of great value to the state," Mr. Branner said yesterday. "Very little work of this kind has been done since John C. Branner published a series of books 36 years ago, while the economical and social changes have been so great that even those surveys are of little practical use.

"The purpose is to locate new resources, map and estimate them and publish reports so that everyone will know just what we have in the state. Outside capital can not be obtained to do this work, but when the possibilities of our undeveloped resources

are made known the capital with which to develop them will be waiting.

"As there are 52,000 square miles of territory in Arkansas to be included in the surveys it may be seen that our present program is no small undertaking. In 1892 John C. Branner had 13 able scientists in the field. These men worked five years, and all other surveys of note have been conducted on a similar scale.

Cost Is Estimated.

"A complete survey of the oil and gas possibilities of the state can be made for \$38,000. The present oil fields show signs of depletion and if the state is to continue to receive a large revenue from this source new fields must be opened. In 1926 the total mineral wealth of the state was approximately \$67,475,000, while for 1925 the returns amounted to \$83,641,000.

"Development of natural resources would put Arkansas a long step ahead of the other Southern states. Take El Dorado and Smackover for example. In 1920 El Dorado was a village with a population of about 3,000. Today El Dorado is among the four largest cities in the state and has the best school system and more churches per capita of any city in Arkansas.

"The contemplated surveys could be financed in three ways as follows: By an appropriation from the general revenue fund; by a small per cent of the severance tax, a small per cent of the cent and turning the proceeds over to the department."

## NOW FOR AN ARKANSAS GEO- LOGICAL SURVEY.

The passage by the General Assembly of Senator McCall's bill increasing the severance tax on mineral products by one-tenth of one per cent to provide funds for a state geological survey will enable Arkansas to resume a vitally important and potentially profitable public enterprise which has lain in abeyance for 36 years or more. The earlier survey, ended in 1891, was in charge of the distinguished Dr. J. C. Branner and his son will continue, as state geologist, the work which the father regretfully laid down. It is worth noting again also, as revealing the character of the work done by that earlier survey, that among the technicians who took part in it were Herbert Hoover, then a young mining engineer; and Richard Alexander Fullerton Penrose, brother of the late senator from Pennsylvania and today a world-famous geologist.

The resumed survey will of course be concerned largely with petroleum and gas, which at present make the chief contribution to the mineral production of Arkansas. But the program laid out by State Geologist George Branner is comprehensive and exhaustive. It looks to the discovery and definite location of many sources of mineral wealth, and also promises to serve agricultural enterprise. Among the projects included in it are oil and gas surveys in the eastern, southern and western areas of the state, the completion of the report on coal resources, reports on clays, kaolins, fuller's earth, cement materials, building and road materials, lead and zinc deposits, mineral fertilizers and underground water supplies, continuation of soil surveying, and establishment of gauging stations to give hydraulic engineers precise data for water power purposes. With facts like these in hand, Arkansas may confidently hope to attract capital engaged in various lines of enterprise which will forward the general development of the state, furnish employment to large numbers of her people, and increase substantially the property values and business activities from which our public revenues are derived by taxation. 3-6-27. Gazette

containing the general provisions which objectionable features eliminated. Representative McGehee sponsored the bill. Geological Survey Favored. Senator McCall's bill to levy a tenth of one per cent additional severance tax to provide a fund to complete a geological survey of the state under the direction of State Geologist George C. Branner, was passed by the House, 77 to 6, over the vigorous protest of Representative Sam Crawford of Union county. Another Senate bill passed by a large majority after Representative Jones of Pulaski and others had attacked it as being "too strong," was Senator Caldwell's bill to limit expenditures in submitting initiated measures to \$25,000. Several members said a measure could

# New Program of Geological Research

## Will Be Started in July

May 29-1927

With the inauguration of the new program of geological research in Arkansas early in July the state geological survey will enter upon a co-operative arrangement with the United States Geological Survey which will multiply the effectiveness of its work, hasten the completion of several of its most important projects and divide the expense of these undertakings between the state and federal governments, the United States Geological Survey having placed at the disposal of the State Geological Survey field experts and made special appropriations of funds to match similar appropriations authorized by the 1927 Arkansas legislature.

These projects, work on which will begin directly after July 1, will include a survey and report on the oil and gas possibilities of the Coastal Plain area of southern and eastern Arkansas, the first of its kind since the discovery of oil and gas in this section and of special importance to these interests for the reason that it will make available important information obtained from a study of more than 700 prospect wells recently drilled in this territory, revealing a vast store of geological data for the purpose of study and correlation in working out a comprehensive cross-section of the underground structure. The detailed discussion of the separate producing areas and county by county reports to be prepared by W. C. Spooner, geologist of Shreveport, La., and his assistant, will serve as a guide for future prospecting in this promising oil and gas region, only a small part of which has been developed.

### Natural Gas Possibilities.

Much interest centers on the question of further developing the natural gas possibilities of the Arkansas valley. Large fields have been known for some time to exist in Sebastian and Crawford counties and recently two producing wells were developed in Johnson county, near Clarksville. It is a popular belief that this field may extend a considerable distance eastward and northward and the State Geological Survey has a considerable amount of unpublished data on the subject. A study of the gas possibilities of this section will be made by Cary Cronels, formerly assistant professor of geology at the University of Arkansas, and now connected with the department of geology. Cronels and an assistant will undertake the field work in this area for the state survey and the results of the survey, embodying all available information on the gas possibilities of this section, will probably be given to the public during the latter part of 1927.

Another of the early publications of the survey will be a report on the upper cretaceous rocks of southwestern Arkansas, which will also be of assistance to those who are seeking to discover new areas of oil and gas in Arkansas. The field work on this survey has been carried on by C. H. Dane of the United States Geological Survey and the maps and plates are now being prepared so that there will be no delay in getting to press this report, which will contain about 150 pages of text. This report is offered by the U. S. Geological Survey to the State Survey as a co-operative project and will be published by the State Survey.

### Zinc and Lead.

Plans are being made to carry out a co-operative survey of the entire zinc and lead region of north Arkansas. Half of the field expense of this survey probably will be borne by the state survey and half by the United States Geological Survey. This will cover all of the zinc and lead counties of north Arkansas and bring part of the survey up to date. The Sharpe and Lawrence county area, which has recently come into public notice, will be included. No survey of the zinc and lead counties has been made since 1904 and there has been much new data brought to light since that time which will be useful to those contemplating carrying on mining in the north Arkansas areas.

Arkansas' first detailed geological map, constructed on a government base map on a scale of about eight miles to the inch and fitting in with similar maps of neighboring states, is in course of preparation and its early publication has been made possible by the recent appropriation. This map will show surface geology, oil and gas fields, coal, bauxite, manganese, lead and zinc areas, gas lines, power transmission lines and water power activities.

Along the principal streams of the state, where there are possibilities of developing hydro-electric power, it is the intention of the state geological survey to establish a series of stations where readings may be taken of the stages of these streams and where observations may be made for the construction of rating curves to show the cubic feet discharge of the streams at various stages, information essential in the calculation of the water power resources. This work will be under-

the direction of H. T. Beckman, United States district engineer, stationed at Rolla, Mo., and he will have at his disposal the data collected over a period of many years by the various stations in Arkansas of the United States weather bureau. A report of this work will be published annually by the United States geological survey and the results are expected to be helpful to those who are interested in the development of water power along the many streams in the upland portions of Arkansas, particularly the White river and its tributaries, the Little Red river, the Arkansas, the Ouachita, Fourche LaFave river, the Little Missouri, the Caddo and the Cassatot.

### Soil Survey Work.

There will be a three-cornered co-operation in the resumption of soil survey work, made possible by the appropriation for the state geological survey, the state college of agriculture, University of Arkansas, as well as the United States geological survey taking important parts in the completion of the soil surveys, which have been at a standstill for several years in account of the lack of state funds. This is a work of vital importance to agriculture and one in which the individual farmer receives a distinct benefit for a map is made of the various types of soil and the characteristics of these soils are studied and reported upon so that the farmer can more intelligently handle them in the preparation of his land for crops. The reports will point out the drainage needs of the area surveyed and the chemical consistency of the soil. If the soil is lacking in any important element of plant food these surveys will reveal the fact and the farmer may supply the necessary material and bring his land to a higher degree of productivity. Only a small por-

tion of the state has had its soils surveyed, but there are surveys in progress in five counties, Pulaski, Bradley, Nevada, Clay and Baxter, and it is the intention to complete these as soon as possible, all interests co-operating and the work starting as soon as the new appropriation becomes available after July 1.

More important, in a fundamental sense, than all of these projects, however, is the movement that will be undertaken to resume the big task of thoroughly mapping the topography of the state, an important work on which very little has been done up to this time. A topographical map is a relief map, showing the shapes and elevations of the land and water features by contour lines; the artificial features such as railroads, highways and buildings, all in their true relations to one another and to the land and water features. It is the key to all physiological study and the guide of the engineer and geologist in all researches. In fact the topographic map has an infinite number of uses. It serves as a base on which most problems affecting human activities may be studied and investigated and plans made for their solution. The possession of such maps ensures the economical planning of improvements and reveals possibilities for the development of resources that otherwise would remain unknown. In this period of great highway extension and development of aeronautics the existence of a complete topographic map of the state would save large sums of money to the local, state and national governments, or business organizations and to individual citizens for they would point the way where roads might be most economically built and where landing fields might be most advantageously located for the accommodation of flying craft.

### Water Power Development.

The development of water power demands a broad, comprehensive knowledge of the topography of the surrounding country, such as the maps to be prepared by the state geological survey in co-operation with the United States geological survey will convey. Such knowledge as the hydro-electric engineer requires cannot be obtained by surveying a few lines where dams are proposed, but must be obtained from a study of accurate topographic maps, showing in addition to the information supplied by ordinary maps the extent of drainage of reservoir sites and many other features valuable in the consideration of the subject of water power development.

In the handling of flood situations, such as recently has existed in Arkansas, and the development of plans to prevent their recurrence, the topographic map has an important use for proper disposal of surplus water is dependent on the slope and character of the surface of the area affected and a knowledge of these conditions is necessary to the solution of drainage problems. Topographic maps show the accurate slope of the land, the area of the basin that will yield water into the drainage system, and the location, slope and capacity of the ditches that must be constructed to remove the water.

Like the soil surveys these topographic maps also render a distinct service to the farmer in that they indicate the desirability or undesirability of any particular piece of land in the calculation of the water power resources. This work will be under-

ner in which these lands may be cultivated. With the two maps the farmer has a most complete set of working plans for the physical handling of his lands.

The first step in the studying the mineral resources of a given section, whether it be oil, coal, zinc, lead, manganese, building stone, cement material, clays or whatnot, is always to obtain topographic data. If no map exists one must be made. No geologist can determine what is under the surface without a knowledge of the contour and physical features of the surface on which to plot the outcrops of the sub-surface formations.

### Value of Map in Forestry.

Topographic maps also are useful in the economical removal of timber from the forests and for the location of stations for the protection of the woodlands from fire. In the study of physical geography the topographic maps are invaluable. Tourists traveling by automobile make frequent use of topographic as well as geographic maps, because they point out not only the relative location of towns and villages, but show the variations in altitude, the minute meanderings of the road, the outstanding landmarks and every house by the roadside. No other map in existence gives details so valuable to the motorist.

Topographic maps have wide use and great value as base maps for the graphic presentation of facts relating to population, industry and other statistical information, and they are of first importance to military forces in time of war. No army without accurate topographic data could cope in a country like America with an enemy in possession of information as to the height of every ridge, the width of every valley and the degree of curvature of every river bend.

The national government recognizes the urgent demand for more rapid progress in topographic mapping to meet the needs of engineering activities of all classes and has entered upon a program of systematic topographic survey extension. This program contemplates a liberal co-operation from the states, as the states are to profit even more greatly and more directly than will the federal government from this work, and the surveys will be made where state aid is available.

In Arkansas it is the plan of the State Geological Survey to undertake the topographical survey of a quadrangle embracing about 250 square miles lying mostly in Union county, the map to be completed on a scale of about one mile to the inch. It is the policy of the United States Geological Survey to supply half of the field force for this work and to defray half of the field expense of such a survey, and the Federal government defray the entire expense of publication. The government has \$25,000 available for this work in Arkansas during the next two years but the state has provided only \$3,750 and under the cooperative arrangement only \$7,500 can be expended for this purpose, during the coming biennium, his, it is estimated, will about cover the cost of completing the El Dorado quadrangle and work on this project will be started early in the summer.

### First "Real" Survey Since 1892

The starting of these several projects, which will put a dozen or more geologists and engineers in the field, is the beginning of the first really pretentious geological research work in Arkansas since the suspension of the Survey's activities under Dr. J. C. Branner in 1892, some 35 years ago. With Dr. Branner at that time were associated a number of eminent men of science, including five geologists who later became state geologists of different states, and the present Secretary of Commerce, Herbert C. Hoover. This survey prepared reports on the zinc and lead fields, manganese deposits, igneous rocks, gold and silver indications, coal deposits, novaculites, mineral waters, and various geographical and geological sections, some 14 volumes in all. As a result of these surveys the boundaries of the coal field in western Arkansas were defined and coal mining stimulated, bauxite was discovered in Central Arkansas and brought to the attention of the world, eventually resulting in the establishment of the great plant of the American Bauxite Company, and the profitable mining of other useful minerals was undertaken, greatly increasing the wealth of the state from its natural resources.

Following the suspension of the work of the Survey a report was prepared by Dr. A. H. Purdue, professor of geology, University of Arkansas, on the slate deposits of the state, a partial report on the water power resources by W. N. Gladson, dean of the College of Engineering, University of Arkansas, and a report on coal mining methods by A. A. Steel, were published. But aside from these and an occasional handbook of geological references, issued by the State Bureau of Mines, Manufacturers and Agriculture, nothing has been done to establish an accurate inventory of the state's mineral wealth and to locate the deposits of useful materials and find a way by which they might be economically worked.

It is the purpose of the present survey to revive its work upon the most effective scale possible with the appropriation available and to make the

fullest use of the cooperation offered by the Federal government through its Geological Survey and Bureau of Soil, so that the study and mapping of the mineral and water power resources of the state may be pushed with all possible speed. The survey maintains headquarters at the state capitol and during the next two years will have a force of men in the field cooperating with the government forces, and as rapidly as the information is obtained it will be translated into maps, graphs and printed page and made available for the use of the public, or such part of it as is interested in the development of these resources which are among the state's greatest assets.

## State's Mineral Resources

## Are Reviewed

## in New Book

"Outlines of Arkansas' Mineral Resources" is the title of a report just published jointly by George C. Branner, state geologist, and William N. Wilkes, commissioner of mines, manufactures and agriculture, an advance copy of which has been received at the capitol from a Fort Smith printing firm.

Although it is probably the most complete review of the state's mineral resources that has been undertaken, it is a compact little volume of the regulation government publication size of 6x9 inches and fits easily into the side pocket. Besides its 352 pages of text the publication contains a geological chart showing the underground structure, and a map, in colors, indicating the geological divisions of the state. There are numerous maps, charts, graphs, and plates distributed through the book illustrating the mining activities and distribution of minerals. Geologists and those interested in minerals and mining will find it a most useful handbook.

On account of the cost of printing and the technical character of this report it is announced that it is not intended for general distribution, but to supply the scientific demand, reference libraries, government agencies and those engaged in the business of prospecting and mining. Already there are enough requests on file to considerably diminish the edition, but State Geologist Branner and Commissioner Wilkes are anxious that no one who has a real need for the book be overlooked in its distribution.

### What the Report Contains.

In the introduction attention is called to the importance of Arkansas' mineral resources and to the retarded state of their development often due to a lack of knowledge as to their nature, location and value. In 1926, the value of the mineral output in Arkansas, Mr. Branner points out, was \$67,000,000, as compared with a return of \$80,000,000 from timber and \$223,000,000 from agriculture. The mineral prospects which seem to offer the greatest opportunity for development, according to the report, are oil and natural gas in the coastal plain region of southern and eastern Arkansas, the natural gas of the Arkansas river valley, the zinc and lead fields of northern and northeastern Arkansas, the chalk and marl deposits of southeastern Arkansas, the brick, tile and pottery clays, the road building materials, the mineral fertilizers, including phosphates, greensands, chalks and chalk marls, miscellaneous minerals, such as manganese, antimony and copper. From a survey of mining operations in neighboring states it is believed that Arkansas can add to this list other important minerals such as cement materials, slate, lignite, Fuller's earth, tripoli and silver, all of which are known to occur in the state, but none of which is now being mined.

It is not difficult to predict that the future holds much for Arkansas as far as the development of her mineral resources is concerned," says the author. "The present development of her extensive oil fields insures benefit for years to come, her gas and coal fields and bauxite deposits will be of benefit to future generations, while yet undeveloped and undiscovered mineral deposits can be confidently counted upon as a source of future wealth."

The organization and working plan of the state geological survey is next discussed and explanation made of the manner in which the state undertakes to help those who are interested in the development of the mineral resources. A table shows the severance tax collections by periods and for the various products, indicating the increase of revenue to state and county from these sources.

### Discussion Covers Wide Range.

Following these preliminary remarks the report enters upon a broad and comprehensive discussion of the mineral wealth of the state, beginning with a chapter of the general physical features, in which the subjects of

physiography, topography, geology and soils are discussed separately and in detail, each discussion being accompanied by a map or graph which adds greatly to the reader's understanding of the technical descriptions.

Under the heading, "Water Power," the report states that streams of the state may be used to generate 125,000 horse power available 90 per cent of the time, and 178,000 horse power available 50 per cent of the time. A list of the hydroelectric plants in Arkansas and a map showing the location of stream gauging stations is of particular interest to those interested in water power development.

The report explains that the distribution of the various minerals in Arkansas directly dependent on the geological formations and as an introduction to the chapter on "Mineral Distribution" there is a brief explanation of the relation of certain minerals to particular geologic features—the metallic ores to the Ozark region, coal, shale and gas to the Coastal Plain, and granite, bauxite and diamonds to the area of igneous rocks. There follows a double-page map showing the location of each important mineral and with this there is a complete list of the minerals and rocks of the state, giving the name, composition, nature of occurrence and locality.

Minerals of the state of commercial importance are then discussed in alphabetical order, the composition, uses and occurrence being indicated in each instance, and tables show the production by years, both in quantity and value. Under this heading there is in brief all that one would want to know about antimony, asphalt, bauxite, building and structural stones, including granite, sandstone, quartzite, limestone, dolomite, and marbles; chalk, clays, coal, including lignite; copper, diamonds, Fuller's earth, glass sand, gold and silver, gypsum, iron, limestone, for burning; manganese, mineral waters, mineral fertilizers, including chalk and chalk marls, green-sand marl, limestone, phosphates and gypsum; novaculite, for use both for manufacture into whetstones and for road-building; ochre, petroleum and natural gas, an exhaustive 43-page discussion of the producing fields containing much information for the first time published; onyx marble, Portland cement materials, road-making ma-

terials, including argillaceous or clay shales, clean sandstone, syenites, or granites, limestone, novaculites, arenaceous shales, gravels and chert; sand and gravel, slate, soapstone, tripoli, and zinc and lead, the latter chapter containing 18 pages of matter relating largely to the north Arkansas zinc areas which are now attracting attention because of the decreased production of the Tri-State zinc fields about Joplin, Mo., and Miami, Okla.

In an appendix the report contains a digest or summary of the state and federal laws affecting mines and mining, grouped under the following headings: "Mining Lands in Arkansas, Federal and State," "The Land Owner's Problem Respecting Oil and Gas," "Law Creating the Office of State Geologist," "Law Creating Arkansas Bureau of Mines, Manufactures, and Agriculture," "United States Mining Laws," "State Mining Laws on Recording Government Claims," "Sand, Gravel, Oil and Coal Taken From River Beds," "Water Power," "Co-operative Soil Survey," "Act Creating Department of Conservation and Inspection" (and rules and regulations promulgated by the department), "State Mine Inspection Laws," "Laws for the Conservation of Oil and Gas," "Right of Eminent Domain to Pipe Line Companies," "Law Requiring Release of Forfeited Leases," "Synopsis of Oil and Gas Inspection Laws," "Synopsis of Arkansas Blue Sky Law," "State Severance Tax Law" and "Mining Lease Forms."

# State Geologist Shows Ark

## George C. Branner Also Gives Outline of Soil and Data Reviewed and Interpreted--Possibility of I

Democrat Sunday

A broad and comprehensive outline of Arkansas' mineral, soil and water power resources is attractively and authoritatively set forth in a 352-page report compiled by Dr. George C. Branner, state geologist, that has just come from the press and will be ready for distribution starting July 1. In the preparation of the volume all available data pertaining to the state's vast undeveloped store of buried natural wealth has been reviewed and interpreted in its commercial aspects with a degree of thoroughness never before attempted.

The material is concisely presented and conveniently arranged, and while the text is largely technical and statistical, it is primarily a work designed for the perusal of laymen, expressed in clear, concise language and illuminated by numerous charts and graphs that help to make the subject matter readily comprehensible. The title is "Outlines of Arkansas' Mineral Resources."

"An attempt has been made," the author explains in the foreword, "to include maps which are out of print or inaccessible to the public, and also to include references which may prove useful. In a work of this nature, which is largely statistical, it is necessary to make liberal use of all available information, including data from the United States geological survey, the state survey, scientific publications and numerous unpublished reports."

Those interested in the material advancement of Arkansas are reminded in the introductory chapter that "the development of a mineral resource does not necessarily follow upon its discovery, and that before a profitable development can take place various difficulties must often be worked out, involving not only chemical and metallurgical problems, but questions of labor, transportation, marketing and finance as well."

"Consequently," the author adds, "although the work of the geological survey is primary and fundamental in its nature, it can, as a rule, supply data for the answering of only one part of the complex problem of selling raw material at a profit in competitive markets."

**State's Mineral Future Bright.**  
"It is not difficult to predict that the future holds much for Arkansas as far as the development of her mineral resources are concerned. The present development of her extensive oil fields insures benefits for years to come; her gas and coal fields and bauxite deposits will of themselves be of benefit to future generations, while yet undeveloped and undiscovered mineral deposits can be confidently counted upon as an added source of future wealth."

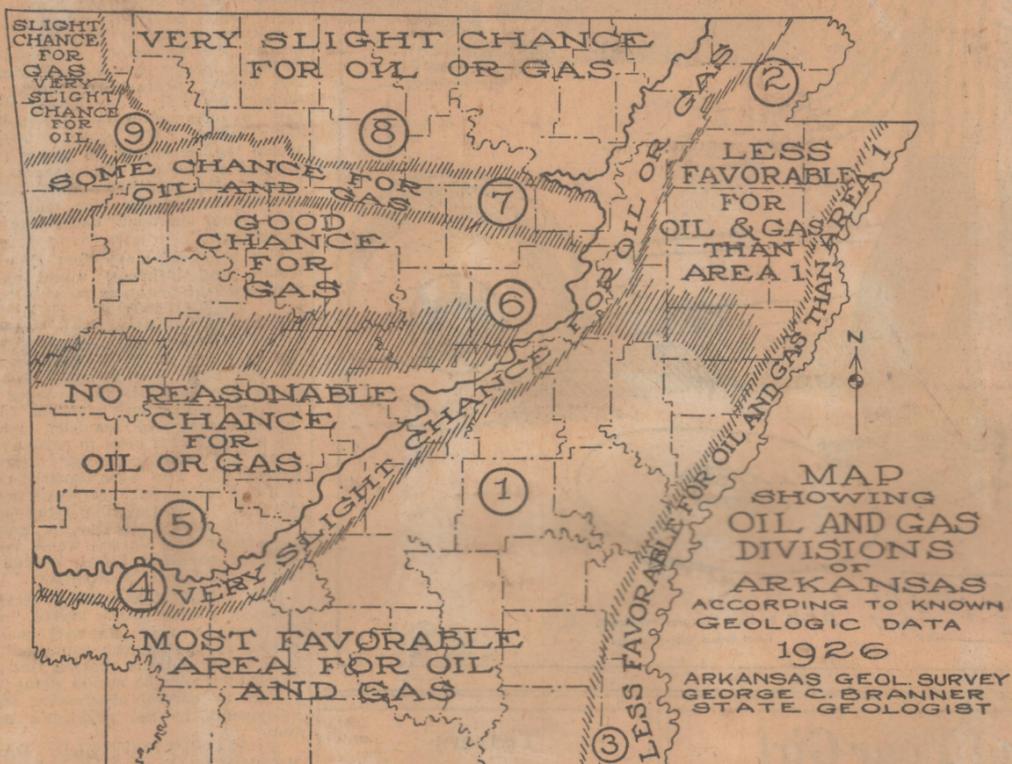
The volume is being published jointly by the state geologist and William N. Wilkes, commissioner of mines, manufacture and agriculture, whose department bears two-thirds of the publication cost. It was printed at Fort Smith by the Calvert-McBride Printing Company, and although it is a veritable encyclopedia of geological information, it is so compact (six by nine inches) that it fits easily into a coat pocket.

In addition to the text the publication contains a geological chart showing the underground structures, and a lithographed map in colors showing the geographical divisions of the state.

**What the Report Contains.**  
In the introduction attention is called to the importance of Arkansas' mineral resources and to the retarded state of their development often due to a lack of knowledge as to their nature, location and value. In 1926 the value of the mineral output in Arkansas, Mr. Branner points out, was \$67,000,000, as compared with a return of \$80,000,000 from timber and \$223,000,000 from agriculture. The mineral prospects which seem to offer the greatest opportunity for development, according to the report, are oil and natural gas in the coastal plain region of southern and eastern Arkansas, the natural gas of the Arkansas valley, the zinc and lead fields of northern and northeastern Arkansas, the chalk and marl deposits of southeastern Arkansas, the brick, tile and pottery clays, the road building materials, the mineral fertilizers, including phosphates, greensands, chalks and chalk marls, miscellaneous minerals, such as manganese, antimony and copper. From a survey of mining operations in neighboring states it is believed that Arkansas can add to this list of important minerals such as cement materials, slate, lignite, Fuller's earth, tripoli, and silver, all of which are known to occur in the state, but none of which is now being mined.

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### June 26 1927 Oil and Gas Map of Arkansas



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**Discussion Covers Wide Range.**  
Following these preliminary remarks the report enters upon a broad and comprehensive discussion of the mineral wealth of the state, beginning with a chapter of the general physical features, in which the subjects of physiography, topography, geology and soils are discussed separately and in detail, each discussion being accompanied by a map or graph which adds greatly to the reader's understanding of the technical descriptions.

Under the heading, "Water Power," the report states that the streams of the state may be used to generate 125,000 horsepower, available 90 per cent of the time, and 178,000 horsepower, available 50 per cent of the time. A list of the hydro-electric plants in Arkansas and a map showing the location of stream gauging stations is of particular interest to those interested in waterpower development.

The report explains that the distribution of the various minerals in Arkansas is directly dependent on geological formations, and as an introduction to the chapter on "Mineral Distribution," there is a brief explanation of the relation of certain minerals to particular geologic features—the metallic ores to the Ozark region; coal, shale and gas to the Arkansas valley; oil and gas to the Coastal plain, and granite, bauxite and diamonds to the area of igneous rocks. There follows a double-page map showing the location of each important mineral, and with this there is a complete list of the minerals and rocks of the state, giving the name, composition, nature of occurrence and locality.

**Alphabetical List of Minerals.**  
Minerals of the state that are of commercial importance are then discussed in alphabetical order, the composition, uses and occurrence being

indicated in each instance, and tables show the production by years, both in quantity and value, the analyses, etc. Under this heading there is, in brief, all that one would want to know about antimony, asphalt, bauxite, building and structural stones including granite, sandstone, quartzite, limestone dolomite and marbles; chalk, clays, coal, including lignite; copper, diamonds, fuller's earth, lass sand, gold and silver, gypsum, iron, limestone for burning; manganese, mineral waters, mineral fertilizers, including chalks and chalk marls, greensand marl, limestone, phosphates and gypsum; novaculite for use both for manufacture into whetstones and for road building; ochre, petroleum and natural gas, an exhaustive 43-page discussion of the producing fields containing much information for the first time published; onyx marble, Portland cement materials, road-making materials, including argillaceous or clay shales, clean sandstone, syenites or granites, limestone, novaculites, arenaceous shales, gravels and chert; sand and gravel, slate, soapstone, tripoli and zinc and lead, the latter chapter containing 18 pages of

matter relating largely to the north Arkansas zinc areas, which are now attracting attention because of the decreased production of the Tri-State zinc fields about Joplin, Mo., and Miami, Okla.

**Oil and Gas Possibilities.**  
The new publication lays special emphasis on the possibilities for the discovery of new oil and gas fields. All of the petroleum and more than half of the natural gas which has been produced in Arkansas up to the present time has been found in the Coastal Plain area. But, although this is conceded to be the most favorable area for future exploration, there are other sections of the state where the chances for production are reasonably good, in the opinion of the state geologist.

Dr. Branner is especially interested in the chances for the discovery of new gas fields in the Arkansas Valley, having detailed three members of his newly organized staff to explore this region thoroughly with a view to obtaining all possible data on the probable location of the vast reservoirs of natural gas that probably lie deep below the surface in numerous unexplored localities.

One of these huge pockets of nature's best industrial fuel was tapped a year and a half ago by the Henry L. Doherty interest, showing a pressure of 1,000 pounds per square inch and a flow estimated at 11,500,000 cubic feet of gas per day, the production being limited only by the size of the bore. The gas sand was encountered at a depth of 2,892 feet. The find is regarded by commercial geologists as of great economic importance, proving as it does the existence of gas-bearing structures many miles beyond the proven territory of the so-called Fort Smith fields, which have been producing for a number of years a volume of cheap fuel that has made Fort Smith a big industrial center.

The Empire Gas and Fuel Company, which brought in the well near Clarksville, is planning to pipe the gas southeast through the Arkansas Valley, supplying Clarksville, Russellville, Morrilton and Conway, the report states. The high pressure indicates an ample reservoir that would probably be more than equal to the needs of these communities for many years, but to make more certain a continuous supply, the company has drilled a second well, which came in several months ago with a flow that is said to be equal to that of the original well.

That there are other large reservoirs of natural gas as yet undiscovered is regarded by Dr. Branner as a certainty. How far east of Clarksville new fields may be found no one can say for certain, but there are good theoretical grounds for the belief that the chances are good all the way to the beginning of the coastal plain—in other words, to the vicinity of Little Rock. The field work that is now in progress may throw some interesting light on this question within the next few months.

### Gas Means Industrial Development.

The state geologist is convinced that the discovery and development of new gas fields between Fort Smith and Little Rock would be a powerful factor in promoting the industrial development of central Arkansas, and probably do more for the general advancement of the state than any other conceivable factor in the whole range of Arkansas' natural resources. In support of this contention he cited the prodigious industrial development that took place in Fort Smith following the development of the gas fields adjacent to the city, and declared that Fort Smith's growth has been largely due to 13-cent gas. The present industrial rate for natural gas in Little Rock is 25 cents per 1,000 feet, and this relatively high rate, due to the great distance

from which gas is piped in to the city, has undoubtedly retarded Little Rock's industrial development to a considerable degree, in the opinion of those who have studied the state's industrial possibilities.

One industry which cheap gas might bring to the Arkansas Valley (Con. on Page Three, Mag. Sec.)

Sept. 1, 1927  
Index to Opportunity  
A real geological survey of 12 counties in northwest Arkansas will begin Sept. 1 under direction of George C. Branner, state geologist. Its purpose is to determine exactly the lead and zinc resources of this state. Three federal geologists will take part, and the results of the work will be widely published.

This is the first of a series of intensive studies of Arkansas resources which will be undertaken as a result of the bill passed by the recent legislature, providing funds for the work. A tax of one-tenth of one per cent on most of the natural resources severed from the soil was levied, and it will provide about \$70,000 a year. Gas, oil, lead, zinc, soil, water power and other resources will be carefully investigated and accurately stated, so that capital anxious to aid in development of this state, will be able to find opportunities clearly defined.

We've talked a lot about our natural resources, but we've talked in general terms. We're about to get specific about it now.

### State Geologist Is to Attend Nashville Meeting.

12-8-27  
G. C. Branner, state geologist, and W. C. Spooner, geologist who recently completed a study of cretaceous and tertiary rocks in southern and southeastern Arkansas, will go to Nashville, Tenn., December 27 to represent this state at a meeting of the geological and geographical section of the American Association for the Advancement of Science. The object of the meeting is to discuss characteristics of the cretaceous and tertiary rocks in the gulf states, with a view of correlating the work of the various state geological departments.

### U. of A. Makes Survey of Rock Strata on White River.

6/27/28  
Special to the Gazette.  
Huntsville, June 26.—Geological surveys are being made on the tributaries of White river this week by the University of Arkansas to determine the strata of flint and other rocks in this section. The information will be used in correcting and bringing present data up to date. Similar surveys are being made on Brush creek, about 20 miles east of Fayetteville.

### New Geological Map.

A new base map, giving the geological formation boundaries in Arkansas, has been completed by the Arkansas and United States Geological Surveys and will be used in printing a new geological map of the state, which will give full detailed information regarding mineral resources, pipe lines, railroads, navigable streams, electric power lines and other data of interest various industries. The geological map will be superimposed on a new base land map of the state recently completed by the U. S. Geological Survey. The map has been in process of making for several months, but will be ready for distribution in three or four months, according to G. C. Branner, state geologist.

# Geological Proj By Making "Two Dollars Year Regardless

Despite the disheartening discovery that the very most the state geological department may reasonably expect this year in the way of funds will fall far short of the amount conditionally appropriated by the legislature, Dr. George C. Branner, state geologist, is resolutely scheming and figuring how to make two dollars do the work of three in carrying out his long-crushed program to promote the development of Arkansas' mineral resources.

When the general assembly imposed an additional severance tax of one-tenth of one per cent for the express purpose of creating a something-like adequate state geologist fund it was estimated that the levy would produce approximately \$120,000, or \$60,000 a year, for the biennial period ending June 30, 1929. But the production of crude oil, on which the fund is largely dependent, has taken such an unexpected drop that all previous calculations have been upset and it now appears that not more than \$40,000, probably somewhat less, will be available for geological work this year.

The realization of the limitations placed upon the work of his department as a result of the failure of the tax to produce the revenue anticipated came as a bitter disappointment to Dr. Branner, who had carefully and judiciously mapped out a comprehensive program of long-neglected geological projects calculated to stimulate and hasten the exploitation of the state's undeveloped mineral resources. But the state geologist has the fighting spirit and he refuses to reel wheeled and discouraged over the disappointing turn the financial affairs of his department have taken. Instead he is facing the situation with a grim determination to carry on with the program originally planned, hoping that he may be able to cover the ground in a satisfactory manner by somehow "making two dollars do the work of three."

So there will be no cessation of the many and varied activities of the revived Arkansas geological survey, which came to life July 1, when the new revenue became available, and launched a number of important projects delayed for many years through the lack of funds. Briefly, these projects, in the order of their importance and the progress that has been made on them to date, are as follows:

### Oil and Gas Survey.

1. An exhaustive oil and gas survey of southern and eastern Arkansas, the printed report on which will be the first comprehensive and authentic work on the subject available to the public, all previous reports of this character having been compiled by private interests and carefully guarded for their own use as an aid to the discovery of new fields. This survey is being made by W. C. Spooner, president of the Shreveport Geological Society, and an oil geologist of international reputation. He has been engaged in the work since July 1, when his appointment as assistant state geologist became effective, and hopes to finish it by the first of the year. One assistant has been assigned to aid him in the work.

The geologist has compiled complete data on all test wells drilled thus far in the wide area assigned to him for report, and from these he has constructed a sub-surface map, including all formations that lie above the oil-bearing Nacatoch sand. The report is to contain a detailed report by counties of the depth and geological structure of favorable "horizons."

Extensive surface mapping has also been done as an aid to better understanding and interpretation of sub-surface structures.

According to Dr. Branner the Spooner report will be of great value to independent interests engaged in oil exploration, affording for the first time all data necessary for an intelligent determination of the most likely prospects for "wildcat" drilling. Heretofore only the big oil companies with unlimited financial resources have enjoyed the advantage of such information. They have obtained it by sending out their own geologists to make such surveys, thus gaining a big advantage over the smaller and less affluent prospectors, who have been groping in the dark, so to speak, in their efforts to discover new reservoirs. Their occasional successes have come about largely by accident, and the "hazards of the oil game" have been enormously increased for the lack of such information as the state geologist will soon be prepared to furnish and the progress that has been indefinite of charge.

This time the joke is on the big fellows, for they are compelled under the provisions of the law to contribute the lion's share of the funds that are being expended for a survey that will serve to strengthen the position of their weaker competitors, but which will be of little or no value to the "lion" who has already made his own survey at considerable expense. It's hard on the big fellows but it's good news for the general public—at least, for that portion of the general public that is interested in oil pros-

### Oil Sources Studied.

2. A detailed report on the upper cretaceous beds of southwest Arkansas. The importance of such a work can be appreciated when it is understood that, according to geologists, these beds were the original source of all the oil that southern Arkansas has produced. That its importance is recognized by the federal government is attested by the fact that the United States Geological Survey is co-operating with the state survey in the work on a "50-50" basis.

This report is now finished and ready for publication. It was prepared by C. H. Dane of the U. S. Geological Survey with the aid of several assistants. The maps will be engraved at the Bureau of Printing in Washington and forwarded in accordance with Dr. Branner's instructions for publication. The cost of publication will be borne by the office of the state geologist.

The report includes a detailed study of surface outcrops, embracing all significant formations in the so-called upper cretaceous area that lies in Little River, Hempstead, Nevada, Sevier, Howard, Pike and Clark counties.

"This study will be of great importance to oil prospectors," said Dr. Branner, "because this little area produced all the oil in southern Arkansas. Mr. Dane's report will give accurate information of these great source beds and by showing their relation to the accompanying structures, make it easier to recognize favorable conditions when test wells are drilled in southern and eastern Arkansas."

Reading the story recorded in the rock structures, geologists find that the oil that was formed in the cretaceous beds of Hempstead and adjoining counties ages ago gradually filtered eastward through beds of sand and porous rock deep below the

surface, guided by the force of gravity, like water following the line of least resistance in its downward flow, until it finally reached the great underground reservoirs that have been tapped by countless producing wells in recent years in the vicinity of El Dorado, Camden and Smackover.

### New Natural Gas Fields Sought.

3. A complete and detailed survey and report on the gas producing possibilities of the Arkansas valley.

In the opinion of the state geologist, Arkansas has long been overlooking one of her "best bets" in neglecting to explore and develop the vast untouched areas where all indications point to the presence of natural gas in almost unlimited quantities.

"It's high time something was done about it," he declared, "and I believe that the work we are now doing in this direction will lead to developments that will do more to promote industrial development in Arkansas than any other one factor. Think what natural gas has done for Fort Smith. The remarkable industrial development of this live little city has been due almost entirely to the cheap fuel afforded by the numerous gas wells that surround it. The story will be repeated in other valley towns all the way to Little Rock some day, in my opinion, and the sooner we locate the gas the quicker the development will take place. Thus far very little has been done in this direction."

The H. L. Doherty interests, persuaded by their own private investigations that the chances were good, tried their luck in the vicinity of Clarksville and brought in two big gassers, one of them showing the highest pressure ever found in Arkansas. A relatively small amount of gas has been discovered near Plumerville, but there has been no intelligently directed effort to locate gas at any point closer to Little Rock, although there is good reason to believe that further exploration would be richly rewarded.

"Any wells discovered in the Arkansas valley region would very likely be long lived, assuring a supply of such duration as would amply justify large-scale industrial development of permanent character. The probability of long-lived wells is indicated by the great size of the structures typical of this region, and also by the exceedingly high pressure of the Johnson gasser near Clarksville."

### Harvard Geologist Employed.

The report on the gas-producing possibilities of the Arkansas valley is being prepared by Carey Croneis, who is an assistant in the department of geology at Harvard University. He was formerly professor of geology at the University of Arkansas.

Mr. Croneis began the work last June and continued his compilation of data throughout the summer, assisted by a staff of students selected from the class in geology at Fayetteville. He was compelled to abandon the field at opening of the fall college term and return to his professional duties at Harvard, but his as-

stant's have continued with the work and the geologist expects to complete the report by December 1, and the publication will probably be available for general distribution some time in January.

The report covers an area roughly 60 miles wide, extending from the edge of the coastal plain to the western boundary of the state. It includes detailed structural maps and a scientific statement regarding the gas possibilities of each structure.

Meanwhile the Doherty interests are said to contemplate further gas prospecting in this region. The Clarksville wells have been capped, and the big public utilities promoters are silent regarding their plans, but it is a well known fact that the possibilities are highly regarded. The company has effected franchise agreements to supply natural gas to Clarksville, Morrilton and Conway, but nothing has been done thus far toward the construction of pipe lines.

The possibility of gas being piped into Little Rock from the west appears to be very remote on account of the conditions of the agreement under which the Little Rock Gas and Fuel Company is supplying this city from its far distant wells in Louisiana. If this company were drawing its supply from a closer point, such as could in all probability be found in the Arkansas valley less than 100 miles from Little Rock, the production costs would undoubtedly be materially lowered and gas rates might be reduced.

### Report on Lead and Zinc.

4. A zinc and lead survey of northern Arkansas counties.

This project has now been under way for about 10 months in charge of E. T. McKnight of the United States geological survey, and an exhaustive report will be published by the state department of geology sometime within the next year. The work covers a large area and will complete and bring up to date previous efforts in this field. The interest with which the project is regarded by the federal authorities is indicated by the fact that Hugh Miser, chief of the fuels division of the United States geological survey, and E. F. Burchard, head of the iron and steel division, have advised Dr. Branner that they will spend time in the field in the near future co-operating with Mr. McKnight in the compilation of the report.

Arkansas' zinc and lead resources have never been systematically and completely surveyed and the report now being prepared will probably play an important part in the future development of these vitally important resources. There are vast deposits of these metals that have scarcely been touched in the northern counties of Arkansas and their development would contribute materially to the wealth and prosperity of the state. The development thus far has been restricted to limited areas and the possibilities have but meagerly realized.

### New Gauging Stations.

5. The installation of a comprehensive system of gauging stations as an aid to flood control, and also as a means of determining the potential water of various streams showing commercial possibilities.

In the past a few stations have been maintained by private interests, but under the project that is now being carried out by the state geologist with the co-operation of the federal government all the stations, new and old, will be maintained on an official status under joint state and federal control, with daily readings taken at all permanent stations.

This work is being financed largely by the state, which is spending \$5 for every \$1 contributed by the federal government. The expenditure is amply justified, however, in the opinion of the state geologist, who sees in the establishment of the gauging system not only a valuable aid to flood control, but also an important step toward the development of new hydroelectric power projects of new hydroties for which have scarcely begun to be realized.

Under the state geologist's direction official gauging stations have already been installed at the following points: Little river, near Heber Springs; White river, near Newport; St. Francis river, near Marked Tree; Big Lake outlet, near Manila; White river, at Clarendon; Arkansas river, at Little Rock; Ouachita river, near Hot Springs (Arkansas Power and Light Company); Little Missouri river, near Murfreesboro; Red river, at Garland City, and Arkansas river, at Van Buren.

Three more stations are to be installed at Cotter, on the White river; Henderson, on the North Fork of White river, and Gilbert, on the Buffalo river.

### Oil Fields Mapped.

6. Publication of a standard topographical map of Union county and vicinity.

This work is now being done on a state-federal basis by the topographical branch of the United States Geological Survey. The primary traverses and leveling have already been completed and the first lithographs will be available about April 1, according to Dr. Branner. The map will cover an area of 250 square miles, embracing all of the important producing oil fields of southern Arkansas.

The cost of these six projects may be in excess of the funds available for the current fiscal year, despite Dr. Branner's utmost efforts to curtail expenses and make the money go as far as possible, and if this proves to be the case the deficit will, of course, have to be absorbed in next year's

budget. But the people of Arkansas, in the opinion of those who are able to appreciate the importance of the work being done, will have received big value for the money, and the faith of the legislature in the ability of the department to produce worthwhile results will have been amply justified.

## History of Coastal Plain Is Prepared by Geologist

### Area of Southeastern and Eastern Arkansas and Louisiana Extends From the Gulf of Mexico to the Ouachita Mountains.

The geological history of the coastal plain area of Arkansas and Louisiana was the subject of a paper read at the meeting of the American Association for the Advancement of Science at Nashville, Tenn., the past week by W. C. Spooner, geologist who recently completed a survey of the Arkansas area for the Arkansas Geological Department.

An abstract of the paper, prepared by Mr. Spooner for the Gazette, follows:

The Gulf Coastal Plain area described in this paper includes all of Louisiana and the southwestern and eastern parts of Arkansas. It extends from the Gulf of Mexico to the Ouachita mountains, a longitudinal distance of 300 to 500 miles. It is a gently sloping plain that rises from sea level on the gulf to more than 700 feet above sea level along its inner margin. The relief rarely exceeds 200 feet.

The Gulf Coastal Plain is underlain by a series of sedimentary formations, made up largely of sands, clays, cherts and limestones, but also containing subordinate beds of gypsum, anhydrite and water-laid volcanic material. These sediments, which range in age from Lower Cretaceous to Recent, rest upon a basement of Paleozoic and older rocks. They increase in thickness from a few hundred feet along the margin of the plain to more than 10,000 feet in the delta of the Mississippi river.

### Sedimentary History.

The sedimentary history of this region begins with the Comanche epoch when an embayment of the Gulf of Mexico extended from Texas, across Louisiana into western Mississippi. As sedimentation progressed the embayment expanded until at the end of the Cretaceous era the Gulf waters covered all of the Gulf Coastal plain.

The Comanche series has a thickness of more than 5,000 feet in northwestern Louisiana, divided as follows: The Washita and Fredericksburg groups 900 feet, chiefly blue and gray shale with thin interbedded limestone. The Trinity group is divided into two members with the Glen Rose formation, 2,500 feet, marine shales and limestone at the top, and the basal Trinity sand and clays more than 2,000 feet thick at the base. The Glen Rose formation becomes thinner northward and eastward and overlaps the basal beds. The Comanche series at the outcrop in southwestern Arkansas consists of 900 feet of beds, mainly sands and clays.

At the end of the Comanche epoch the seas withdrew from most of Arkansas and northern Louisiana; the sediments were uplifted and tilted westward. After an interval of erosion the Upper Cretaceous seas transgressed this region from the West and the South.

During most of Upper Cretaceous time a peninsula extended southward from the Ouachita mountains into north-

eastern Louisiana. The width of this land was gradually reduced as the Mississippi embayment was expanded, but a small area in northeastern Louisiana remained emergent throughout the Cretaceous.

The sediments deposited during this epoch are dominantly marine, made up of shales, cherts and limestones with subordinate beds of sands. Their maximum thickness in central Louisiana is more than 3,000 feet. The character and the uniform thickness of the formations that make up the Gulf Series indicate more uniform conditions of deposition than obtained either during the preceding epoch or during the succeeding Tertiary period. The Cretaceous closed with retreat of the seas beyond Arkansas and northern Louisiana.

The Tertiary was a period of relative instability during which the strandline migrated widely. During the Eocene the Mississippi embayment reached its maximum northern extent but since Jackson time, when marine sediments were deposited beyond Arkansas, the seas did not extend far up the embayment. From the Miocene to recent warping has been active in the lower embayment region. The Eocene sediments total more than 6,000 feet mainly sands. The Oligocene is represented by a maximum of 250 feet of marine sands and cherts, which with the exception of a small outcrop in Catahoula parish have been overlapped by the Catahoula sandstone. The Miocene is represented by the Catahoula sandstone, Hattiesburg and Pascagoula clays. The Catahoula is non-marine, mainly sand; the Hattiesburg and Pascagoula, mainly clays, and is part marine. The thickness of the Miocene on the outcrop has been estimated at from 350 to 1,500 feet, but well records show a thickness of nearly 4,000 feet. The Pliocene and the recent is not easily separable nor are their thickness definitely known except that they total more than 4,000 feet in the Mississippi delta and adjacent areas.

Northern Louisiana and southern Arkansas may be considered as an anticlinal area that is bound on the east by the Mississippi embayment, on the west by the east Texas embayment and on the south by the Angelina-Caldwell monocline. The most recent deformation which is now shown in the areal geology and by contour lines drawn in the top of the Upper Cretaceous is comparatively recent and may be referred to the Miocene and perhaps in part to the Pliocene.

### New Geological Map of State to Be Made Soon.

G. C. Branner, state geologist, has returned from Washington, D. C., where he attended the annual meeting of state geologists and officials of the United States Geological Survey. He said officials of the federal department have agreed to rush work on a new base map of Arkansas and that it is expected that the map will be ready to publish in about three months.

The geological base map now in use has not been revised since 1913 and many changes and corrections will be necessary.

A geological map, prepared by the Arkansas Geological Department and the state Department of Conservation and Inspection, showing all oil and gas fields, pipe lines, coal fields and other mineral locations, will be printed on the new base map, which will be in two colors, showing streams and drainage structures in blue. A new topographic map of the state will be prepared by the federal survey and will be printed by the Arkansas department. This work will be completed in time to print the map by September, Mr. Branner said.

He reported that the federal department has increased the allotment of funds for stream gauging from \$500 to \$1,250 for the fiscal year beginning July 1. The state has been paying for this work at the ratio of five to one, but the increased federal allotment will reduce the state's contribution to the basis of about two to one. Gauging stations have been established on several streams in the state during the past year and several other stations will be located in the next few months.

# Data on Mineral Deposits

Gathered by C. of C Here

Consulting Engineer of American Mining Congress  
Supplies Much Information Practically Every  
County in State Included in Survey.

Indicating renewed interest in the mineral deposits of Arkansas the Little Rock Chamber of Commerce has gathered data concerning the deposits in practically every county in the state. Credit is given Dr. Henry Mace Payne, consulting engineer of the American Mining Congress, for much of this information. His study of mineral deposits in the South has been fruitful.

The survey shows that diatomaceous earth is reported from several points in Arkansas, but probably is crystalline quartz.

Tripoli occurs in Arkansas in Hot Spring, Garland, Ouachita, Montgomery, Washington, Pike, Benton and Independence counties. Outside of Benton county, however, but little development has been attempted. There is an abundance of this material in the zinc region of the White river valley, but no attempt has been made to exploit it.

## Fuller's Earth.

To Arkansas belongs the honor of the first discovery of Fuller's earth in the United States, at a point east of Benton, in Saline county, in 1891. The state has fluctuated between second and third rank ever since in the production. Much of the output goes to the soap manufacturers, and comes entirely from Saline county. An undeveloped deposit has been reported at Forrest City, St. Francis county, on the Rock Island Railway and Missouri Pacific Lines, and another at a point three miles north of Levesque, Cross county.

Bauxite in Arkansas was discovered by the late Dr. John C. Branner in 1887. Up to 1899 shipments were small and no records were kept. There are two producing fields, the Bryant district, around the town of Bauxite, and the Fourche mountain district adjacent to the southern limits of Little Rock, the two lying about 15 miles apart. Arkansas produces approximately 86 per cent of the entire output of the country. There are several competitive producers. A small producer with an advantageous location and a well-prepared product can frequently undersell a large producer.

Arkansas is not a producer of barytes, although lenticular deposits are reported in the counties extending southwestward from Pulaski to Sevier. The entire area is traversed by several different lines of railroads, so that should the quality and extent of the Arkansas deposits be proved, commercial, no difficulty would be experienced in marketing the product.

In many localities in Arkansas, an ochre-clay or red chalk known as "red-die" is found. In Pulaski county brown ochre occurs in contact with brown iron ore, in Fourche mountain. Yellow ochre is found near Monticello and Piggot, Clay county, but none of these ever has been developed beyond local consumption for homemade paints. A reddish ochre also is found on Hurricane creek in Saline county.

## Chalk Cliff Deposits.

Chalk cliff deposits are soft and pure, requiring little or no grinding, and being easily calcined are of great value. The cliffs are 150 feet in height, and are the only known deposits of their kind in the United States.

It is probable that the development of the bentonite industry will prove one of the most rapid of all the minerals. Its bulk and hygroscopic qualities, however, make it necessary to establish other industries using it as raw material, near the source of supply. The chief mechanical difficulty encountered is the necessity for a special type of grinding machine, as the powder clogs the machine unless removed as fast as it is made.

## Coal Field Opened in 1841.

The Arkansas coal field is in the west central part of the state, in the valley of the Arkansas river. It was first opened for domestic purposes in 1841, but no material output was had until the railroads reached the field in 1883. Sebastian county, which is the most active field in the state, was opened in 1887. The coal ranges from sub-bituminous and bituminous into semi-anthracite, and in the extreme eastern part of the field, on the north side of the river, to anthracite. This furnished the active domestic trade, and the balance suffers from keen competition with oil and gas from Oklahoma, Louisiana and Texas. Many individual undeveloped properties are offered for sale. The coal resources of the state have only been scratched.

The Chattanooga, Floyd and Fayetteville shales of northwest Arkansas carry oil, but have never been developed. Branner's report, in connection with a survey in 1888, discusses these formations.

In 1918 the U. S. Geological Survey issued Bulletin 691-J on asphalt deposits in southwest Arkansas. Three deposits were noted in Pike county and four in Sevier county. They occur in the Trinity sands, and are obviously an extension of the Texas deposits. The Missouri Pacific and the Kansas City Southern railroads serve the district. Opened in 1903, the asphalt sand from Pike county has long been shipped to Little Rock and elsewhere, and used for street paving. It has but little cover, and is mined by stripping and open cutting. The sand hardens on exposure to the sun and makes a natural paving mixture. Occasional portions are too rich to be used in the natural state. No experiments have been made, however, toward refining it for pure asphaltum.

Gasoline extracted from natural gas in the United States now amounts to more than half a billion gallons per year, of which more than one-third comes from Texas, West Virginia, Louisiana, Kentucky and Arkansas.

## Iron Deposits Scattered.

A survey of Arkansas, made in 1890, said that there were no commercial deposits of iron in the state. There are many scattered deposits of limonite, hematite and magnetite. The counties of Montgomery, Garland, Saline, Grant, Dallas, Nevada and Ouachita are considered in a later (1892) report to be susceptible of development. Ores also occur in Crawford, Franklin, Johnson, Pope, Van Buren, Conway, Sebastian, Logan, Yell, Scott, Washington, Madison, Thorp Lawrence, Fulton and Randolph counties to such extent that the concentration and beneficiation processes of recent years brought hope for their ultimate operation, in connection with hydro-electric development now taking place in the state. Of the entire group, Lawrence and Sharp counties, on the Frisco Lines and Missouri Pacific Lines, hold greatest promise.

The first manganese was mined in Arkansas about 1851 when Matthew Martin shipped small quantities of ore from Batesville. This is said to have been the second manganese deposit mined in the United States. There are two well defined fields in the state. The first, known as the Batesville district, is in the northern part of Independence county, extending into Izard and Sharp counties. The second field extends from the Pulaski county line to the western boundary of the state.

A survey made during the World war, embracing 180 mines and prospects, gave as an estimate of reserves in Arkansas, 250,000 tons of ore, 40 per cent or better, and 170,000 tons containing less than 40 per cent manganese. It is probable that this estimate is too low. The field covers 120 square miles and the ore runs in pockets. New ore bodies are constantly being uncovered. An estimate of several billion tons would be as accurate as one of several hundred thousand. Nothing but years of prospecting will serve to adequately measure the actual extent of the manganese reserves of the state. The Batesville district enjoys better railroad facilities than the rest of the field. The fine ore occurs mixed with clay.

The outstanding development of 1927 in the Arkansas manganese field was gaseous reserves of the state. The Batesville, and beneficiation of medium to low grade ores with a view to electric furnace production of ferromanganese.

Data on minerals in Arkansas as compiled by the Chamber of Commerce includes that on rutile, molybdenum, tungsten, nickel, magnesium, corundum, gems, diamonds, graphite, gold, silver, copper, pyrites, gossan, coppers, sulphur, salt, zinc, lead, tin, kaolin, clays, cyanite, sillimanite, mica, chlorite, sericite, talc, soapstone, shales, slate, fluor spar, lithographic stone, potash, feldspar, cinnabar, building stones, marble, granite, sand, glass sand, molding sand, molding clay, gravel, chert, phosphate rock, phosphoric acid, mineral fertilizers, stone, marls, asbestos, gypsum, waters and oil.

## Progress Is Reported on Nine Geological Projects.

Work on nine geological projects being carried out by the state Geological Survey is progressing satisfactorily and several of the projects will be completed in a few months. G. C. Branner, state geologist, said yesterday.

The report on the upper cretaceous formations in southwestern Arkansas, being prepared by C. H. Dane, is in the hands of the printer and will be ready for issue in a few weeks. The report gives detailed information as to the depth of various formations below which oil-bearing sands of southern Arkansas usually are found.

A report on the oil and gas geology of southern and eastern Arkansas, which W. C. Spooner is preparing, will be ready for publication soon. Maps have been completed and thousands of well logs, drilling cores and cuttings have been studied during the past 15 months to obtain information for the report.

Gas possibilities of the Arkansas river valley in western Arkansas is the object of a project being carried out by C. C. Cronels. Structure maps have been completed and the report will be ready for publication in a few weeks.

Completion of a new geologic map of Arkansas, showing detailed geology such as mines, oil and gas wells, pipe lines, faults, etc., has been delayed awaiting completion of a new base map by the United States Geological Survey. The present base map is 15 years old, and it was considered undesirable to put the new geologic map on an old base map. A new topographic map of the state is being prepared for publication on the new base map. The federal government is doing the engraving for both these projects, but the State Department will pay for printing the maps.

A new topographic quadrangle will be surveyed this fall as a co-operative state and federal project. The area to be surveyed probably will be the quadrangle just east of the El Dorado quadrangle which was surveyed last year. It will give much needed information on oil and gas possibilities of that section.

The ground water survey of the rice belt, recently undertaken as a co-operative project, will continue through two years. It is expected that it will reveal the probable life of the deep wells used for flooding rice fields and will give an indication of how the source may be replenished by artificial means. Routine stream-gauging work is going on in the northwestern part of the state to determine water power possibilities. This work will be continued as a permanent service.

The final project now under way is a report on the commercial possibilities of the St. Peter and associated sandstone beds in northern Arkansas. This work is being done by Prof. Albert W. Giles of the University of Arkansas. This sandstone is used for making glass, for molding sands and other similar uses.

## Geologists of Four States on Tour of Ozarks.

Special to the Gazette. Sept. 4-28  
Eureka Springs, Sept. 3.—After assembling here yesterday, members of the Geological Societies of four states left today on the first day's outing of a geological conference which will last throughout the week, and which will carry them over a large section of the Ozark region. The meeting is sponsored by the Kansas Geological Society, which is holding its second annual field conference, and invited the societies in Missouri, Arkansas and Oklahoma to attend. Formations over the Ozarks will be studied and samples of the outcroppings collected. From here they will motor by Harrison to Batesville, where they will spend the night. From there the itinerary is by Mammoth Spring, Eminence, Cape Girardeau, Iron town and Steelville in Missouri, ending at Hahatonka, Mo.

The Kansas delegation is in charge of Anthony Folger and L. W. Kesler. Dr. H. W. Buehler and two assistants, C. L. Baker and J. Bridge, head the Missouri group; G. C. Branner and C. D. Robinson, the Arkansas delegation. Only a few are attending from Oklahoma. Eighty-three are attending the meeting. They spent the night at the Crescent and Basin Park hotels, holding the first session of their conference at the Basin Park last night.

## Tri-State Geologists to Meet in Eureka Springs.

Special to the Gazette. 8-31-28  
Eureka Springs, Aug. 30.—Geological societies of Missouri, Kansas and Arkansas recently completed plans for a seven-day conference from September 2 to 9 to be held in different localities in southern Missouri and Northern Arkansas.

Representatives will assemble in Eureka Springs Sunday the 2, and start activities Monday from here. Anthony Folger and L. W. Kesler of Kansas will be in charge of the conference. George C. Branner will head the Arkansas delegation. Approximately 75 geologists will attend.

## New Geological Map of State Is Being Prepared.

Geological maps of Arkansas now are being prepared by George C. Branner, state geologist, which will resemble huge slices of cake and will give the geological formations in a more striking manner than the ordinary geological map. The maps are shown on banks, representing the under strata, and these banks along the edges of the map will give the various underlying formations and their slope. The surface formations also will be shown in colors. A slanting view of the state thus is obtained, but the map likely will be cut in four sections to give a better idea of the underlying strata.

## TRACE OF ICEBERGS SEEN IN ARKANSAS

### Frigid Waters Once Covered Part of State, Geologist Says.

Special to the Gazette.  
Fayetteville, Dec. 1.—Icebergs, similar in form and size to those that imperil the ship lanes of the North Atlantic ocean, once were carried by ocean currents into western Arkansas. This was millions of years ago, in the Carboniferous period, when the sea covered much of the present area of Arkansas and adjoining states. Just as the icebergs of the North Atlantic are derived from the glaciers of Greenland, the icebergs that visited Arkansas in Carboniferous times were derived from an ancient ice and snow-clad range of mountains lying in Oklahoma and northeastern Texas, south of Ardmore, Oklahoma. From these mountains ocean currents carried the bergs across southeastern Oklahoma into Arkansas.

That such frigid waters once spread into Arkansas is the conclusion of Hugh D. Miser of the U. S. Geological Survey, from evidence he recently discovered at a locality half a mile east of the village of Boles, Scott county. Mr. Miser, a graduate of the University of Arkansas in 1908, has spent considerable time during the past year studying that territory.

In the locality of Boles he found fragments of numerous boulders that had been transported by floating ice from the Oklahoma-Texas mountains. The boulders were dropped to the bottom of the sea when the rock-laden bergs melted and they now are found in black shale which was mud at the time the boulders dropped to the ocean floor.

The boulders found by Mr. Miser are limestone of many different kinds, and

## Finds Residue From Large Icebergs in Arkansas Hills



Hugh D. Miser.

some of them are several feet in length. Only portions of them were observed by him, since farmers of the regions gathered up much of the limestone many years ago and burnt it into lime.

Although the Boles locality is the first occurrence of ice-transported boulders to be discovered in Arkansas, it is not unlike many such occurrences in the Ouachita mountains of southeastern Oklahoma, according to Mr. Miser. It is, however, 30 miles east of the easternmost Oklahoma occurrence; namely, one near the village of Stapp on the Kansas City Southern railroad.

The character and origin of the boulders in that part of Oklahoma formed the subject of a special field study by Mr. Miser in 1927. The boulders there had the same source and origin as those in Arkansas and they were transported by icebergs at the same time, the geologist says. The boulders in Oklahoma, however, are nearer their source—the ancient snow-clad Texas-Oklahoma mountains—than those in this state. The bould-

ers near Boles were transported from these mountains a distance that measures at least 180 miles in an air-line.

A noteworthy feature of many of these boulders is their enormous size. The huge pieces, which are limestone, range in size up to blocks measuring 30 feet across, though Mr. Miser observed one block measuring 200 feet in length, another with revealed dimensions measuring 50 by 369 feet. All these large blocks were observed in a mountain cove, called Johns Valley, which is 14 miles north of the village of Kosoma, on the Frisco railroad in Oklahoma.

"A person with a mathematical turn of mind," says Mr. Miser, "easily can form an idea of the size of an iceberg required to transport a block of limestone the size of those mentioned above. The largest bergs were many hundreds of feet in their largest dimension and towered high above the surface of the sea—and stuck about eight times as far below the surface.

The pictures of the past, as painted by the geologist who studies the ice-transported boulders, are strikingly different from those of the present; the white cotton fields on the fields of Texas and Oklahoma compared with the snow and ice-clad mountains that once stood there; the contrasting views of the Ouachita mountains—the highest mountains between the Alleghenies and the Rockies—and the iceberg-dotted frigid sea that once spread over the very area where these mountains occur in Arkansas and Oklahoma.

## Proof of New Geological Map Received by Geologist.

Special to the Gazette. 3-7-21  
After three years of painstaking effort and comprehensive investigation, George C. Branner, state geologist, and his staff, were gratified yesterday to receive the first proof of the new state geological map, which represents the last word in geological map making for Arkansas, the first comprehensive map of the kind to be published in the state.

There will be about 5,000 copies of the map, and it will be ready for distribution in May. Free copies will be supplied public institutions that need them, and a minimum charge will be made to individuals.

The map shows the geological structure of the whole state almost at a glance, and will be an invaluable aid to all persons interested in tapping the raw resources of the state. The surface formation of the state is shown, including faults and folds, and the map will be filled in with 22 different colors. All power transmission lines and all oil and gas pipe lines are shown.

These lines are considered a valuable addition to the map. If an investor should be interested, for example, in developing Arkansas clay products, he could glance at the map and determine the position of lines for fuel and power.

The map shows the exact position of oil and gas areas, coal beds, chalk, novaculite, marble, manganese and the like. It is considered a valuable reference for geologists, and can be interpreted by persons who are not familiar with geology.

Columns and cross lines on the margin are of additional aid in studying the geology of the state.

For article concerning Hilly Timber Tract in Dallas County makes 8 foot drop see article dated 3-24-29 under State Geologist.

## MYSTERY OF SUNKEN LAND IS EXPLAINED

Special to the Gazette. 3-29-29  
The sinking of approximately two acres of timber land recently on the farm of Ben Ross in Dallas county to a depth of about eight feet was described yesterday by George C. Branner, state geologist, after a visit to the Ross farm, as a "superficial, miniature landslide." Mr. Branner said a small stream at the foot of the slope affected, apparently had undermined the soil at a depth of eight or 10 feet and that a gradual settling had been prevented by roots of trees holding the soil together until it became so saturated with moisture that the tree roots could no longer hold the soil in its original form. The "baby landslide" then resulted, the area affected slipping a few feet down hill. The slide is in the shape of a half moon, he said.

# Geologists Finish Elaborate Report on Formations in Southwest Arkansas

An elaborate and detailed report on the Upper Cretaceous formations of southwestern Arkansas, which geologists have identified as the source of nearly all the oil and gas produced in the Union and Ouachita county fields, came from the press last week under the auspices of the Arkansas Geological Survey. To the average layman, perhaps, this announcement has no special significance, but to the oil prospector, however, it is a matter of transcendent importance, since the information thus made available may well be expected to pave the way to the discovery of new producing areas.

The report, 215 pages in length with numerous sketches and charts and half-tone plates showing the typical fossils of the various formations studied, is the work of Carle H. Dane of the United States Geological Survey. A detailed study of the southwest Arkansas area was originally planned as a federal-state co-operative project, but on account of lack of funds the state survey was unable to pay any part of the expense of the field work, but this was met by the federal government. The expense of publication, however, was borne by the state survey.

In a letter of transmittal to Governor Parnell, Dr. George C. Branner, state geologist, explains the nature and probable value of the report as follows:

"This report provides detailed information concerning the characteristics, sequence and surface distribution of the various formations found in the Upper Cretaceous area of southwestern Arkansas, an area which includes portions of Clark, Pike, Nevada, Hempstead, Howard, Miller, Little River and Sevier counties. This information is useful for an understanding of the economic possibilities of the area. Also since these formations are the source of nearly all of the oil and gas produced in southern Arkansas where they are covered by considerable thickness of younger beds, a detailed knowledge of their characteristics and sequence as determined by a surface examination is of direct value to an understanding of the geology of both

the producing and potential oil and gas areas of southern Arkansas.

From a more general geological standpoint, this report is a contribution to the knowledge of the Upper Cretaceous beds of the Gulf Coastal Plain of southern and eastern United States.

## Significance of Work.

The report is, of course, highly technical and practically unintelligible to most readers, but the introduction by Mr. Dane gives some insight of the significance of the work:

"The search for hidden oil fields in southern Arkansas and northern Louisiana has been guided principally by the study of the records of deep wells drilled in those regions, and as a correct interpretation of the underground structure controlling the accumulation of oil and gas depends upon the accurate identification in wells of the Cretaceous formations in which these substances are found, it is of great importance that the variations of the formations in character and thickness from place to place be ascertained as accurately as possible.

"The investigation of the Upper Cretaceous outcrops in southwestern Arkansas upon which this paper is based was therefore undertaken primarily to give an adequate starting point for sub-surface correlation, and the lithography and stratigraphic relations of the Upper Cretaceous deposits of the area are described in detail.

"The interest in the geology of these Cretaceous formations has been enhanced by a realization of the economic value of the chalk, gravel and clay found in some of them and by the recognition of the fact that they form reservoirs of artesian water. The stratigraphy of these formations has been described in a general way by R. T. Hill and A. C. Veatch. During the years that have passed since the older comprehensive papers were published several geologists have contributed reports on the stratigraphic relations, our knowledge of the geology of sediments of about the same age in adjoining areas has been made more

(Con. on Page 5, Mag. Sec.)

detailed and accurate, and a large number of facts have been disclosed by the record of prospect holes drilled for oil and gas. The need of a general revision of the stratigraphy has now become evident.

"The present report includes not only the results of the writer's detailed field observations, but information given by others, which has been interpreted in the light of our present knowledge. The value of the earlier reports of Robert T. Hill, Joseph A. Taff and A. C. Veatch, published by the state and the federal surveys, is increased rather than diminished by the more complete discussion of the stratigraphic relations here presented. Their careful records of field observations and of well logs make them permanently useful sources of information.

"The early investigators faced extraordinary difficulties in deciphering the geology of this region. The whole region, except a few small prairies, was forested and covered with underbrush. The terraces of sand and gravel found at many levels provided a widespread blanket which effectually masked the character of the underlying Cretaceous formations over large areas. Outcrops were confined almost entirely to the bluffs along the larger streams and along gullies at the heads of smaller drainage courses, many of them invisible from a distance of a few hundred yards. The population was scanty and travel was difficult. That these investigators obtained as correct a knowledge of the geologic relations as they did is surprising, and their reports form a high tribute to their insight and perseverance. Many of the obstacles to a full understanding of the local geology have been removed since their work was done.

"Travel has been greatly facilitated by the construction of gravel highways and the development of a system of public roads, most of them available for use by automobile. The extensive construction of roads has also greatly increased the number of outcrops, for at many places the roads have been cut through a mantle of surficial sand and expose the underlying Cretaceous rocks. The clearing of the land for agriculture has promoted gullying and has produced small outcrops in areas that were once forest covered and that showed no outcrops. The numerous wells drilled for water and oil have also been helpful. Well records, though many of them give vague information, contribute much to our knowledge of the thickness and distribution of the formations where the stratigraphic succession is known, and well cuttings and cores give more valuable information.

## Summary of Results.

"One of the principal results of the present work is the recognition of a considerable number of breaks in sedimentation, which separate the lithologic units mapped as formations. These breaks have not heretofore been recognized, partly because of the general lithologic similarity of the beds constituting the formations, and partly because of the scarcity of outcrops showing contacts between formations, but perhaps chiefly because of the conception that the Upper Cretaceous series represented continuous sedimentation and the consequent lack of interest in the actual contact relations of the formations.

"From the data collected by the writer and from that previously assembled by others, it is now possible to give a fairly accurate and complete picture of the character of the Cretaceous formations exposed in southwestern Arkansas, of their mutual stratigraphic relations, and of their areal distribution.

"Despite the considerable advance in knowledge that has been made, it should not be supposed that the work done is final. More detailed study will doubtless bring to light new problems, and the present report should be regarded only as one step forward in the advance toward the ultimate solution of the geologic history of Cretaceous sedimentation in even this rather narrow area."

# New Geologic Map of State Is Completed After Three Years

Copies May Be Obtained From State Geological Survey

—Dr. Branner Discusses Arkansas

Mineral Formations.

The new geologic map of Arkansas, in course of preparation by the state Geological Survey for the past three years, has been received from the printers and is ready for distribution to the public, Dr. George C. Branner, state geologist, announced yesterday.

The map represents an accumulation of economic and scientific information from a large number of sources and has been awaited with great interest by engineers, geologists and others. It will be sold at cost, \$1.50, at the department office, or \$1.80 by mail.

It is printed in 31 colors and shows the detailed surface distribution of the numerous formations found in the state. North-south and east-west geologic cross sections are shown, together with mines, quarries, oil and gas fields and structural axes lying in the Arkansas river valley region.

The scale of the map is eight miles to the inch, the same as that used on the Oklahoma and Missouri geologic maps so that the geology and mineralogy of these three states has been connected and can be studied as a unit.

## Tells of Value of Map.

In discussing the value of the map as an aid to development of the state's resources, Dr. Branner said:

"Generally speaking, the surface formations of the state may be divided into four main groups which occur respectively in the Ozark region of northern Arkansas, the Arkansas valley region of central and western Arkansas, the Ouachita mountain region of south central and western Arkansas and the gulf coastal plain region of southern and eastern Arkansas. A little study of these areas as shown on the state map will permit anyone with some understanding of the state's mineral resources to locate various areas through which deposits of certain minerals may be expected. Engineers may thus use the map as a guide to the mineral deposits of the state and as a means to prevent unprofitable search for minerals in areas where their occurrence is unlikely.

"For example, the minerals of the Ozark region which have been commercially developed are zinc, lead and manganese ores, limestone, marble, silica and glass sand. Practically all of the zinc and lead ores occur either in the Boone and Everton limestones or the Powell and Cotter dolomites. Of these the Everton limestone contains the greater concentrations of ore. All of these formations are traceable throughout the Ozark area and consequently the map serves as a general guide to the possible distribution of these ores. The manganese deposits of Independence, Izard and Sharp counties for the most part occur in pockets in limestones lying beneath the Cason shale principally in the Fernvale, Kimmswick, Plattin and Joachim limestones which may be located on the geologic map. Practically all of the limestone, marble and silica quarried in the Ozark region is found in the Boone limestone (above referred to) formation, which is readily traceable.

## Probable Gas Areas Shown.

"The commercial minerals which have been found in the Arkansas valley region of central and western Arkansas are coal, natural gas, shale and sandstone. Very nearly all of the coal mined in Arkansas occurs at the top of the Hartshorne sandstone which is traceable on the map, and the location of the coal mines in the coal basin area makes apparent their relationship to the Hartshorne sandstone. All of the natural gas found in the Arkansas river valley comes from the Atoka sand-

stone and shale formation, which has a wide distribution both in Arkansas and in Oklahoma. Its limits can be easily traced. The anticlinal axes in the Atoka area which have been mapped by the Arkansas Geological Survey are shown as orange lines and represent the more favorable localities for prospecting for new gas producing areas. Shales and sandstones are widely distributed throughout the Arkansas river valley and are found in the coal measure sandstone and shale beds and in the Atoka formation.

The principal minerals which have been commercially developed in the Ouachita Mountain region are novaculite, slate, stone and some manganese ore. The distribution of the Arkansas novaculite formation is shown as is also the Missouri Mountain slate formation from which the larger portion of the slate quarried in Arkansas is obtained. Both the Arkansas novaculite formation and the Hot Springs sandstone formation have been used to produce crushed rock and their distribution may be easily traced. Manganese ore has also been produced from the Arkansas novaculite formation. Antimony ore has been produced near Gilham in the Stanley shale formation, the outlines of which are shown.

"The commercial minerals which have been produced in the Gulf Coastal plain of southern and eastern Arkansas are oil and gas, bauxite chalk, clays, sand and gravel.

## Oil Limits Indicated.

"The oil and gas produced in this section thus far has been obtained from the cretaceous and thicker portion of the Gulf Coastal plain. The state map shows the northern and western limits of the coastal plain and it is consequently apparent that drilling in the shallower and edge portions of the Gulf Coastal Plain would be accompanied by too high a risk to justify the expense of exploration. However, not a great deal can be expected from the state geologic map in connection with oil and gas exploration in the Gulf Coastal plain except that the broad outlines of the more likely areas may be understood from it. A detailed report on the structural conditions of the coastal plain is in course of preparation by this survey and this will form the basis of a more detailed understanding of the oil and gas situation in southern and eastern Arkansas.

"All of the bauxite found in Arkansas is immediately associated with the nephelinite syonite or "granite" masses, which occur in Pulaski and Saline counties. These are mapped in detail.

"The chalk which is being utilized at White Cliffs, Okay and Foreman in southwestern Arkansas is mapped as the Annona chalk formation, and its distribution can easily be traced.

"The commercial clays of coastal Arkansas are very nearly all confined to the cretaceous and lower tertiary beds. Their distribution can be easily traced on the map.

"Gravels of coastal Arkansas cap the hills in the tertiary areas following the higher lands lying between the stream courses in the northern part of tertiary areas. The localities in which gravel beds are likely to occur can be located easily. Very persistent gravel beds also are found in the trinity formation of lower cretaceous age in southwestern Arkansas."

## A VALUABLE CONTRIBUTION.

For more than 50 years the people of Arkansas had little knowledge of the mineral resources of their state other than information gained from federal government surveys which enjoyed only a very limited circulation. Of course, they had heard in their school days that Arkansas "produced everything found in every other state"—which isn't true—but where to search for minerals and other such products or rather it would be better to say where "not" to search, was entirely unknown.

Then came the creation of the Arkansas Geological Survey with a recognized geologist at its head, who immediately began the compilation of all such available data in a map from which one could learn at a glance more about our resources than our grandfathers learned in a lifetime.

This map has just been received from the printers by State Geologist George C. Branner, and, as he expresses it, "represents an accumulation of economic and scientific information from a large number of sources." The map is printed in 31 colors and shows the detailed surface distribution of the numerous formations found in the state.

It is an established fact in geology that in certain strata, formations, or whatever you may choose to call them, can be found certain products. Therefore, geologists waste no time in seeking such products in formations to which they are "not" peculiar. "Engineers may thus use the map as a guide to the mineral deposits of the state and as a means to prevent unprofitable search for minerals in areas where occurrence is unlikely, "is the way Mr. Branner says it."

The value of the map to the layman lies in the fact that it will "enable any person with some understanding of the state's mineral resources to locate various areas through which deposits of certain minerals may be expected."

The completion of this map is a contribution of incalculable value to the economic welfare of Arkansas. It gives us another sound argument in behalf of our contention that we really have a "wonder state."

## GOLF.

Sweeping like a Florida hurricane over that dub-killing course at the Shrine Club, Paul Runyan, the biggest little man in golf in these parts, shot the first nine of his morning round in 30. The second nine required but seven more blows and he came in with a wonderful card of 67, four under par and within a lone stroke of "Jock" Guild's course record.

Then came the afternoon round and the tiny Concordia Club "pro" continued his triumphant trampling of Old Man Par. For 16 more holes he shot "perfect" or "better" and then on the No. 17 hole, almost within sight of the clubhouse, he made that horrible "8." Of course, he won the tournament, but think what that did to an otherwise wonderful

# Ozarks Have Plenty of Natural Wonders

BY TOM SHIRAS.

The Arkansas Ozarks have enough natural wonders and paradoxical situations to keep the "believe it or not artists" in material for many, many moons. Many of the natural interesting things in the hills are unknown except to people who live adjacent to them, and to whom they have become common, while others, like Diamond Cave and Mammoth Spring, are well known in all parts of the United States.

The Arkansas Ozarks have no Yellowstone national park with its blowing geysers, but deep down in the mountains on Buffalo river, at the mouth of Fish Trap Hollow there is a whistling spring. On quiet days, one can hear it several hundred feet away. It emits a low, moaning guttural whistle, and if one passed that way at night, and was not aware of its existence they would think someone was asleep and snoring lightly.

There is an ebb and flow spring near the mouth of Strawberry river. It will flow for an hour, then cease, then start to flow again. Somewhere back in the underground water channel is a natural check valve, that causes the phenomenon.

The Rockies have many famous mountains, but probably not one with the noisy eccentricities peculiar to Blue mountain, which rises majestically into the sky just back of Mountain View, county seat of Stone county. Under certain conditions Blue mountain roars. When the weather changes suddenly from warm to cold, it emits a noise like the singing of a hundred telephone wires in a stiff breeze in cold weather.

The shades below are well represented in the hills. When you roll through the pass in the mountain on state Highway 65 between Marshall and Leslie, in Searcy county, you go over The Devil's Backbone. There is a Devil's Fork, in Van Buren county, and a Hell creek in Stone county.

There is a tree in a cave in a huge sandstone bluff on White river, three miles above Calico Rock, on which the sun has never shone. The bluff sets at such an east and west angle that the

sunlight never penetrates, the mouth of the cave.

Izard county has a Hidden creek that isn't hidden, while Stone county has Cagen creek that flows through a mountain on its way to White river. The makers working in the interior along this creek, raft their ties down it, and through the mountain to the river, thereby saving a long haul around by wagon.

Mammoth Spring, from which the town of Mammoth Spring takes its name, is said to be the largest spring in the world. This is often denied, but we have yet to see one bigger. It is the source of Spring river, one of the largest rivers in the east part of Arkansas.

There is a Twin creek in Izard county, but it isn't a twin, and a Sister's creek in Marion county, with no one to be a sister to.

There is a Sugar Loaf mountain in Izard county and one in Boone county, near Lead Hill, but there is no blood relation between the two.

A blowing cave on Sullivan creek, in Independence county is a puzzle to geologists. Stand in the mouth of this cave and hold an unfolded handkerchief in your hands and the wind coming out of the cave is sufficient to straighten it out. The mystery here is "where is the bellows?"

Independence county also has a Bone cave, in which there are still plenty of bones. It is said that it was the scene of an Indian battle in the early days, and the losers made their last stand in the cave, being massacred there.

The largest turtle we have in our streams in the Arkansas Ozarks will weigh upwards of 100 pounds. In the Keener cave, near Keener, in Boone county are two petrified turtles that will weigh at least one ton each. That is, these huge pieces of stone resemble turtles in shape and no one is in position to deny that they were not turtles once.

They might have been the kind of turtles that were here, when sometime way back in the unknown but much talked of dim yesterdays, a tribe

of prehistoric human beings left their footprints in the sand, which are still in evidence. Two of these footprints were found in a sand ledge near the old Lime Spur, five miles west of Batesville, on the Missouri Pacific right of way. They were channeled out intact and now repose in the Missouri Pacific museum at St. Louis. Other footprints of the same kind can be found in a ledge in the bed of the creek near Mt. Olive.

Arizona, or the other Western states which boast of petrified trees and fossils, haven't got a thing on the White river country. There are a half a dozen petrified trees plainly visible from the train in the big bluff at Twin creek, on the White River Division of the Missouri Pacific, in Izard county.

The bovine family is well represented in the hills. There is a Bull mountain and Bull shoals in Marion county on White river; a Bull hollow and a Bull bottom in Searcy county, and a Calf creek and a Cow creek in Marion county. And to keep the cow brutes

company in this county someone threw in a Hogskin creek.

There is a Long mountain and a Short mountain in Marion county. Long mountain looks the longest from a distance, but when one climbs Short mountain end for end he knows the names have been juggled.

There is a cave on Gaither mountain in Boone county in which the bones of many prehistoric animals have been found. It is said that part of the skeleton of a saber tooth tiger was taken from this place, but we do not vouch for it.

Boiling spring on Rush creek in Marion county, is a small geyser in wet weather. In ordinary weather it just boils, and in boiling polishes every little pebble that drops into it with the same kind of a polish a jeweler puts on a cameo setting.

Diamond cave, near Jasper, in Newton county contains no diamonds. It takes its name from sparkling silica crystals, and is becoming one of the most noted caverns in the United States.

# Hemmed-In Hollow Little Known Wonder of Ozarks

By RALPH A. HULL.

Harrison, March 14.—Natives long have sung the praises of the scenic grandeur offered to the view of travelers along the highways that span the Arkansas Ozarks. Tourist for several years have joined in the chorus.

The praises are justified. Vistas opened up to the motorist as he rolls along Highway No. 67 or No. 7, for instance, are truly wonderful. The heights above and the valleys below present a continuing panorama of magnificent mountain scenery. In the various seasons the picture is painted in gorgeous colors—bright greens, yellows, reds and purples, or the more somber hues of winter. From many points one may see the peaks stretching, tier on tier, apparently for a hundred miles, first green, then purple, then blue and finally gray.

But, as the cynical old toper said of those who had never experienced delirium tremens, tourists or natives who have taken their scenery only from a rolling automobile along the highways, "ain't been nowhere and ain't seen nothin'."

For some of the most wonderful examples of nature's handiwork cannot be seen from the improved highways. Furthermore they cannot even be reached by automobile or other wheeled vehicle. They may be enjoyed only after the effort involved in walking through rough wooded country, up and down hill, climbing or descending the faces of bluffs or crossing bridgeless streams.

Almost Inaccessible.

One such spot is about 20 miles southwest of Harrison and less than two miles from the Harrison-Boxley-Clarksville highway. Yet it is so nearly inaccessible that many residents in the neighborhood of Compton, the nearest postoffice, have never seen it.

This natural wonder is known by the homely name of "Hemmed-In Hollow." It is a small edition of the Grand Canyon of the Colorado and ingress and egress are just about as difficult. One who views it for the first time might easily imagine that some mighty hand with a giant implement like one of those scoops to be seen in the grocery store sugar barrel, had gouged a hole in the mountainside 300 feet deep, a half mile across and a mile and a half long.

This writer, along with Garland Case, Harrison photographer, recently made a personally conducted tour to, into, through and out of Hemmed-In Hol-

low. The trip was divided into four stages because each stage represented a difficult job and each seemed to involve a different set of muscles to get tired and then sore.

The tour was conducted by I. A. Bruce whose experiences as a pioneer goat raiser of the Newton county Ozarks section was described in an article in the Gazette recently. The two "tourists" felt afterward that they were qualified to join "The Goat Man's" herd.

No Trails But Goat Trails.

Mr. Bruce is the nearest resident to the hollow. He lives a mile and a half from Compton, which is on the highway, but the nearest an automobile may approach his ranch house is half a mile. After negotiating this half mile over a burro trail to the ranch house, the real labor started; from the Bruce home to the brink of the Hollow there are no trails, except those made by goats.

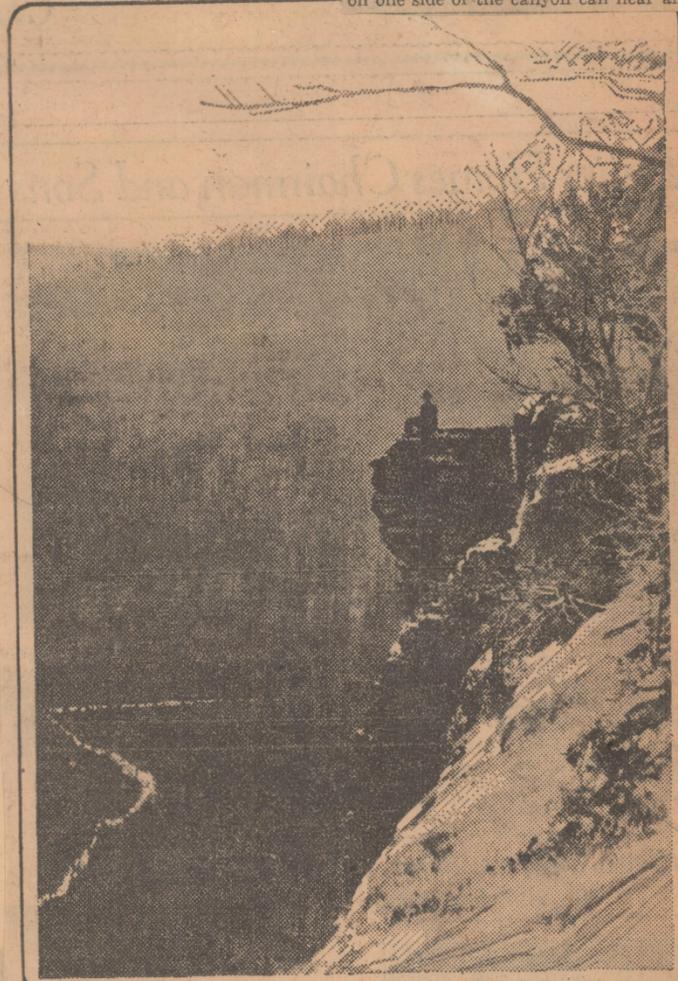
Once at the top of the sheer cliffs that inclose the Hollow on three sides, Mr. Bruce led the visitors along a trail beside the rim—a trail sometimes less than a foot wide—to a fissure where by climbing down a cedar pole with a few branches left for handholds, the descent into the hollow was begun. By working along ledges, back and forth on the face of the cliff but always downward, the floor of the Hollow finally was reached.

Inside the canyon, the picture beggars description. It is in the shape of a horseshoe, widening out somewhat at the lower end where Buffalo river, clear, deep and swift cuts across it at right angles. The sides of the horseshoe are formed by cliffs that rise perpendicularly for 300 feet, except that at places the rim juts out over the hollow, or a point of rock sticks out from the side like a nose.

**Waterfall 280 Feet High.**  
At the upper end, in the middle of the arc formed by the cliffs a stream flows over the lip of the rock to form a waterfall, varying in volume according to whether there has been much or little rainfall. The stream which feeds this fall has cut into the surface of the ground above the hollow, and through the rock itself, to a depth of 20 feet, making the fall exactly 280 feet high. Below, a deep pool has been dug in by the water, and to this pool the Bruce family repairs frequently in

A few years ago, Mr. Bruce said, one of two forest rangers whom he was conducting through the hollow, saw the birds light in their hole in the cliff and impulsively said he would give \$50 for a pair of their eggs for museum specimens. Mr. Bruce promptly accepted the offer, got a neighbor and 100 feet of rope to help him, let himself 80 feet down the face of the cliff and after two hours and a half delivered the eggs to the ranger. They were sent to Washington.

The Hollow is no place in which to tell secrets. It is a natural amphitheater with acoustic qualities seldom equalled artificially. A person standing on one side of the canyon can hear and



—Photo by Case, Harrison.  
This picture gives an idea of the depth of Hemmed-In Hollow, a hole a mile wide and a mile and a half long, in the side of a mountain in northern Newton county.

mid-summer when the members feel like taking an icy plunge on a torrid day. At any other time the water is too cold to be inviting.

The cliffs on all sides are many-hued. Limestone, snowy white, is visible in layers or streaks. Some of the strata are almost blood red. Yellow relieves gray monotony in other places. Green mosses grow where water trickles over the top or seeps through crevices. In spots the face of the rock has been discolored by foreign matter deposited by the water, until it is black, or blue or purple.

Overhead circles a pair of kites (cliff hawks). Their gyrations alone are worth a trip to the Hollow. The male, apparently seeking to impress his mate, with whom he has lived in a hole high up in the face of the cliff for several years, does several spirals, turns over and flies on his back or, folding his wings drops like a plummet for several hundred feet. Then, just as he seems doomed to dash himself to pieces on the ground, he spreads his wings and soars high into the air again.

**Cries Fill Canyon.**  
The two kites then may fly down within the walls of the hollow. They scream, and although their cries might not seem loud anywhere else, the noise fills the hollow, reverberating from side to side of the rock walls, finally to die out as a whisper after what seems a full minute.

This pair of birds, a species of falcon, has had its nest in the Hollow for several years. The young apparently leave as soon as they are able to fly, but the old pair stays on, winter and summer, year after year.

understand another person, standing a quarter of a mile or more away, speaking in a conversational tone.

At spots along the face of the rock may be seen holes of varying sizes, many of them inhabited by ground-

hogs. In another place Mr. Bruce pointed out a crevice from which three wolf whelps were taken a few years ago after their mother had been killed. The last wolf seen in the hollow was killed some three years ago, but bobcats still inhabit the section and Mr. Bruce

took seven last winter, with traps or after hunting them down with dogs.

**Bobcats Are Cowards.**

Bobcats, the goat rancher said, are the most arrant cowards to be found, unless cornered, but they are death to young goats when other food is scarce in the winter.

In the opinion of natives of the vicinity of Hemmed-In Hollow, the mountain spur which provides the setting for the hollow is honeycombed with huge caverns. On frosty mornings, particularly after a heavy rain, Mr. Bruce said, every groundhog hole in the cliff emits a cloud of steam.

It is the theory that the hollow itself once was a vast cave, the roof of which fell in perhaps thousands of years ago. Afterward, it is believed, the rock and other debris was ground to pieces and washed away.

Something less than a score of years ago Col. William P. O'Neill, father of Rose O'Neill, originator of the Kewpies and noted magazine illustrator, saw Hemmed-In Hollow and promptly took up a homestead in the lower end of it. He built a log cabin on the floor of the hollow, cultivated a small plot of ground and laboriously built a burro trail up the mountainside near the river where the cliffs begin to play out, to be replaced by an almost perpendicular wooded mountainside.

Mr. O'Neill and his wife lived on the place long enough to "prove up" on the homestead. Their daughter, already gaining recognition in the world of art, visited them several times and is well known to the natives thereabouts, as well as in Harrison where she spent a large part of one summer.

About 14 years ago the elder O'Neills left their homestead and went to California. The cabin burned and the land was sold or given to friends in the West and ownership of that part of the Hollow now rests in these Californians. The old burro trail is hardly discernable and practically impassable.

Mr. Bruce has a vision of one-time owning all of the Hollow and transforming it into a deer preserve. By fencing in a small stretch near the lower end of the canyon, and close the one or two gateways through the cliffs now used by goats, no animal could escape, he says, and the hollow would provide just the environment in which deer would thrive.

The visitors are convinced that Mr. Bruce is right about the difficulty of escape from the Hollow. They made their exit on the other side from which they entered by climbing Alpine-fashion from one ledge to another, resting frequently, but finally reaching the top again for a last view of one of the most beautiful, yet almost unknown phenomena of the Arkansas Ozarks.

### Two New Topographic Maps of Arkansas Completed.

Two new topographic maps of Arkansas, in process of preparation for more than a year, have been completed and now are ready for distribution by the Arkansas Geological Survey. G. C. Branner, state geologist, announced yesterday. They were prepared and published as a co-operative project by the state and federal geological surveys.

The first map is on a base of eight miles to the inch with a contour interval of 250 feet. It shows elevation of cities and towns, national forests, power lines, oil and gas pipe lines, primary and secondary highways, mines and quarries and oil and gas fields. The amount of labor involved in preparation of the map and cost of printing prohibit free distribution, Mr. Branner said. It will be sold at the department offices for \$1, but if ordered by mail 25 cents should be added for packing and postage, he said.

The second map is on the same base as the first, but topographic features of the Gulf Coastal Plain are shown in greater detail, the contour interval being 100 feet. This map shows roads, oil and gas fields, elevation of towns, bench marks and boundaries between natural drainage systems. This map will be sold for 75 cents at the office or \$1 by mail, Mr. Branner said.

These maps, with a state geologic map published in 1929, complete a series of maps designed to meet economic and commercial requirements for authentic information which may be shown on such maps, Mr. Branner said. He plans to build a relief map on the base of the state topographic map and transfer it to a plaster cast from which copies may be produced for schools and others interested in such maps at a nominal cost.

**BOOK IN DEMAND.** State Geologist G. C. Branner said yesterday that about 250 copies of the Geology of the Arkansas Paleozoic Area, published recently by the state Geological Survey, have been sold and that orders are received daily from oil and gas concerns and industrial firms throughout the country. The report deals especially with the oil and gas possibilities of the western and north-central sections of the state. It was written by Dr. Carey Cronels. The book is being sold at the cost of printing, \$2.95, plus 25 cents mailing charge.

## STATE RESOURCES GIVEN PUBLICITY

Arkansas Geological Survey Has 6,300 Names on Its Mailing List.

Of the many agencies at work in Arkansas to bring facts about the state's mineral resources to the attention of persons interested in their development none is more attractive than the state Bureau of Mines, Manufactures and Agriculture and the Arkansas Geological Survey, according to a bulletin issued by the Arkansas State Chamber of Commerce.

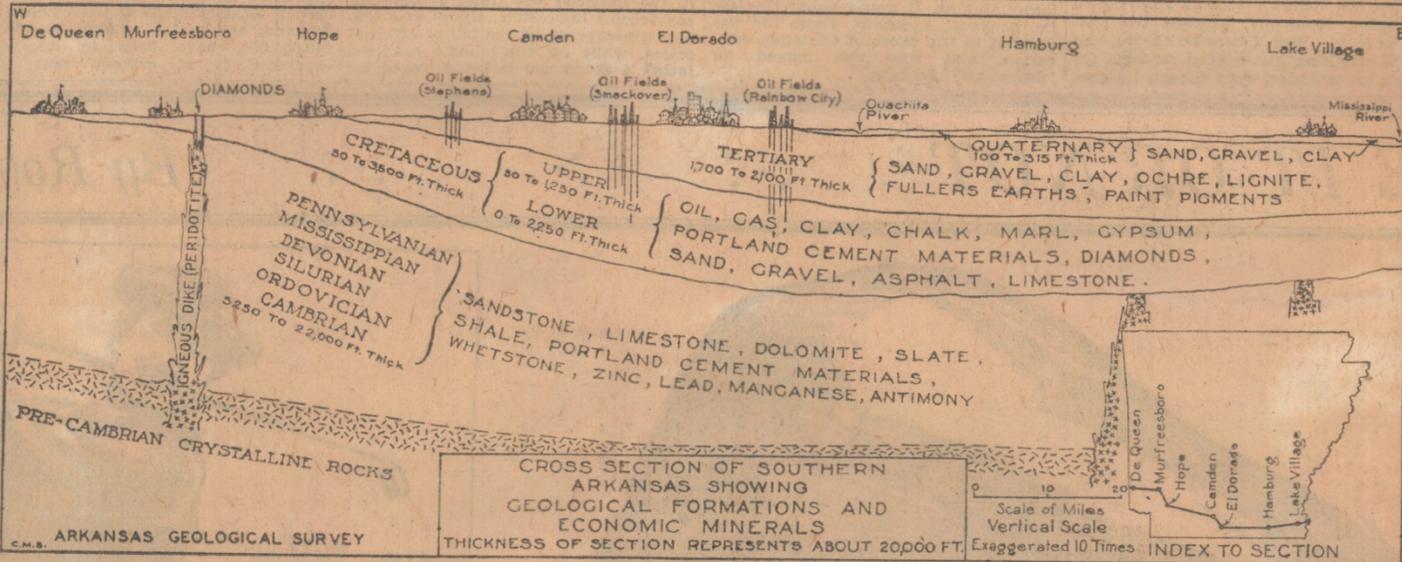
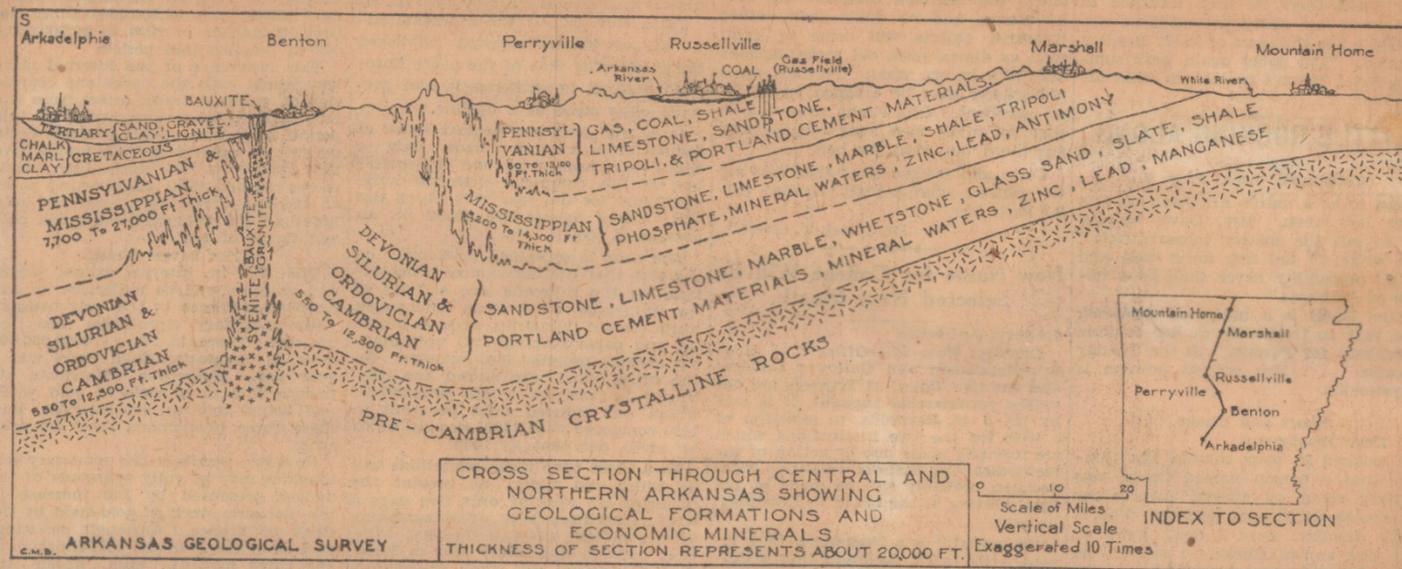
During the past seven years, the bulletin says, the Geological Survey has been building up a system of mail publicity until its mailing lists now contains more than 6,300 names. Books, reports and maps prepared for free distribution by the department are sent to all recipients on the list.

The mailing list includes all state geologists in the country, high schools of A-grade in Arkansas, depository libraries of the Department of Commerce publications, members of the Arkansas legislature, Arkansas senators and members of Congress, scientific magazines, newspapers in Little Rock and other leading cities in this section, members of the American Association of Petroleum Geologists, members of the American Institute of Mining and Metallurgical Engineers in several states, members of the Mining and Metallurgical Society of America, members of Economic Paleontologists, members of the Geological Society of America, members of the Paleontological Society, economic geologists, registered professional engineers in Arkansas and names of all individuals who ask to be placed on the list.

Besides sending publications to those recipients, the Geological Survey mails considerable special information in response to inquires. Numerous personal calls at its headquarters have been made during the past year by geologists and engineers and much information has been given out in that way. It is estimated that about 10,000 maps and reports have been sent to points in the United States and foreign countries since 1923.

LITTLE ROCK, SUNDAY, NOVEMBER 23, 1930.

# State Geologist Presents Graphic Pictures of Subterranean Arkansas



By GEORGE C. BRANNER, (State Geologist.)

The two sections shown in the illustrations give fairly clear pictures of the rock structure of north and south Arkansas. The vertical scale has been exaggerated about 10 times to make the relationships clear, the maximum thickness of the sections being a little less than four miles.

Naturally, no one has complete information of the rock at such a great depth, but the general relationships shown are dependable since, in order to explain a great many facts which have been secured from deep wells and from the age and structure of the surface formations, it is necessary to assume them.

For instance, in the north-south section (top drawing), it is apparent that the age of the surface beds in the vicinity of Mountain Home belong to the same group as those which occur

near Benton. We find also that the beds near Mountain Home have a slight inclination to the south. If we go south from Mountain Home we find we are passing over continually younger beds until we reach the coal measures of the central part of the Arkansas river valley. From these beds we pass to consecutively older rocks until we come almost to Benton, at which point the age of the formations is approximately the same as was the age of those on which we started.

We also find that as we have progressed from northern to central Arkansas, the surface beds are more and more severely folded. From these facts and from deep well records, we reach the conclusion that the rocks lie in a great regional trough of the general character shown.

In the west-east section (lower drawing) the older rocks of the state are shown reaching the surface near De Queen. These extend downward, creating a great structural trough and, continuing eastward, these reach the surface again in Alabama. This trough is filled with relatively unconsolidated beds of Quaternary, Tertiary and Cretaceous age, the surface of which makes up the Gulf Coastal Plain.

The sections also illustrate the fact that if we know what surface formations are to be found in any portion of the state, we shall know, at least in a general sense, what minerals we may expect to find.

If we are looking for commercial bodies of coal, for instance, we will not waste time in north Arkansas or in the Ouachita mountains, or in the Gulf Coastal Plain, but will give our at-

tention exclusively to the coal measures of western Arkansas. If we are looking for chalk or marl, we will confine our search to the Upper Cretaceous beds of southwestern Arkansas. If bauxite is the object of our search, we will look for it in association with the masses of syenite of Pulaski and Saline counties, which lie on the surface or close to it. Likewise diamonds are associated exclusively with igneous plugs of a certain character and are not found in the sedimentary beds. (Note the geyser-like column of peridotite in the lower sketch.)

We note also that the oil which has been commercially produced in southern Arkansas has been found in the Upper and Lower Cretaceous beds, and that all of the gas found in western Arkansas has come from the Pennsylvania beds. The limestones and dolomites are almost exclusively confined to the north Arkansas outcrop area of the Mississippian and older beds, as are also the marbles.

The metallic minerals are definitely related to the older formations of northern Arkansas and occur only in relatively small quantities in central Arkansas, and are not found commercially in the Gulf Coastal Plain of eastern and southern Arkansas.

Clays, on the other hand, are found in great abundance in the lowland portion of the state and all the potteries and all but two of the brick and tile plants of Arkansas are located in that portion of the state.

Beds in which other minerals are characteristically found are shown in the sections.

The most basic fact that these sec-

tions illustrate is that the surface rocks of the state are almost entirely rocks made up of sediments which were once laid down in seas or lakes which covered portions of the state from time to time. Very nearly all of the surface rocks of the state, when examined, will be found to consist of masses of compacted clay, sand, or lime, or some combination of these. These sedimentary rocks rest on a base of crystalline rocks, probably granite for the most part.

In a few points, molten rocks, probably from great depth, have broken through the crust of consolidated sediments and have formed small areas of crystalline rocks. Those found near Little Rock, Bauxite, Murfreesboro and Hot Springs are especially well known. These small igneous plugs, however, only aggregate about 14 square miles of the area of the state, or about one-fifth of one per cent of the total.

# Little Rock Is Situated on 'Wrinkle' of Earth's Crust

Dec. 14-1930 Gazette

By GEORGE C. BRANNER.  
(State Geologist.)

The construction and extension of the Cantrell road from Pulaski Heights through the Negro settlement near Pulaski Station and along the Arkansas river lowlands into Lincoln avenue has necessitated the cutting away of the sides of some of the hills along the way, and has resulted in the exposure of the bedrock in an interesting manner.

As Cantrell road slopes downward from Edge Hill, sandstone beds are exposed for several hundred yards. These change almost entirely to laminated

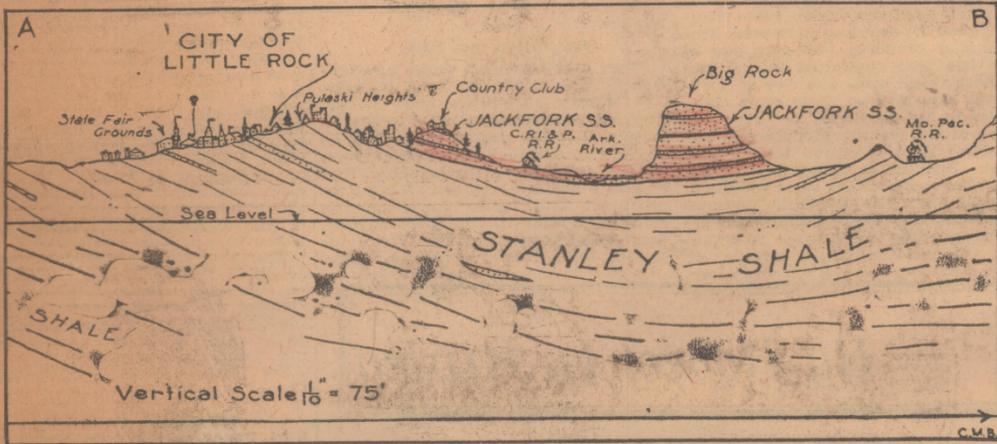
sands, gravels and clays, resting upon the Carboniferous rocks which serve as a basement.

On the other hand, the Carboniferous rocks near Little Rock are of relatively great age (probably something like 50,000,000 years), and are usually hard and consolidated claystones, laminated clay or shale, and sandstone, and have been subjected to enormous pressures which have folded and distorted them.

Both the Gulf Coastal Plain beds and the Carboniferous beds were originally deposited as sediment on the bottoms of seas which have long ago disap-

peared. of a great structural trough known as the Big Rock Syncline, which is one of the first of the great "wrinkles" created on the north flank of the Ouachita uplift.

The flank of, this great structural trough extends at least eight miles southwest of Little Rock. The axis of this "down fold," which is about 22 miles in length, passes through the grounds of the Little Rock Country Club, swings across the Arkansas river, passes through the approximate center of the Big Rock Stone and Material Company's quarry, and crosses United



The above drawing shows a cross section of the Big Rock Syncline, or great structural trough, near the center of which Little Rock is situated.

and compacted clays near the base of the hill, which may thereafter be seen along the road cuts all the way to Markham street.

It will be noticed that both the sandstones and claystones exposed are tilted at various angles, varying from about five degrees to as high as 40 degrees. The direction in which the beds are inclined, however, is more or less the same along the drive, and usually varies from due north to about 45 degrees west of north.

In order to understand the reason for this, it is necessary to know something about the geologic position of Little Rock. The southern portion of the city is built upon the gravels, sands and clays which make up the surface of the Gulf Coastal Plain of southern and eastern Arkansas.

North Little Rock and the west and northwest parts of Little Rock, however, are built on rocks which were laid down in early Carboniferous times. The Gulf Coastal Plain series of beds are of relatively recent origin and are, as a usual thing, rather soft and unconsolidated

peared.

The rock folds, or great "wrinkles" which are found in central Arkansas, were caused by the rising of a great area in west-central Arkansas, known as the Ouachita uplift. This area extended in a more or less east-west direction from the central portion of the state through Pulaski, Saline, Garland, Hot Spring, Montgomery, Polk and Howard counties.

This great raised area, which has been slowly worn down until today it has relatively low relief, compressed the area to the north and south of it with slowly acting but enormous force, and caused the wrinkling of the earth's crust both north and south.

Rock folds arising from this cause can be traced as far north as Searcy, Newton and Madison counties, and south to the Coastal Plain under which they disappear. These folds are usually called "synclines" and "anticlines," which terms simply refer to the trough of the fold or the crest of the fold, depending upon the part under discussion.

Little Rock is situated near the center

States Highway No. 65 just south of Levy.

The northwest flank of the fold may be seen in the bluffs along the Rock Island tracks for several miles northwest of Pulaski station, the rocks there being tilted to the south.

The central portion of the trough is made up of a series of sandstones known as the "Jackfork sandstone" formation. This sandstone has provided all the rock quarried at Big Rock. The lower part of the trough is made up of the "Stanley shale" formation. Both formations are of Mississippian, or early Carboniferous age.

The accompanying map shows the distribution of the Jackfork sandstone and Stanley shale formations in Little Rock and vicinity. Both of these formations are of great areal extent in Arkansas and have been traced across the state into Oklahoma. The Jackfork sandstone has a maximum known thickness of 6,000 feet in Arkansas and the Stanley shale 6,600 feet.

It is interesting to consider the enormous periods of time which the slow depositing of the sands and clays which formed the Carboniferous rocks found in Little Rock alone represent.

If we assume an average inclination of these rocks of 30 degrees, and if we assume that one can walk across three

miles of the upturned edges of these beds within the city limits, the thickness of the beds measured at right angles to the position in which they were laid down is approximately 7,920 feet.

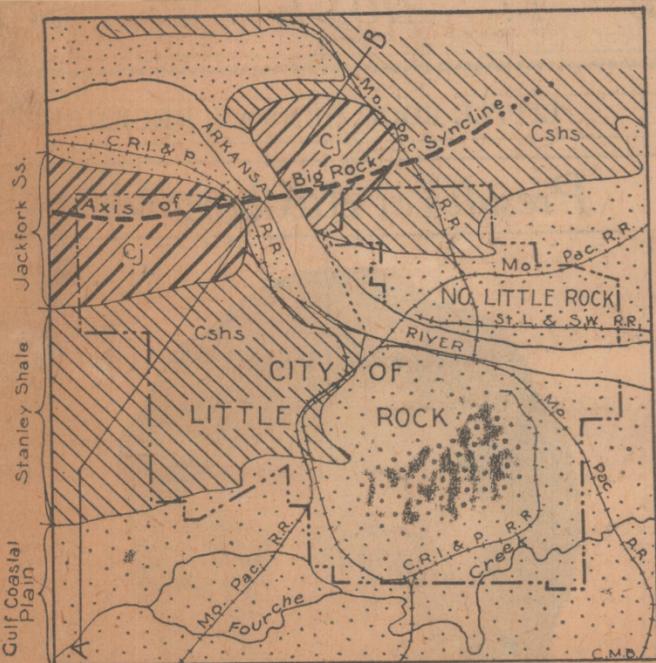
If we assume the average rate of the deposition of the beds to be 100 years to the inch, which appears to be a conservative estimate, the time required for the forming of these beds alone is more than 9,500,000 years.

## 'Bubbling Well' in Vicinity of Stamps Arouses Interest.

Special to the Gazette. **F-3-32**  
Stamps, Jan. 2.—Indications of natural gas in a well on the J. M. Gage place five miles south of Stamps, appears favorable to Stamps people who have visited it. The dug well, which is only 32 feet deep, began four weeks ago to bubble slightly, and bubbles have increased in size and volume daily until at present the water in the well looks as if a huge fire was boiling the water.

Four main jets of gas coming in from the side veins appear with other small jets all over the well and one in the center. The water is clear and shows no sign of oil.

G. C. Branner, state geologist, said yesterday that information received here concerning the "bubbling well" near Stamps indicated that a local pocket of natural gas, commonly known as "marsh" gas, may be responsible for the disturbance of water in the well. He said it might be a small pocket of non-inflammable nitrogen gas, but that it is unlikely that any considerable amount of natural gas would be found at the depth indicated. Shallow pockets of natural gas have been found in several sections of the state, but the gas soon is exhausted, he said.



The above drawing shows the axis of the Big Rock Syncline and the distribution of the sandstone and shale formations. The line AB cutting across the axis is the line followed by the cross section.

# Erosion, Maker of Scenery

The Mountains Were Carved by the Eroding Elements, Wind and Water, Which Work Slowly but Surely Through the Ages. Except for Them, the Ozark Mountains Would Have Remained a Great Plateau.

By TOM SHIRAS

Erosion is the greatest destructive force in the Arkansas Ozarks. During the past thousands of years, approximately one-half of the entire surface of the section has been cut away to an average depth of about 300 feet and the material carried down by the surface drainage to the Gulf. To try and conceive the total weight of this material would be like trying to conceive of the weight of a roof many thousands of square miles in extent.

If no erosion had taken place, the Arkansas Ozarks today would be an undulating plain, with sluggish streams and no beautiful mountains or scenery. The soil probably would have been deep and black, and the farms laid out in square blocks rather than in the irregular shapes they are today. The section would have the topographical appearance of the plains sections of Texas and Oklahoma. The winter climate would be much more severe and the summers hotter with hot winds.

Erosion is a destructive force that is active all the time, but for the most part its action is so slow that no one notices it. In that respect it is like interest on a debt, or the hands of a clock, but its action is as certain and sure as death itself.

While erosion is taking place everywhere its action is faster in a mountain section, because one of its principal agents is water, and water moves faster and cuts deeper flowing down steep hillsides.

Many people not familiar with the geological history of the Ozarks, imagine that the Ozark mountains were thrust up from below. The fact is they were carved out by erosion. Away back yonder in the distant yesterdays interior forces of the earth caused a bulge in the Ozark region. This action left the section in the shape of a plateau.

Erosion then began its work of shaping the surface into what it is today. Rains fell and the surface water wore out stream beds, and hollows, and the underground water attacking the weak places or cracks, cut out caves and underground water courses, which discharge on the mountainsides in the shape of springs.

All of the beautiful Ozark Mountain streams flowed at a much higher level 10,000 years ago than they are flowing now, and in the dim yesterdays they ran across and around what are mountain tops today.

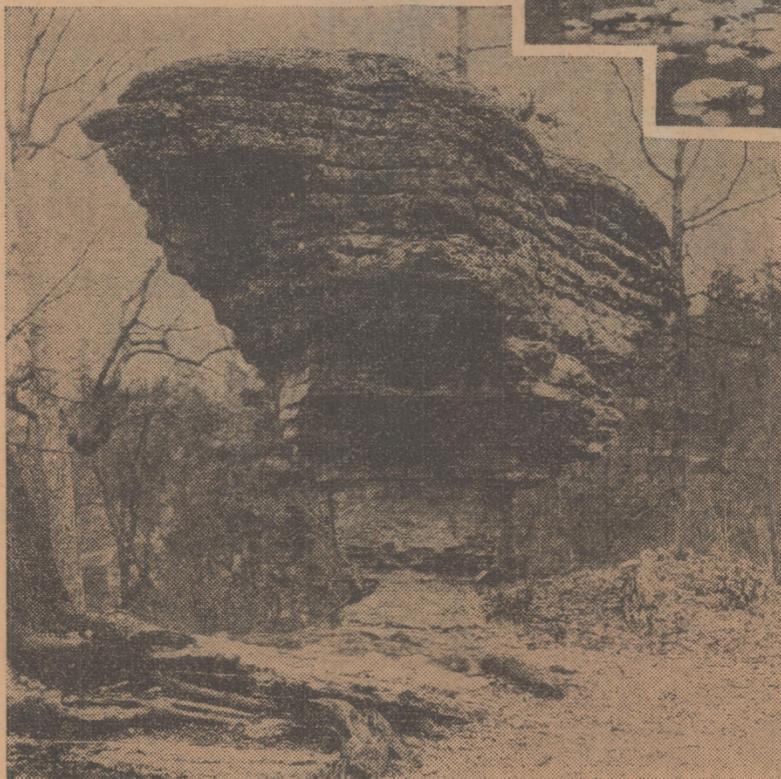
During the zinc mining boom in 1914, 1915, 1916 and 1917 many evidences that these streams flowed at a much higher level were found. When J. C. Shepherd was operating the Sure Pop mine on Water creek, in Marion county, miners drove a cut through a creek gravel bar containing mussel shells that was nearly 100 feet higher than the present bed of the stream. How long it took erosion to lower the bed 100 feet is problematical, but to say the least it was many thousands of years.

Every beautiful bluff along the White river and its tributaries is an outstanding example of what erosion has done in the Ozarks. At one time the tops of these bluffs represented the low banks of the streams. Now they are hundreds of feet above the beds of the streams. Their rugged, cedar-clad faces represent the lines of the wearing of the surface rock, the material washed away leaving them in bold relief overlooking the stream.

Many beautiful examples of erosion can be seen in the Arkansas Ozarks. Sugar Loaf mountain near Heber Springs in Cleburne county, stands out all by itself, with a bluff some 50 feet high on top of it, making one of the most beautiful mountain pictures in the territory. Because this mountain was of firmer and harder material than the rest of the stuff around it, it stood the ravages of erosion better and held its own against time, its natural enemy. Eventually, however, erosion will level this mountain.

It is impossible to drive through the Arkansas Ozarks and not see a balanced rock, or a rock isolated by itself in some field, or a column of rock standing like a chimney along some creek or rising from some shelf on a bluff. Many wonder how they came to be there. They are merely examples of erosion that is taking place all the time in the hills but is so slow it is not noticeable. Nature made them of sturdier, harder material than the material surrounding them. Erosion cut this softer material away, leaving them in bold relief.

Water and wind are the two elements that lend their aid to erosion. The action on rock and dirt formations is downward and inward and is constantly in progress. The destruction is faster on limestone than on most any other material, due to the fact that it is more soluble than other rocks. This accounts for the many caves always found in a limestone section.



Pivot Rock, near Eureka Springs, is one result of erosion. Above is a view of Sylamore creek in Stone county.

Water as an element in erosion acts in two ways. The water in the streams is always cutting, cutting, cutting, wearing down the bed and banks. Most folks would think that this is the only manner in which water assists erosion in its destructive work, but rain plays its part as well.

Rain striking the face of any limestone ledge softens it and carries off a part of its lime value in solution, leaving a little soft shell on the face. When this little soft shell dries, the wind comes along and keeps tearing at it until it finally scales the face. Another rain and more wind, and hundreds of rains and wind, and the fact of the rock is cut back half an inch. In a thousand years maybe a foot, and so erosion takes its toll.

Wind plays a very important part in the destructive forces of erosion. The action of water alone would probably not be half as fast if it weren't assisted by wind. Water softens and decays and wind carries away the debris. Wind tears at every little crack in a rock, blowing out the debris to make a larger opening for water to percolate in and hurry its work of destruction. Every cloud of dust raised by the wind means that billions of small grains of matter have been torn

away from solids. Its destructive work never stops. Somewhere the wind is always blowing.

Erosion has cost the Arkansas Ozarks millions of dollars in land values. The first time the writer ever visited the big bottoms on the lower White river he wondered how many thousand acres of top soil in the hills it took to create these rich, level fields. The amount of material carried by rivers is much greater than ordinarily supposed. For instance, tests indicate that over 28,000,000 tons of material were carried in suspension and solution by the Arkansas river past Little Rock during one 12-month period (1887-'8).

Mountain farmers, however, are not letting as much of their good soil go to their bottom neighbors as they used to. They are planting tame grass which retards the action of erosion, and also terracing many of their cultivated fields which has the same effect. Nothing they can do can stop it entirely. It rains, wind blows, and water runs down hill.

Erosion also takes a big toll from the state's roads and highways. It is estimated that it takes about 10 inches from each shoulder on every highway every 12 months. That is, it would take it if

there were no maintenance work done, and this gives one an idea of how long our highways would last if no work were done on them. What wind and rain take away has to be put back constantly, if roads are to be preserved.

The destructive force of erosion works slowly. Slower in sheltered places than in exposed ones. In excavating a rock house on Clear creek in Boone county, once occupied by the Rock Shelter people, the first known inhabitants of the Ozarks, Otto String, archaeologist, moved eight feet of rock dust before he reached the original floor. This dust had eroded from the walls and roof of the shelter. No rain had touched the walls or roof, the eroding elements being dampness and wind. The shelter was about 40 by 50 feet. He said it had been occupied by the Rock Shelter people at the end of the Ice Age, and found evidences of their occupation on the original floor. If he was right in his conclusions and the writer is right in his, it took around 20,000 years for this eight feet of dust to accumulate.

Besides the farmers, the Missouri Pacific is probably more concerned about the ravages of erosion than any one else in north Arkansas. The White River division runs for 150 miles under bluffs which are constantly scaling. Until they put on scaling gangs they had numerous derailments and several bad wrecks caused from boulders dropping on the tracks from the bluffs above. Since they put on scaling gangs there has been no trouble from this source.

It is the duty of these gangs to keep the scaling safe, and they are constantly combating the destructive forces of erosion. Scales and boulders that are safe today will have to be shot down or otherwise removed in a year from now else they will come tumbling down of their own accord when least expected.

The men who make up these gangs are young and agile and they probably know more about the destructive forces of erosion than any other men in the Arkansas Ozarks. If you catch them in the right humor, they can also relate some tales about their work as thrilling, probably, as any ever told by a guide in the Alps of Switzerland.

Ouachita Mountain Area Will Be Publicized. Gazette 3-9-32. Special of the Gazette.

Hot Springs, March 8.—A movement was launched tonight by Scott D. Hamilton, manager of the local Chamber of Commerce, to make the Ouachita area, which boasts the highest mountain range between the Alleghenies and the Rockies, the most publicized section of Arkansas.

Hereafter in Hot Springs' national advertising campaigns the Ouachita area, of which Hot Springs National Park is a high point, will get a big play. The Chamber of Commerce will have co-operation of Thomas J. Allen, superintendent of Hot Springs National Park, and A. C. Shaw, supervisor of the Ouachita National Forest.

At the chamber's directors' meeting tonight Mr. Hamilton pointed out that, according to the United States Geological Survey, the Ouachita province is one of the major physical divisions of the United States.

# Breezes Blow on Petit Jean

## Noted Rendezvous of Summer Visitors Is One of the Most Attractive Resorts in Arkansas — For Many Years a Settlement Has Existed on the Mountain Top, and the State Y. M.

### C. A. Camp Is Held There Every Year.

By D. MOORE MITCHELL

*Gazette*

*July 17, 1933*

A group of Frenchmen landed at the foot of Petit Jean mountain in early days after a long voyage across the ocean and up the Arkansas, and ascended the rugged mountain in quest of gold. One of their party was dubbed "Petit Jean" because of his small size. This little member of the party could not stand the hardships and became ill. Then it was that "Petit Jean" disclosed her identity. She had donned man's clothing to be near the man she loved. When she died she was buried on the mountain and it was called Petit Jean in her honor.

The mountain faces east in the form of a horseshoe, with two points, Sunrise and Blue Point, forming the ends. Not so long ago an immense rock fell from Blue Point causing consternation among the inhabitants below. To the west, breaking into many ranges, is what the natives call "Little mountain." The Petit Jean river flows at its base and empties into the Arkansas. The brow of the mountain, except a few gaps, is held in place by moss-covered granite. The mountain from each brow slopes to the center, where Cedar creek takes up the waters. It flows to a steep precipice, over which, in rainy seasons, the water goes with a roar, but settles to a mere trickle when dry weather comes. It is known as Cedar falls. For many years there has been a settlement on the mountain. Settlers came, presumably, from the mountain sections of the older states, and seem to be indigenous to the soil. The old road south of Sunrise Point passed through what was called "Stout's Gap," which was named for the owner of a large plantation at the base. Mr. and Mrs. Stout were cultured and wealthy. On a prospecting trip up the river they were so impressed with the beauty of the mountain and the fertility of the soil that they bought the place later known as the "Stout plantation." The road went across the mountain, with neighboring roads diverging (for the mountain top is a miniature country, with hills and valleys and long stretches) down the west side through what is known as York's Gap. Then the road was changed to the north side of Sunrise Point, winding around the point near the recent acquisition to the Y. M. C. A. camp. On the west side, with his home hanging, it seemed, perilously on the side of the mountain, lived Dr. Jackson, who practiced medicine in the rich Carden bottoms. When the old-timers came down the mountain across the Stout's ferry over the Arkansas river on their semi-annual trading trip, they could see the mountain across the lowlands on their return and approached it reverently. Even the children loved the mountain and would call it "my little Petit Jean Mountain."

Years later settlers came from the Eastern states, presumably attracted to this out-of-the-way place by an advertising campaign. Mr. and Mrs. Middleton came from New York. Sturdy German settlers came from Pennsylvania. One can understand why they should think the mountain suitable to grow grapes and fruit. One of these settlers, a Mr. Brown, built a large house and operated a hotel during the summer.

Young people have gone to the mountain on outings for many years and families have camped out for rest and to enjoy cool nights and pure water. Most of the natives of the mountain have died and younger members of their family have sought other scenes. Not many of the old stock remain.

Near New Haven lives Miss Celeste Goodrich, one of the descendants of the settlers from the East, who is known as one of the "Goodrich heirs." Recently Miss Celeste had an opportunity to sell her inheritance, a steep mountainside, but after consulting a lawyer she was advised that she wasn't offered enough. It was the last chance.

A Mr. Nelson, manager of the Stout plantation, erected what is known as "The Guest House." Many people visit the mountain and the manager planned to

build a home above the farm to take care of those who wanted to stay awhile on the mountain top. It was a pretentious structure for its day with a stone foundation and a superstructure of two and a half stories. It was a great undertaking to haul the lumber and dressed stone, which had been shipped from Little Rock by boat, up the mountain. This house now is the administration building of the "Y" camp. In old days the people on the mountain must have been annoyed by visitors seeking lodging. One little shack with a lean-to had this sign: "Positively no boarders taken here."

Several years ago a young doctor came to the mountain for his health. Dr. T. W. Hardison and his wife have been instrumental in developing the mountain from an educational and scenic viewpoint. His skill as a physician has been limited to the mountain and adjacent country, but his ability as a writer has gone abroad. His articles have appeared in the leading magazines of the country. It is to Dr. Hardison that the state is indebted for the Petit Jean State park,



Top—Left to right: View of the Arkansas river and Point Remove creek from the "Point" of Petit Jean mountain. The mountain, approached from the highway to the east.

Bottom: View of Cedar Falls in the state park.

Missouri Pacific Railway Company turned over 2,300 acres to the state.

In 1919 Dr. John L. Hunter conceived the plan of making a Y. M. C. A. camp on Petit Jean. It comprises "The Guest House," to which a large dining room has been added, a wonderful auditorium in a natural amphitheater overlooking the river, Tumble Inn and College Lodge. This is at Sunrise Point. Farther down the south brow from the Y. M. C. A. camp is the beautiful Hugh D. Hart Lodge. The first effort to make Petit Jean serve the state as a gathering place for various meetings was made in 1888. Petit Jean lost this distinction to Mount Nebo by one vote. Many gatherings since then have been held on the mountain top.

on which the state has not spent a dollar. Signs have been erected by the Boy Scouts. The project was started when Dr. Hardison urged citizens of Morrilton to give 80 acres in 1923. In June, 1930, the Fort Smith Lumber Company and the

## Geological Survey Prepares to Erect First Sign Giving Background of Rock Formations

*Democrat, Oct 27, 1935*

Tourists and residents of Arkansas who wonder about the geological background of huge boulders, shale and other interesting formations along the roadside are to be provided with just that information by the State Geological Survey.

A program which will provide for erection of signs of billboard size along the highways in the vicinity of the formations of interest has been announced by Dr. George C. Branner, state geologist.

The first of the group of signs is to be erected on Highway 70 near Forrest City, where the highway crosses Crowley's Ridge, Dr. Branner said. This sign will show the location of the ridge with reference to Forrest City, the height of the ridge, and the various geological formations which make up the mountain.

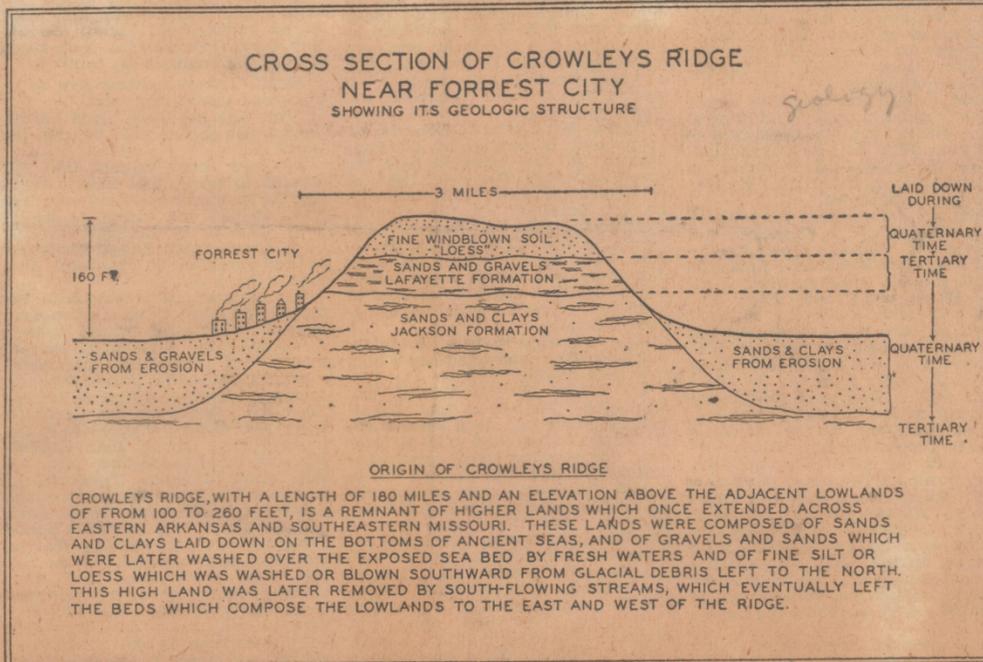
Beneath the drawing will be a brief description of the ridge, listing its length as 180 miles, and the elevation above adjacent lowlands as from 100 to 260 feet. The ridge at one time was a part of higher lands which extended across eastern Arkansas and southeastern Missouri.

A similar program has been carried out by Oklahoma and a number of other states and has proven popular with both tourists and residents, Dr. Branner said. The plan is approved and advocated by the National Park Service, he said.

Information from Oklahoma in Dr. Branner's files state that "grass hasn't a chance to grow" in the vicinity of signs erected in that state. Persons interested in the information given on the signs have left their cars and have walked to the vicinity of the billboards in such numbers that all grass has been killed, it was stated. Similar interest has been displayed in other states, Dr. Branner said.

The State Highway Department will co-operate with the Geological Survey in the program for erection of the signs. The first sign is expected to be erected near Forrest City within the next few weeks.

Sites for the signs as announced by Dr. Branner include the following:



CROWLEY'S RIDGE, WITH A LENGTH OF 180 MILES AND AN ELEVATION ABOVE THE ADJACENT LOWLANDS OF FROM 100 TO 260 FEET, IS A REMNANT OF HIGHER LANDS WHICH ONCE EXTENDED ACROSS EASTERN ARKANSAS AND SOUTHEASTERN MISSOURI. THESE LANDS WERE COMPOSED OF SANDS AND CLAYS LAID DOWN ON THE BOTTOMS OF ANCIENT SEAS, AND OF GRAVELS AND SANDS WHICH WERE LATER WASHED OVER THE EXPOSED SEA BED BY FRESH WATERS AND OF FINE SILT OR LOESS WHICH WAS WASHED OR BLOWN SOUTHWARD FROM GLACIAL DEBRIS LEFT TO THE NORTH. THIS HIGH LAND WAS LATER REMOVED BY SOUTH-FLOWING STREAMS, WHICH EVENTUALLY LEFT THE BEDS WHICH COMPOSE THE LOWLANDS TO THE EAST AND WEST OF THE RIDGE.

Large signs similar to the one shown above are to be erected at various points throughout Arkansas by the State Geological Survey to provide residents and tourists with information of interest concerning geological formations in adjacent territory. The above sign will be one of the first to be erected and will be placed on Highway 70 near Forrest City where the highway crosses Crowley's Ridge and where interesting formations are exposed to view.

Highway 70, near Forrest City, Crowley's Ridge formations; Highway 70, near Hot Springs, rock formations and formations which have made the nationally famous hot springs possible; highway leading to Petit Jean State Park, near Morrilton, cross-section of the mountain

showing various formations and their origin; Highway 62, near Eureka Springs, geological formations in mountains in this area; Highway 71, south of Winslow, geological structures in mountains in this area. Plans also are being made, Dr.

Branner said, for erection of signs at a later date in the state parks at Mt. Nebo, near Dardanelle, and at Devil's Den, west of Winslow. These signs will give data on geological formations in mountains surrounding the parks.

Branner Receives

### Small Scale Maps

A new small scale base map of Arkansas, the first to be prepared since 1916, has been received from the printer by the State Geological Survey, Dr. George C. Branner, state geologist, announced yesterday. Copies of the map will be available from the survey at cost.

The map, in black and white, is on a sheet 16 by 18 inches and is drawn on a scale of one inch to 16 miles. It shows drainage throughout the state, cities and towns and railroads operating in the state.

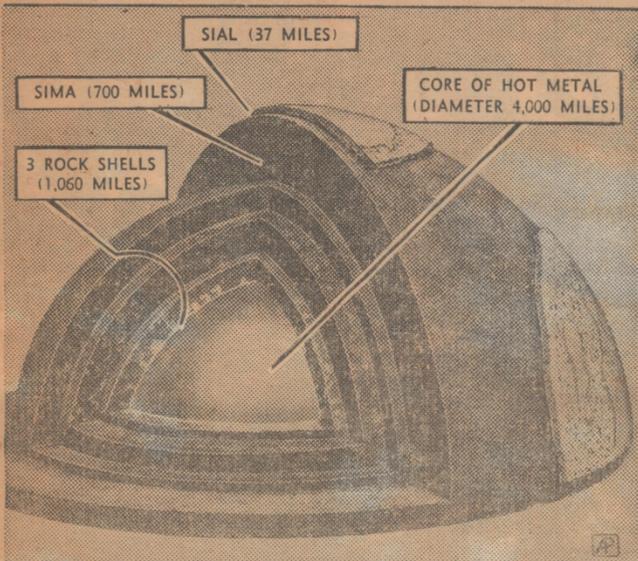
## Pattern of Earth's Interior Shown in Geologist's Model

A geologist's conception of a cross-section of the earth has just been placed on exhibition at the Field museum at Chicago.

It depicts the Southern hemisphere, with

posed of an alloy of iron and nickel.

Nichols depicts the outer shell of the earth as incomplete. It underlies the land but is absent under the deeper parts of the rocks, is known as the sial, and is



The concentric shells of rock which house the earth's core of molten metal are represented in this model showing a geologist's idea of the internal structure of the earth.

parts of the semi-globe cut away to show the interior, and was made in the museum's laboratories under the direction of Henry W. Nichols, curator of geology.

Since the earth has a diameter of 8,000 miles and the deepest excavations have penetrated less than two miles, the model's major structural features were determined indirectly by surface observations.

Instead of a thin crust over a molten interior, as the earth was once conceived to be constructed, the Nichols model shows three concentric shells of rock of increasing density wrapped around a core of hot metal 4,000 miles in diameter and com-

posed of granite and re-

usually 37 miles thick. Beneath it is another layer, known as the sima, and 700 miles thick. It rests upon a third shell, concerning which little has been learned. It is known to be 1,060 miles thick and is divided by two discontinuities into three concentric shells also shown on the museum model.

The model shows rocks and metals as they would appear cooled, at the surface of the earth, whereas Nichols says their true appearance must be quite different owing to the tremendous heat and pressure to which they are subjected.

## Dr. Branner Urges More Survey Work

Jan 10 1937  
Makes Recommendation in Report of State Geologic Survey.

Plans for carrying forward a broad program of geologic, topographic and stream gauging work by the Arkansas Geologic Survey in co-operation with several Federal agencies are urged and recommended in a report by Dr. George C. Branner, state geologist, to Governor Futrell. The report, announced yesterday, covers administrative work of the state geologist for the year from December 1, 1935, to November 30, 1936, and includes accomplishments of the 12 months.

The Arkansas Geologic Survey issued eight publications during the year, six on geology and mineral resources and two on topography, the latter consisting of descriptions of 14,421 elevations in Arkansas and a complete set of county maps. Much of the work was done through two WPA projects.

Seven projects are under way now to list and classify water wells, springs, lakes, caves and caverns, commercial minerals of Magnet Cove and oil shales of northern Arkansas, while several new projects will be started if funds are available. These will include information on limestone quarrying, mineral resources data by counties, sand, gravel and stone deposits, and other mineral resource information.

### Maps Prepared.

Included in the topographic projects were preparation of a complete set of county maps, co-operation with the Arkansas Forestry Commission and the Arkansas State Highway Commission to complete a series of county base maps, and to compute and run level and traverse lines. Co-operation with the United States Geological Survey has resulted in maintaining 17 stream gauging stations in the state while the recommendation has been made by the Federal survey that 28 additional stations be installed and maintained. The office of the state geologist has directed two WPA projects and persons in the office have co-operated with numerous agencies in preparing information and providing information.

One of the important activities of the office was that of the severance tax agent, the report said, who was added to the staff following the 1935 legislature. Five-year audits of several firms were made and nearly \$32,000 in back severance taxes were collected and claims are pending for \$19,000 more.

Plans for the geological survey for the coming year include completion and publication of several reports, continuation of field studies on mineral resources, completion of a topographic survey of the state and co-operation in a stream gauging program.

The report also includes a list of severance tax payers, a list of mineral producers in the state and a directory of mineral producers for general information.

## Arkansas Needs Greater Balance Between Income And Debt, Says Geologist

Democrat 2-12-37  
By GEORGE C. BRANNER,  
(State Geologist)

Among the sixteen states in the Union usually classified as "The South", Arkansas, in 1933, ranked fifteenth in the value of manufactured products, wages paid in manufacturing, percentage of persons employed in manufacturing, and in number of factories.

In contrast to these indications of comparatively low industrial development, Arkansas, in 1934, stood eleventh in the value of agricultural products; twelfth in the quantity of timber produced; and, in 1933, tenth in the value of minerals produced.

In state revenue, Arkansas ranked ninth in 1932. The state's per capita debt, however, in the same year was the highest in the Union, necessitating the allocation for debt service of approximately 33 per cent of each tax dollar collected by the state during the fiscal year 1935-36. The situation is therefore one of below average income and large annual debt service which indicates clearly the imperative need for the development of all of the wealth-producing resources of the state, if the standard of living of its citizens is to be maintained or improved.

Although there is no simple solution to this problem, one obvious approach is the creation of new industries and the further development of existing industries which will utilize the wealth of raw material available. Continued migration of industries to the South from the East and North offers unprecedented possibilities in this direction.

Immense quantities of agricultural products including cotton, cotton seed, corn, rice and fruits, are available for the manufacture of industrial alcohol and other derivatives.

As to timber resources, the state is in a position to supply a heavy demand for pine, gum, oak and other species for the manufacture of wood products, provided scientific methods of removal for sustained yield are practiced.

In the mineral group, there exists an abundance of cheap fuels in the form of oil, natural gas, bituminous and semi-anthracite coal. Unlimited amounts of limestone, dolomite, chalk, clay, glass sand, tripoli, slate, building stone, sand and gravel are also available.

The development of hydro-electric power within the state has recently moved forward with the undertaking of the construction of the Blakeley Mountain dam, and the contemplated construction of a dam at Wildcat Shoals on the White river in Arkansas. With the completion of these two dams, the total hydro-electric horsepower developed will approximate 42 per cent of 527,800 horsepower estimated available.

There are, of course, certain drawbacks to the development of some types of industries within the state of Arkansas, which affect basic costs and the security of profits, just as there are in any state. An Industrial Commission, however, as suggested by Governor Bailey might bring about the removal or substantial elimination of any serious barriers to industrial growth in Arkansas if it faces the problems squarely and secures the necessary legislative support. The full co-operation of established state and municipal agencies with the objectives of such a commission would be vital. These include the State Planning Board, the State Forestry Commission, the State Geological Survey, the Agricultural Extension Service of the University of Arkansas, the State Chamber of Commerce and many local chambers.

### Geological Maps of Areas Near City Received.

Gazette 2-12-37

The state Geological Department has received advance sheets of the United States Geological Survey's maps of the McAlmont and North Little Rock quadrangles, which with two quadrangles south of the river previously issued, complete the geological map of the Greater Little Rock area. The maps are made on a scale of four-tenths mile to the inch and show contour lines at frequent intervals. A supply of maps will be received later for sale at cost.

## Survey Urged For Benefit Of Industry

Dem 2-12-37  
Research Would Lead to Development of New Mineral Industries.

A state geological survey may render great assistance to industry by leading the way in basic research to the development of new mineral industries.

Although it is true that the development of many of our mineral preserves are at present marginal as to profits, the fact remains that the profits in the mineral industry are determined by present methods of extraction, preparation, and use. If researches are made into the character of our various clay, bentonite, and fuller's earth deposits, it is not improbable that certain new and unknown qualities in these earths will be discovered which may, in turn, increase the value of the raw material and the profits to be realized from its production.

This also applies to research in the shales and slates, limestones and dolomites.

Researches in Illinois on the siliceous limestones resulted in the development of a rock wool industry there. Coal researches as to the chemical character of Arkansas coals may be of substantial value to the coal producers. Researches into petroleum production, the study of such items as flowage through oil sands, sub-surface structure, and the chemical and paleontological character of well cuttings, will be of unquestionable value.

The following list of mineral resources are suggested by George C. Branner, state geologist, as necessary for continued and added survey and basic research.

Fuel minerals: Petroleum, natural gas, lignite in southwestern Arkansas, and oil shales of northern and western Arkansas.

Metallic minerals: Cinnabar, rutile in Hot Spring county, manganese carbonate, iron ore in northern Arkansas, antimony.

Non-metallic minerals: Clays, tripoli, phosphate-bearing rocks, brines, fuller's earth and bentonite, limestone suitable for dock wool manufacture, green sand, building sand, building stones, mineral waters, sand and gravel.

Non-mineral: Caves and caverns. Adequate justification is believed to exist for the expenditure of state funds for such investigations.

All that any public agency can do to stimulate and assist in the development of natural resources is to clear the way, so far as possible, for the easy flow of capital to the development of any natural resource. To simplify and expedite this bringing together of capital and natural resources, those public agencies whose function it is to provide the detailed information required by capital before funds are invested should be given every support for which reasonable justification can be shown, Mr. Branner said.

## Dr. Branner Plans To Talk in East

Democrat 2-12-37

Dr. George C. Branner, state geologist, left Little Rock yesterday for New York and Washington to attend conferences. He will speak in New York Tuesday before the American Institute of Mining Engineers and tell of the development of the limestone deposits in north Arkansas.

In Washington he will preside over a meeting of the National Association of State Geologists Thursday and Friday. The geologists will take up with federal officials while in Washington plans which call for the completion over a period of several years of a mapping program for the entire nation.

Accurate maps are of great value, Dr. Branner said, and the job is not more than half completed for the nation as a whole. In Arkansas detail maps never have been made for 27 per cent of the state, and other sections are inadequately mapped.

The limestone deposits of the state have yielded an income of more than \$9,000,000 since 1889. Br. Branner announced as a result of his research in preparing the paper to be read at the New York conference. Of this total, about \$5,500,000 has been received from the production of nearly 1,000,000 tons of lime. Since 1930 a total of 43,600 cubic feet of black marble has been taken from Arkansas quarries and has been used in many sections of the United States.

### "TRADE IN ARKANSAS."

"Trade at home" was the advice and counsel given all its employes recently by an Arkansas insurance house to stimulate a greater interest in and trade with Arkansas business interests.

"This office calls to your thoughtful attention the matter of increased profit to Arkansas interests which would flow out of your doing all the business you can with Arkansas citizens and Arkansas industries, thereby aiding our state in being more self-supporting," was the thought presented by the company.

Of course, in many cases you want a peculiar quality or type of service that is not readily available within our state. At such times no unsuitable thing should be accepted just to support a local business, but many dollars now are being sent out of Arkansas for goods or services that can be procured here in like or better quality and at no higher price.

The more times you turn over the dollar in Arkansas, the greater the proportion of it remains here, and the more likely you are to get back a portion of it.

Even a higher price sometimes paid a local man is often in the end less expensive when we take all factors into consideration, particularly that additional profit to the purchaser and his customers that will follow the further trading with other home persons who will get some of the cents out of the dollar spent at home.

Arkansas would make economic progress in a substantial way if more of us would make a sincere and continuous effort to promote Arkansas enterprises and businesses by simply giving to them more of our patronage and inviting them to further the practice in making their purchases.

Think it over!

## Geologists Seek Wider Land Survey

Democrat  
Jan 20, 1937  
Dr. Branner Returning to Little Rock After Presiding at Sessions.

Washington—Dr. George C. Branner, state geologist of Arkansas, was en route to Little Rock today after closing a three-day meeting of the association of American State geologists, which he heads. Representatives of forty-two states attended the meeting, generally declared to have been the best in the history of the organization.

Under Dr. Branner's leadership, the association adopted several resolutions which are expected to aid the drive to secure better geological studies of the nation during the next several years.

Included were resolutions requesting an extension of geophysical control stations throughout the nation for use in connection with surveys of mineral resources; requesting the geological society of America to take the lead in improving the lay public's understanding of geological science; and endorsing the program for expediting and topographic mapping of the United States, proposed by Secretary of Interior Ickes. Nationally known scientists and engineers participated in the conference-discussion meeting of the association. Walter C. Mendenhall, director of the United States Geological Survey, John W. Finch, director of the United States Bureau of Mines, Charles W. Eliot, II, executive officer of the national resources committee, and others high in official circles addressed the meeting on particular phases of their work.

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16 Regional Geologists Attend Hot Springs Conference.

Hot Springs, Ark., April 2 (AP).—Sixteen regional geologists of the National Park Service, here for a conference, took time out from their executive sessions today to inspect geological formations in Hot Springs National park and Magnet Cove. They spent a half day on the field trip, exploring the area for data of scientific interest. Dr. George C. Branner, Little Rock, state geologist, was a guest on the field trip. Tonight the delegation attended an illustrated lecture given by Earl A. Trager, chief of the service's naturalists, branch of research and education. The lecture was held under auspices of the Hot Springs Natural History Association. The geologists discussed technical subjects today before embarking on their field trip. Speakers included Trager, Dr. J. Voley Lewis, San Francisco; Dr. Harry Ladd, Atlanta, Ga., and Dr. Ross Maxwell, Alpine, Tex. The three-day conference will close tomorrow in time for the geologists to be guests of the Chamber of Commerce at the Arkansas Derby at Oaklawn park. Tomorrow night they will be guests of Supt. Donal S. Libbey of the Hot Springs National park at dinner.

Geological Survey Object Of Conference National Park Service Scientists Open Hot Springs Session.

Hot Springs—National Park Service geologists opened a three-day session here today to discuss plans for co-ordinating geologic work in all areas of the park service, and in national and state parks. Earl A. Trager, chief of the naturalist division, branch of research and education, National Park Service, is presiding. He indicated most of the discussions would be technical.

The geologists are also formulating a program for a survey of all areas in the nation with a geological interest. Under present plans, lands of national parks and monuments will be excluded. Speaking on this proposal, Mr. Trager said: "These areas will be surveyed with a view to embracing them within the service if found they possess sufficient geological importance of interest."

Donald S. Libbey, superintendent of Hot Springs National park, welcomed the delegates. Superintendent Libbey is deputy assistant director in charge of emergency conservation work for the service. Before being stationed here he was closely allied with the naturalist division, as he was a representative on Director Robert Fechner's advisory council.

The work of the naturalist division embraces two classes of service, Mr. Trager explained. First, the interpretation of the geologic features of the area to the visitor; second, to supervise all projects pertaining to geology to safeguard their scientific features.

The work of the naturalist is doubly important now because of the great amount of construction and other projects under way, Trager explained.

On a field trip over Hot Springs National park and to Magnet Cove, east of here, Friday afternoon, Dr. George C. Branner, Arkansas state geologist, of Little Rock, will be guest of honor. After adjourning Saturday the geologists will attend the Arkansas derby at the Oaklawn race track.

Those scheduled to be here for the conference in addition to Mr. Trager include Dr. H. C. Bryant, assistant director of the National Park Service, in charge of the research and education branch; Howard E. Rothrock, assistant chief, naturalist division, Washington, D. C.; Harold H. Hawkins, assistant geologist, Washington, D. C.; George Chadwick, regional geologist, Richmond, Va.; Harry Ladd, district geologist, Atlanta, Ga.; Carroll H. Wegemann, regional geologist, Omaha, Neb.; Luther Kennedy, district geologist, Omaha, Neb.; Dr. C. N. Gould, regional geologist, Oklahoma City; Okla.: Vincent W. Vandiver, regional geologist, Santa Fe, N. M.; J. Volney Lewis, regional geologist, San Francisco; D. K. Mackay, regional geologist, Portland, Ore.; Dr. Ross Maxwell, geologist assigned to study of the Big Bend National park, Alpin, Tex.; Harry W. Lix, acting park naturalist, Hot Springs, and Superintendent Libbey.

ROADSIDE GEOLOGY

By GEORGE C. BRANNER, State Geologist.

*By the Arkansas Gazette, Jan. 1936*  
The state-wide road construction program of Arkansas which has been carried forward so actively in recent years has meant a great deal to geologists. Usually, in order to familiarize himself with the character of the rocks in various regions, the geologist must climb over the hills and break open the surface rocks here and there with a hammer, often being able at best to get only a very incomplete picture of the section of the rocks at any one place. Now, in many areas, he may drive along in the comfort of his automobile over a smooth, modern highway whose construction has caused to be revealed, like a great picture, the layers of rock which make up the surface of the earth. A few minutes' examination of one of these cuts by the roadside will often save a geologist hours of work.

The most complete exposures in the state are in the Ozark Plateaus where the beds lie nearly flat and a winding road cut from the top of a mountain to the bottom will often expose nearly the entire rock section in detail. For example, a trip along Highway 62, immediately west of Eureka Springs, clearly exposes hundreds of vertical feet of the beds. Anyone may observe there the entire series of flat-lying rocks from the well known "Boone" or "Mississippi" lime which covers many thousands of square miles in the Ozarks, to the dolomites which lie hundreds of feet beneath.

There are other remarkably fine exposures along Highway 71, between Fayetteville and Alma. Fayetteville lies on the "Boone" lime, and the road passes from this formation through thousands of vertical feet or more of recent beds which lie over it. A very fine series of exposures can also be seen along Highway 9 between Melbourne and Sylamore, where, in several places, over 700 feet of the vertical section from the "Boone" lime, through the well-known St. Peter sandstone (from which glass sand is obtained) to the underlying dolomites, is exposed. Still another excellent series of exposures occur on Highway 25 between

Batesville and the south Independence county line, where the winding road cuts through a vertical section of about 1200 feet of the flat-lying beds. South of Marshall on Highway 65 is an especially fine exposure of the black marble beds. State Highway 70 from Benton to Hot Springs exposes the shales and sandstones which make up the central core of the Ouachita Uplift. Between Kirby and Murfreesboro State Highway 7 cuts across many thousands of feet of sandstones and shales which make up the Athens Plateau.

These and numerous other exposures have been of sufficient interest to students of geology to attract geological societies and many geologists to the state. Their motor tours are often laid out with reference to the best routes for observing the rocks which are exposed in the road cuts.

It is planned to erect signs on some of the best exposures in order that the local geology may be more appreciated by the tourist. The first of these signs is to be installed near Forrest City, on a cut in Crowley's Ridge, where the sign will show the structure of the ridge.

Fifty Years Ago.

(Arkansas Gazette, April 2, 1887.)  
Prof. J. C. Branner has accepted the position of state geologist of Arkansas and will be here soon to begin his work. From the testimonials Governor Hughes has received he is satisfied that a better man for the place could not be found. Professor Branner formerly was with the Geological Department of the University of Indiana. *4-2-37*

DR. BRANNER ON COMMITTEE.

Appointment of Dr. George C. Branner, state geologist, on the Committee on Surveys and Maps of the American Engineering Council, was announced yesterday by Dean Potter, president of the council. Dr. Branner is president of the Association of American State Geologists. *Gazette 4-8-37*