ANNUAL REPORT OF THE STATE GEOLOGIST

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THE MINERAL INDUSTRIES OF ARKANSAS IN 1942

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BULLETIN 10

ARKANSAS GEOLOGICAL SURVEY
446 State Capitol—Little Rock

Figure 1

Polished surface of syenite from Granite Mountain, south of Little Rock in Pulaski County. This plate will appear in a bulletin on Building Stones of Arkansas, now in preparation. Syenite block furnished by Monahan and Son, Little Rock.

STATE OF ARKANSAS

ARKANSAS GEOLOGICAL SURVEY

RICHARD J. ANDERSON

Acting State Geologist

BULLETIN 10

ANNUAL REPORT OF THE STATE GEOLOGIST AND THE MINERAL INDUSTRIES OF ARKANSAS IN 1942

LITTLE ROCK

JANUARY 1, 1943

ARKANSAS GEOLOGICAL SURVEY

Personnel

RICHARD J. ANDERSON - - - - - - - *Acting State Geologist*

EDGAR R. RICHARDSON - *In Charge—Mining Production Section*

ROSE MARIE GOUGEON - - - - - - - - *Secretary-Supervisor*

EDITH ANN PIERCE - - - - - - - - - - - - - *Librarian*

ELIZABETH POE - - - - - - - - - - - - - - *Statistician*

ALBERT HESS - - - - - - - - - - - - - *Chief Draftsman*

GEORGE H. PACE - - - - - - - - - *Oil and Gas Recorder*

PAULINE G. BEESON - - - - - - - - - - - - *Bookkeeper*

BETSY MCGREW - - - - - - - - - - - - - *Stenographer*

LETTER OF TRANSMITTAL

ARKANSAS GEOLOGICAL SURVEY

Little Rock, Arkansas,

December 7, 1942.

Honorable Homer M. Adkins,

Governor of Arkansas,

Little Rock, Arkansas.

Sir:

I have the honor to submit herewith the Annual Report of the State Geologist, in which has been incorporated a review of the mineral industries of the state for the calendar year 1942.

Great strides have been made in the last twelve months in our mines and mineral industries, in the development of our petroleum and natural gas resources, in the progress of topographic mapping, in flood control, and in soil conservation.

That this progress may be more widely appreciated and more clearly understood, this bulletin is presented as a review of the past year.

Respectfully submitted,

RICHARD J. ANDERSON,

Acting State Geologist.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

ANNUAL REPORT OF THE STATE GEOLOGIST

The work of the Arkansas Geological Survey was conducted by a reduced personnel during 1942. The demands of the war program have greatly increased the duties of the department, and the present opportunity to serve the State of Arkansas has never been equalled.

Every effort is being made to increase the service facilities of the department so that it will be in a position to carry on in a satisfactory manner the tasks which it will undertake during 1943.

Publications

Four bulletins were released during 1942. A chapter on the mineral resources of Arkansas, prepared by George C. Branner for the recently published "Arkansas' Natural Resources, Their Conservation and Use," [1] was reprinted for distribution by the Arkansas Geological Survey as Bulletin 6.

A report on a field study of a group of kaolin deposits in southern Pike County by Paul G. Herold and George R. Heyl was published as Bulletin 7.

A detailed study of the Pitkin limestone of northern Arkansas by William H. Easton was published as Bulletin 8.

George Rose Smith's compilation of the mining and mineral laws of Arkansas was published as Bulletin 9.

The work of the State Mineral Survey (Work Projects Administration Project No. 7187-9) in Montgomery, Garland, Saline, and Pulaski Counties was assembled and published as County Mineral Report No. 3.

To accompany the exhibit "Arkansas' Minerals for War," a nineteen page pamphlet setting forth important facts on Arkansas' mineral production was compiled and published for distribution by this department and by the Arkansas Publicity Commission.

A new list of publications was published in March, and is kept up to date by the inclusion of printed data.

Field Equipment

In order to make possible a field program during 1943, necessary new surveying equipment was purchased during the past year.

1 Published by the Source Book Committee, Fayetteville, Arkansas, 1942.

This equipment included a plane table and alidade, two stadia rods, and a half-ton truck for the transportation of equipment, samples, and personnel. Purchase of this equipment was made possible by grants from the National Defense Fund, Item 19 of the departmental budget.

Figure 2

International half-ton truck purchased by the Arkansas Geological Survey and used to transport equipment, samples, and personnel.

Laboratory Space and Equipment

Conversion of unused storerooms on the fourth floor of the Capitol Building to laboratories, workrooms and supply rooms has been partially effected and is now in progress.

The proposed arrangement, as shown on the accompanying floor plan, is as follows:

Room 453

A laboratory for blow-pipe analysis and microscopic examination and identification of mineral specimens.

Stockroom for supplies of typical Arkansas rocks and minerals for distribution to schools and colleges in Arkansas.

Room A

Stockroom for office supplies.

Workroom for librarian and stock space for overflow from the departmental library. Storage of duplicate reports and out of state publications.

Room B

Severance Tax Records File Room.

Storage of maps published by the Arkansas Geological Survey.

Room C

Publications storeroom.

Workroom for map mounting.

Room D

Oil and water well records storage and workrooms.

Mimeographing Room.

Room E

Laboratory for Microphotography.

Storage for drill cores and well cuttings.

The department has been fortunate to secure the loan of a petrographic microscope from the University of Minnesota, Department of Geology. This valuable instrument will be in use until the department is able to secure a new instrument to replace it.

Roosevelt Road Laboratory

The facilities of the Roosevelt Road Laboratory, formerly occupied by the State Mineral Survey, (W. P. A. Project No. 7187-9) have been extended temporarily to the United States Bureau of Mines to house the field office of the Bureau's bauxite investigations.

The main building of the laboratory group has been insulated throughout and repainted. The sample preparation room and the laboratory proper have been repaired and placed in usable condition. The roofs of the entire group of buildings have been repaired to prevent further damage of equipment by rain.

Department Library

The library of the Arkansas Geological Survey has been benefited during the past year by the services of a full-time librarian. A complete inventory of the department's collection of state geological reports from other state surveys has been made, and exchange agreements which had been allowed to lapse were renewed.

The entire book collection of the Department is open to the public as a reference library. Library hours are from 8 A. M. to 5 P. M. Monday through Friday, Saturday (8:00-12:00 A. M.).

Mineral Exhibits

A special exhibit of Arkansas' strategic minerals was prepared for the Southern Governors' Conference in Hot Springs, April 19-21, 1942, in cooperation with the Arkansas Publicity Department. This exhibit has since been placed on view at the Marion Hotel, Little Rock, in Chicago and Dallas, and at the time of this writing is displayed, in part, on the ground floor of the State Capitol Building.

A permanent exhibit was designed and set up in the north and south corridors on the ground floor of the Capitol Building.

An improved geological museum is now under construction on the fourth floor of the Capitol Building, and will be completed early in 1943.

Mineral and Rock Identification Service

The Arkansas Geological Survey maintains a laboratory for the identification of mineral and rock specimens submitted to the department by residents of the state. No charge is made for this service. Due to the extremely large number of specimens which were received during the past year, there has been considerable delay in the release of replies to such requests. This situation will be

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Explanatory Note:

Rooms 443 to 447 on the fourth floor of the State Capitol are shown by the numbers 1-5 on the plan which appears on the opposite page.

These rooms are used as follows:

1. Office of State Geologist
2. Secretary
3. Library
4. Drafting Room
5. Clerk and Stenographer

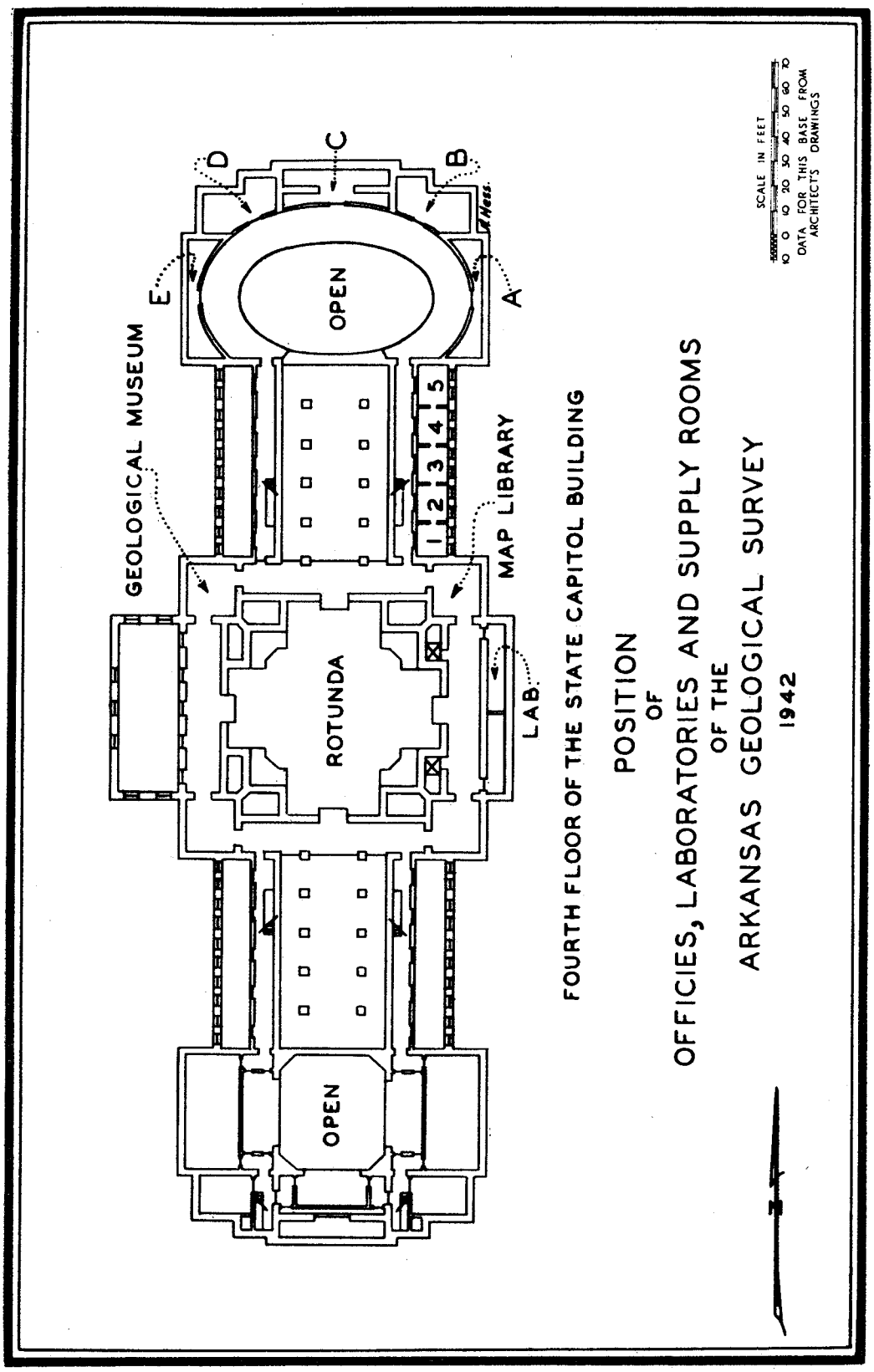

D
C
B
E
A
OPEN
GEOLOGICAL MUSEUM
MAP LIBRARY
1 2 3 4 5
ROTUNDA
LAB
OPEN
FOURTH FLOOR OF THE STATE CAPITOL BUILDING
POSITION
OF
OFFICIES, LABORATORIES AND SUPPLY ROOMS
OF THE
ARKANSAS GEOLOGICAL SURVEY
1942
SCALE IN FEET
10 0 10 20 30 40 50 60 70
DATA FOR THIS BASE FROM
ARCHITECTS DRAWINGS

Figure 3

improved during 1943 by additions to the staff of the department, which is now too small to adequately cope with the demands placed upon it.

School Study Service

Any student or teacher in any school or college in Arkansas may receive specimens of the state's common minerals free of charge by writing to the Arkansas Geological Survey. A stock room of these minerals is maintained by the department, the supply of minerals being regularly replenished by contributions from mining companies and by collecting trips made by the staff of the department.

Specimens of the following rocks and minerals are now on hand:

Barite
Bauxite
Chalk
Cinnabar
Clay
Coal
Gypsum
Kaolin
Lignite
Limestone
Limonite
Manganese oxide
Marble
Novaculite
Quartz
Slate
Smithsonite (Zinc carbonate)
Sphalerite (Zinc sulphide)
Syenite
Titanium oxide

Copies of Bulletin 6, a handy reference to the mineral resources of Arkansas, may be obtained by writing to the department. This booklet of 100 pages is priced at 30 cents per copy.

Sale of Publications and Maps

The publications of the Arkansas Geological Survey may be purchased by writing or applying in person to the department. A few publications are distributed free of charge. The prices of the department's publications are based on the printing cost only, no other expenses enter into the purchase price of any map or report. A complete list of the publications of the Arkansas Geological Survey appears on page 141.

In addition to the maps and reports published by the department, maps and bulletins published by the United States Geological Survey and the United States Bureau of Mines, dealing with the geology and mineral resources of Arkansas, are offered for sale at cost by the Arkansas Geological Survey.

Lecture Service

Any school, college or civic organization in Arkansas can obtain the services of a lecturer from the staff of the Arkansas Geological Survey by writing to the department at least thirty days in advance

of the lecture date. No charge is made for this service. Lectures are illustrated by lantern slides, and are given on the following subjects:

Arkansas' Minerals for War
The Geology of Arkansas
Mineral Resources of Arkansas
Rivers and Mountains of Arkansas

Map Library

The map library of the Arkansas Geological Survey has been designated as an official depository for maps published by the United States Geological Survey. The storage facilities of the map library are being enlarged to receive the additional maps, which will not be received until the end of the war.

The facilities of the map library are restricted at the present time. At the close of the war a better and a more complete collection will be opened to the public.

Water-well Records

Laboratory and storage facilities for samples of drill cuttings from well drilling operations throughout the state are now in preparation, and drillers are invited to write to the Arkansas Geological Survey for instructions in the saving and forwarding of samples. The samples will be examined, classified as to rock type, and filed for reference purposes.

The purpose of this program is to compile useful data on the depth and character of water-bearing formations, which information will in turn be of great assistance to municipalities, industrial concerns, and private individuals who desire to obtain water from underground sources.

Sponsored Projects

The State Mineral Survey (Work Projects Administration Project No. 7187-9) operated during the first six months of 1942 on a limited basis in keeping with the general national retrenchment of the W. P. A. program. The project was discontinued on June 30, 1942.

The Arkansas Geodetic Survey (W. P. A. Project No. 7359-9) was continued throughout 1942. Sibley L. Ward is Superintendent, and Harry T. Flanders is chief computer.

The field work of the State Geodetic Survey during the past year included the running of control lines, setting and description of bench marks, and recovery and establishment of magnetic stations throughout the state. The Geodetic Survey cooperates with the Arkansas Geological Survey, the U. S. Geological Survey, the U. S. Coast and Geodetic Survey, and the U. S. Engineer Corps in mapping areas of strategic importance throughout the state.

FINANCIAL STATEMENT

APPROPRIATIONS

For the fiscal years July 1, 1941, to June 30, 1943, the items of the appropriations for the support of the Office of State Geologist are summarized as follows:

	Fiscal Year 1941-1942	Fiscal Year 1942-1943
Salaries, miscellaneous wages	$23,800.00	$23,800.00
Travel, State Geologist, Severance Tax Agent, and Others	3,400.00	3,400.00
Topographic Mapping	2,000.00	2,000.00
Stream Gaging	250.00	250.00
Field Studies of antimony, clay, phosphate and other mineral deposits—cooperative with WPA on State Mineral Survey field and laboratory work	5,000.00	5,000.00
General Maintenance, office supplies, stationery, equipment, printing forms, pamphlets and reports	7,200.00	7,200.00
National Defense Purposes, to be used only at the direction of the Governor and Comptroller	10,000.00	10,000.00
Total	$51,650.00	$51,650.00

RECEIPTS

For the fiscal years July 1, 1941, to June 30, 1943, the receipts for the support of the Office of State Geologist are summarized as follows:

	Fiscal Year 1941-1942	Fiscal Year 1942-1943 (Estimated)
Severance tax	$ 28,787.40	$ 30,900.00
Sand and gravel sales	40,366.43	33,615.32
Sale of publications	1,286.35	1,511.40
Transfer	3,900.00	3,900.00
Total	$ 74,340.18	$ 69,927.52
Less 1% of receipts from severance tax and sand and gravel sales for deposit in sinking fund	704.35	660.27
Amount received for current expenses	$ 73,635.83	$ 69,267.25
Amount carried over from preceding year	28,572.24	40,267.57
Total amount available for current expenses	$102,208.07	$109,534.82

Appropriations for current expenses:			
Arkansas Geological Survey	$48,606.88*		
Flood Control Commission	13,333.62*	61,940.50*	79,250.00**
Balance to be carried over		$ 40,267.57	$ 30,284.82

* Actual expenditures.
** Total appropriations: AGS $51,650.00; FCC $27,600.00.

EXPENDITURES

The expenditures of the Office of State Geologist for the years 1941-1942 and 1942-1943 are summarized as follows:

		Fiscal Year 1941-1942	Fiscal Year 1942-1943 (Estimated)
Salaries of office employees, severance tax agent, and extra help		$19,677.51	$23,800.00
Contribution to State Mineral Survey WPA project including equipment, supplies, salaries, and travel; geological field studies		5,614.53	2,100.00
Topographic Mapping:			
Contribution to WPA mapping project including travel	$ 945.47		
Cooperation with USGS	3,142.33*	4,087.80	7,200.00
Stream Gaging (Cooperation with USGS)		250.00	250.00
Travel:			
State Geologist	$1,144.50		
Sev. Tax Agent	1,229.65		
Others	1,534.65	3,908.80	4,300.00
Publications of reports and maps		3,581.59	3,000.00
Office supplies, equipment, books, postage, express, and other miscellaneous maintenance		5,565.14**	4,200.00
National Defense Fund:			
Salaries	$4,419.01		
Mineral Exhibit, American Legion Convention	500.00		
Engineering instruments	352.50		
State Car	650.00	5,921.51	6,800.00***
		$48,606.88	$51,650.00

* $1,000.00 transferred from the Natl. Defense Fund to Topo. Mapping.
** $50.83 transferred from Natl. Defense Fund to Maintenance Appropriation.
*** $2,000.00 transferred from the Natl. Defense Fund to Topo. Mapping and $1,200.00 transferred from the Natl. Defense Fund to travel, field agt.

SINKING FUND

For the fiscal years July 1, 1941, to June 30, 1942, the receipts and disbursements from the State Geologist Sinking Fund are summarized as follows:

	Fiscal Year 1941-1942	Fiscal Year 1942-1943 (Estimated)
Balance on hand, July 1, 1941	$1,664.98	$1,369.33
Receipts	704.35	660.27
Total available	$2,369.33	$2,029.60
Expenditures	1,000.00	1,000.00
Balance	$1,369.33	$1,029.60

TEMPORARY EMPLOYEES, JANUARY 1, 1942, TO DECEMBER 31, 1942, AND MEMBERS OF THE REGULAR STAFF WHO RESIGNED DURING THE YEAR

Temporary Employees

Clyde Bingham	Field Agent	7- 1-42—12-31-42
John F. Evans	Field Agent	10-18-41— to date
Charles Goslee	Defense Council	11- 1-42— to date
Sarah Large	Part-time Librarian	Resigned— 3-31-42
Howard A. Millar	Engineer	11- 5-41— 2-20-42
Janie McCulloch	Typist	4-10-42— 6-15-42
William Rinehart	Field Agent	3-15-42— 6-30-42
Eugene Scisson	Clerk	12-16-42— to date
Eugene Wiley	Defense Council	3- 1-42— 9-15-42

Regular Staff

George C. Branner	Geologist	Called to active duty U. S. Army 3- 5-42
Effie Combs	Bookkeeper	8-24-42—12-31-42
Zeffie Evans	Bookkeeper	9- 1-41— 8-10-42
Mary Gibson	Clerk	Resigned— 7-20-42
Gregg Hamilton	Writer	7-7-41— 1-31-42
Alpha R. Hubbert	Stenographer	7- 3-42— 8- 5-42
Jeanice Hundley	Stenographer	3- 1-40— 6-30-42
J. L. McAdams	Coordinator	2- 6-42— 9-26-42
Frank V. Stevenson	Coordinator	11- 3-41— 2- 5-42

THE MINERAL INDUSTRIES OF ARKANSAS IN 1942

INTRODUCTION

Moderate to substantial advances in all branches of the mineral industry in Arkansas during 1942 were responsible for a record year in Arkansas' mining history. Excluding the totals for petroleum and natural gas production, the value of all minerals produced in 1942, both metallic and non-metallic, has been estimated at $27,400,000 an increase of approximately ten million dollars over 1941. The value of petroleum and natural gas produced during 1942 has been estimated at $27,900,000, an increase of approximately $2,000,000 over 1941. Nearly all the December figures have been estimated and in some cases the November totals as well, in order that an estimate could be presented at this time. Revised figures will be published in 1943 when complete production data has been received.

At the request of the Office of War Censorship all statistics on the production of strategic or critical minerals in Arkansas have been deleted from this report. This ruling also affects any detailed discussion by this department of the aluminum, manganese, and mercury mining trends and developments during 1942. Estimates of reserves have been omitted on request.

The mineral industry in Arkansas has been divided into 24 sections, each of which is discussed separately on the following pages. Petroleum and natural gas production is discussed in a separate section (page 45).

Antimony

The Southwest Minerals Corporation operated a mine in the Sevier County antimony district during 1942. Approximately forty-one tons of high grade ore, virtually pure stibnite, and some 230 tons of milling ore were produced during the year. The main shaft was sunk to a total depth of 175 feet, before the operation was closed down. The flow of water into the mine constituted the chief handicap to economical operation.

Southwest Minerals Corporation
Address: 109 Rector Street, Little Rock, Ark.
Location of mine: Gillham, Sevier County

Barite

Mining of the extensive deposit of barite-bearing rock in Hot Spring County, two miles east of Magnet Cove, increased con-

siderably during the year. The total production for 1942 is estimated at 52,000 tons, an increase of more than 20,700 tons over 1941.

The major producers in the barite field in Arkansas are the Baroid Sales Division of the National Lead Company and the Magnet Cove Barium Corporation. Mining operations in the district are confined to open cuts and quarries since the barite rock crops out at the surface or is covered by a thin veneer of soil. (See Figure 4.)

Separation of the barite from the other materials present in the ore is accomplished by a milling process, which consists essentially of crushing, fine grinding, and concentration of the barite by flotation technique. The final product averages 325 mesh in size.

Arkansas barite concentrates are used in the manufacture of heavy density muds which are essential for the drilling of oil wells by the rotary method in areas of high gas pressure. Other uses to which this product is put include the refining of sugar and the manufacture of glass.

BARITE PRODUCING COMPANIES IN ARKANSAS
1942

Baroid Sales Division, National Lead Co.
Address: 830 Ducommun St., Los Angeles, Calif., or Malvern, Ark.
Location of mine: Magnet Cove, Hot Spring County

Milwhite Co., The
Address: Cotton Exchange Bldg., Houston, Tex.
Location of mine: Magnet Cove, Hot Spring County

Magnet Cove Barium Corp.
Address: Malvern, Ark.
Location of mine: Magnet Cove, Hot Spring County
Location of plant: Malvern, Hot Spring County

Bauxite

The extensive deposits of bauxite in Pulaski and Saline Counties, in central Arkansas, have provided the basis for a spectacular increase in mining activity during 1942. The demands of the war program have brought a number of new producers into the bauxite district, and have permitted the older operators to greatly increase production.

For the first time in the history of the Arkansas bauxite industry, plants have been constructed within the boundaries of the state for the extraction of alumina from the bauxite, and for the reduction of alumina to aluminum metal. The bauxite-to-alumina operation is now being carried on at the Hurricane Creek plant of the Defense Plant Corporation, constructed and operated by the Aluminum Company of America. The Jones Mills plant near Hot Springs is now producing the first aluminum metal to be produced in Arkansas.

Figure 4

Quarry of the Magnet Cove Barium Corporation, near Magnet Cove, Hot Spring County.

Figure 5

Drag-line stripping the overburden on the property of the Victory Bauxite Company south of Sweet Home, Pulaski County.

During 1942, a smaller percentage of the total bauxite production has found its way into the manufacture of non-metallic products. Due to the tremendous increase in the total tonnage mined, however, the non-metallic consumption has considerably increased over former years. Among these non-metallic consumers may be listed the manufacturers of industrial chemicals, aluminum oxide abrasives, activated bauxite for the gasoline and synthetic rubber industry, and cement.

Figure 6

Stripped bauxite surface at the Sweet Home Bauxite Company's operation in Pulaski County.

Arkansas maintained its position as the leading domestic producer of bauxite in 1942. Prospecting programs carried on by the individual operators and by the federal government have added to the already known reserves of bauxite and high-alumina clays in Saline and Pulaski Counties. At the time of this writing the known deposits of bauxite are confined to these two counties.

The Metals Reserve Company has established stockpiles for bauxite which, at the present time, does not meet the specifications of the Hurricane Creek Plant. These stockpiles will constitute a readily accessible source of aluminum ore for future use.

BAUXITE MINING COMPANIES IN ARKANSAS

1942

American Cyanamid and Chemical Corp.
Address: 30 Rockefeller Plaza, New York, N. Y., or P. O. Box 726, Little Rock, Ark.
Location of mines: Pulaski and Saline counties

Crouch Mining Co.
Address: Benton, Ark.
Location of mine: 2½ miles north of Bauxite, Saline County

Dixie Bauxite Co.
Address: Sweet Home, Ark.
Location of mine: 2 miles north of Sweet Home, Pulaski County

Dulin Bauxite Co.
Address: 2222 Vance St., Little Rock, Ark.
Location of mine: 7 miles south of Little Rock, Pulaski County

Norton Co., The
Address: Worcester, Mass., or Bauxite, Ark.
Location of mine: 1 mile southeast of Bauxite, Saline County

Republic Mining and Manufacturing Co.
Address: 230 Park Ave., New York, N. Y., or Bauxite, Ark.
Location of mines: Pulaski and Saline counties

Reynolds Mining Corp.
Address: Boyle Bldg., Little Rock, Ark.
Location of mines: Pulaski and Saline counties

Sweet Home Bauxite Co.
Address: Sweet Home, Ark.
Location of mine: Pulaski County

Victory Bauxite Co.
Address: 2115 Chester St., Little Rock, Ark.
Location of mine: Pulaski County

Cement

The cement industry embraces a wide variety of cement types, used for an equally varied number of purposes. During 1942, Arkansas' main contribution to the cement industry was the production of Portland cement from Howard County. The plant of the Arkansas Portland Cement Company at Okay will probably substantially exceed their 1941 production of 915 thousand barrels in 1942. This plant is supplied from quarries in the Annona chalk (Cretaceous), one of the important lime-bearing formations of the Coastal Plain in Arkansas.

High-temperature cements are now being manufactured by the Acme Brick Company at their Perla (Hot Spring County) plant.

CEMENT PRODUCING COMPANIES IN ARKANSAS

1942

Arkansas Portland Cement Co.
Address: Okay, Ark.
Location of plant: Okay, Howard County

Acme Brick Company
Address: Fort Worth, Tex.
Location of plant, Perla, Hot Spring County

Clay and Clay Products

The manufacture of clay products is one of the leading mineral industries in Arkansas. Eight companies were engaged in the manufacture of various types of brick, tile, pottery, clay pipe, or other clay products during 1942. Refractory brick made up a large

Figure 7

Quarry of the Arkansas Portland Cement Company near Okay, Howard County. The car in the foreground is electrically operated by remote control.

percentage of the total volume of clay products manufactured during the past year. Hollow building tile, sewer pipe, flue lining, and high-temperature cements were also produced in quantity by the larger concerns. A plant at Benton is now turning out porcelain products in addition to earthenware, stoneware, and artware.

The clays of the Wilcox formation (Eocene) make up the chief source of domestic clay used in the state's ceramic industry. The outcrop of the Wilcox formation extends southwestward from Little Rock to the state line near Texarkana. The clay product manufacturers at Benton, Malvern, Hope, and Texarkana obtain much of their raw material from clay members of the Wilcox formation. Deposits of shale in western Arkansas contribute another major share of raw material. The brick plant at Fort Smith and the pipe and tile plant at Texarkana utilize large quantities of shale.

Perhaps no other mineral operation in Arkansas has a greater supply of raw materials than that which lies at the disposal of the ceramic industry. The great strides which this industry has made in the past year may point to more significant advances in 1943.

CLAY PRODUCTS COMPANIES IN ARKANSAS

1942

Acme Brick Co.
Address: Fort Worth, Tex.
Location of plants: Malvern, Hot Spring County; Perla, Hot Spring County, and Greenwood Road, Sebastian County

Camark Pottery
Address: Camden, Ark.
Location of plant: Camden, Ouachita County

Dickey, W. S., Clay Manufacturing Co.
Address: Texarkana, Tex.
Location of pits: Texarkana, Miller County, Ark., and Sevier County. (Plant in Texas.)

El Dorado Brick Works
Address: P. O. Box 335, El Dorado, Ark.
Location of plant: El Dorado, Union County

Hope Brick Works
Address: Hope, Ark.
Location of pits: Clark, Hempstead, Nevada, and Ouachita counties
Location of plant: Hope, Hempstead County

Jonesboro Brick Co.
Address: Jonesboro, Ark.
Location of plant: Jonesboro, Craighead County

Malvern Brick and Tile Co.
Address: Malvern, Ark.
Location of plant: Malvern, Hot Spring County

Niloak Pottery and Tile Co.
Address: Benton, Ark.
Location of plant: Benton, Saline County

Coal

Production of bituminous and semi-anthracite coals in Arkansas in 1942 will exceed any single year's total in the last two decades. Estimates made by the State Coal Mine Inspector and the Mining Production section of the Arkansas Geological Survey place the 1942 figure at well over 1,940,000 short tons. This is the first year that the two million ton mark has been approached since 1920, when production totaled 2,103,595 tons. The coal district was active throughout the year, since the usual seasonal lull in consumer demand was less noticeable in 1942.

Production was reported from six counties during the year. Listed in order, the leading producing county first, they are: Sebastian, Logan, Johnson, Franklin, Pope, and Scott.

For a complete list of Arkansas coal mines, and for data on coal analyses and mining methods, the Annual Report of the State Inspector of Coal Mines should be consulted. Copies of this report can be obtained from Mr. J. W. Fitzjarrell, State Coal Mine Inspector, Fort Smith, Arkansas.

Gravel

Large quantities of gravel were taken from gravel pits and stream and river beds throughout the state during the past year. Used chiefly for construction purposes, the total gravel produced has been estimated at 3,316,834 cubic yards. Production in 1941

of 1,880,978 cubic yards, was exceeded by 1,435,856 cubic yards in 1942.

The reserves of gravel in Arkansas are known to be very great, and can well support the tremendous demands which have been experienced during the past twelve months.

GRAVEL PRODUCING COMPANIES IN ARKANSAS
1942

A. & G. Gravel Co.
Address: Camden, Ark.
Location of pit: Ouachita County

Amyx and Fishaw
Address: Hampton, Ark.
Location of pit: Near Artesian, Calhoun County

Arkansas Gravel Co.
Address, 115 North Spring St., Little Rock, Ark.
Location of pit: Near Greenway, Clay County

Arkadelphia Sand and Gravel Co.
Address: Arkadelphia, Ark.
Location of plant: Edge of Arkadelphia, Clark County

Arkhola Sand and Gravel Co.
Address: Fort Smith, Ark.
Location of plant: Van Buren, Crawford County

Atkins, G. E.
Address: 600 South Main St., Camden, Ark.
Location: Ouachita River, Ouachita County

Barfield Sand and Gravel Co.
Address: Blytheville, Ark.
Location: Mississippi River, Mississippi County

Bearden Gravel Co.
Address: Pine Bluff, Ark.
Location of pit: Ouachita County.

Bench, W. C.
Address, Paris, Ark.
Location: Arkansas River, Logan County

Benton Gravel Co.
Address: Benton, Ark.
Location of plant: Edge of Benton, Saline County

Brabham, Abb and Burgess, C. W.
Address: Atlanta, Tex.
Location of pit: Miller County

Brown,. G. A.
Address: Monticello, Ark.
Location of pit: Drew County

Campster, Geo. R.
Address: Monticello, Ark.
Location of pit: Drew County

Clements, T. S.
Address: 129 Boulevard, Shreveport, La.
Location of pit: Fafayette County.

Clift, M. H.
Address: Melbourne, Ark.
Location of pit: Izard County

Cloud, Mrs. T. R.
Address: Monticello, Ark.
Location of pit: Drew County

Concrete Sand and Gravel Co.
Address: Reader, Ark.
Location of pit: Ouachita County

Crary, Mrs. Frank
Address: Fordyce, Ark.
Location of pit: Dallas County

Cromwell, A. R.
Address: Harrisburg, Ark.
Location of pit: Poinsett County

Cross County Gravel Co.
Address: Pine Bluff, Ark.
Location of plants: (1) 1 mile east of Cherry Valley, Cross County; (2) 3 miles east of Wynne on Coppers Creek, Cross County.

Crow Creek Gravel and Sand Co.
Address: Forrest City, Ark.
Location of plant: 1 mile west of Madison, St. Francis County

Cruce, W. C.
Address: Monticello, Ark.
Location of pit: Drew County

Davis, E. F., Sand and Gravel Co.
Address: DeQueen, Ark.
Location of pit: Sevier County

Dennis, Lucy
Address: Walcott, Ark.
Location of pit: Greene County

Dixon, S. M.
Address: Warren, Ark.
Location of pit: Cleveland County

Estep, S. R.
Address: Van Buren, Ark.
Location: Arkansas River, Sebastian County

Furlong, Pierce
Address: Board Camp, Ark.
Location of pit: Polk County

Gifford-Hill and Co., Inc.
Address: 412 Texas Bank Bldg., Dallas, Texas
Location of pits: Little River and Sevier counties

Graves Brothers
Address: Hamburg, Ark.
Location of pit: Drew County

Green Brothers Gravel Co.
Address: Lexington, Miss.
Location of pit: 2 miles south of Malvern, Hot Spring County

Greenville Sand and Gravel Co.
Address: Memphis, Tenn.
Location: Mississippi River, Chicot County

Hermitage Gravel Co.
Address: 115 North Spring St., Little Rock, Ark.
Location of pit: Calhoun County

Hecker & Sons
Address: Camden, Ark.
Location: Ouachita River, Ouachita County

Ingram, Ralph, Gravel Co.
Address: Murfreesboro, Ark.
Location of pit: Pike County

Jackson and Squire
Address: Ashdown, Ark.
Location of pit: 4 miles northeast of Allene, Little River County

Jeffrey, Roy N., Lumber Co.
Address: Batesville, Ark.
Location of plant: Batesville, Independence County

Johnston, C. M. & Sons, Inc.
Address: Box 116, Helena, Ark.
Location: Mississippi River, Phillips County

King, Miss Dora
Address: Route 3, Jonesboro, Ark.
Location of pit: Craighead County

Little River Sand and Gravel Development
Address: Wilton, Ark.
Location of plant: Wilton, Little River County

Lutesville Sand and Gravel Co.
Address: Black Rock, Ark.
Location of plant: Black Rock, Lawrence County

Malvern Sand and Gravel Co.
Address: Malvern, Ark.
Location of pit: 2 miles west of Malvern, Hot Spring County

Meriwether Gravel Co., Inc.
Address: Shreveport, La.
Location of plant: Lewisville, Lafayette County

Mobley Construction Co.
Address: Morrilton, Ark.
Location of plants: (1) Newport, Jackson County; (2); North of Dardanelle, in Pope County

Mooney, Mrs. L. E.
Address: Magnolia, Ark.
Location of pit: Columbia County

Newark Gravel Co.
Address: Newark, Ark.
Location of pit: Independence County

Newark Sand and Gravel Co.
Address: Pine Bluff, Ark.
Location of pits: Cross and Drew counties

Parnell, T. J.
Address: Warren, Ark.
Location of pit: Bradley County

Peck, Frank C. & Son
Address: 1920-32 Paseo, Kansas City, Mo.
Location of pit: Horatio, Sevier County

Pine Bluff Sand and Gravel Co.
Address: Pine Bluff, Ark.
Location of pits: Grant, Jefferson, and Lincoln counties

Posey, John B.
Address: Monticello, Ark.
Location of pit: Drew County

Porter, E. C.
Address, Clarksville, Ark.
Location: Arkansas River, Johnson County

Red River Gravel Co.
Address: Murfreesboro, Ark.
Location of pit: Pike County

Red River Gravel Co.
Address: Box 306, DeQueen, Ark.
Location of pit: 4 miles north of DeQueen, Sevier County

St. Louis Southwestern Ry. Co.
Address: St. Louis, Mo.
Location of plant: Britton, Ouachita County

Sanders, J. W.
Address: Camden, Ark.
Location of plant: 3 miles north of Camden on Ouachita River, Ouachita County

Schwartz, Max
Address: Route 5, Malvern, Ark.
Location of pit: Hot Spring County

Smith, Hugh E.
Address: Fordyce, Ark.
Location of pit: Dallas County

Standard Materials Corp.
Address: Indianapolis, Ind.
Location of pit: 1 mile south of Blevins, Hempstead County

Treadwell, John D.
Address: Fordyce, Ark.
Location of pit: Dallas County

Utah Construction Co. & Morrison Knudsen Co.
Address: Mountain Home, Ark.
Location: White River, Baxter County

Watson, A. F.
Address: Grapevine, Ark.
Location of pit: Grant County

Watson, Joe
Address: Nashville, Ark.
Location of pit: Howard County

Weaver, Tom
Address: Jonesboro, Ark.
Location of pit: 4 miles southwest of Jonesboro, Craighead County

Webb, C. E.
Address: McGehee, Ark.
Location: Mississippi River, Chicot County

White, Fred
Address: Okolona, Ark.
Location of pit: Clark County

Young, Mrs. Nancy
Address: Pyatt, Ark.
Location of pit: Marion County

Gypsum

The Arkansas Gypsum Company continued as the state's only gypsum producer in 1942. Total production for the year from the mine near Highland, Pike County, is estimated at about 33,000 short tons.

The gypsum is mined by both quarrying and underground operations. The mine run is crushed and sized to the consumer's specifications.

Arkansas gypsum is chiefly used as a cement retarder.

Arkansas Gypsum Co.
Address: Murfreesboro, Ark.
Location of mine: ½ mile north of Highland, Pike County

Lignite

The lignite reserves of central and southern Arkansas, which constitute one of the greatest of the state's mineral resources, have been mined on a small scale during the past year. The raw lignite has been used as a source of coloring materials, such as Vandyke brown (a paint pigment) and Sap brown or Walnut crystals (a water soluble dye-like substance).

The research department of the American Dyewood Company has perfected a process for the extraction of montan wax, as well as the coloring materials, from Dallas County lignite, and plans are now under way to construct a plant in Arkansas.

The poor performance of many Arkansas lignites when used as a fuel should not deter investigations as to other possible uses for this plentiful natural resource. Ouachita County alone has an

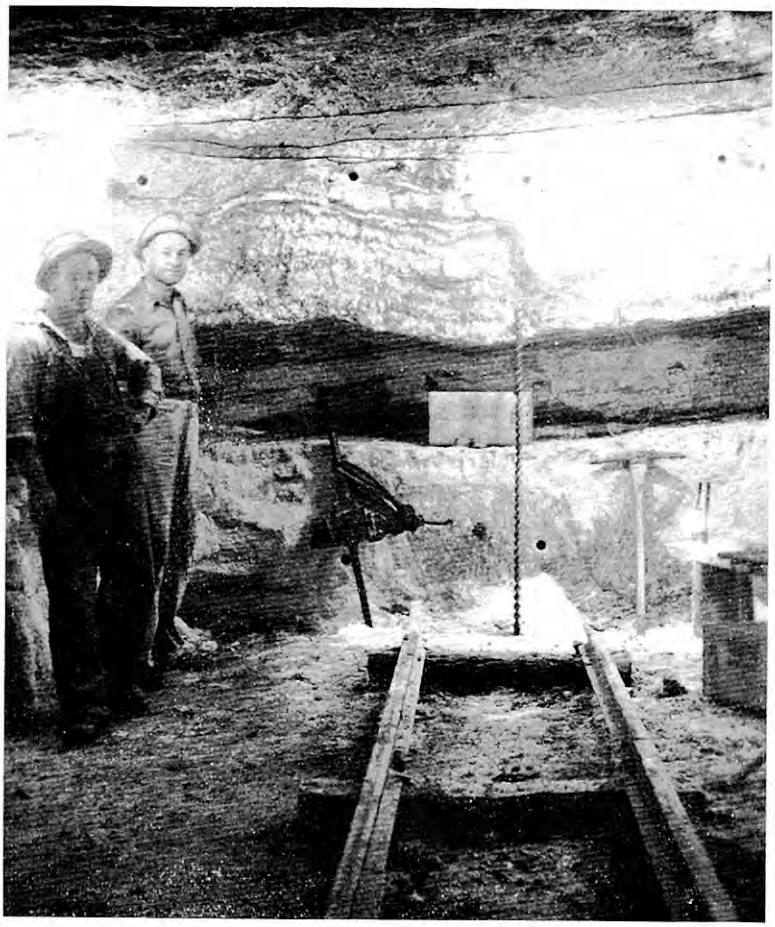


Figure 8

Working face in the Arkansas Gypsum Company mine near Highland, Pike County.

estimated reserve of 75 million tons of lignite. The possibilities of the by-products which can be extracted by destructive distillation and other chemical techniques, place lignite as one of the foremost sources for industrial raw materials now known to exist within the state.

COMPANIES MINING LIGNITE IN ARKANSAS

1942

American Dyewood Co.
Address: 22 East 40th St., New York, N. Y.
Location of mine: 2 miles south of Manning, Dallas County

Arkansas Dye and Chemical Co.
Address: El Dorado, Ark.
Location of mine: Near Chidester, Ouachita County

Limestone and Dolomite

The limestones and dolomites of northern Arkansas form the basis for one of the major quarrying industries of the state. Six companies were in operation during 1942, producing an estimated total of 224,625 tons of rock. Production during the past year exceeded that for 1941 by approximately 36,477 tons.

Figure 9

View of the limestone quarry of the Batesville White Lime Company near Limedale, Independence County.

The chief factor responsible for the recorded increase in production was the construction and initial operation of the alumina plant near Bauxite, Saline County. This plant utilizes large quantities of caustic lime or quicklime in the Bayer process. This quicklime is produced in northern Arkansas by burning limestones in kilns, and is shipped to Bauxite in covered railroad cars.

Large quantities of limestone and dolomite were used as rail ballast and as road building material.

LIMESTONE AND DOLOMITE PRODUCING COMPANIES IN ARKANSAS

1942

Dolomite

Independent Gravel Co.
Address: 220½ West 4th St., Joplin, Mo.
Location of quarries: Sulphur Springs and Rogers, Benton County

Limestone

Arkansas Products Co.
Address: Harrison, Ark.
Location of quarry: Searcy County

Batesville White Lime Co.
Address: Batesville, Ark.
Location of quarry: Limedale, Independence County

Lilly White Lime Co.
Address: Rogers, Ark.
Location of quarry: Benton County

Lime Products Co., The
Address: Fayetteville, Ark.
Location of quarries: Boone, Carroll, Madison, Washington counties

Lawrence County Limestone Co.
Address: Black Rock, Ark.
Location of quarry: Lawrence County

Ozark White Lime Co.
Address: Fayetteville, Ark.
Location of quarry: Washington County

Figure 10

View of the limestone quarry of the Arkansas Products Company near St. Joe, Searcy County.

Manganese

The manganese mining districts in Arkansas have been increasingly active during the past year. The area north of Batesville, in Independence County, continued as the larger of the state's two manganese producing districts. However, the considerable increase in total tonnage produced in Arkansas in 1942 over the production for the previous year was due in part to the encouraging developments in the Ouachita manganese district, lying chiefly in Polk and Montgomery Counties. Several new mining enterprises in this latter area are just now reaching the production stage, and will make their contributions to the total production for 1943, rather to that of the past year.

Early in 1942 the American Zinc Company of Arkansas was designated as the official purchasing agent of the Metals Reserve Company in the Batesville area, and was instructed to establish two stockpiles for the purchase of low-grade oxide ore (wad). These stockpiles, located at Cushman and Pfeiffer in Independence County, received the entire "soft" ore output of the Batesville district until December 23, 1942, when "soft" ore buying was discontinued. The accompanying price schedule governed purchases at the above mentioned depots. After December 23, the Metals Reserve Company continued to purchase ore containing 35 per cent manganese or better.

METALS RESERVE COMPANY—INDEPENDENCE COUNTY STOCKPILES

Price Schedule

For ore containing:	Price per long dry ton
34% Manganese	$16.66
33% "	15.84
32% "	15.04
31% "	14.26
30% "	13.50
29% "	12.76
28% "	12.04
27% "	11.34
26% "	10.66
25% "	10.00
24% "	9.36
23% "	8.74
22% "	8.14
21% "	7.56
20% "	7.00

The shipping of high-grade oxide ore (hausmanite and other oxides) to out of state consumers continued throughout the year. Prices paid for this type of ore ranged upwards from $48.00 per long ton, depending on the percentage of manganese present.

Early in 1942 a temporary stockpile for ore from the Ouachita district was established at Gurdon, Clark County, by the Metals Reserve Company. This was later abandoned in favor of shipping direct to the St. Louis (Corondolet) stockpile of the Metals Reserve Company.

The Ouachita district ore is characterized by high-grade oxide material in a siliceous (novaculite) matrix. While some of this material can be shipped in lumps just as they come from the mine, much of the manganese oxide is so intimately associated with the novaculite that concentration by milling is necessary. The introduction of milling machinery and equipment by several concerns

is rapidly bringing the district into the ranks of the state's major mining industries.

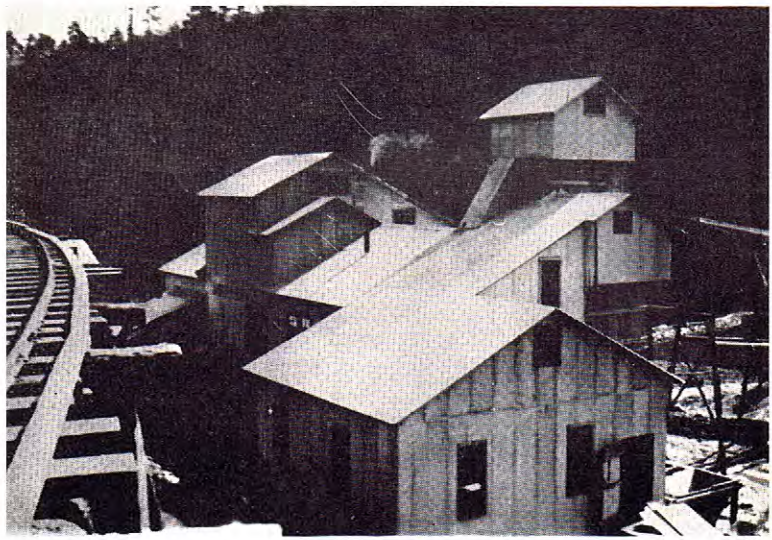


Figure 11

Mill of the North American Manganese Company northwest of Glenwood, Arkansas.

MANGANESE MINING COMPANIES IN ARKANSAS

1942

Arkansas Manganese Co.
Address: Cushman, Ark.
Location of mine: 2 miles east of Cushman, Independence County

Consolidated Mining Co.
Address: Cushman, Ark.
Location of mine: Independence County

Denison, Walter H., Manganese & Contracting Co., Inc.
Address: Cushman, Ark.
Location of mines: Independence County

Dixie Manganese Co.
Address: 727 Donaghey Bldg., Little Rock, Ark.
Location of mine: 15½ miles west of Norman, Montgomery County

Fitzgerald and Miller
Address: Batesville, Ark.
Location of mine: Independence County

Hartt, Grover
Address: Batesville, Ark.
Location of mine: Independence County

Hearell, W. B.
Address: Batesville, Ark.
Location of mine: Independence County

Helfer, J. J.
Address: Batesville, Ark.
Location of mine: Independence County

Hixson & Hixson Mining Co.
Address: Paris, Ark.
Location of mine: Polk County

Leiter, Sam
Address: Batesville, Ark.
Location of mine: Independence County

Little, C. S., Receiver
Address: Batesville, Ark.
Location of mine: Independence County

McGehee, Marshall
Address: Batesville, Ark.
Location of mine: Independence County

Manganese Development & Purchasing Corp.
Address: 32 North Euclid Ave., St. Louis, Mo.
Location of mine: Independence County

Mena Mining Corp.
Address: 721 Giddens-Lane Bldg., Shreveport, La.
Location of mine: 18 miles southeast of Mena, Polk County

North American Manganese Corp.
Address: Glenwood, Ark.
Location of mine: About 10 miles southwest of Glenwood, Pike County

Ouachita Minerals, Inc.
Address: Mena, Ark.
Location of mine: Polk County

Ozark Development Co.
Address: Batesville, Ark.
Location of mine: Independence County

Sims, C. C.
Address: Cushman, Ark.
Location of mine: Independence County

Schneider, J., and Associates
Address: Batesville, Ark.
Location of mines: Independence and Izard counties

Marble

Four marble companies reported production in 1942. Black marble beds of commercial thickness, occurring in the Fayetteville and Pitkin formations, were quarried in Independence and Searcy Counties. White, gray and pink marbles occur at several horizons, and were quarried during the past year in Baxter and Independence Counties.

Marble produced in Arkansas in 1942 was valued at an estimated total of 11,650 dollars. No production of stone for flooring cements (terrazo) was recorded during the year.

MARBLE QUARRYING COMPANIES IN ARKANSAS

1942

Arkansas Black Marble Co.
Address: Batesville, Ark.
Location of quarry: 2 miles south of Locust Grove, Independence County

Ozark Black Marble Co.
Address: Leslie, Ark.
Location of quarry: Searcy County

Scheid, P. H., Cut Stone Co.
Address: 1301 East Third St., Little Rock, Ark.
Location of quarry: 3 miles north of Batesville, Independence County

White River Marble Co.
Address: Cartney, Ark.
Location of quarry: Baxter County

Mercury

Production of strategically valuable mercury in Pike and Clark Counties continued to increase in 1942. In contrast to the plants of the district's early days, the new producers are benefiting from their predecessors' errors both in mining and milling technique. The district is now known to possess a most complicated geological structure, the proper interpretation of which is an important factor in economical mine management.

The known reserves of the district are believed to be great enough to maintain production on the present scale for at least another ten years. Continued discovery of additional deposits may prolong the life of the district far into the future.

After completion of a prospecting program begun in the summer of 1941, the Humphreys Gold Corporation became one of the state's leading mercury producers in 1942. A report on the operations of this company is given below. Future mining development in the mercury district will do well to follow the well-planned program of the Humphreys Corporation.

MERCURY PRODUCING COMPANIES IN ARKANSAS
1942

Arkansas Quicksilver Div. of Humphreys Gold Corp.
Address: First National Bank Bldg., Denver, Colo.
Location of mines: 5 miles southeast of Amity, Clark County

Arkansas Quicksilver Mines, Inc.
Address: Amity, Ark.
Location of mines: Pike County

Big Six Mining Co.
Address: Murfreesboro, Ark.
Location of mine: Pike County

Caddo Quicksilver Corp.
Address: Box 46, Little Rock, Ark.
Location of mine: Near Alpine, Clark County

Hintze, W. F.
Address: Murfreesboro, Ark.
Location of mine: 12 miles northwest of Murfreesboro, Pike County

National Quicksilver Corp.
Address: 615 Merchants Nat'l Bank Bldg., Fort Smith, Ark., or Murfreesboro, Ark.
Location of mine: Pike County

Pike Mining Co.
Address: Glenwood, Ark.
Location of mine: Pike County

Superior Mercury Mines
Address: Murfreesboro, Ark.
Location of mine: 15 miles northeast of Murfreesboro, Pike County

Union Mining Co.
Address: Murfreesboro, Ark.
Location of mine: Pike County

United States Mercury Co.
Address: Murfreesboro, Ark.
Location of mine: Pike County

Wann Mercury Mining Co.
Address: Mena, Ark.
Location of mine: 10 miles south of Murfreesboro, Pike County

Yantis-Vandruff Co.
Address: Glenwood, Ark.
Location of mine: Pike County

OPERATIONS OF HUMPHREYS GOLD CORPORATION CLARK COUNTY, ARKANSAS

By Jay P. Wood, Mining Engineer

Manager, Arkansas Quicksilver Division

Humphreys Gold Corporation

The Humphreys Gold Corporation of Denver, Colorado, became interested in the Arkansas quicksilver district in May, 1941. Preliminary field work by C. M. Hardman, and subsequent extensive investigations by P. W. Racey,[1] culminated in prospecting and mining agreements with the Southern Kraft Division of the International Paper Company. Approximately 50,000 acres in western Clark County, south of the towns of Alpine and Amity were involved. Active prospecting began in the summer of 1941.

The prospecting program consisted of widespread scouting for float ore, preliminary hand trenching and test pitting at favorable localities, followed by extensive stripping of the surface soil to expose mineralized formations. Mules and scrapers were used at first to supplement hand work but were soon displaced by a D-7 Bulldozer with which extensive exposures along and across the strike of the formations could be made rapidly. All exposures were carefully hand-cleaned and closely examined and their location, extent, and geological features were mapped in detail.

Detailed geologic mapping of all exposures was found to be an invaluable aid in guiding the surface exploratory work and in all subsequent underground development.

Five principal localities developed sufficiently favorable surface showings to warrant underground exploration. Other places show mineralization but exploration has been deferred for the time being.

The ore deposits occur in the Jackfork sandstone as fracture fillings, irregular masses of cinnabar crystals, and disseminated grains of cinnabar within the sandstone. Native quicksilver has been found in small amounts at a few places, but is rare. The deposits are closely related to fault fractures that cross the east-west striking sandstones at all angles, but principally as northwesterly trending tear faults. In general the formations dip steeply to the south and the tear faults dip to the northeast. The most favorable conditions for ore deposition appear to be where sandstone beds are shattered by folding and faulting close to a transverse tear fault, and where thin shale beds form impervious walls to the sandstone that probably aided in confining mineralizing solutions to the favorable bed. The result of this structural control is to produce

1 Mining Engineer and Geologist, Oakland, Calif., consultant for Humphreys Gold Corp.

ore shoots which are somewhat wedge shaped in horizontal section and which pitch or rake steeply to the east in depth. The depth of commercial mineralization is not known, the deepest workings so far being but 150 feet below the surface.

A southerly crosscut tunnel on the site of the most important discovery, found three ore shoots about 250 feet south of its portal, one of which has proven to be probably the largest so far found in the east end of the district. This ore body and a smaller one near it formed on the intersections of northwesterly trending tear faults with steep southerly dipping fractured sandstone beds, between confining shale strata. The larger of the two, No. 1 ore body, is about 110 feet long and from 10 feet to over 30 feet wide at the tunnel level 60 feet below the surface. It was mined upward to close to the surface where it terminated against flat dipping minor fissures and showed only an insignificant outcrop. Old surface workings on a footwall spur of the body failed to discover it. On the 150 foot level, 90 feet below the tunnel level, the ore body is 95 feet long by an average width of about 20 feet. It continues below the level and will be opened by deeper levels shortly.

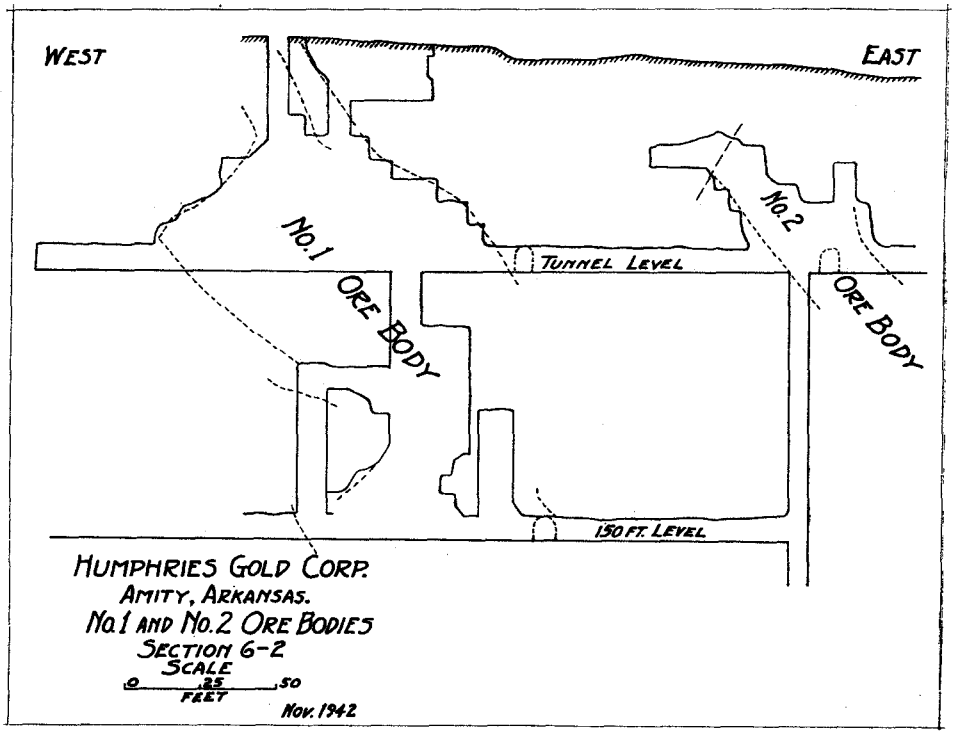


Figure 12

Cross section of underground workings of Section 6-2 Mine, Arkansas Quicksilver Division, Humphreys Gold Corporation.

The No. 1 ore body is being mined by standard square-set stoping methods. Values have varied from about 6 pounds per

ton to 10 pounds, with a general tenor of about 7½ pounds. The better values are frequently entirely disseminated and appear on casual inspection to be much lower in grade than the more showy parts of the ore body where crystal filled seams and blobs of cinnabar show quite prominently. Some sections of the stope were estimated to run well above 30 pounds. This ore body is shown in vertical section in Figure 12.

The company is developing a series of small ore shoots first worked by previous operators from open pits along the top of the ridge. Stopes have been carried to the surface workings on three of these ore shoots from a tunnel level 150 feet below the ridge top. These workings are being extended to the east seeking the extension of other ore shoots known on the surface.

The ore shoots in one area are from 2½ feet to 8 feet wide and from 15 feet to 30 feet long. They yield from 6 to 12 pound ore under shrinkage stoping methods, depending upon waste dilution. The shoots are connected by more or less continuous mineralization along certain beds and fractures. This zone occasionally is good enough to produce some ore, but in general stoping values are confined to the wedge-shaped zone associated with the tear faults.

Production from prospecting and early development work was furnaced intermittently, commencing December 18, 1941, on a custom basis at the plant of the Caddo Quicksilver Company. Construction of a new plant was begun early in 1942 and it was put in service on May 1.

Ore is hauled to the plant from the various operations by truck. Plant storage consists of a 130-ton crude ore bin and a crushed-ore bin of similar size. The ore is crushed to 1½ inches and fed by an oscillating plunger-type feeder to an oil fired rotary kiln 60 feet in length. (Outside diameter 5½ feet, inside diameter inside of firebrick lining 4 feet). The kiln revolves at slightly more than one revolution per minute. Electric power with unit drives is used throughout the plant.

The gases pass through a cyclone type dust collector to a standard type cast-iron condenser system. The condenser tubes are set vertically in two rows of 15 tubes to 18 feet high, connected with cast iron U's at top and bottom. They have an inside diameter of 12 inches. The cooled gases are drawn through the system by a variable speed exhaust fan at the end of the tubes and pass to a standard type red-wood tank and red-wood stack.

Water sprays are used on the outside of the first 6 condenser tubes in each row. The temperature of the gases at discharge end of the kiln above the dust chamber averages about 580°F; at the

exhaust fan 90° to 120°F; and in the red-wood tank at about 10°F cooler.

From 7½ to 8½ gallons of diesel fuel oil is burned in the kiln per ton of ore furnaced. The kiln capacity is not definitely established. It has handled 100 tons in 24 hours successfully, but the present ore supply runs from 70 to 90 tons per day.

The ore is clean sandstone with small amounts of shale, and it offers no particularly difficult extraction problem. Associated with the cinnabar are small amounts of pyrite, occasionally small amounts of stibnite, and variable amounts of dickite. The volatile constituents are very low; ignition-loss tests show under 5%. The consequent small volume of gases, compared to customary volumes in other mercury fields such as California, give the condensers a larger capacity in tons of ore treated than is usually the case.

Most of the mercury is recovered as a liquid. The amount of finely divided mercury mixed with soot is relatively small and is easily treated on the hoe-table. Loss of mercury in the calcined rock is apparently nil as careful sampling does not detect any measureable amount. Stack losses are thought to be negligible; periodic testing by the wet gunny-sack method yields negative results. The low temperatures at the fan and the stack, together with the low velocity of the stack gases are believed responsible for these favorable results. All drainage from under the condensers and from the red-wood tank flows to a large sump which is cleaned out every three months. The fine sludge caught in the sump amounts to about one ton per month, and assays around 200 pounds of mercury per ton. This is dried and fed back to the furnace. A small D-retort is to be installed for the retreatment of this sludge so as to avoid building it up in the circuit.

Novaculite

Novaculite, a hard, fine grained sedimentary rock which is well exposed in the Ouachita Mountains of western Arkansas, was quarried for the manufacture of whetstones and as railroad ballast in 1942. The novaculite used for whetstones is usually quarried in areas where the rock is massive, contains a minimum number of joint planes, and is free from iron and manganese oxide stain. The requirements for novaculite rail ballast are similar to those for other rock used for the same purpose, namely a location close to a railroad, and an unlimited available reserve.

Despite the fact that exporting of high grade novaculite to Europe has been temporarily halted by the war, production in 1942

exceeded that of the previous year. Products manufactured in 1942 from this type of novaculite were valued at 149,156 dollars. Only the rough stone is produced in Arkansas; final finishing is done in New England.

An estimated total of 121,800 tons of novaculite ballast was quarried in 1942, an increase of 34,400 tons over the previous year.

NOVACULITE MINING COMPANIES IN ARKANSAS

1942

Novaculite (Whetstones)

Norton Pike Co.
Address: Littleton, N. H., or 901 Central Ave., Hot Springs, Ark., c/o Archer J. Smith
Location of quarry: Garland County

Novaculite (Ballast)

Chicago, Rock Island & Pacific Ry. Co.
Address: Room 1106 LaSalle Station, Chicago, Ill.
Location of quarry: Butterfield, Hot Spring County

Quartz Crystals

The greatly increased demand for quartz crystals for use in the war program has brought considerable attention to the Arkansas occurrences during the past year. The crystals are known to occur in scattered deposits throughout the Ouachita Mountain region, but are perhaps best known in the area around Hot Springs, Garland County. The crystals occur both in clusters and as single masses of quartz. They are usually imbedded in a clay which fills cracks and crevices in the sandstones and novaculites of the Ouachita district.

In order to be acceptable for the manufacture of radio oscillators, quartz crystals must be water-clear, and free from all flaws, inclusions, veils, or other phenomena which may impair the electrical properties of the crystal. Portions of crystals can be utilized in cases where discoloration or other detrimental factors are limited to only part of the individual crystal. The larger the crystal, the greater the number of oscillator plates which can be cut from it, hence the greater the value.

Assuming that all specifications are met, the smallest crystal which can be utilized should weigh not less than six ounces. The prices given below were recently released by the War Production Board. The prices are approximate in each case, and the value of each individual crystal will depend on its own particular characteristics. However, the table may be used in range calculations of crystal values.

Figure 13

A cluster of quartz crystals from the Crystal Mountains, Arkansas. (Courtesy of the U. S. Geological Survey.)

CRYSTAL PRICES

Weight	60% Usable	45-60% Usable	30-45% Usable
7-11 ozs.	$ 1.50	$ .60	$ .20
11-18 ozs.	2.30	1.00	.30
1-1½ lbs.	5.50	1.60	.70
1½-2 lbs.	6.40	3.60	.90
2-3 lbs.	8.00	4.50	2.00
3-4 lbs.	11.10	5.70	2.70
4-7 lbs.	14.80	8.00	3.40
7-9 lbs.	19.10	10.00	4.30
9-11 lbs.	20.80	12.00	5.70
11-15 lbs.	23.90	13.60	6.80
15-22 lbs.	30.00	15.90	8.90

Sand

Two types of sand were produced in Arkansas during 1942. Sand for construction purposes, derived chiefly from river beds, sand bars, and terrace deposits, was produced in a number of localities throughout the state. Molding or foundry sand, glass sand, and pure silica sand for a variety of industrial purposes was produced by two companies in the northern part of Arkansas.

Figure 14

Working face in sand quarry operated by Silica Products Company, Guion, Izard County. The drilling scaffold appears at the left side of the opening.

The marked increase in construction of army air bases and training camps was largely responsible for the rise in construction sand

Figure 15

View of the exposure of the St. Peter sandstone near Guion, Izard County, showing mined out portions with intervening supporting pillars.

production. 1,242,222 cubic yards of construction sand were produced during the year, compared to a total of 436,007 cubic yards for 1941.

Production of foundry sand, glass sand, and special silica sand totaled 122,011* tons during 1942. Arkansas foundry and molding sand was supplied to many foundries throughout the southwest during the year, and played an important part in the rearmament program to which these foundries are now devoting much if not all of their capacities.

SAND PRODUCING COMPANIES IN ARKANSAS

1942

Construction Sand

Arkadelphia Sand and Gravel Co.
Address: Arkadelphia, Ark.
Location of plant: Edge of Arkadelphia, Clark County

Arkansas Gravel Co.
Address: 115 North Spring St., Little Rock, Ark.
Location of pit: Near Bassett, Mississippi County

Arkhola Sand and Gravel Co.
Address: Fort Smith, Ark.
Location of plant: Van Buren, Crawford County

Atkins, G. E.
Address: 600 South Main St., Camden, Ark.
Location: Ouachita River, Ouachita County

Bench, W. C.
Address: Paris, Ark.
Location: Arkansas River, Logan County

Big Rock Stone and Material Co.
Address: Foot Ashley St., Little Rock, Ark.
Location of plant: Little Rock, Pulaski County

Concrete Sand and Gravel Co.
Address: Reader, Ark.
Location of pits: Nevada and Ouachita counties

Crow Creek Gravel and Sand Co.
Address: Forrest City, Ark.
Location of plant: 1 mile west of Madison, St. Francis County

Estep, S. R.
Address: Van Buren, Ark.
Location: Arkansas River, Sebastian County

Gifford-Hill and Co., Inc.
Address: 412 Texas Bank Building, Dallas, Texas
Location of pits: Little River and Sevier counties

Green Brothers Gravel Co.
Address: Lexington, Miss.
Location of pit: 2 miles south of Malvern, Hot Spring County

Greenville Sand and Gravel Co.
Address: Memphis, Tenn.
Location: Mississippi River, Chicot County

Hecker & Sons
Address: Camden, Ark.
Location: Ouachita River, Ouachita County

Jeffrey, Roy N., Lumber Co.
Address: Batesville, Ark.
Location: Batesville, Independence County

Johnston, C. M. & Sons, Inc.
Address: Box 116, Helena, Ark.
Location: Mississippi River, Phillips County

Little River Sand and Gravel Development
Address: Wilton, Ark.
Location of plant: Wilton, Little River County

Lutesville Sand and Gravel Co.
Address: Black Rock, Ark.
Location of plant: Black Rock, Lawrence County

Mobley Construction Co.
Address: Morrilton, Ark.
Location of plants: (1) Newport, Jackson County; (2) North of Dardanelle, in Pope County

* Estimated.

Pine Bluff Sand and Gravel Co.
Address: Pine Bluff, Ark.
Location of plant: Pine Bluff, Jefferson County

Porter, E. C.
Address: Clarksvillé, Ark.
Location: Arkansas River, Johnson County

Red River Gravel Co.
Address: Box 306, DeQueen, Ark.
Location of pit: 4 miles north of DeQueen, Sevier County

Sanders, J. W.
Address: Camden, Ark.
Location of plant: 3 miles north of Camden on Ouachita River, Ouachita County

Utah Construction Co. & Morrison Knudsen Co., Inc.
Address: Mountain Home, Ark.
Location: White River, Baxter County

Webb, C. E.
Address: McGehee, Ark.
Location: Mississippi River, Chicot County

Wilson, Lee and Co.
Address: Wilson, Ark.
Location of pit: Mississippi County

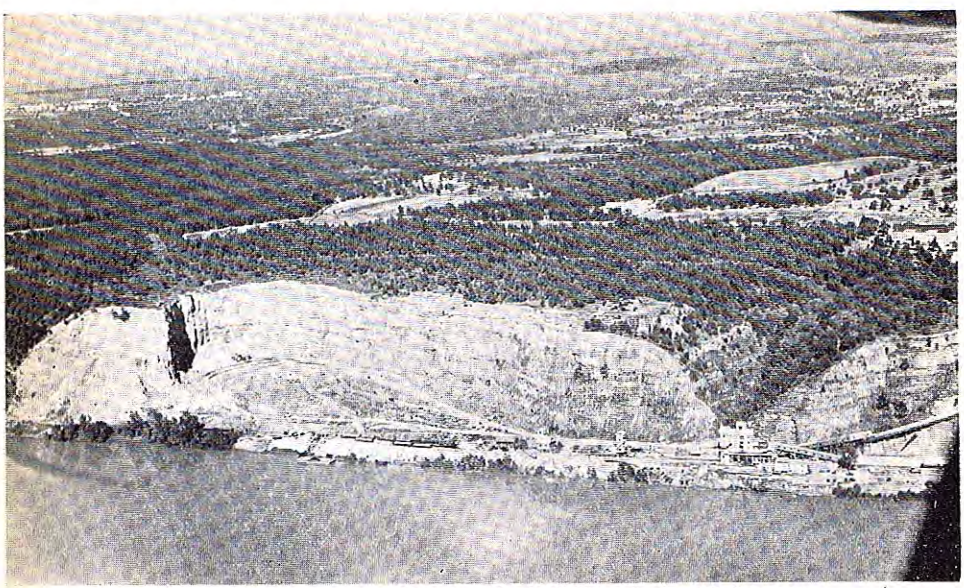
Molding Sand

Hardy Sand Co.
Address: 507 S. E. Second St., Evansville, Ind.
Location of plant: Piggott, Clay County

Silica Products Co.
Address: Guion, Ark.
Location of plants: Everton, Boone County; and Guion, Izard County

Sandstone and Quartzite

Large quantities of sandstone, ranging in character from friable, poorly cemented material to dense quartzite rock, were quarried in Arkansas in 1942. Production for the year is estimated at 1,060,922 tons, an increase of approximately 328,350 tons over the total production of 1941.



—Courtesy, Big Rock Stone & Material Company

Figure 16
Aerial view of the sandstone quarry of the Big Rock Stone and Material Company on the Arkansas River, Pulaski County.

Construction of war plants and military establishments greatly increased the demand for crushed sandstone for concrete during the year. Other uses for the stone were in road building and as rail ballast.

Small quantities of sandstone in slab form were locally quarried as a building stone, chiefly for residences and small structures.

SANDSTONE QUARRYING COMPANIES IN ARKANSAS

1942

Big Rock Stone and Material Co.
Address: Foot Ashley St., Little Rock, Ark.
Location of quarry: Big Rock, Pulaski County

Everist, L. G., Inc.
Address: Sioux Falls, S. D.
Location of quarry: Sebastian County

Little Rock Stone Products Co.
Address: Box 863, Little Rock, Ark.
Location of quarry: Heber Springs, Cleburne County

Slate

The manufacture of roofing granules from vari-colored slates has been carried on for the past decade in the southern Ouachita Mountains. The slate is quarried in rough blocks and trucked to crushing plants. The granules, ranging from 10 to 30 mesh in size, are produced in three colors, black, green, and red.

Due to the pronounced folding and faulting to which the district has been subjected, large masses of slate which are free from cross joints and fractures are rare in the average slate quarry. The type of slate available lends itself admirably to the requirements of the slate granule trade, and the total tonnage of available slate is very great.

Over 1,600 tons of slate granules, valued in excess of $14,000, was produced in Polk and Montgomery Counties in 1942.

SLATE QUARRYING COMPANIES IN ARKANSAS

1942

Arkansas Slate Mfg. Co., Inc.
Address: Glenwood, Ark.
Location of quarry: 18 miles west of Caddo Gap, Montgomery County

Lehrack, Otto J., Products
Address: Box 233, Joplin, Mo.
Location of quarry: Polk County

Spring Water

Seven operating concerns marketed approximately two million gallons of spring water derived from springs in Carroll, Garland, and Pulaski Counties during 1942. Production during the past year decreased slightly from the 2,020,168 gallon total for 1941.

SPRING WATER COMPANIES IN ARKANSAS

1942

Eureka Springs Water Co.
Address: Eureka Springs, Ark.
Location of spring: Carroll County

Happy Hollow Springs Co.
Address: Hot Springs, Ark.
Location of springs: Garland County

Lithox Mineral Water Co.
Address: 179 Cedar St., Hot Springs, Ark.
Location of spring: Garland County

McFadden 3 Sisters Springs
Address: Hot Springs, Ark.
Location of springs: Garland County

Mountain Valley Springs Co.
Address: 2930-32 Olive St., St. Louis, Mo., or 360 Central Ave., Hot Springs, Ark.
Location of springs, Garland County

Radio Magnesia Springs Co.
Address: 206 Central Avenue, Hot Springs, Ark.
Location of springs: Garland County

Raleigh Springs Water Co.
Address: 2301 Pulaski St., Little Rock, Ark.
Location of springs: Pulaski County

Syenite

Irregular blocks of syenite from the quarry on the Arch Street Pike south of Little Rock were shipped during the past year. This material was used for rip-rap in levee and break water construction. The only operator in 1942 is listed below.

Tobin Quarries, Inc.
Kansas City, Missouri.

Titanium

Deposits of titanium oxide (rutile and brookite) have been mined at Magnet Cove since 1934. In April, 1942, the holdings of the Titanium Corporation at Magnet Cove were acquired by the Titanium Alloy Company of Arkansas. A new plant to treat the titanium ore was constructed during the summer of 1942, and is now in operation. Maximum plant capacity will be reached by January 1, 1943.

In addition to the activities of the Titanium Alloy Company, prospecting for rutile and brookite deposits has been carried on by the Southwest Minerals Corporation and by Wynn O. Christy and Associates. Large bodies of titanium ore have been blocked out, and actual mining activity is expected to begin in 1943.

Arkansas titanium oxide concentrates have been used in the manufacture of special alloys, welding rod fluxes, and titanium cyanide smoke screen.

TITANIUM PRODUCING COMPANIES IN ARKANSAS

1942

Titanium Alloy Co. of Arkansas
Address: Box 356, Malvern, Ark.
Location of mine: Magnet Cove, Hot Spring County

Figure 17

Temporary headframe and portable compressor used in prospecting operations by Wynn O. Christy and Associates, Magnet Cove, Hot Spring County.

—Courtesy, Titanium Alloy Company

Figure 18

A view of the washing and preliminary crushing plant of the Titanium Alloy Company's mill at Magnet Cove, Hot Spring County.

Tripoli

Tripoli, a finely divided form of silica, was mined near Rogers, in Benton County during 1942. This material is used as an abrasive or as a polishing agent, and as a component of portland cement to produce greater strength and washability.

Arkansas production of tripoli during the past year is estimated at 770 tons, a considerable decrease from the production of the previous year. Curtailment of operations because of war conditions is partially responsible for the drop in production.

TRIPOLI PRODUCING COMPANIES IN ARKANSAS

1942

Corona Products, Inc.
Address: Rogers, Ark.
Location of plant: Rogers, Benton County

Zinc

A general increase in activity in the zinc mining district of northern Arkansas was in evidence during the past year, although production records show that only a small tonnage of zinc concentrates were produced.

It soon will be realized by operators in the district that the Arkansas ores have a complex mineralogy which does not yield satisfactorily to a simple crush-jig milling process, regardless of the success of such a technique in other zinc districts. Zinc sulphide (sphalerite) is frequently associated in Arkansas with variable amounts of zinc carbonate (smithsonite), and fine grinding plus a selective milling technique is required to separate the two minerals. Zinc silicate (calamine) is a common mineral in some parts of the district, and it is equally important to separate this mineral from the other zinc minerals if commercial concentrates are to be produced. Small quantities of lead in the zinc ore further complicate the milling problem.

The technique now followed in many of the mills results in a mixed "zinc" concentrate, which is severely penalized by smelters due to the variety of impurities present. The amount paid for the concentrates is thus frequently too low to meet mining and milling costs. In addition, large quantities of valuable ore are lost in mill tailings, since the coarse grinding now generally practiced leaves part of the ore adhering to particles of wall rock and gangue.

Unless a modern milling technique is adopted in the near future, the present opportunity for obtaining a foot hold among the nation's zinc producing districts will be allowed to slip by, and the close

of the present war will once more see the district inactive and abandoned.

Mining activity has been recorded for Boone, Marion, Newton and Searcy Counties in the Western portion of the zinc district, and for Sharp and Lawrence Counties in the eastern part of the district.

ZINC MINING COMPANIES IN ARKANSAS*

1942

Dillard, Ira
Address: Mull, Ark.
Location of mine: Cantrell mine, Searcy County

Fescott Mining & Milling Co.
Address: Kansas City, Mo.
Location of mine: Silver Run mine, Marion County

Gentry and Dean
Address: Rush, Ark.
Location of mine: Yellow Rose mine, Marion County

Hurricane Mining Co.
Address: Harrison, Ark.
Location of mine: Excelsior mine, Searcy County

Kanarka Mining Corp.
Address: Yellville, Ark.
Location of mine: McIntosh mine, Marion County

Leader Hollow Mining Co.
Address: c/o Chas. D. Turner, 1019 Republic National Bank Bldg., Dallas, Texas
Location of mine: Leader Hollow mine, Marion County

Lyons, J. K.
Address: Rush, Ark.
Location of mine: Morning Star mine, Marion County

Marican Mining Co.
Address: Wichita, Kans.
Location of mine: Edith mine, Marion County

Moark Mining Corp.
Address: Box 402, Harrison, Ark.
Location of mines: Alma, Gloria, Jack Pot and Minnie Lee mines, Boone County

Palmer and Sherill
Address: Maumee, Ark.
Location of mine: Myers mine, Searcy County

Tripp, Henry
Address: Buffalo, Ark.
Location of mine: Turkey Mt'n mine, Marion County

* The mining companies here listed are only those whose production is on record with the Arkansas Geological Survey. Other firms have been active during the year, but have not yet reached the production stage.

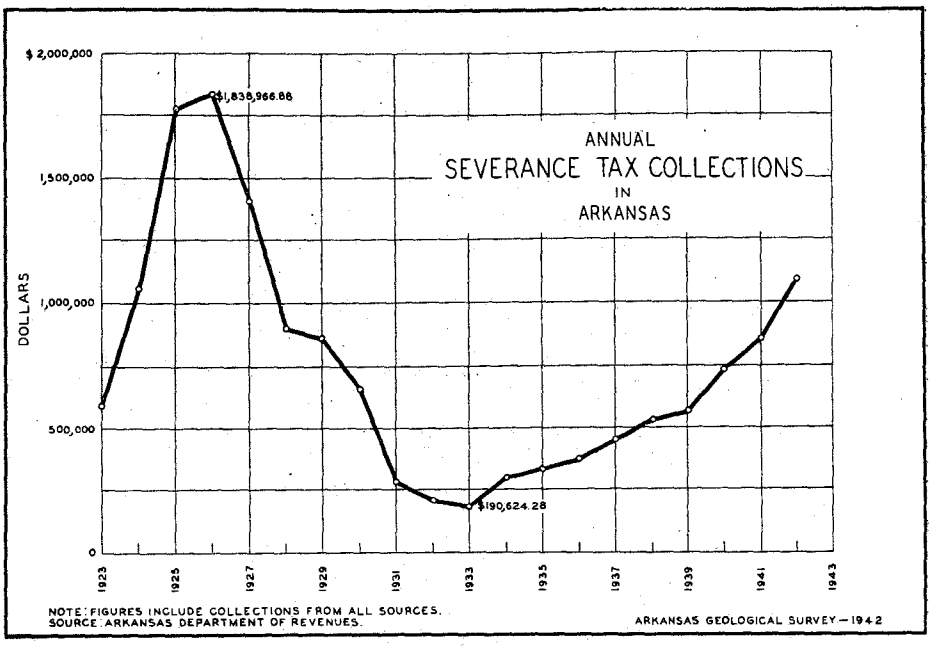


Figure 19

ANNUAL REPORT OF THE MINING PRODUCTION SECTION

ARKANSAS GEOLOGICAL SURVEY

EDGAR R. RICHARDSON, In Charge

The functions of the mining production section of the Arkansas Geological Survey consist of making audits for additional production and tax, determining taxable values, and locating new accounts. In addition to the regular field work, this office maintains a complete file of all producers of natural resources. The severance tax returns are made available to this office by the Revenue Department. Their reports make it possible to compile figures showing the number of units and value of minerals produced by operating companies. The amount of severance tax collected is an accurate index to the production of minerals and timber within the state. Severance tax totals tend to reflect the general economic conditions of the state. The war building program has stimulated the production of Arkansas' various natural products, and this stimulation is reflected in the severance tax collections.

The following schedule shows the detail of all severance tax assessments made and taxes collected by the Severance Tax Section of the Arkansas Geological Survey, applicable to the various taxable resources. The report shows a total assessment for the year of $27,942.97, from which collections in the amount of $14,264.03 have been made, leaving an uncollected balance of $13,678.94.

SUMMARY OF SUPPLEMENTARY SEVERANCE TAX ASSESSMENTS AND COLLECTIONS MADE BY MINING PRODUCTION SECTION, ARKANSAS GEOLOGICAL SURVEY

From December 1, 1941, to November 30, 1942

Resource	Tax Assessed	Tax Collected	Uncollected Balance
Oil and Gas	3,564.57	3,564.57	
Timber	5,715.63	3,953.26	1,762.37
Quicksilver	322.47	322.47	
Limestone	201.80	201.80	
Miscellaneous Stone	1,790.72	947.06	843.66
*Sand and Gravel Royalty	1,621.07	1,355.21	265.86
Sand and Gravel Severance	13,208.83	2,408.02	10,800.81
Slate	21.97	15.73	6.24
Manganese	590.00	590.00	
Bauxite	905.91	905.91	
Total	27,942.97	14,264.03	13,678.94

The greater part of the uncollected balance is for severance tax accruing on gravel taken by railroad companies for use as ballast. The right to collect the tax has been questioned by the operating companies on the contention that their operation is not commercial, since the gravel is being severed from lands owned by the company and used to improve railroad tracks without change in the title of the product. The state contends that such operations are commercial and subject to the severance tax laws of Arkansas. Audits have been made, taxes assessed, and the case is now in the hands of the attorney for the Department of Revenues.

The validity of Act 116 of 1933, an Act purporting to amend Act 118 of 1923 by exempting hewn cross-ties from severance tax, has been questioned. It is the opinion of this office, as well as the opinion of the Department of Revenues, that the Act is invalid because of failure of the title of the Act. It has been recommended to the Commissioner of Revenues that the question either be settled by a court test or correction be made by legislative act. Several thousand dollars of back tax depend on the settlement of this question. It is difficult to administer the severance tax laws pertaining to sawn ties, since hewn and sawn ties become intermixed in handling.

The increased demand for sand and gravel, due to construction of a large number of war plants, called our attention to the necessity of a study of the severance taxable value applicable to sand and gravel. It was found that companies severing sand and gravel were making severance tax returns and using a taxable value based on the royalty cost. The royalty on such products range from one and one-half cents to seven and one-half cents per cubic yard. The average customary royalty is five cents per cubic yard.

* Applies to sand and gravel from the beds of state owned navigable streams.

Section 4 of Act 283 of 1929 provides:

> "The value of such products shall be computed as of the time when and at the place where the same have been severed or taken from the soil or water, and in their unmanufactured state immediately after such severance." Sec. 13374, Pope's Digest.

Based on this section of the law, it was determined that a value of ten cents per cubic yard should be established as uniform taxable value for sand and gravel. This value was established by the Commissioner of Revenues effective November 1, 1942. Prior to an adjustment of sand and gravel severance, the state was losing approximately fifty percent of severance tax due the state from this source.

In December of 1941 cost audits were made of the bauxite companies operating in the state. Prior to that time the taxable value of bauxite had been set at $2.25 per long ton. Cost audits of a four-year period revealed that an increased taxable value of fifty cents per ton was justifiable. Effective December 1, 1941, the severance taxable value was raised from $2.25 per long ton to $2.75. From December 1, 1941, to November 30, 1942, 2,524,842.43 tons were produced. The increased value of fifty cents per ton resulted in an increased taxable value of $1,262,421.21, or an increased total tax at 2.6% of $32,822.95.

The advice and suggestions given by Richard J. Anderson, Acting State Geologist, and the cooperation of Joe Hardin, former Commissioner of Revenues, Murray McLeod, present Commissioner of Revenues, and Dye Waldrip, Supervisor of the Severance Tax Division of the State Revenue Department, have greatly assisted the proper functioning of the Mining Production Section of the Arkansas Geological Survey.

PETROLEUM AND NATURAL GAS

From the standpoint of value in dollars, production of petroleum, natural gasoline and natural gas together comprise the greatest single item in Arkansas' annual revenue from subterranean resources. The chief member of this important group is petroleum, followed, in order of descending value, by natural gasoline, natural gas, and butane.

Petroleum

Production of crude oil in Arkansas in 1942 totaled 26,659,278* barrels. Thirty-five fields located in six southern counties recorded production during the year (Columbia, Lafayette, Miller, Nevada, Ouachita, and Union).

Three new fields were discovered during the year. On January 1, 1942, the Barnsdall Oil Company brought in their Bond No. 1, the discovery well of the Midway field, in Section 11, township 15 South, range 24 West, Lafayette County. On August 25, the Carter Oil Company brought in their Orr No. 1, the discovery well of the Texarkana field, in Section 3, township 16 South, range 28 West, Miller County. On May 12, the Marine Oil Company completed their Frost No. 1, the discovery well of the New London field, in Section 13, township 18 South, range 12 West, Union County.

RESERVES OF OIL AND DISTILLATE POOLS IN ARKANSAS

JANUARY 1, 1943

Flush Oil Fields

Field	Reserves Oil-Million Bbls.	Reserves Gas Billion Cubic Feet
Atlanta	5	9
Buckner	8	1
Magnolia	157	197
Midway	50	34
Mt. Holly	5	9
New London	2	1
Schuler-Jones	32	45
Schuler-Reynolds	3	5
Schuler-Cotton Valley	4	4
Schuler-East	2	2
Village	3	9
TOTAL	271	316

* Statistics for January through October from severance tax reports filed with the State Department of Revenues, November and December production estimated by Arkansas Geological Survey.

Flush Distillate Fields

Big Creek	3	66
Dorcheat-Lime	18	140
Dorcheat-Cotton Valley	3	40
Macedonia-Lime	12	181
Macedonia-Cotton Valley	4	50
McKamie	36	423
Texarkana	5	100
TOTAL	81	1000

The petroleum producers in 1942 are listed in Appendix A on page 157.

As the year drew to a close, wildcat prospecting was well under way, with several prospects located by geophysical exploration being drilled. The Cotton Valley and Smackover formations of Jurassic age appear to be the most favorable horizons for future exploration. The discovery of new fields in these formations and the completion of wells in the Cotton Valley formation in the Dorcheat, Macedonia, and McKamie fields points to the new importance of potential Jurassic production.

A detailed discussion of the stratigraphy and structure of the lower Cretaceous and Jurassic formations of southern Arkansas appears in Information Circular 12 of the Arkansas Geological Survey (See page 157).

Natural Gasoline

Natural gasoline is recovered from what is commonly called "wet" natural gas, which contains the gasoline in vapor form. The natural gasoline is a by-product of natural gas wells and annual production fluctuates with the total gas produced during the same period. 31,029,300* gallons of natural gasoline were produced in 1942, an increase of 6,161,930 gallons over 1941 production. Natural gasoline was produced in nine plants, located in Columbia, Miller, Ouachita, and Union Counties.

* Statistics for January through October furnished by the natural gasoline extraction plants, November and December production estimated by Arkansas Geological Survey.

NATURAL GASOLINE PLANTS OPERATING IN ARKANSAS
1942

Arkla Oil Co.
Address: Dallas, Tex.
Location of plant: Capps City, Miller County

Lion Oil Refining Co.
Schuler Unit Gasoline Plant**
Address: Exchange Bldg., El Dorado, Ark.
Location of plant: Schuler field, Union County

Magnolia Petroleum Co.
Address: Box 900, Dallas, Tex.
Location of plant: Kenova, Union County

Shell Oil Co., Inc.**
Address: Shell Bldg., Houston, Tex.
Location of plant: Magnolia, Columbia County.

** Produce Natural Gasoline and Butane Gas.

Sklar, Sam
Address: P. O. Box 189, El Dorado, Ark.
Location of plants: Louann, Ouachita County; Armstrong, Helwig, Pratt, and Rainbow, Union County

Natural Gas

Arkansas production of natural gas is contributed by two producing areas, the southern and the northwestern districts. The southern district is the largest of the two, and was responsible for a production of 36,903,191,000** cubic feet in 1942. The northwestern district produced 5,449,199,000** cubic feet during the year. The natural gas producers in 1942 are listed in Appendix A on page 157.

Greatest single development in the natural gas industry during the past year is the great forward stride taken by the "sour" gas areas. This development is fully discussed in the accompanying article by Alec M. Crowell, Director of the Arkansas Oil and Gas Commission.

A complete report on the northwestern natural gas producing area is now being prepared by the Commission, and will be ready early in 1943.

NATURAL GAS PRODUCTION IN ARKANSAS
1942

Month	Southern Arkansas M cu. ft.	Northwestern Arkansas M cu. ft.
January	2,990,985*	812,849*
February	3,383,335	760,256
March	3,287,462	541,497
April	3,224,346	531,623
May	3,246,921	329,770
June	3,185,764	234,745
July	2,554,775	200,247
August	2,757,563	272,753
September	2,913,965	322,582
October	3,108,075	392,877
November	3,000,000*	450,000*
December	3,250,000*	600,000*
TOTAL	36,903,191	5,449,199

* Estimated by Arkansas Geological Survey.

** Statistics for February through October furnished by the Arkansas Oil and Gas Commission, January, November and December production estimated by Arkansas Geological Survey.

PRINCIPAL STRIPPER OIL FIELDS OF ARKANSAS

Field	County	Date of Discovery	Estimated Production 1942	Estimated Production Cumulative	Number of Wells	Est. Remaining Reserves of Oil January 1, 1943
Champagnolle	Union	1927	276,150	15,187,111	74	723,850
El Dorado	Union	1920	420,821	58,263,627	243	3,579,179
Fouke	Miller	1940	318,992	520,963	7	1,181,008
Garland City	Miller	1932	84,091	2,124,877	9	165,909
Irma-Troy	Nevada	1921	599,242	9,596,470	116	1,400,758
Lewisville	Lafayette	1939	68,112	542,484	17	431,888
Lisbon	Union	1925	64,251	6,826,997	143	185,749
Nick Springs	Union	1940	142,772	630,566	13	857,228
Rodessa	Miller	1937	241,511	6,638,911	62	3,301,043
Schuler-Morgan	Union	1937	398,957	2,512,893	14	3,758,489
Smackover	Union, Ouachita	1922	4,942,226	393,964,668	1,605	35,057,774
Stephens	Columbia, Nevada, Ouachita	1922	213,002	6,912,642	195	1,237,998
Urbana	Union	1930	797,452	7,019,775	66	2,202,548
TOTAL			8,567,579	510,741,984	2,564	54,083,421

Data Compiled by Petroleum Engineering Department of Arkansas Oil & Gas Commission, El Dorado, Arkansas.

Reserves

The total oil and distillate reserves of Arkansas, on January 1, 1943, have been estimated at 406 million barrels. The total natural gas reserves are estimated at 1,316 billion cubic feet.

Crude Oil Pipeline

Although no Arkansas crude oil will be thus transported, the construction of the 24 inch pipeline across the state attracted considerable interest during the past year. Laying of the pipeline is now virtually complete, and construction of the six pumping stations located within the boundaries of the state is well under way. The first oil will be pumped through the line early in 1943.

Figure 20

Figure 21

Trench ready to receive the pipe which lies in 40 foot sections, ready for the welding operations.

Figure 22

Tractor derrick moving pipe into place preparatory to welding into single line.

Figure 23

Welding operations in progress.

Figure 24

Wrapping pipe after coating with corrosion resistant covering. Pipe can now be lowered into trench and covered.

UTILIZATION OF SOUR NATURAL GAS RESERVES

By ALEC M. CROWELL, Director

Arkansas Oil and Gas Commission

(Reprinted by permission Arkansas Oil and Gas Commission from the Oil Weekly, Vol. 107, No. 3, Sept. 21, 1942.)

Since October, 1937, there have been 16 oil and gas pools discovered in Southern Arkansas that have attracted considerable attention because of their size and type of production. All 16 of these pools produce from a depth exceeding 6,500 feet below the surface and while there were shallower discoveries during this time they are of minor importance from the standpoint of gas production.

Eleven of the 16 pools have, as of September 1, 1942, a proven reserve in excess of one trillion cubic feet of gas associated with some 280 million barrels of crude oil, condensate or distillate. Approximately half of the average daily production for Arkansas comes from this group of 11 pools and amounts to approximately 41,000 barrels of crude petroleum oil, condensate or distillate, together with in excess of 78 million cubic feet of natural gas each day.

Entrained with this daily gas production is an estimated total of 70 tons of elemental sulphur and associated with the trillion cubic foot reserve of natural gas it is estimated there is a reserve of 1,733,962 tons of unproduced recoverable elemental sulphur.

Attention was first attracted to the group of pools mentioned for the reason that the gas produced contained what was thought to be an impossible quantity of deleterious material. These deleterious substances are nitrogen, carbon dioxide and hydrogen sulphide. The concentration of hydrogen sulphide was so great, rendering the gas so poisonous, that two human lives were lost in the very early stages of production.

Another characteristic was that in their natural state in the reservoir these gases contained as a component of their make-up varying quantities of vaporous gasoline motor fuel which is recovered as water-white liquids when processed. Some of the gas, in its natural state, contains in each 1,000 cubic feet a recoverable content of more than 5 gallons of water-white liquid, of which 4 gallons are a possible motor fuel. Further, as production proceeded in these pools it became evident that all the limestone group, which includes all but one pool, were of the water-drive type and reservoir pressure could be maintained effectively by proper production control. For this reason the necessity for costly recycling operations in order to recover the high liquid content of the gases was precluded.

Cheap Fuel Source

Cheap fuel has never been readily accessible in large volume in Arkansas although an amazing variety of minerals have been ready for exploitation, only awaiting fuel and power. In the Ozark Mountain region are found in commercial quantity certain metallic ores of manganese, zinc and lead; and the non-metallic minerals including tripoli, phosphate, sandstone, marble, limestone, and dolomite.

The Ouachita Mountain area possesses novaculite, sandstone and certain commercial metallic ores of manganese, copper, silver, lead, zinc and iron. In the ridge and valley area south of the Ouachita Mountains, quicksilver and antimony ores occur. The characteristic minerals found in the igneous areas of Arkansas are bauxite, rutile and diamonds.

The federal government during the latter part of 1940 became interested in the growing reserves of natural gas in Southern Arkansas for two reasons, the first being the possibility of exploiting the production of bauxite, the ore of aluminum, of which Arkansas accounts for 97 percent of that ore in the United States, and the second, the strategic location of the state from a military standpoint in a time of war. This interest of the federal government, coupled with the untiring efforts of oil companies and the people of Arkansas, has resulted not only in the conversion of a waste product into a useful product, but has made this same waste material the key that is unlocking a large industrial empire. As this is written already approximately $500,000,000 has been invested in 13 war industries that will make use of what was originally called sour gas.

Due to the fact that processed natural gas is now available to industry in the Ouachita Valley area at from 2 to 5 cents per thousand cubic feet and that these gas reserves are adequately protected by a sound and effective conservation policy, even more industries will seek to establish themselves within the vicinity of the area. This for the reason that in equivalent gas at 2 cents per thousand cubic feet equals 1 ton of average coal at 52 cents, or at 5 cents per thousand cubic feet, a price of $1.30. This comparison is based on coal costing $8.00 per ton with a Btu value of 26 million. A saving of $7.48 to $6.70 per ton of coal in equivalent, has not been overlooked by industry.

Aside from the world's largest alumina and aluminum plant now in operation, manganese, zinc, lead and mercury mines are utilizing this cheap fuel. Other industries are also interested in the ethane, propane and butane which will be available for plastic resins in increasing quantities as more and more gas is processed. The Ouachita River, which furnishes cheap year-around water transpor-

tation within a stone's throw of the reserves of natural gas, is crowded with barges from the headwaters of navigation near Camden to the Mississippi. Along this Ouachita River an electric power plant is being constructed which will use the reformed sour natural gas as fuel under the boilers. It is estimated that this electric power will be generated at a cost of 3½ to 4 mills per kilowatt hour, based on a 30,000-kilowatt-capacity plant operated at 65 percent load factor. Electric power at this price compares very favorably with government subsidized power.

Occurrence and Location of Reserves

The more recent gas reserves developed to date in the southern part of the state are confined to a local area, apparently spread throughout three counties, Lafayette, Columbia and Union, bordering on Louisiana and Texas. The gas production of these Southern Arkansas counties is derived from formations of Jurassic age which are the basal Coastal Plain formations. The Gulf Coastal Plain overlaps the eroded surfaces of the formations of the Ozark Mountains and Arkansas Valley on the east and of the Ouachita Mountains on the south. The formations making up the Gulf Coastal Plain in Arkansas are an extension of the Gulf Coastal Plain of Texas from the west and of Louisiana from the south.

TABLE 1

RESERVE, PRODUCTION AND SULPHUR DATA

Eleven of the 16 sour-gas fields of Arkansas are shown here to contain over 280 million barrels of crude oil or condensate associated with over one trillion (one thousand billions) cubic feet of gas. Computation made showing a possible 70 tons daily of elemental sulphur entrained in gas production. Southern Acid & Sulphur Company estimates 90 percent of sulphur recoverable.

NAME	Reserves		Average Daily Production		Hydrogen Sulphide 100 Cu. Ft. (Grains)	Possible Sulphur Daily (Gr. Tons)	Total Sulphur in Gas Reserves (Gr. Tons)
	Million Bbls. Oil	Billion Cu. Ft. Gas	Oil Bbls.	Gas M.C.F.			
Atlanta	5	9	2,844	3,830	1,800	4.39	10,331
Big Creek	3	66	114	3,126	335	0.67	14,100
Buckner	8	1	1,916	606	167	0.64	106
Dorcheat	18	140	1,145	9,694	2,400	14.84	214,284
Magnolia	157	197	17,142	16,119	1,400	14.39	175,386
Macedonia	12	181	555	6,174	1,900	7.48	219,318
McKamie	36	423	1,193	9,313	4,050	24.05	1,092,524
Mt. Holly	5	9	369	2,283	374	0.54	2,147
Schuler-Jones	32	45	11,971	21,310	30	0.41	861
Schuler-Reynolds	3	5	2,164	1,865	865	1.03	2,758
Village	3	9	1,198	4,067	374	.97	2,147

The Gulf Coastal Plain is, for the most part, covered by beds of Quaternary age which form a thin surface mantle. These are underlaid by formations of Tertiary, Upper and Lower Cretaceous

and Jurassic age. Some gas has been produced in Arkansas in past years from the Upper and Lower Cretaceous formations but this production is not now important. The Jurassic beds underlie an area somewhat greater than the three counties covered in this report and hold limited probabilities of oil and gas discovery in the extended area.

Of the 36 producing pools in the oil area of Arkansas, 18 derive their production from the producing section identified geologically as the Smackover Lime.

Sour Gas

The character of the oil and gas produced from this section in general is commonly designated as "sour" oil and gas, owing to the presence of hydrogen sulphide gas which occurs in varying amounts and concentration throughout the producing reservoirs.

Sour gases of this character are very common, having been produced in many localities in the Mid-Continent area and represent more than 10 percent of the present known total gas resources of the United States. They are largely confined to the Texas Panhandle, West Texas and Southeastern New Mexico areas. The hydrogen sulphide content (0.5 to 7.5 percent by volume) of the gases of Arkansas renders them very poisonous. As such they are required to undergo a purification treatment before being consumed for domestic and most industrial uses.

Within the three producing counties under discussion, the gas reserves in the reservoir are in some cases directly associated with oil and in other cases occur as gas alone. In addition to the presence of hydrogen sulphide in the gas, there is also found in variable quantities, carbon dioxide and nitrogen.

The presence of hydrogen sulphide and carbon dioxide in these gases does not void their utilization for all purposes in which ordinary sweet gas is commonly used, due to the industry's proven ability to purify these gases to commercial degree and specifications. On elimination of the hydrogen sulphide and carbon dioxide contents, the resultant gas retains a heat value of the order of 950 to 1,000 Btu per cubic foot.

Uses to Date

In some states "sour gases" may be legally used for the manufacture of carbon black, but Arkansas has seen fit to forbid such processing and has limited its utilization to the same channels of industry as those of sweet gas. In so doing, the large reserves of this type of gas of Southern Arkansas is receiving the same protection for the benefit of the owners and of industry as the sweet gas.

As this is written, only one desulphurization plant is in operation, having processed its first hydrogen-sulphide-bearing gas September 1, 1941. The unit was constructed by Lion Oil Refining Company of El Dorado, Arkansas. The sweet gas is being utilized industrially in the vicinity of El Dorado.

The plant is in the Magnolia field, Columbia County. It processes residue gas from Shell Oil Company's gasoline plant in that field and also raw gas from the Village field, six miles east of the Magnolia field. The gas entering the desulphurization unit is laden with approximately 1,400 grains of hydrogen sulphide per 100 cubic feet, and is stripped to a content of less than one grain per 100 cubic feet. The capacity of the plant is 18 million cubic feet of gas treated daily under a pressure of 160 pounds per square inch. The cost of treatment exclusive of depreciation, is appreciably less than 1 cent per 1,000 cubic feet.

Two other plants of much greater capacity have been announced and are nearing completion, which should bring the total amount of gas treated to 110 million cubic feet daily within the near future.

The larger of these two plants is one nearing completion between the Dorcheat and Macedonia pools. This unit has been designed to incorporate both purification and recovery of natural gasoline, butane and iso-butane. The unit will service both the Dorcheat and Macedonia pools and will be operated by Arkansas-Louisiana Gas Company. This gas-treating facility expects to process under 600 pound per square inch pressure gas containing about 1,940 grains of hydrogen sulphide per 100 cubic feet.

The remaining plant is being built by McKamie Gas Cleaning Company of Magnolia, Arkansas, and will service only the McKamie pool. All plants utilize the "Girbotol" process of purification and while both will supply war industry through newly constructed pipe lines, the latter unit will be directly connected into a large electric generating plant now under construction.

Arkansas Power & Light Company is constructing an electric power plant that will utilize between 9 and 10 million cubic feet of reformed gas daily, all from the McKamie pool. This semi-outdoor type plant, which is expected to produce a kilowatt hour on about 13,000 Btu, will operate on an 85 percent load factor. Trial operation is expected by May 15, 1943.

Due to the fact that the discovery of large reserves of sour gas in Southern Arkansas has been of recent occurrence, it still remains necessary for most industries in Southern and Central Arkansas to import such quantities of gas as may be necessary to meet their current requirements. The gas imported into the state is transported from North Louisiana, where it is secured at the prevailing

prices in that gathering area plus a tax of ½-cent per thousand cubic feet imposed by Louisiana on all gas exported from the state. The price paid for this gas at the wells in Louisiana varies from field to field and no specific figure is available on this point. It may be stated, however, that little or no gas is sold for less than 3 cents per thousand cubic feet. These importations of gas are made by Arkansas-Louisiana Gas Company and Louisiana-Nevada Transit Company. A new thirty-six mile ten-inch gas line has been constructed by the Arkansas-Louisiana Gas Company from the Lisbon field to the plant of the Ozark Ordnance Works near El Dorado. This line will transport gas produced by the Big West Drilling Company from their acreage in the Lisbon area.

Currently a very large quantity of sour gas is serving the petroleum industry locally within the entire oil area of Arkansas. It is being used principally for fuel and as an aid in promoting, through secondary recovery operations, a higher ultimate recovery of oil from producing reservoirs in the area. The consumption, both present and contemplated, at 13 war industries is a military secret.

The Susearch Corporation (Texas-Gulf Sulphur Company) and Southern Acid & Sulphur Company, placed in operation during 1941 pilot plants to determine the feasibility of transforming to commercial sulphur the hydrogen sulphide removed at the plants. These experiments have been successful, evidently, since the latter company has a small plant in operation in the Magnolia field and has the processing contract for the McKamie field gas.

There exists within a radius of some 150 miles of the locality a daily demand of approximately 300 tons of "salt cake," which is used in the manufacture of wood pulp in the paper industry. When hydrogen sulphide is used as the source of sulphur in the manufacture of salt cake, it becomes necessary to eliminate carbon dioxide from the hydrogen sulphide.

The presence of carbon dioxide as a component of hydrogen sulphide gas does not in any way disqualify its use in the manufacture of sulphuric acid, should such a venture seem justifiable. In the process of manufacturing acid the carbon dioxide gas remains as an inert factor, and, therefore, offers no problem. The possibilities of disposing of sulphuric acid in Southern Arkansas territory, due in large to the war effort, seem impressive. The former threat of strong competition from the nearby areas in Louisiana and Texas, which produce more than 80 percent of the world's sulphur, under present conditions is non-existent.

Development Policy

One example of the practical effect of the development of a deep gas pool in conformity with sound conservation policy is very

apparent in the case of the McKamie gas pool in Lafayette county. Here the wells, properly classified as gas wells, are completed at a depth of below 9,000 feet at a cost of approximately $90,000. The gas production from these wells is accompanied by condensed water-white hydrocarbon liquids which, in place in the reservoir, occur as gaseous vapors and are uniformly dispersed as a component of the reservoir gas. The indicated ultimate recovery of such condensate as is separated on arising at the surface with the gas is estimated to average 10,000 barrels per acre. This unusually high recovery expected is due to the great thickness of the pay and the rich content of the gas. After hearing evidence of the operators and after having made a study of the field on their own part, a well-spacing rule of 1 well to each 160 acres was adopted by the Oil and Gas Commission, approved in time by the Office of the Petroleum Coordinator for War, and the pool is now being developed on that basis. Accordingly, wells so spaced and properly operated should ultimately recover approximately 1,600,000 barrels of condensate in addition to the residual gas. At a value of $1.00 per barrel, this indicates an ultimate value of $1,600,000 recoverable from each well from the condensate alone not to speak of the ultimate value of the residual gas. It is at once obvious that the favorable ratio of the ultimate value of the total products recovered to the cost of completing the well is reflected in the following:

(a) An expressed desire on the part of operators so affected, to explore to the limit, the possibilities of discoveries of new pools.

(b) The assurance of obtaining the greatest ultimate recovery through elimination of unnecessary drilling, resulting in economies, a portion of which in turn, permits the properties to be maintained on a higher than usual standard of operations.

(c) The ability of the operators to market the residue gas at rates which will enable them to economically penetrate the lowest competitive residue gas rates offered on gas from out-of-state sources.

In its administration of the conservation statutes as applied to practical oil and gas conservation, the Oil and Gas Commission has set up among its foremost objectives, the attainment of advanced development and operating practices. While these practices were prescribed primarily to avoid physical waste, they have resulted in the development, especially in the case of the gas-condensate pools, along lines which have a very important bearing not only on the availability, but also upon the ultimate price at which gas is offered to industry. A portion of these savings to the operators has readily enabled them to overcome the difficulties with which they were faced in the necessity of additional processing of the sour gas before it could be available for the domestic market. In addi-

tion, operators owning gas reserves in pools of this type are able to compete without handicap against those more fortunate operators whose gas does not require such treatment for domestic and industrial disposal.

As can be seen from a study of Table 1, the gas reserves of the three counties of southern Arkansas are not found in any conventional type dry gas field. They are located in one of three type pools, gas-condensate, gas-cap oil pool or normal oil pool. One of each type is discussed.

Gas-Condensate Type

The McKamie gas field is located in eastern Lafayette County. The discovery well, The Atlantic Refining Company's Bodcaw 1, was completed in the Smackover lime in June, 1940, at 9,221 feet. The porous gas-saturated section of the lime proved to be slightly more than 100 feet in thickness. On testing the well after completion it was observed to produce only a water-white condensate with the gas, and subsequent tests and operations soon disclosed that the reservoir was unusual in a number of respects.

While producing under routine operations and separating the gases from the condensed liquids under a pressure of approximately 300 pounds per square inch, the ratio of gas to liquid measured was 8,000 cubic feet per barrel, a very low ratio for a well whose only liquid products are water-white in color and showing no crude oil. A determination by lowering of pressure recording instruments to the bottom of the well indicates a reservoir pressure of 4,365 pounds per square inch and a temperature of 239° F., under which conditions it has been determined that all of the products as produced from the well occur entirely as gaseous products in the reservoir.

Those portions of the reservoir gases which on being transported to the surface condense into liquids when subjected to the lowering of temperature and the point of segregation in the separator, are commonly called "distillates" or "condensates." Gases of this type have been well known to the industry during the past 10 years. These condensates (generally water-white in color) are typical components of deep, high-pressure-reservoir gases but vary greatly as between fields in the ratio of liquid to gas when separated at the surface. In this respect it is interesting that the condensate content of the gas from the McKamie pool was the second richest yet discovered by the petroleum industry. Its content is approximately 125 barrels of condensate per million cubic feet of separator residue gas. It is true that the physical conditions (temperature and pressure) existing at the point of separation will and do have some bearing on the amount of liquid condensed from gases of this

character, the content reported here being that recovered at a separator pressure of 275 pounds per square inch and a temperature of 75° F. When reservoir gases contain such large quantities of condensable vapors, it is apparent that the liquids recovered become the primary product of production and the residue gas becomes the by-product of production. This is unusual.

In the case of practically all shallower gas pools, such as those less than 4,000 feet in depth, for example, and even in the case of many of the deeper pools, the products of condensation are secondary in value to the gas which is separated from them. It follows then that the development and production policy which may be expected to be carried on in the McKamie pool will be governed, not by the income to be expected from the sale of gas, but rather from the income to be derived from the recovery of the liquefiable components of the reservoir gas.

Although it would seem to appear fortunate to discover a large reserve of rich condensate gas such as occurs here, it is not without its unfavorable elements, the chief of which is the presence of some 7.5 percent by volume of hydrogen sulphide gas. This is a very poisonous and corrosive gas, whose presence somewhat complicates what otherwise would be the simple and routine manner in which the producing operations could be carried on. In addition to the presence of hydrogen sulphide gas, there is also some 4.3 percent by volume of carbon dioxide gas, which is also an undesirable adulterant to be considered in the routine of operations. Undesirable as these two adulterants are, their extraction and separation from the gas can be economically effected, which will render the residue gas remaining after the extraction of liquids, equally suitable for all domestic and industrial purposes for which "sweet" gas is now used. The latter operation is feasible largely by reason of the high content of extractable liquids from the gas. This, together with the 160-acre well spacing in the field, overcomes the unfavorable aspects of the sour gas.

Referring to Table 2, there is shown a summary of pertinent reservoir gas data of the principal pools discussed in this article. While no oil is as yet evident in either the McKamie or Big Creek pools, there is in each case the possibility that oil may yet be discovered at lower levels on the flanks of both structures when development is carried to those points. In the case of the McKamie pool, one of the more recent well completions, which produces from the lowest level yet developed in this pool, shows indications of the presence of oil in very small quantities. This is evidenced by a somewhat darker color than any of the condensate liquids from the other wells producing from higher structural levels. The appearance of color is not sufficiently conclusive to forecast definite

TABLE 2

FACTUAL DATA ON SOUR GAS POOLS

Of the 16 sour-gas producing pools of Southern Arkansas basic data is given on 11 in this tabulation. Another tabulation, Table 1, sets out the reserves of oil, condensate and gas as all of these pools, with one exception, have water drives and are making effective use of the fact through optimum production policy. The exception is the Schuler-Jones pool, a sand reservoir of the gas-drive type. This pool is completely unitized and is being repressured with gas. Pool was developed on 20-acre unit basis and 146 wells drilled, now average wells open to production is 40 with 5 input wells. Original gas-oil ratio maximum was 3,500 cubic feet to barrel of oil. After all recoverable oil is produced from Schuler- Jones pool there will be stored 200 billion cubic feet of sweet gas.

POOL	Atlanta	Big Creek	Buckner	Dorcheat	Magnolia	Macedonia	McKamie	Mt. Holly	Schuler Jones	Schuler Reynolds	Village
COUNTY	Columbia	Columbia	Columbia	Columbia	Columbia	Columbia	Lafayette	Union	Union	Union	Columbia
Year of Discovery	1938	1939	1937	1939	1938	1941	1940	1941	1937	1937	1938
Producing Formation	Lime	Lime	Lime	Lime	Lime	Lime	Lime	Lime	Sand	Lime	Lime
Water Level	8,000′	7,730′	7,010′	8,660′	7,300′	8,660′	?	6,943′	7,280′	7,420′	7,123′
Effective Section	30′	33′	30′	40′	125′	75′	100′	20′	38′	20′	20′
Porosity—Percent	15	13	20	13	19	14	17	20	18	20	20
Permeability—Millidarcys	1,276	250	50	155	1,500	230	500	1,500	355	1,500	2,000
Producing Wells	22	1	28	22	115	15	16	5	Unit	15	12
Well Spacing—Acres	40	160	40	80	40	80	160	40	Unit	40	40
Original Pressure (B.H.P.)	3,821	3,723	3,195	4,243	3,465	4,130	4,365	3,180	3,520	3,550	3,350
Current Pressure (B.H.P.)	3,480	3,723	2,561	3,300	3,050	3,800	4,300	3,100	1,500	3,300	3,200
Gas-Oil Ratio, C.F./Bbl.	1,604	24,000	250	10,000	900	13,000	8,000	7,500	126	867	3,000
B.t.u. Value Gas	1,100	790	1,000	1,081	1,082	1,074	1,006	1,114	1,000	987	900
Natural Gasoline—G.P.M.	1.0	.5	3.0	.5	1.3	.5	.7	.7	.7	1.5	.5
Carbon Dioxide—Percent Volume	4.9	3.0	5.1	2.0	6.2	2.5	4.3	x	x	x	x
Nitrogen—Percent Volume	2.9	36.6	1.1	5.7	1.3	6.1	12.0	x	x	x	x
Gravity of Gas	.78	.78	1.06	.72	.95	.74	.82	.77	.76	.80	.88
Gravity Oil or Condensate	45	69	32	56	38	60	58	43	34	38	41

occurrence of oil along the lowest productive contour of the McKamie pool. Reservoir bottom water or edge water has been encountered in the course of development in this pool and pressure behavior indicates an active, effective water drive.

Gas-Cap Type

The Dorcheat pool, located in southwestern Columbia County, was discovered on August 28, 1939, through the exploratory operations of The Atlantic Refining Company on the Pine Woods Lumber Company lease. Production is obtained from 8,850 feet from the Smackover lime, the same as that from which production is obtained at 15 of the 16 pools discussed. There are 22 producing wells in the pool, proving a productive area of 900 acres, but the limits of the pool eastward are not yet indicated. This pool is unlike McKamie in that it produces oil from each of the 22 wells completed and oil covers the entire area of the pool. The oil-saturated section is in turn underlain throughout its area by bottom water. Lying above the oil, and occupying the upper portion of the producing lime, is a "gas cap" containing condensable vapors of a character relatively similar to those in the McKamie and Big Creek pools. In the practice of completing the producing wells, it is customary to set the casing through both the gas- and oil-saturated zones to a point close to the water table, and cement. Following this procedure the casing is perforated in the oil-saturated section, with care taken to limit the perforations to a height sufficiently above the water table and sufficiently below the base of the gas cap so that production of oil may be secured with a minimum amount of accompanying gas or water.

Due to the fact that the section lying between the base of the gas cap and the water table, which porous section is occupied and saturated with oil, is limited to probably not over 25 feet in thickness, it of necessity becomes very difficult to extract the oil without at the same time also producing variable and considerable quantities of gas. This has led to a prevalence of high gas-oil ratios in a great many cases with the result that the liquid products recovered in the separator are not the normally expected 43- or 44-gravity oil which is desired to produce. Instead a blended oil is produced which carries a considerable quantity of light liquids derived from condensates from the excess gas which accompanies the oil and whose effect is reflected in the form of exceptionally high-gravity oil. As produced at present, gravity of the oil from the Dorcheat wells varies from 48 to as high as 58 degrees A.P.I. The gas-oil ratios of these wells average 10,500 cubic feet per barrel of oil, the minimum observed being 2,200 cubic feet per barrel and the maximum over 14,000 cubic feet per barrel.

The foregoing results in an unstable situation with regard to producing operations and has called for modification of the rules regulating production from this pool. Spacing of wells in the area originally was fixed at 1 well to the center of each 40 surface acres. This for the reason that upon early behavior it was believed that the field was a normal oil pool. Subsequent behavior proving to the contrary it was ordered by the Oil and Gas Commission, approved by the Office of the Petroleum Coordinator for War, that all wells drilled after April 1, 1942, be located on 80-acre units. It was specified that the wells be centered in the north or south half of governmental quarter sections of land.

The Dorcheat pool was found to be, by The Atlantic Refining Company's Pine Woods B-1 well plugged back on Februarv 3, 1942, to 7,860 feet below the surface, productive of sweet gas and condensate in the Cotton Valley series. The field has been recognized as one of multiple-zone production and is being developed on a dual well basis.

Normal Oil Pool

The Magnolia pool, discovered February 23, 1938, by Kerr-Lynn Oil Company's Barnett A-1, in central Columbia County, is primarily an oil pool. The producing horizon is encountered at an average depth of 7,500 feet. Development of the pool has been practically completed and indicates an area of approximately 4,500 acres, all oil producing. The formation from which production is obtained is the Smackover lime and the character of the oil and gas is somewhat similar to that at Dorcheat, the gas containing 1,500 grains of hydrogen sulphide per 100 cubic feet and 6.2 percent by volume of carbon dioxide.

Unlike the Dorcheat pool, the oil production from Magnolia is accompanied by an average of only 899 cubic feet of gas per barrel of oil. In the case of the Magnolia pool practically all of the gas is contained in solution in the oil and is distributed more or less uniformly with the oil throughout the reservoir. Owing to the extremely large reserves of oil in this pool, the volume of gas reserves is proportionately large, being indicated at approximately 200 billion cubic feet, which will be available as a gas supply only in the ratio in which the oil is recovered from the pool. Even so, it must be recognized as a well protected reserve, and, therefore, equally available to industry in the future in the same sense as though it were an outright gas pool.

Currently a part of the daily gas production of Magnolia is being prepared for disposition in the service of secondary recovery of oil from the Jones Sand of the Schuler pool. While practically all of its daily gas production is reserved for these operations and

industrial use in the vicinity of El Dorado, it will have available in the future large quantities of gas of first quality, suitable for both domestic and industrial consumption. In meeting its present commitment the gas, after having passed through a gasoline plant, is desulphurized and transmitted through high-pressure lines 15 miles to the Schuler pool where a part is injected into the Jones sand at 7,500 feet and used as an agent in increasing the ultimate recovery of oil from this sand. Here it will remain in the reservoir in reserve as a future supply of fuel gas, after having first performed its services as an aid in the recovery of the remaining oil reserves of the Jones sand. These operations in the ultimate will not by any means require all, or even a great part of the present gas reserve of the Magnolia pool, and it may be considered as reasonable to expect that the Magnolia pool itself will offer in the future the major portion of its gas reserves, along with the other neighboring gas pools, to such industrial or domestic demands as may be made upon it.

Future Supply

The total daily volume of gas available to industry from the present sour-gas sources and produced during the course of normal operations in these fields on completion of development will approximate 150,000,000 cubic feet. This volume will be ready and available to industry by January 1, 1943.

Exploratory work which is now being carried on throughout the area may be expected to continue and to result in many discoveries of both oil and gas. Even though the areal extent of the individual discoveries may be small, any gas pools discovered probably will contain large reserves per acre, due to the fact that gas being a compressible medium, greater quantities of it can exist in relatively small confines of space under high pressure such as exists in these deep pools.

OIL PRODUCTION BY FIELDS

The following section contains the production by months for each of the producing oil fields in Arkansas. Production statistics have been supplied by the Arkansas Oil and Gas Commission for the first ten months of 1942. The production for November and December has been estimated by the Arkansas Geological Survey.

The fields are arranged in two groups, and the fields are listed alphabetically in each group. The first group, known as the "Controlled" fields, total twenty-three in number. Separate and distinct producing horizons in the same area are considered as separate fields by the Oil and Gas Commission. The second group of twelve fields make up the "Settled" fields.

CONTROLLED FIELDS

ATLANTA FIELD

(LIME POOL)

Location: T. 18S., R. 19W., Columbia County.

Geology: Anticlinal Fold 7,950′ Subsea; "Oolitic" Limestone.

Discovered: Tide Water Assoc. Oil Co., J. T. Beene Estate No. 1, December 19, 1938.

Data as of December 31, 1942.

Producing Acreage: 880.

Wells Producing: 22.

Production by Months	Barrels
January	90,677
February	83,717
March	93,592
April	87,354
May	80,637
June	79,405
July	88,183
August	92,283
September	86,855
October	86,802
November (Est.)	82,200
December (Est.)	87,110
Total for 1942	1,038,815

BIG CREEK FIELD

(REYNOLDS LIME)

Location: T. 17S., R. 21W. Columbia County.
Geology: Anticlinal Fold, 7,700′ Subsea; Reynolds Lime.
Discovered: Louark Producing Co., Petty Stave No. 1, December 23, 1939.
Data as of December 31, 1942.
Producing Acreage: 160.
Wells Producing 1.

Production by Months	Barrels
January	4,695
February	4,355
March	5,679
April	4,090
May	3,606
June	3,686
July	3,539
August	3,037
September	3,406
October	3,781
November (Est.)	3,660
December (Est.)	3,875
Total for 1942	47,409

BUCKNER FIELD

(LIME POOL)

Location: T. 16S., R. 22 & 23W. Columbia and Lafayette Counties.
Geology: Anticlinal Fold, 6,900′ Subsea; "Oolitic" Limestone.
Discovered: Standard Oil Co., J. P. McKean No. 1, November 31, 1937.
Data as of December 31, 1942.
Producing Acreage: 1,130.
Wells Producing: 28.

Production by Months	Barrels
January	69,669
February	64,044
March	71,149
April	66,241
May	68,707
June	64,515
July	59,373
August	56,651
September	54,240
October	65,068
November (Est.)	62,600
December (Est.)	65,135
Total for 1942	767,392

DORCHEAT FIELD

(BIG LIME)

Location: T. 18S., R. 22W. Columbia County.
Geology: Anticlinal Fold, 8,650′ Subsea; "Oolitic" Limestone.
Discovered: Atlantic Refg. Co., Pinewood A-1 August 28, 1939.
Data as of December 31, 1942.
Producing Acreage: 1,000.
Wells Producing: 25.

Production by Months	Barrels
January	63,894
February	55,952
March	41,554
April	54,721
May	61,866
June	66,749
July	35,499
August	37,356
September	36,102
October	38,511
November (Est.)	43,000
December (Est.)	38,440
Total for 1942	573,644

DORCHEAT-COTTON VALLEY

Location: T. 18S., R. 22W. Columbia County.
Geology: Anticlinal Fold, Subsea 7,640-68′; Cotton Valley.
Discovered: Atlantic Refining Co., Pinewood B-1, February 3, 1942; Plugged Back.
Data as of December 31, 1942.
Producing Acreage: 760.
Wells Producing: 12.

Production by Months	Barrels
January	
February	3,051
March	4,219
April	1,498
May	Shut In
June	0
July	0
August	4,735
September	5,057
October	4,633
November (Est.)	3,139
December (Est.)	21,700
Total for 1942	48,032

FOUKE FIELD

Location: T. 17S., R. 27W. Miller County.
Geology: Fault, Subsea 3,200-3,300′; Glen Rose (Paluxy).
Discovered: Standard Oil Co., of La., W. P. Sturgis No. 1, June 6, 1940.
Data as of December 31, 1942.
Producing Acreage: 200.
Wells Producing: 10.

Production by Months	Barrels
January	20,434
February	18,346
March	20,525
April	20,522
May	24,698
June	26,520
July	31,871
August	33,831
September	32,310
October	35,296
November (Est.)	28,292
December (Est.)	29,235
Total for 1942	321,880

MACEDONIA FIELD

(REYNOLDS LIME)

Location: T. 18S., R. 21W. Columbia County.
Geology: Anticlinal Fold 8,650′ Subsea; Reynolds Lime.
Discovered: McAlester Fuel Co., Lizzie Franks 1, July 8, 1941.
Data as of December 31, 1942.
Producing Acreage: 1,440.
Wells Producing: 18.

Production by Months	Barrels
January	35,046
February	35,681
March	26,971
April	36,435
May	35,965
June	38,198
July	17,155
August	24,950
September	27,357
October	32,805
November (Est.)	36,769
December (Est.)	27,900
Totals for 1942	375,232

MACEDONIA-COTTON VALLEY

Location: T. 18S., R. 21W. Columbia County.
Geology: Anticlinal Fold, Subsea 7,794'; Cotton Valley.
Discovered: Atlantic Refining Co., Brewer & Warmock Unit No. 1, August 3, 1942.
Data as of December 31, 1942.
Producing Acreage: 720.
Wells Producing: 9.

Production by Months	Barrels
January	
February	
March	
April	
May	
June	
July	
August	
September	2,459
October	2,367
November (Est.)	
December (Est.)	200
Totals for 1942	5,026

MAGNOLIA FIELD

(BIG LIME)

Location: T. 17S., R. 19 & 20W. Columbia County.
Geology: Anticlinal Fold 7,100' Subsea; "Oolitic Limestone."
Discovered: Kerr-Lynn Oil Co., Barnett No. 1, March 5, 1938.
Data as of December 31, 1942.
Producing Acreage: 4,494.
Wells Producing: 115.

Production by Months	Barrels
January	582,672
February	524,802
March	581,125
April	526,495
May	525,806
June	502,441
July	531,419
August	522,494
September	512,214
October	511,945
November (Est.)	521,910
December (Est.)	539,307
Total for 1942	6,382,630

McKAMIE FIELD

(REYNOLDS LIME)

Location: T. 17S., R. 23W. Lafayette County.
Geology: Anticlinal Fold 9,000′ Subsea; Reynolds Lime.
Discovered: Atlantic Refining Co., Bodcaw No. 1, June 8, 1940.
Data as of December 31, 1942.
Producing Acreage: 2,720.
Wells Producing: 17.

Production by Months	Barrels
January	81,973
February	80,736
March	64,737
April	85,357
May	82,894
June	79,419
July	36,995
August	39,272
September	57,892
October	40,719
November (Est.)	33,844
December (Est.)	41,850
Total for 1942	731,988

McKAMIE-COTTON VALLEY

Location: T. 17S., R. 23W. Lafayette County.
Geology: Anticlinal Fold, Subsea 6,968′, Cotton Valley; Plugged Back.
Discovered: Carter Oil Co., R. R. Cornelius Unit No. 1, February 11, 1942.
Data as of December 31, 1942.
Producing Acreage: 160.
Wells Producing: 1.

Production by Months	Barrels
January	0
February	2,568
March	724
April	0
May	2,189
June	1,927
July	1,901
August	1,558
September	1,413
October	1,325
November (Est.)	1,009
December (Est.)	1,325
Total for 1942	15,939

MIDWAY FIELD

(REYNOLDS LIME)

Location: T. 15S., R. 23 & 24W. Lafayette County.
Geology: Elongated Anticlinal Fold, Subsea 6,050'; Reynolds Lime.
Discovered: Barnsdall Oil Co., Bond 1, January 1, 1942.
Data as of December 31, 1942.
Producing Acreage: 1,252.
Wells Producing: 31.

Production by Months	Barrels
January	12,400
February	12,636
March	60,175
April	38,708
May	87,549
June	100,767
July	131,055
August	143,001
September	153,271
October	148,726
November (Est.)	160,173
December (Est.)	169,725
Total for 1942	1,218,186

MT. HOLLY FIELD

(REYNOLDS LIME)

Location: T. 17S., R. 18W. Union County.
Geology: Anticlinal Fold 6,910' Subsea; Reynolds Lime.
Discovered: Atlantic Refining Co., Davis 1, November 4, 1941.
Data as of December 31, 1942.
Producing Acreage: 200.
Wells Producing: 5.

Production by Months	Barrels
January	6,956
February	10,444
March	13,061
April	14,324
May	10,398
June	11,564
July	11,436
August	11,326
September	10,981
October	11,385
November (Est.)	11,250
December (Est.)	11,780
Total for 1942	134,905

NEW LONDON FIELD

Location: T. 18S., R. 12W. Union County.
Geology: Anticline, Subsea 5,700'; Cotton Valley sand.
Discovered: Marine Oil Co., Frost No. 1, April 12, 1942.
Data as of December 31, 1942.
Producing Acreage: 200.
Wells Producing: 5.

Production by Months	Barrels
January	
February	
March	
April	
May	2,628
June	3,247
July	6,422
August	6,704
September	6,518
October	9,324
November (Est.)	15,105
December (Est.)	15,609
Total for 1942	65,557

NICK SPRINGS

Location: T. 17S., R. 14W. Union County.
Geology: Faulted Anticline, Subsea 3,500'; Travis Peak.
Discovered: Delta Drilling Co., Grace No. 1, February 6, 1940.
Data as of December 31, 1942.
Producing Acreage: 140.
Wells Producing: 13.

Production by Months	Barrels
January	14,982
February	12,451
March	12,718
April	10,979
May	10,363
June	11,259
July	11,179
August	11,249
September	9,360
October	9,012
November (Est.)	8,158
December (Est.)	8,432
Total for 1942	130,142

PATTON FIELD

Location: T. 17S., R. 24W. Lafayette County.

Geology: Anticlinal Fold, Subsea 9,100′; "Oolitic Limestone."

Discovered: Tide Water Assoc. Oil Co., H. Moore, No. 1, September 5, 1941.

Data as of December 31, 1942.

Producing Acreage: 40.

Wells Producing: 1.

Production by Months	Barrels
January	
February	
March	
April	
May	
June	
July	
August	747
September	3,171
October	4,373
November (Est.)	1,500
December (Est.)	1,550
Totals for 1942	11,341

SCHULER-COTTON VALLEY

Location: T. 18S., R. 17W. Union County.

Geology: Anticlinal Fold, Subsea 5,400′, Morgan Sand, Cotton Valley.

Discovered: Marine Oil Co., Justiss No. 6, 1941.

Data as of December 31, 1942.

Producing Acreage: 140.

Wells Producing: 7.

Production by Months	Barrels
January	
February	9,901
March	21,527
April	18,112
May	15,319
June	16,693
July	18,142
August	20,232
September	20,793
October	20,140
November (Est.)	20,424
December (Est.)	21,700
Total for 1942	202,983

SCHULER-EAST FIELD

Location: T. 18S., R. 17W. Union County.
Geology: Syncline, Subsea 5,500′, Cotton Valley.
Discovered: Crescent Drilling Co., W. A. Burns No. 1, May 20, 1941.
Data as of December 31, 1942.
Producing Acreage: 240.
Wells Producing: 6.

Production by Months	Barrels
January	14,818
February	13,705
March	17,072
April	17,591
May	14,179
June	17,649
July	16,911
August	16,969
September	17,295
October	15,874
November (Est.)	17,970
December (Est.)	18,569
Total for 1942	198,602

SCHULER FIELD

(JONES POOL)

Location: T. 18S., R. 17 & 18W. Union County.
Geology: Anticlinal Fold 7,300′ Subsea; "Tight Sandstone."
Discovered: E. M. Jones, Marine No. 1, Sept. 17, 1937.
Data as of December 31, 1942.
Producing Acreage: 2,944 Closed to
Wells Producing: 146. Production*

Production by Months	Barrels
January	407,944
February	376,725
March	412,623
April	359,046
May	369,419
June	359,549
July	372,481
August	370,002
September	361,065
October	369,533
November (Est.)	360,000
December (Est.)	372,000
Total for 1942	4,490,387

*Now being operated under unit agreement, 46 wells to each unit (one operator with 6 wells refused to enter the agreement).

SCHULER FIELD

(LIME POOL)

Location: T. 18S., R. 17 & 18W. Union County.
Geology: Anticlinal Fold, 7,350′ Subsea; "Oolitic Limestone."
Discovered: Lion Oil Refg. Co., Edna Morgan A-1, October 22, 1937.
Data as of December 31, 1942.
Producing Acreage: 606.
Wells Producing: 15.

Production by Months	Barrels
January	69,365
February	59,419
March	67,979
April	67,135
May	68,306
June	65,493
July	67,090
August	66,263
September	64,031
October	65,406
November (Est.)	67,620
December (Est.)	69,874
Total for 1942	797,981

TEXARKANA FIELD

Location: T. 16S., R. 28W. Miller County.
Geology: "Oolitic Lime," Subsea 7,000′.
Discovered: The Carter Oil Co., Lena E. Orr, No. 1, August 25, 1942.
Data as of December 31, 1942.
Producing Acreage: 0*.
Wells Producing: 1.

Production by Months	Barrels
January	
February	
March	
April	
May	
June	
July	
August	
September	2,397
October	3,086
November (Est.)	3,000
December (Est.)	3,100
Total for 1942	11,583

*No acreage assigned.

URBANA-CRAIN FIELD

Location: T. 18S., R. 13W. Union County.
Geology: Anticline, Subsea 2,845′; Travis Peak.
Discovered: Marine Oil Co., Thompson No. A-13, July 31, 1940.
Data as of December 31, 1942.
Producing Acreage: 190.
Wells Producing: 19.

Production by Months	Barrels
January	45,164
February	36,180
March	43,084
April	37,494
May	39,826
June	39,605
July	36,042
August	38,702
September	37,477
October	38,373
November (Est.)	33,508
December (Est.)	35,627
Total for 1942	461,082

VILLAGE FIELD

(LIME POOL)

Location: T. 17S., R. 19W. Columbia County.
Geology: Anticlinal Fold, 7,050′ Subsea; "Oolitic Limestone."
Discovered: Standard Oil Co., W. P. Phillips No. 1, May 26, 1938.
Data as of December 31, 1942.
Producing Acreage: 480.
Wells Producing: 12.

Production by Months	Barrels
January	35,006
February	29,011
March	33,672
April	31,923
May	31,927
June	32,545
July	39,724
August	38,816
September	32,992
October	38,936
November (Est.)	39,355
December (Est.)	41,788
Total for 1942	425,695

SETTLED FIELDS

CHAMPAGNOLLE FIELD

Location: T. 17S., R. 13 & 14W. Union County.
Geology: Terrace or nosing lens, Subsea 3,000'-3,400'; Sand, Travis Peak.
Discovered: Ohio Oil Co., Crain No. 1, January 22, 1927.
Data as of December 31, 1942.
Producing Acreage: 2,000 (Est.).
Wells Producing: 74 (Est.).

Production by Months	Barrels
January	23,134
February	23,039
March	25,960
April	21,485
May	22,154
June	23,495
July	22,532
August	22,303
September	19,914
October	21,040
November (Est.)	20,361
December (Est.)	20,880
Total for 1942	266,297

EL DORADO-EAST FIELD

Location: T. 17S., R. 13, 14 & 15W. Union County.
Geology: Terrace or anticline; depth 2,207'; Nacatoch sand.
Discovered: Terry Summerfield Oil Co., Smith No. 1, January 10, 1922.
Data as of December 31, 1942.
Producing Acreage: 1,380 (Est.).
Wells Producing: 56 (Est.).

Production by Months	Barrels
January	11,448
February	9,309
March	9,714
April	9,230
May	10,436
June	9,904
July	10,165
August	11,891
September	11,212
October	11,787
November (Est.)	11,406
December (Est.)	11,523
Total for 1942	128,025

EL DORADO-SOUTH FIELD

Location: T. 17, 18 & 19S., R. 15 & 16W. Union County.
Geology: Series of anticlines, depth 2,242'; Nacatoch sand.
Discovered: *Constantin Oil & Refining Co., gas well, Hill No. 1, April 22, 1920.
Data as of December 31, 1942.
Producing Acreage: 7,740 (Est.).
Wells Producing: 203 (Est.).

Production by Months	Barrels
January	29,582
February	29,151
March	34,800
April	33,566
May	30,309
June	34,165
July	31,103
August	31,890
September	30,689
October	28,884
November (Est.)	27,951
December (Est.)	28,860
Total for 1942	370,950

*The discovery of oil Mitchell and Busey, Armstrong No. 1, January 10, 1921.

GARLAND CITY FIELD

Location: T. 15 & 16S., R. 26W. Miller County.
Geology: Anticline; sand, Trinity; 2,900'.
Discovered: *Lenz, et al., Johnson No. 1, July, 1930.
Data as of December 31, 1942.
Producing Acreage: 290 (Est.).
Wells Producing: 15 (Est.).

Production by Months	Barrels
January	5,535
February	6,318
March	9,051
April	6,822
May	7,248
June	7,851
July	6,276
August	6,962
September	8,609
October	7,310
November (Est.)	7,075
December (Est.)	7,310
Total for 1942	86,367

*Garland City field proper—by Baker McMurray, Beck No. 1, December 18, 1932.

IRMA-TROY FIELD

Location: T. 14S., R. 20 & 21W. Nevada County.
Geology: Faulted and steeply folded anticline; Depth 1,200′ and 2,100′, Nacatoch and Tokio-Woodbine sands.
Discovered: *
Data as of December 31, 1942.
Producing Acreage: 1,540 (Est.).
Wells Producing: 86 (Est.).

Production by Months	Barrels
January	59,887
February	48,419
March	43,182
April	54,055
May	47,749
June	46,598
July	45,354
August	54,250
September	52,092
October	46,154
November (Est.)	44,664
December (Est.)	45,990
Total for 1942	588,394

*Irma field discovered in Ames and Zengy, T. P. Waters No. 1, well October 17, 1921, and the Troy field in Benedum Trees Oil Co., Groves Land & Timber Co., No. 1, well November 11, 1936.

LEWISVILLE FIELD

(LOWER GLEN ROSE AND TOKIO)

Location: T. 16S., R. 23 & 24W. Lafayette County.
Geology: "Oolitic Limestone," Saturated Thickness 11′, Second Lime 6′, Lenticular Sands from 0′ to 20′; 3,075′ Subsea.
Discovered: East Texas Refining Co., Patten Estate A-1, April 26, 1939.
Data as of December 31, 1942.
Producing Acreage: 320.
Wells Producing: 16.

Production by Months	Barrels
January	6,483
February	5,307
March	6,091
April	5,959
May	5,639
June	5,283
July	5,103
August	5,162
September	4,894
October	4,919
November (Est.)	4,758
December (Est.)	4,900
Totals for 1942	64,498

LISBON FIELD

Location: T. 17S., R. 16W. Union County.
Geology: Part anticline and part syncline; Depth 2,060′, Nacatoch sand.
Discovered: Raines, et al., Dumas No. 1, December 31, 1925.
Data as of December 31, 1942.
Producing Acreage: 2,640 (Est.).
Wells Producing: 144 (Est.).

Production by Months	Barrels
January	6,350
February	5,616
March	5,696
April	5,406
May	4,717
June	5,270
July	4,986
August	4,794
September	4,805
October	4,629
November (Est.)	4,480
December (Est.)	4,625
Total for 1942	61,374

McDONALD FIELD

Location: T. 15S., R. 18W. Ouachita County.
Geology: Anticline, Upper & Lower Glen Rose, Subsea 2,700′ *.
Discovered: McDonald Oil Corp., Wilson No. 1, April 13, 1929.
Data as of December 31, 1942.
Producing Acreage:
Wells Producing:

No production record.
*Lower Glen Rose production abandoned and Nacatoch gas well discovered by Sherry O'Brien, Cook Estate No. 1, October 26, 1939. Depth 1590 feet.

RODESSA FIELD

Location: T. 20S., R. 28W. Miller County.
Geology: Extension along major faults; Sand and lime; Lower Glen Rose, 5,800'-6,100'.
Discovered: W. L. McClanahan, Cupp Bros. No. 1, June 12, 1937.
Data as of December 31, 1942.
Producing Acreage: 1,740 (Est.).
Wells Producing: 91 (Est.).

Production by Months	Barrels
January	34,513
February	32,136
March	32,919
April	32,182
May	33,723
June	35,542
July	32,069
August	32,889
September	29,015
October	25,914
November (Est.)	25,077
December (Est.)	25,835
Total for 1942	371,814

SCHULER-MORGAN FIELD

Location: T. 18S., R. 17W. Union County.
Geology: Anticline, Subsea 5,300', Sand, Cotton Valley.
Discovered: Lion Oil Refining Co., Edna Morgan No. 1, April 5, 1937.
Data as of December 31, 1942.
Producing Acreage: 220 (Est.).
Wells Producing: 11 (Est.).

Production by Months	Barrels
January	21,232
February	20,736
March	20,744
April	19,964
May	21,497
June	18,689
July	19,562
August	19,273
September	19,315
October	19,478
November (Est.)	18,850
December (Est.)	19,400
Total for 1942	238,740

SMACKOVER FIELD

Location: T. 15 & 16S., R. 15, 16 & 17W. Ouachita and Union Counties.

Geology: Anticline to east, terrace to west, limited by fault on north; depth 1,900'-2,300', Nacatoch, Graves and Meakin sands.

Discovered: *Oil Operator's Trust, Murphy No. 1 (Gas Well), April 14, 1922.

Data as of December 31, 1942.

Producing Acreage: 29,515 (Est.).

Wells Producing: 1,705 (Est.).

Production by Months	Barrels
January	414,381
February	389,275
March	437,163
April	391,043
May	419,413
June	416,317
July	413,584
August	413,642
September	403,055
October	409,093
November (Est.)	395,895
December (Est.)	409,000
Total for 1942	4,911,861

*V. K. F. Oil Co., Richardson No. 1, (Oil Well) July 31, 1922.

STEPHENS FIELD

Location: T. 15S., R. 19 & 20W. Columbia and Ouachita Counties.

Geology: Terrace or nosing lens, depth 1,400' and 2,100'; Nacatoch & Buckrange sands.

Discovered: Hude and Aarnes, Brown No. 1, June 2, 1922.*

Data as of December 31, 1942.

Producing Acreage: 2,870 (Est.).

Wells Producing: 214 (Est.).

Production by Months	Barrels
January	30,823
February	33,316
March	41,551
April	38,589
May	46,907
June	53,551
July	59,153
August	58,185
September	58,647
October	61,761
November (Est.)	60,785
December (Est.)	63,875
Total for 1942	607,143

*"Smart sand" Travis Peak discovered by R. H. Crow, W. C. O'Farrel and A. B. Turner, J. W. Smart No. 1, January 19, 1941, depth to sand 3417 feet.

URBANA FIELD

Location: T. 18S., R. 13W. Union County.
Geology: Anticline, 3,535′, Sand, Travis Peak.
Discovered: *Marine Oil Co., Thompson No. A-3, January 19, 1930.
Data as of December 31, 1942.
Producing Acreage: 680 (Est.).
Wells Producing: 34 (Est.).

Production by Months	Barrels
January	42,080
February	38,662
March	41,708
April	42,123
May	39,998
June	36,983
July	40,263
August	39,966
September	35,353
October	35,763
November (Est.)	35,370
December (Est.)	36,575
Total for 1942	464,844

*Gas was discovered in Marine Oil Co.'s Winn Estate No. 1, February 13, 1927.

TOPOGRAPHIC MAPPING IN ARKANSAS

One of the fundamental requirements which must be met before a scientific examination of natural resources can be made, and one of the principal foundations for the development of a plan to use such resources, is an accurate three dimensional chart, generally known as a topographic map.

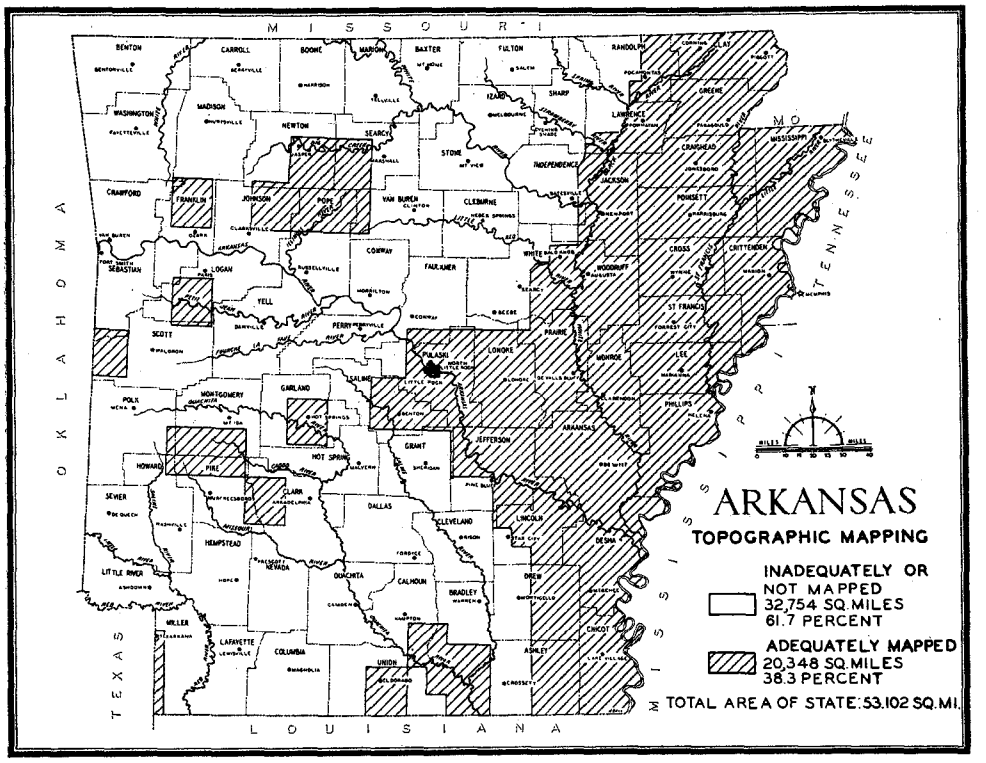


Figure 25

The close of 1942 finds 61 per cent of the State of Arkansas without adequate topographic maps (Figure 25). The greatest portion of the state which has been adequately mapped lies in the flood plain of the Mississippi River, east of the areas richest in mineral resources. No adequate topographic map has ever been made for such important areas as the Magnet Cove district, the Lawrence-Sharp County lead and zinc district, the Randolph County iron district, the Dallas and Ouachita County lignite district and the Polk County manganese district. Until such time as the state has been mapped throughout, no effort or expense should be spared in this vital program.

Two important topographic mapping projects are now being carried on. The first of these is the remapping of the old Little Rock Quadrangle; second, the remapping of the old Batesville Quadrangle. Descriptions of these two programs are given below.

FUNDS EXPENDED FOR TOPOGRAPHIC MAPPING IN ARKANSAS IN COOPERATION WITH THE U. S. GEOLOGICAL SURVEY

Fiscal Years, 1940-1944

Fiscal Year	Arkansas's Contribution	Federal Contribution	Total Funds for Topographic Mapping
1939-40	$ 1,463.16	$ 1,463.16	$ 2,926.32
1940-41	1,866.97	1,866.97	3,733.94
1941-42	3,142.33	3,142.33	6,284.66
1942-43	6,000.00[1]	6,000.00[1]	12,000.00[1]
1943-44	10,000.00[2]	10,000.00[2]	20,000.00[2]

1 Estimated.
2 Proposed.

REMAPPING OF THE OLD LITTLE ROCK QUADRANGLE

The original Little Rock Quadrangle was surveyed in 1891. The first edition appeared in September, 1893, and was one of the earliest topographic maps to be published for Arkansas.

The scale of this map is approximately two miles to the inch, represented numerically by the fraction 1/125,000. The contour interval adopted for the map is 50 feet. The total area shown on the map is about 1,000 square miles, from 34° 30′ to 35° North Latitude, and from 92° to 92° 30′ West Longitude. Since this quadrangle covers 30 minutes of latitude and 30 minutes of longitude, it is frequently referred to as the "Little Rock 30-minute sheet" to distinguish it from the 15 minute and 7½ minute sheets published in the last few years.

Although revised in 1918 and again in December, 1940, by the U. S. Engineers, Seventh Corps Area, the original Little Rock Quadrangle is now out of date, and is of little value for other than reference purposes.

During the past few years a program to remap the old Little Rock Quadrangle has been carried on. This program is now in its final stage and will be completed in 1944 if the present mapping rate is continued. The index map of the Little Rock 30 minute sheet (Figure 26) shows the manner in which the old Little Rock Quadrangle was divided for remapping purposes. Each of the units shown on this index map is described below.

Alexander Quadrangle

The Alexander Quadrangle represents the remapping of the southeast quarter of the old Little Rock Quadrangle. Named after the town of Alexander in southwestern Pulaski County, the Alex-

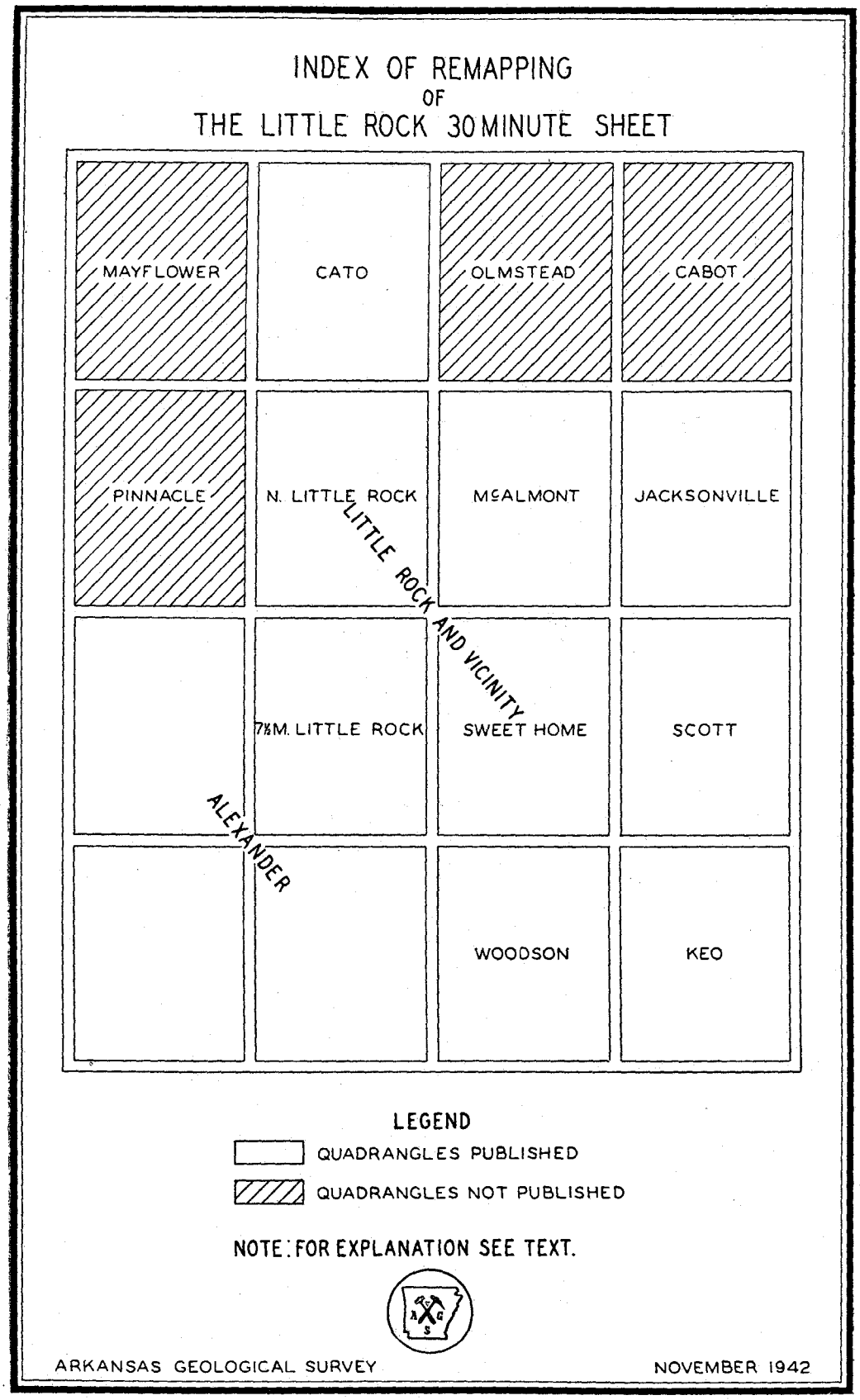

INDEX OF REMAPPING
OF
THE LITTLE ROCK 30 MINUTE SHEET
MAYFLOWER
CATO
OLMSTEAD
CABOT
PINNACLE
N. LITTLE ROCK
McALMONT
JACKSONVILLE
LITTLE ROCK AND VICINITY
7½M. LITTLE ROCK
SWEET HOME
SCOTT
ALEXANDER
WOODSON
KEO
LEGEND
QUADRANGLES PUBLISHED
QUADRANGLES NOT PUBLISHED
NOTE: FOR EXPLANATION SEE TEXT.
ARKANSAS GEOLOGICAL SURVEY
NOVEMBER 1942

Figure 26

ander Quadrangle actually includes a large portion of the city of Little Rock, but it was so named to avoid confusion with other maps of Little Rock and vicinity. This topographic map includes portions of the Pulaski and Saline County bauxite areas and shows such interesting topographic features as Granite Mountain, Alexander Mountain, and the foothills of the Ouachita Mountains. The scale of the map is 1/62,500 or one mile is equal to approximately one inch. The contour interval used over the entire map is 20 feet. The map was surveyed in 1934 and 1935 and was published December 16, 1941.

The Alexander Quadrangle, as finally published, includes the 7½ minute Little Rock sheet reduced in scale from 1/24,000 to 1/62,500. The 7½ minute Little Rock sheet is available, therefore, only in advanced form, and present plans do not call for separate publication of this sheet.

Cabot Quadrangle

The Cabot Quadrangle represents the remapping of the extreme northeastern corner of the old Little Rock Quadrangle. The field mapping of this quadrangle has been completed and the final map has been inked and is ready for publication. A limited number of advanced copies of this map are available. The final edition will probably be released early in 1943.

The scale of the final map as now planned will be 1/31,680 or approximately two inches are equal to one mile.

Cato Quadrangle

The Cato Quadrangle consists of an area directly north of Camp Joseph T. Robinson in northern Pulaski County. This quadrangle has been partially mapped by the United States Engineer Office, Little Rock, Arkansas. Due to the present critical situation in military affairs, distribution of the War Department map of a portion of the Cato Quadrangle has been discontinued. Plans for completion of the Cato Quadrangle at the end of the war are now being made.

Jacksonville Quadrangle

Mapping of the Jacksonville Quadrangle has been completed, the final map has been inked and is now awaiting publication.

The completed map will be published on a scale of 1/31,680 or two inches are equal to approximately one mile.

Keo Quadrangle

The Keo Quadrangle was surveyed in 1939 as a joint project by the United States Geological Survey and the Works Projects Administration and was sponsored by the Arkansas Geological Survey. The scale of the map is 1/31,680, or one mile equals approximately two inches on the map. The map was released in 1941.

The Keo Quadrangle covers an area of about sixty square miles in eastern Pulaski County and western Lonoke County. The winding course of Plum Bayou, a former channel of the Arkansas River, is well shown on this map.

The map is available with or without a green overprint, showing the extent of the wooded areas within the boundaries of the quadrangle.

Little Rock and Vicinity Quadrangle

Representing the compilation of four quadrangles surveyed in 1934 and 1935 (McAlmont, North Little Rock, 7½ Minute Little Rock, and Sweet Home) the Little Rock and Vicinity Quadrangle was published in 1941.

The scale of this map is approximately one mile to the inch, and is the best all around map of metropolitan Little Rock and its environs that is available at the present time.

The Little Rock and Vicinity Quadrangle overlaps the Alexander Quadrangle, since the 7½ Minute Little Rock sheet has been used as the southwest quarter of the Little Rock and Vicinity map, and is the northeast quarter of the Alexander map.

Little Rock (7½ Minute) Quadrangle

The 7½ Minute Little Rock Quadrangle has been published only as an advance map on a scale of 1/24,000, or one mile is equal to approximately two and one-half inches. Since the final edition of this map was incorporated in the Alexander and Little Rock and Vicinity Quadrangles, the Little Rock 7½ Minute sheet is of interest only as a stage in the mapping of these areas.

A limited number of copies of this map are still available.

McAlmont Quadrangle

The McAlmont Quadrangle represents the northeast quarter of the Little Rock and Vicinity sheet. The final edition of the McAlmont map was incorporated in the Little Rock and Vicinity Quadrangle and only a limited number of the advanced sheets of the

McAlmont Quadrangle are available at the present time. Since no separate final map of the McAlmont Quadrangle is to be published, it is of interest only at a stage in the remapping of Little Rock and vicinity.

Mayflower Quadrangle

The Mayflower Quadrangle represents the extreme northwestern corner of the old Little Rock Quadrangle. This is the only portion of the entire mapping program which is now awaiting remapping. Present plans call for the completion of the topography in 1943 and publication of the final map in 1944.

North Little Rock Quadrangle

The North Little Rock Quadrangle represents the northwest quarter of the Little Rock and Vicinity sheet. The final edition of the North Little Rock map was incorporated in the Little Rock and Vicinity Quadrangle and only a limited number of the advanced sheets of the North Little Rock Quadrangle are available at the present time. Since no separate final map of the North Little Rock Quadrangle is to be published, it is of interest only at a stage in the remapping of Little Rock and vicinity.

Olmstead Quadrangle

The Olmstead Quadrangle has been completely mapped, and the map is now awaiting publication. Present plans call for a final map on a scale of 1/31,680, or one mile is equal to approximately two inches.

Pinnacle Quadrangle

The Pinnacle Quadrangle, named from Pinnacle Mountain, is now being mapped under the cooperative program. On October 27, 1942, fifty-seven square miles or approximately ninety per cent of the quadrangle had been completed.

Publication of this quadrangle has not been definitely scheduled, but present plans call for release in late 1943 or early 1944. The scale of the final map will be 1/31,680 or one inch equals approximately two miles. A five-foot contour interval is being used in the flat land near the Arkansas River, and a ten-foot contour interval is being used in the more rugged portions of the quadrangle.

Scott Quadrangle

The Scott Quadrangle was surveyed in 1939 as a joint project by the United States Geological Survey and the Works Projects

Administration and was sponsored by the Arkansas Geological Survey. The scale of the map is 1 to 31,680, or one mile equals approximately two inches on the map. The map was transmitted by the Rolla office of the U. S. Geological Survey to Washington for lithography in January, 1942, and the map was released in November, 1942.

The Scott Quadrangle covers an area of about sixty square miles in eastern Pulaski and western Lonoke Counties. A number of oxbow lakes, representing old courses of the Arkansas River, are shown on the map. The Toltec Indian mounds on the southeast edge of Mound Pond are clearly shown on this map. The mounds are three in number, standing from 10 to 40 feet above the surrounding land level.

The map is available with or without a green overprint showing the extent of the wooded areas within the boundaries of the quadrangle.

Sweet Home Quadrangle

The Sweet Home Quadrangle represents the southeast quarter of the Little Rock and Vicinity sheet. The final edition of the Sweet Home map was incorporated in the Little Rock and Vicinity Quadrangle and only a limited number of the advanced sheets of the Sweet Home Quadrangle are available at the present time. Since no separate final map of the Sweet Home Quadrangle is to be published, it is of interest only as a stage in the remapping of Little Rock and vicinity.

Woodson Quadrangle

The Woodson Quadrangle is now in the final stages of publication on a scale of 1 to 31,680 or one mile is equal to approximately two inches. Receipt of the published map is expected early in 1943.

REMAPPING OF THE OLD BATESVILLE QUADRANGLE

The original Batesville sheet was surveyed in 1890. The first edition appeared in September, 1891, and was one of the earliest topographic maps to be published for Arkansas.

The scale of this map is approximately two miles to the inch, represented numerically by the fraction 1/125,000. The contour interval is fifty feet. The total area shown on the map is about one thousand square miles, from 35° 30′ to 36° north latitude, and from 91° 30′ to 92° west longitude.

This map was surveyed by reconnaissance methods and is of little value as a base for detailed geological work. During 1942 a

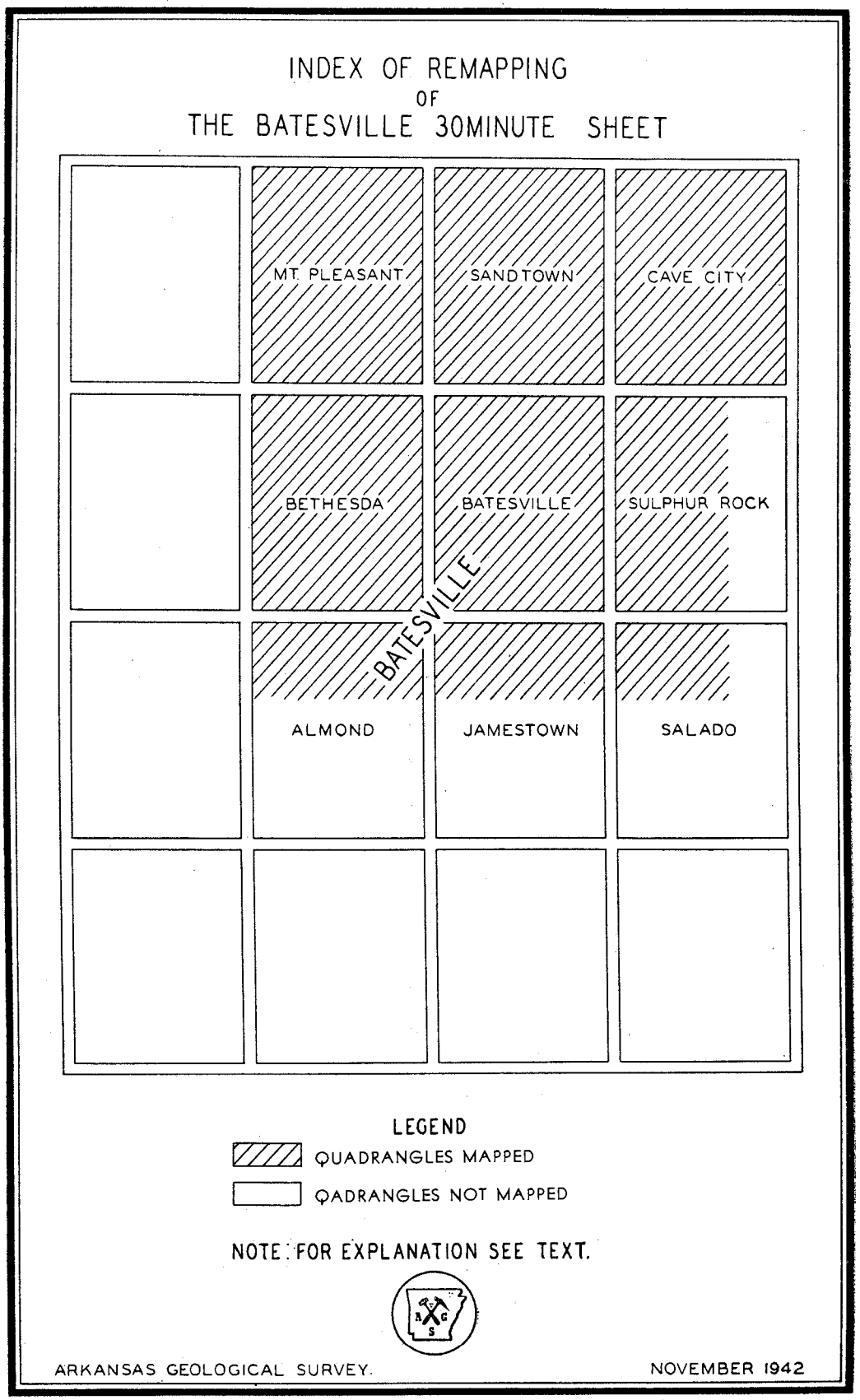

INDEX OF REMAPPING
OF
THE BATESVILLE 30MINUTE SHEET
MT. PLEASANT
SANDTOWN
CAVE CITY
BETHESDA
BATESVILLE
SULPHUR ROCK
BATESVILLE
ALMOND
JAMESTOWN
SALADO
LEGEND
QUADRANGLES MAPPED
QADRANGLES NOT MAPPED
NOTE: FOR EXPLANATION SEE TEXT.
ARKANSAS GEOLOGICAL SURVEY.
NOVEMBER 1942

Figure 27

topographic map of the Batesville manganese district was undertaken by the U. S. Geological Survey as a Federal Defense project. This survey covers 323 square miles (Figure 27) and comprises the Batesville and Bethesda 7½ Minute Quadrangles; major portions of the Mt. Pleasant, Sand Town, Cave City, and Sulphur Rock Quadrangles; and the north edges of the Almond, Jamestown, and Salado Quadrangles. In order to complete the Mt. Pleasant, Sand Town, Cave City, and Sulphur Rock Quadrangles, the area in these quadrangles which remains unmapped by the Federal survey is now being mapped by the U. S. Geological Survey and the Arkansas Geological Survey on a cooperative basis. Preliminary maps are available in limited quantities only, but the publication of the final editions is expected in the near future.

This new topographic map of the Batesville manganese area constitutes the first step in the detailed study of the geology and ore deposits of the manganese district which is now being carried on by the U. S. Geological Survey. When released, both the report and the accompanying maps will be of great assistance to the mining operators, County and State Highway Departments, and to the communities which fall within the remapped area.

TOPOGRAPHIC MAPS PUBLISHED IN 1942

The following maps were published during 1942:

Athens Glenwood Scott

The Athens and Glenwood Quadrangles were mapped by the U. S. Geological Survey with Public Works funds, and are described below. Mention of the Scott Quadrangle is included in the description of the remapping of the old Little Rock Quadrangle.

Athens Quadrangle

The Athens Quadrangle, published in 1942, represents the re-mapping of the northwest quarter of the old Caddo Gap Quadrangle, published in 1906.

Portions of the Cossatot and Caddo Mountain groups are shown on this map, giving a vivid picture of the rugged topography in the southern Ouachita Mountains.

The map is named after the village of Athens (Population 74) in northeastern Howard County. Early reports on the geology of this area refer to the rolling country which lies south of the Ouachita Mountains as the "Athens Plateau." In reality this area is not a plateau, but a region underlain by folded beds of shale and sandstone, less resistant to weathering than the hard novaculite which forms the prominent ridges in the Cossatot Mountains to the north.

In addition to a small portion of Howard County, the Athens Quadrangle includes parts of northern Pike County, western Montgomery County, and eastern Polk County. The longitude of the map ranges from 93 degrees, 45 minutes to 94 degrees; the latitude ranges from 34 degrees, 15 minutes to 34 degrees, 30 minutes. The scale of the map is 1 to 62,500, or approximately one inch is equal to one mile. The map was surveyed in 1935 and 1936, and the culture and drainage as shown on the map were compiled in part from aerial photographs.

The map is available with or without a green overprint, designating the areas of forest.

Glenwood Quadrangle

The Glenwood Quadrangle represents the remapping of the northeast quarter of the old Caddo Gap Quadrangle, published in 1906, thirty-six years ago. At that time there was no town on the site which Glenwood now occupies.

The new Glenwood Quadrangle was surveyed in 1935 and 1936 by the United States Geological Survey. The culture and drainage as it appears on the final map were compiled in part from aerial photographs. The scale of the map is one to 62,500, or approximately one inch equals one mile.

The map shows the interesting topography in the Caddo Mountains, a southern member of the Ouachita Mountain chain. The map area falls partly in southern Montgomery County and partly in northern Pike County. The northern boundary of the quadrangle lies some three miles north of Norman, while its southern boundary lies just south of Kirby. The longitude of the map ranges from 93 degrees, 30 minutes to 93 degrees, 45 minutes; the latitude ranges from 34 degrees, 15 minutes to 34 degrees, 30 minutes.

This map will prove of great value to prospectors and miners in the location of section corners, and as a general field aid. The area covered by the Glenwood Quadrangle contains manganese mines and prospects, slate quarries, quartz crystal occurrences, and numerous geologic and topographic features of great interest to geologist and layman alike.

The map is available with or without a green overprint designating its forested areas.

PURCHASE AND SALE OF TOPOGRAPHIC MAPS

The Arkansas Geological Survey maintains a complete file of the topographic maps of the state. At the present time the sale of the maps published by the War Department, Corps of Engineers, has been discontinued for the duration of the war. The sale of maps in the remaining portion of the state is to a large extent unrestricted. Copies of the available topographic quadrangle, priced at ten cents per map, may be obtained by writing to the Arkansas Geological Survey, Room 446, State Capitol, Little Rock.

TOPOGRAPHIC QUADRANGLES IN ARKANSAS

The following maps are available at the Arkansas Geological Survey or the U. S. Geological Survey, Washington, D. C. Price 10 cents each plus 10 cents for mailing charges, when ordered from Little Rock.

1. Siloam Springs
2. Fayetteville
3. Eureka Springs
4. Harrison
5. Yellville
6. Mountain Home
7. Tahlequah
8. Winslow
9. Watalula
10. Mount Judea
11. Ozone
12. Treat
13. Marshall
14. Mountain View
15. Batesville
16. Fort Smith
17. Magazine Mountain
18. Booneville
19. Dardanelle
20. Morrilton
21. Poteau Mountain
22. Mount Ida
23. Hot Springs
24. Benton
25. Little Rock 30-minute
26. North Little Rock
27. McAlmont
28. Little Rock 7½-minute
29. Sweet Home
30. Alexander
31. Stuttgart
32. DeQueen
33. Caddo Gap
34. Athens
35. Glenwood
36. Hot Springs Vicinity
37. Gurdon
38. Camden
39. Texarkana
40. Atlanta
41. El Dorado
42. Moro Bay
43. Ingalls
44. Strong
45. Felsenthal
122. Lonoke
123. England
124. Benton, 15-minute
125. Snowball
126. Poteau Mountain 2**
127. Antoine**
128. Smyra**
129. Woodson
130. Keo
131. Scott
132. Jacksonville*
133. Cabot*
134. Horn Lake
135. Conway**
136. Enola**
137. Beebe**
138. Waldron
139. Sheridan**
140. Cato**
141. Mayflower**
142. Pinnacle**
143. Olmstead**

* Being prepared for publication.

** Being surveyed.

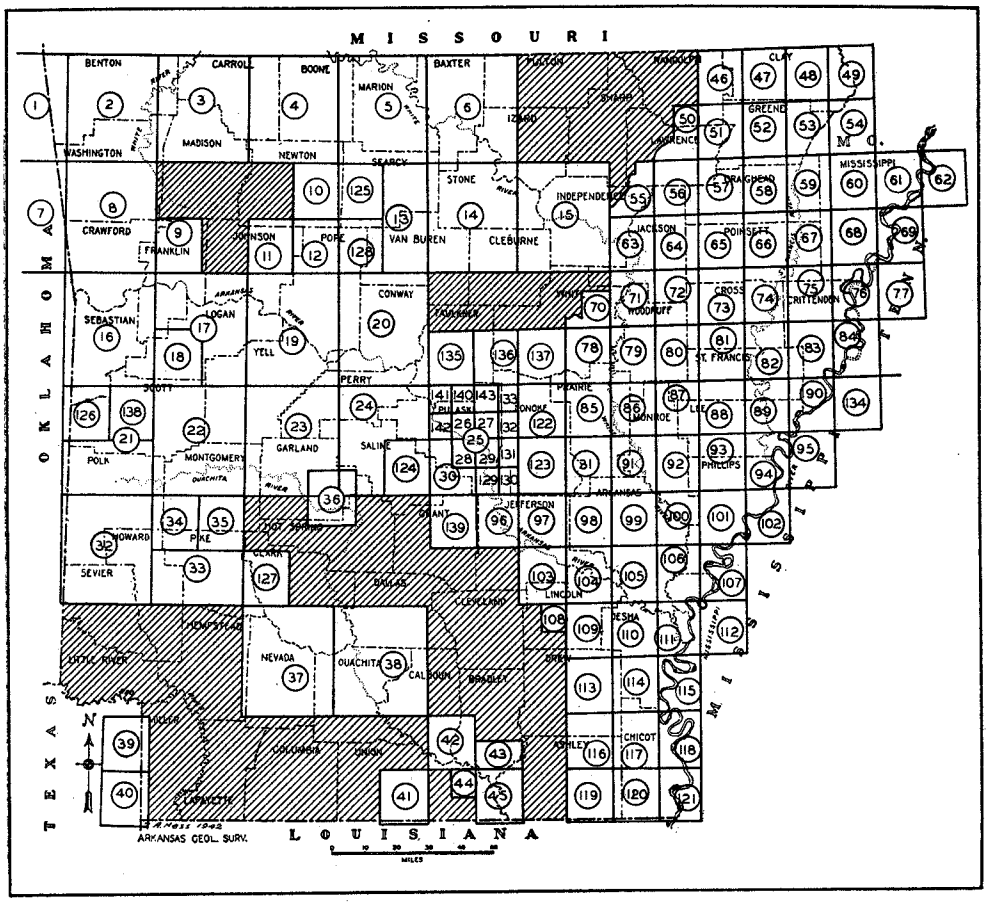


Figure 28

Index Map of the Topographic Quadrangles in Arkansas. The cross-hatched portions are unmapped areas.

The following maps have been published by the War Department-Corps of Engineers. Sale of these maps has been discontinued for the duration of the war.

46. Reyno
47. Knobel
48. Rector
49. Piggott
50. Powhatan
51. Walnut Ridge
52. Gainesville
53. Marmaduke
54. Kennett
55. Strawberry
56. Alicia
57. Sedgwick
58. Jonesboro
59. Leachville
60. Manila
61. Blytheville
62. Hale's Point
63. Newport
64. Tuckerman
65. Weiner
66. Dee
67. Marked Tree
68. Evadale
69. Osceola
70. Bald Knob
71. Augusta
72. Tilton
73. Vanndale
74. Princedale
75. Deckerville
76. Jericho
77. Milington
78. Kensett
79. Gregory
80. Hunter
81. Wynne
82. Whitmore
83. Edmonson
84. Memphis
85. Hazen
86. De Valls Bluff
87. Brinkley
88. Marianna
89. Park Place
90. Horseshoe Lake
91. Clarendon
92. Holly Grove
93. Marvell
94. La Tour
95. Clayton
96. Pastoria
97. Altheimer
98. Goldman
99. DeWitt
100. Indian Bay
101. Modoc
102. Farrell
103. Noble Lake
104. Varner
105. Gillett
106. Henrico
107. Mellwood
108. Feenyville

109. Rotan
110. Red Fork
111. Big Island
112. Pace
113. Cominto
114. McGehee
115. Lamont
116. Mist
117. Lake Village
118. Refuge
119. Wilmot
120. Eudora
121. Readland

STREAM GAGING IN ARKANSAS

A Cooperative Program Maintained by the State of Arkansas and the United States Geological Survey

Historical Review

The first stream flow records in Arkansas were collected from 1903 to 1905 on the Ouachita River near the site of Remmel Dam. During 1909 and 1910 the late Dean W. N. Gladson carried on river measurement work at a number of stations. Many of the early records collected, unfortunately, are useful only for preliminary studies, as the stations were maintained only a short time. During the 15 years from 1911 to 1926, very few stream-flow records were collected. Some were collected through the cooperation of private companies, but no comprehensive studies were made.

In 1927, the first State-wide cooperative water resources investigation in Arkansas was begun, and in September, 1928, a district office of the United States Geological Survey for carrying on this work within the State was established. Under the provisions of Act 142, Sec. 1, 1927, setting up the State Geologist Fund for ". . . the establishment of gauging stations on certain streams of

Figure 29

Map showing the location of stream-gaging stations now in operation and the sites of proposed gaging stations.

the State," the State Geologist maintained cooperation with the Federal Geological Survey during the fiscal years 1928-1933. However, as revenues for the State Geologist Fund became insufficient for carrying on the work, the number of stream-flow measurement stations was reduced each year—the number of stations being reduced from 21 in 1929 to 12 at the end of September, 1931.

In 1933 an attempt was made to obtain a legislative appropriation to carry on these investigations, but the bill failed to pass the lower House by four votes. River measurement work in Arkansas was accordingly curtailed, and during the next few years only a few stations of primary Federal interest were maintained, these few stations being financed mainly by an allocation of Public Works Administration or other Federal funds.

In 1937, the State Legislature appropriated $5,000 per annum for the next biennial to the Arkansas Highway Commission for cooperation with the United States Geological Survey. This contribution was matched by an equal amount of Federal funds and again a comprehensive State-wide stream gaging program was initiated. The succeeding legislatures have appropriated $7,500 per year to the Highway Commission for these cooperative investigations.

Under the present cooperative agreements for the fiscal year ending June 30, 1943, the Arkansas Highway Commission is contributing $7,500, the Arkansas Flood Control Commission $1,500, and the Arkansas Geological Survey $250. These amounts are matched by equal allotments of Federal funds by the Geological Survey. In addition, the Little Rock, Denison, and Tulsa Districts of the Corps of Engineers, U. S. Army, are contributing about $4,500 toward the operation of stream-gaging stations on Arkansas streams in connection with special studies authorized by the Congress. The Memphis and Vicksburg District offices of the Corps of Engineers are also collecting records on a few streams in the State that are not being gaged under the above program.

Due to the drop in the tax revenue, the Arkansas Highway Commission will not include an item for a cooperative stream-gaging program in its budget proposal for 1943-44. Subject to the approval of the State Legislature, a major portion of the expense of maintaining the State's share of the stream-gaging program will be undertaken by the Arkansas Geological Survey. (Office of the State Geologist).

The stream gaging program from 1939 to 1942 was financed as shown in the following table:

Agency	Fiscal Periods 1939-1940	1940-1941	1941-1942	1942-1943
Arkansas Highway Commission	$ 7,500	$ 7,500	$ 7,500	$ 7,500
Arkansas Flood Control Commission			750	1,500
Arkansas Geological Survey	800	850	250	250
U. S. Geological Survey	11,450	10,850	11,950	12,700
Corps of Engineers, U. S. Army	4,075	4,250	4,525	4,525
Federal Power Licensees	1,600	1,500	1,500	1,500
	$25,675	$24,950	$26,475	$26,950

Purpose of Stream Gaging

Records of river discharge are among the principal tools used by engineers in evaluating developments relating to the use or control of water and in planning the layout and design of structures that compose such developments. They afford a sound basis for the economic study of any such project and likewise a basis for design that will assure stability and safety of structures that might otherwise endanger life and property. Without these records the engineer is hopelessly handicapped, and the ultimate decision or design must rest upon guess work. There are few reliable agencies or corporations nowadays who are willing to hazard their reputation or capital upon a mere guess, regardless of how scientific that guess may be. The lack of reliable data, therefore, will retard development and progress until this information can be obtained. In general, no adequate knowledge of the behavior of a stream can be obtained in a period of less than ten years. Therefore, in order that such information may be available when needed, records of discharge must be kept over a period of many years; the longer the period for which a continuous record is available the more valuable that record becomes.

Water, a most vital need in modern civilization, has attained even more critical importance in warfare and requests for water-supply information have recently been received from both military and civil agencies for assistance in problems relating to:

Cantonments
Emergency housing
Public supplies
Hospitals
Air fields
Manufacturing plants
Munition industries
Sewage disposal
Generation of hydraulic and steam power
Inland—Waterway navigation
Flood protection

Stream Gaging Stations

The following list shows the stream-gaging stations which were operated during 1942. The location of the stations is shown in Figure 28.

1. St. Francis River at Marked Tree
2. St. Francis Floodway near Marked Tree
3. White River near Flippin
4. White River near Batesville
5. White River at DeValls Bluff
6. West Fork of White River near Fayetteville
7. Buffalo River near Rush
8. North Fork White River near Fayetteville
9. Black River near Pocahontas
10. Spring River at Imboden
11. Eleven Point River near Eleven Point
12. Strawberry River near Poughkeepsie
13. Little Red River near Heber Springs
14. Red River at Index
15. Lagrue Bayou near Stuttgart
16. Arkansas River at Van Buren
17. Arkansas River at Dardanelle
18. Arkansas River at Little Rock
19. Frog Bayou near Mountainburg
20. Petit Jean Creek near Booneville
21. Petit Jean Creek at Danville
22. Fourche La Fave near Nimrod
23. Petit Jean Creek near Blue Mountain
24. Bayou Meto near Stuttgart
25. Red River at Garland
26. Little River near Horatio
27. Cassatot River near DeQueen
28. Ouachita River near Mountain Pine
29. Ouachita River near Malvern
30. Mulberry River near Mulberry
31. Little Missouri River near Murfreesboro
32. Saline River near Rye
33. Black River near Corning
34. Buffalo River near St. Joe
35. Crooked Creek near Humphrey
36. Fourche La Fave near Gravelly
37. Middle Fork Little Red River near Shirley
38. Piney Fork of Strawberry River at Evening Shade
39. Poteau River at Cauthron
40. Saline River near Dierks
41. South Fork of Little Red River near Clinton
42. Strawberry River near Evening Shade
43. White River at Calico Rock
44. White River at Newport
45. Black River at Black Rock
46. Crooked Creek at Yellville
47. Kings River near Berryville
48. Arkansas River at Pine Bluff

ACTIVITIES IN ARKANSAS OF THE UNITED STATES DEPARTMENT OF INTERIOR

The Bureau of Mines and the Geological Survey 1942

Bureau of Mines

In order to better organize field work, the Bureau of Mines was reorganized in July, 1942. Under this reorganization the continental United States was divided into three regions and each region into a number of districts. Each district is headed by a district engineer, who has a number of project and examining engineers under his jurisdiction. Project engineers are in charge of specific projects for which definite funds are allocated. Examining engineers are assigned the task of examining mineral deposits and reporting thereon with the objective of recommending exploration projects. Arkansas and Louisiana make up District 7 of the Central Region. The District Engineer, Mr. J. R. Thoenen, maintains an office in Little Rock,* headquarters for District 7.

Foreseeing the need for a rapid increase in the development of domestic sources of bauxite, the Federal Congress in the Second Supplemental National Defense Appropriation Act, 1941, approved October 28, 1941, (Public Law 282, 77th Congress, Chapter 460—1st Session, H. R. 5788) authorized the Bureau of Mines and the U. S. Geological Survey to investigate the extent, mode of occurrence, and quality of bauxite and alunite ores and aluminum clays in the United States. Under this authority, the Bureau of Mines set up a number of projects to investigate these important minerals. The largest of these projects was that on Arkansas bauxite covering 1,500 square miles. A magnetic survey was initiated December 19, 1941, and a gravimetric survey on January 28, 1942. The first rig started drilling on May 1, 1942, and five additional drills were added by September 9 and continued operating the rest of the year.

The gravimetric survey was completed on November 30 and the magnetic survey on December 31, 1942. Both surveys discovered several interesting anomalies on which check drilling had commenced by the end of the year.

A total of 135,000 feet of hole was drilled which discovered a total of 5 1/3 million tons of bauxite and bauxitic material. Of this, it was estimated, 60 per cent or 3.1 million was commercial grade ore based on Metals Reserve specifications. The presence of some of this ore was known or indicated by former private drilling, but the majority of the deposits were new discoveries. The entire drill-

* 603 Union Life Building.

ing program for the year was confined to Pulaski County, no prospecting having been done in Saline County. Exploration agreements have been negotiated with over 600 individuals and corporations, involving over 150,000 acres of land. A staff of approximately 40 engineers and field employees has been maintained, and a complete laboratory for analysis of bauxite core samples has been established.

Under additional Congressional authority, a project was initiated to explore for zinc ore in geologic strata deeply buried below the present ore bearing horizon in the Rush district in Marion County. A definite program for diamond drilling was laid out and a staff appointed. Unfortunately funds available were inadequate to complete the program as planned and exploration was necessarily curtailed. No zinc ore was discovered in the drilling completed. It is hoped that additional funds will be provided to complete the original program.

Geological Survey

Geologic Branch

Two geological investigations were carried on during the year. The geology and ore deposits of the Batesville manganese district were completely mapped and a report is now being prepared. A second investigation, carried on jointly with the Bureau of Mines, was made of the geology and ore deposits of the Arkansas bauxite district. This investigation is still in progress. Mr. Robert P. Bryson is in charge.

Topographic Branch

Remapping of the old Batesville Quadrangle, in cooperation with the Corps of Engineers, War Department, and the Arkansas Geological Survey was carried on during the year. Details of this program are included in the section on Topographic Mapping of this report (Page 90).

Remapping of the old Little Rock Quadrangle was continued in 1942, most of the work being concentrated in the Pinnacle Quadrangle. (See page 89.)

Primary control in the Magnet Cove area was established in cooperation with the Arkansas Geodetic Survey, preparatory to a topographic mapping program in 1943.

Water Supply Branch

A program of stream gaging was maintained during the year, in cooperation with the State of Arkansas. A review of this program appears on page 97.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

E. A. HODSON

State Conservationist for Arkansas

ARKANSAS SOIL TYPES AND THE PROBLEM OF SOIL EROSION IN ARKANSAS

By MARVIN LAWSON

Survey Supervisor

Arkansas Soil Types

The character of a normal soil is determined largely by the climatic conditions under which it has developed and the nature of the geological material from which it is derived. Most of the soils in Arkansas have developed under similar climatic conditions so that differences in types are the result of development on different parent rock material.

In the northern two tiers of counties of Arkansas the parent rocks are very old limestones and dolomites. Tops of the higher mountains are usually capped with sandstone and shale. There are also quite extensive areas of friable sandstone and shale, frequently calcareous, interbedded with the thick limestone formations. This physiographic region is the Limestone Valleys and Uplands Soil Province.

Figure 30

Some of the limestones are free of chert or "flint" while in others the chert predominates in the rock mass. Limestone is soluble in ground waters and by decomposition gives rise to silt loams or cherty silt loams, depending on the type of limestone. The weathered parent soil material may be many feet in thickness. Soils developed from limestone are usually moderately to highly productive. Although the geological source material is alkaline (magnesium and calcium carbonates) the weathering processes in a humid warm climate have resulted in the loss of the alkaline material by solution and removal, leaving the soils acid in reaction. There are small areas where the soils have retained enough bases to be neutral to slightly alkaline in reaction. In the northwest part of the state and in small areas eastward toward Batesville prairie soils have been found. The prairie soils were developed under grass cover and retain the typical dark color of surface soil.

The remainder of the Uplands area of Arkansas has soils characteristic of the Ozark-Ouachita soil province. These soils have developed on material left by the disintegration of sandstones and shales by weathering. There are infrequent thin beds of calcareous shales which have had little influence in soil type development. The Boston Mountain section of the Ozark Mountains is an old plateau of horizontal to slightly folded beds of sandstone and shale. Streams have cut the area deeply, resulting in rough and mountainous terrain. On benches and stream divides the land is nearly level to rolling and the soils are moderately productive acid sandy soils. In this type of material the normal rate of erosion is so nearly equal to the rate of disintegration that the mantle of soil and soil material is comparatively thin, usually not exceeding three feet to bedrock. The rocks of the Arkansas Valley Province are similar to those of the Boston Mountains but are steeply folded into northeast-southwest trending ridges. The strata in the Ouachita Mountains have been severely folded and faulted and large areas have been subjected to pronounced metamorphic change. There are large areas of rough, mountainous land. Near Little Rock, Benton, and Hot Springs are outcrops of igneous rocks which give rise to soils characteristic of another soil province. These areas have not yet been mapped in sufficient detail to justify a separate delineation.

The southwest and south central parts of the state and a narrow band in the east extending northward to the north boundary line lie in the Coastal Plains soil province. The soil types of this province vary widely in character. An extensive belt of "blackland" soils has developed on the Cretaceous marl, chalk, and limestone which outcrop along the north edge of the Coastal Plain. This area extends southwestwardly from the vicinity of Arkadelphia through Prescott to Ashdown and westward to the boundary of the state. The soils are acid to alkaline in reaction and are usually clay loams

and silt loams. They were developed under grass cover. The remainder of the Coastal Plain consists of soils developed on clays, sands, gravel beds, or mixtures of these materials. The topography varies from a level plain to steeply rolling hills. The soils are acid in reaction and in texture range from clay to gravel, depending on the parent material.

From the north boundary of the state extending southward through Clay, Greene, Craighead, Poinsett, Cross, St. Francis, and Phillips counties is a narrow ridge of soils of the Loessial soil province. These soils are predominantly silty throughout with some clay accumulation in the subsoil. The origin of the loessial material on this ridge has not been definitely determined. The soil consists of material apparently derived from the loess and glacial areas of the middle west, possibly carried down by streams and redeposited by wind. There are small areas of the same material on the edge of the Ozark hills in Randolph, Lawrence, Independence, and White Counties and in southeastern Arkansas.

Along the streams of the state are areas of soils, alluvial in origin, varying in area with the size of the stream and varying in characteristics as do the regions drained by the stream. The soils vary in texture with the distance from the stream at the time of deposition. Usually the lighter sandy soils are deposited near the stream and heavy clay soils by backwater at a distance from the stream.

The Arkansas and Red Rivers have carried in much purplish calcareous material from the Permian Red Beds of Oklahoma and Kansas and from other prairie soils. The soils in the valleys of these rivers are usually medium acid to calcareous in reaction and highly productive. The Ouachita River and other local streams in the Ouachita and Boston Mountains carry mostly sandy material. The White River carries alluvium from both sandstone and shale regions and from limestone areas. The Mississippi floodplain material has been derived from all parts of the central United States.

The Problem of Soil Erosion

Soils vary in their reaction to erosion factors as they vary in their inherent characteristics. The type and number of gullies which develop when the land is cleared of its natural cover depends partly on the nature of the soil. There are shallow gullies which develop on thin soils and soon cut to bedrock. These are found on soils derived from both sandstone and limestone. On deep limestone soils, alluvial bench soils, Coastal Plain and loessial soils, gullies may cut many feet deep, until they reach stable grade, and then run through vertical banks which slough or cave off in large

blocks. Vertical banks are particularly characteristic of gullies in the loessial soils.

Figure 31

Field destroyed by gully erosion. This field was cultivated until about 15 years ago when serious gullying started and it had to be abandoned. Since that time it has been pastured or has been idle. Little or no effort was made to stop the gullies and as a result, approximately 35 acres of this 80-acre farm have gullied to such an extent that reforestation is the only practical treatment. This farm is in one of the first settled communities on Crowley's Ridge. Near Paragould, Arkansas.

The heavier soils are more resistant to sheet erosion when wet, due to the finer binding material. When dry, at the beginning of a rain, however, they are subject to considerable washing from "slacking" of the soil particles. Sandy soils have a relatively high rate of infiltration but lower water-holding capacity as compared with silty and clay soils.

Many erosion factors in Arkansas are intense in comparison with some other regions. Rainfall is frequently heavy during short periods of time, exceeding the infiltration rate of any but the most coarse soil material. The total annual rainfall averages about 48 inches, most of it falling in a few heavy rains. Since the soil is frozen only a few short periods per year, erosion is a year round problem. Cropping systems as practiced over most of the state leave the soil bare much of the year.

From data compiled on about 2,000,000 acres of detailed conservation surveys of the state, the status of erosion of the different provinces is given in the accompanying table, stated in round numbers.

	Northwest Prairie		Ozark-Ouachita Mountains		Coastal Plains		Loessial Uplands		Alluvial Soils, Bottom and Recent Terrace		Limestone Valleys & Uplands (168)	
	Per Cent	Acres	Per Cent	Acres	Per Cent	Acres	Per Cent	Acres	Per Cent	Acres	Per Cent	Acres
Bottomlands and level land not subject to severe erosion	4.5	31,500	15.8	1,580,000	43.0	3,440,000	21.2	116,600	80.7	8,594,550	6.6	257,400
Sloping Woodland—Subject to erosion if cleared	49.1	343,700	57.1	5,710,000	32.4	2,592,000	38.3	210,650	6.3	675,500	62.9	2,453,100
Land having slight to moderate sheet erosion	23.6	165,200	2.1	210,000	4.8	384,000	11.7	64,350	12.1	1,283,450	19.2	748,800
Land having moderate sheet erosion and occasional gullies	20.6	144,200	17.1	1,710,000	18.3	1,464,000	11.4	62,700			6.5	253,500
Land having severe sheet erosion and frequent gullies	2.2	15,400	7.9	790,000	1.5	120,000	17.4	95,700	.9	96,500	4.8	187,200
Total	100.0	700,000	100.0	10,000,000	100.0	8,000,000	100.0	550,000	100.0	10,650,000	100.0	3,900,000

Treatment recommendations for each land use capability class are prepared in the same manner as are the land use capability classes. When a farmer has made application to the soil conservation district supervisor, and the application has been accepted by the supervisor, a detailed soil conservation survey is made. The survey completed, a conservationist goes to the farm and with the farmer plans a system of soil and water conservation.

In the establishment of measures and practices for soil and water conservation, the first step is a detailed soil conservation survey indicating the soil type, slope, erosion, and other natural and cultural features pertaining to conservation planning and a land capability classification by a member of a soil conservation survey party. The land capability classification is determined from all factors shown on the survey by conservation surveyors, assisted by conservationists and personnel of all other agricultural agencies. At the present time eight capability classes in three categories are recognized.

First Category: Land which may be used for cultivated crops and is moderate to high in productivity.

Class I. Land which requires no special measures other than good soil and crop management. In Arkansas this class is usually only well drained or moderately well drained bottomlands.

Class II. Land which in addition to good soil and crop management requires simple soil and water conservation practices such as contour tillage, crop rotation, and water diversion; or simple drainage practices.

Class III. Land which in addition to good soil and crop management requires intensive soil and water conservation practices such as complete terrace system with adequate vegetated outlets, contour tillage, crop rotation with more frequent use of green manure crops, gully treatment, and water diversion; or complex or designed drainage system.

Class IV. Land which may be used occasionally for clean tilled crop when cultivated for renewal or improvement of stand of permanent vegetative cover, but should remain in permanent vegetative cover most of the time.

Second Category: Land which should remain under permanent vegetative cover.

Class V. Land which is not subject to erosion but not suitable for clean tilled crops. Level and poorly drained land or stony land.

Class VI. Land which is subject to erosion if vegetative cover is removed but requires no severe restriction in use for pasture or trees.

Class VII. Land which requires severe restriction in use, (for example, for pasture or woods). This includes very steep and severely eroded land and shallow soils.

Third Category: No useful vegetation can be established.

Class VIII. Land on which no useful vegetation can be grown. Rock outcrop.

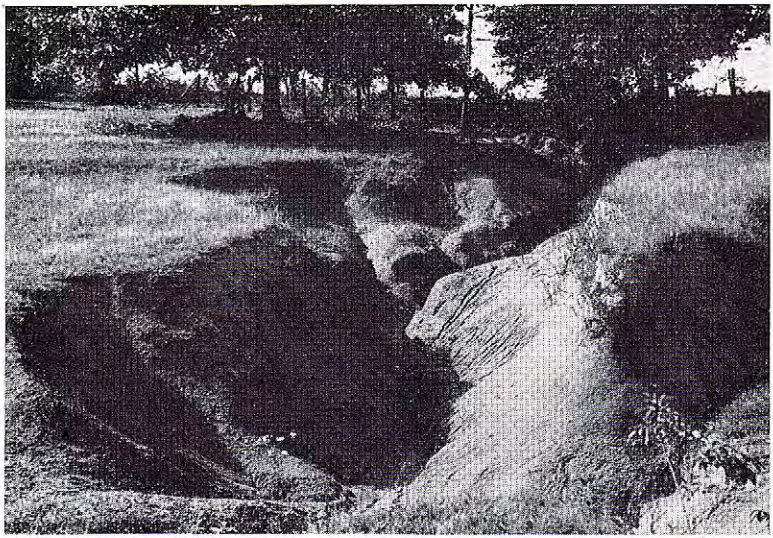


Figure 32

Soil erosion on the Williamson farm near Monticello. The gully was caused by terrace water from a cultivated field above it.

Figure 33

After the gully shown above was sloped with a plow it was sodded in June. The above photograph was taken the following spring.

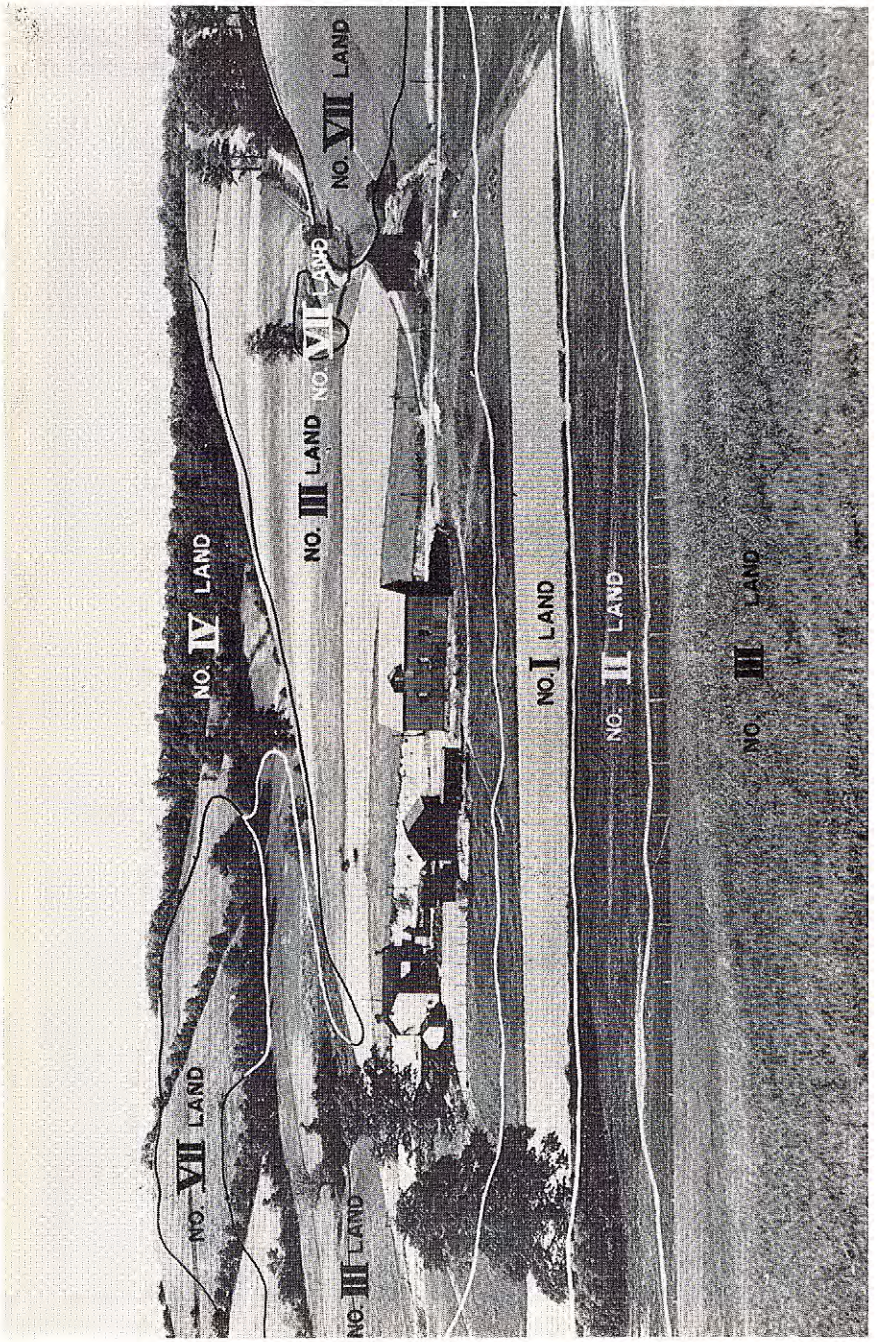


Figure 34

Typical landscape showing relative positions of land classes.

ANNOTATED LIST

of the

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY

Dealing With the Geology, and Mineral and Water Resources of Arkansas

Compiled and Annotated by

EDITH ANN PIERCE

Librarian, Arkansas Geological Survey

ANNUAL REPORTS

*__Sixteenth Annual Report__ of the United States Geological Survey, 1894-95; Charles D. Walcott, Director. 1896. (Parts II, III, and IV, 1895.) 4 parts.

*PART III. Mineral Resources of the United States, 1894: Metallic products, xv, 646 pp., 23 pls.

Discussion of manganese of the Batesville district and of the west-central Arkansas district. Analyses of manganese from the Batesville district and report on production from 1850 to 1894. (pp. 401-405.)

Brief statement on bauxite in Arkansas. (p. 550.)

*PART IV. Mineral Resources of the United States, 1894: Nonmetallic products, xix, 735 pp.

Discussion of coal and coal fields of Arkansas. Production from these. (pp. 70-73.)

Brief statement on the limestone industry of Arkansas in 1894. (p. 495.)

*__Seventeenth Annual Report__ of the United States Geological Survey, 1895-96; Charles D. Walcott, Director. 1896. 3 parts in 4 vols.

*PART I. Director's report and other papers, xxii, 1076 pp., 67 pls.

*(b) Magnetic declination in the United States, by Henry Gannett, pp. 203-440, pls. ii-iii.

Data for determination of secular variation in Arkansas. (pp. 257-259.)

Magnetic declination in Arkansas. (pp. 310-313.)

*PART III. Mineral Resources of the United States, 1895: Metallic products and coal, xxii, 542 pp., 8 pls.

Tables on coal production in Arkansas. (pp. 369-371.)

Brief summary of other mineral resources of Arkansas.

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PART III (continued). Nonmetallic products except coal, iii, pp. 543-1058, 5 pls. $1.

Brief discussion of pyrites in Arkansas. (p. 977.)

*Eighteenth Annual Report of the United States Geological Survey, 1896-97; Charles D. Walcott, Director. 1897. (Parts II and III, 1898.) 5 parts in 6 vols.

PART I. Director's report, including triangulation and spirit leveling, 440 pp., 4 pls. $1.

*(b) Triangulation and spirit leveling, by H. M. Wilson, J. H. Renshawe, E. M. Douglas, and R. U. Goode, pp. 131-422, pls. ii-iv.

Locations of stations for control of Hot Springs special map, Garland County, Ark. (pp. 173-174.)

Elevations in the Hot Springs district, Garland County, determined by spirit leveling. (pp. 337-338.)

*Twentieth Annual Report of the United States Geological Survey, 1898-99; Charles D. Walcott, Director. 1899. (Parts II, III, IV, V, and VII, 1900.) 7 parts in 8 vols. and separate case for maps with Part V.

PART I. Director's report, including triangulation and spirit leveling, 551 pp., 2 pls. $1.

*(b) Triangulation and spirit leveling, by H. M. Wilson, J. H. Renshawe, E. M. Douglas, and R. U. Goode, pp. 211-530.

Arkansas meridian marks in Arkadelphia, Clark County; Benton, Saline County; Malvern, Hot Spring County; and Mena, Polk County. (p. 264.)

Elevations in the Winslow quadrangle determined by spirit leveling. (pp. 405-406.)

*Twenty-first Annual Report of the United States Geological Survey, 1899-1900; Charles D. Walcott, Director. 1900. (Parts III, IV, VI, VI continued, and VII, 1901.) 7 parts in 8 vols. and separate case for maps with Part V.

PART I. Director's report, including triangulation, primary traverse, and spirit leveling, 608 pp., 3 pls. $1.25.

*(b) Triangulation, primary traverse, and spirit leveling, by H. M. Wilson, J. H. Renshawe, E. M. Douglas, and R. U. Goode, pp. 205-582.

Geographic positions (latitude and longitude) in Arkansas, determined by primary traverse in 1898. (pp. 262-265.)

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Elevations in the Fayetteville, Siloam Springs, and Prescott quadrangles, determined by spirit leveling. (pp. 475-479.)

*PART II. General geology, economic geology, Alaska, 522 pp., 68 pls.

*(f) Preliminary report on the Camden coal field of southwestern Arkansas, by J. A. Taff, pp. 313-329, pls. xxxviii-xxxix.

Topography of the area of the coal field in north-central Ouachita County, Ark. Character of Tertiary coal-bearing rocks. Occurrence and structure of coal. Mining development. Composition of Camden coal including physical properties, tables of analyses, and table of gas-producing qualities. Contains map of southern Arkansas showing the Camden coal field, and a map of the Camden coal field.

*PART III. General geology, ore and phosphate deposits, Philippines, 644 pp., 68 pls.

*(d) The Arkansas bauxite deposits, by C. W. Hayes, pp. 435-472, pls. lx-lxiv.

Distribution of bauxite in the United States. Location, and general geologic and physiographic relations of the Arkansas bauxite region. Detailed description of bauxite deposits of the Bryant (Saline County) district, Fourche Mountain district, and deposits near Mabelvale, Alexander, Bryant, and Bearden. Discussion of the origin of the deposits. Economic relations including development, amount of ore, quality of ore, and mining and preparation of ore. Contains general geologic map of the bauxite district, geologic map of Bryant (Saline County) district, and geologic map of Fourche Mountain district.

***Twenty-second Annual Report** of the United States Geological Survey, 1900-1901; Charles D. Walcott, Director. 1901. (Parts III and IV, 1902.) 4 parts.

*PART II. Ore deposits, 888 pp., 82 pls.

*(b) Preliminary report on the lead and zinc deposits of the Ozark region, by H. F. Bain, with an introduction by C. R. Van Hise, and chapters on the physiography and geology by G. I. Adams, pp. 23-228, pls. vi-xxv.

Brief description of the features of the north Arkansas lead and zinc district which seem to link it with the other districts in the Ozark region. General geology, country rock, ores, ore bodies. Very brief statement concerning the southwestern Arkansas district which represents a different and separate class of deposits from those found in the Ozark region. (pp. 195-202.)

*PART III. Coal, oil, cement, 763 pp., 53 pls.

*(i) The southwestern coal field, by J. A. Taff, pp. 367-413, pls. xxv-xxviii.

Location and boundaries of the southwestern coal field in west-central Arkansas. Stratigraphy and structure. Number and extent of workable beds (Pennsylvanian in age). Character of coals and chemical analyses. Development of coal

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mining. Coning tests and steaming tests. Tables on physical properties and evaporation tests. Tabular summary of coal mining. Map of the coal field.

*(o) Chalk of southwestern Arkansas, with notes on its adaptability to the manufacture of hydraulic cements, by J. A. Taff, pp. 687-742, pls. xlvii-liii.

General geography and geology of the region. Sketch of the geologic history beginning with the Cretaceous, and detailed description of the Cretaceous formations. Materials and process of manufacturing natural hydraulic cement and portland cement. Chalks and clays of southwestern Arkansas as portland cement materials. Descriptions of chalks of different areas and tables of analyses. Brief statement concerning the clays and shales available, and analyses of the clays. Portland cement industry in Arkansas.

MONOGRAPHS

*39. The Eocene and lower Oligocene coral faunas of the United States, with descriptions of a few doubtfully Cretaceous species, by T. W. Vaughan. 263 pp., 24 pls. 1900.

Detailed report on the Eocene and lower Oligocene coral faunas of the United States. Alabama, Mississippi, Arkansas, and Louisiana furnish the type section of the gulf state Eocene.

PROFESSIONAL PAPERS

*24. Zinc and lead deposits of northern Arkansas, by G. I. Adams, assisted by A. H. Purdue and E. F. Burchard, with a section on the determination and correlation of formations, by E. O. Ulrich. 118 pp., 27 pls. 1904.

General information concerning the northern Arkansas lead and zinc district. Physiographic relations and topography of the area. Description of geologic formations and grouping with respect to ore deposits. History of physical changes. Principal faults. Brief discussion of the various ores, minerals, and country rock. Genesis and classification of the ore deposits. Descriptions of mines and prospects by counties. Suggestions for prospecting and mining. Determination and correlation of the formations, with table. General geologic map of the lead and zinc district showing mines and prospects. Other geologic and sketch maps. Cross sections and illustrations.

*46. Geology and underground water resources of northern Louisiana and southern Arkansas, by A. C. Veatch. 422 pp., 51 pls. 1906.

Outline of the topography of northern Louisiana and southern Arkansas. Historical geology of the area. General underground-water conditions including principal water-bearing horizons, mineral springs and mineral waters, hygienic value of deep-well waters, and the history of their development. Methods and cost of well making. Underground-water prospects by counties. Detailed well and spring records, and dictionary of altitudes. Numerous maps, diagrams, and other illustrations.

*71. Index to the stratigraphy of North America, by Bailey Willis, accompanied by a geologic map of North Amer-

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ica, compiled by the United States Geological Survey in cooperation with the Geological Survey of Canada and the Instituto Geologico de México, under the supervision of Bailey Willis and G. W. Stose. 894 pp., 1 pl. 1912.

Brief summary of the stratigraphy of each period by areas of occurrence, including tables and sections.

*91. The lower Eocene floras of southeastern North America, by E. W. Berry. 481 pp., 117 pls. 1916.

Brief description of the Midway of Earle, Texas, and systematic descriptions of the Midway flora. General information concerning the Wilcox group. Plant-bearing outcrops including those on Crowley's Ridge in Clay, Greene, and Poinsett Counties, at Benton in Saline County, at Malvern in Hot Spring County, and in Ouachita County. Local distribution of the Wilcox flora, correlation with other flora, and systematic descriptions. Plates, maps, and diagrams.

92. The middle and upper Eocene floras of southeastern North America, by E. W. Berry. v, 206 pp., 65 pls. 1924. $1.

Brief discussion of the general area in which the Claiborne (middle Eocene) and Jackson (upper Eocene) deposits are found. Detailed descriptions of the Claiborne and Jackson flora and the local distribution of these deposits. Plates illustrating the flora.

*95. Shorter contributions to general geology, 1915; David White, chief geologist. iv, 120 pp., 7 pls. 1916.

Issued also in separate chapters.

*(f) Erosion intervals in the Eocene of the Mississippi embayment, by E. W. Berry, pp. 73-82.

Discussion of the Midway, Wilcox, Claiborne, and Jackson formations of the Mississippi embayment, presenting evidence of erosion intervals. The Gulf Coastal Plain of Arkansas is included in the area discussed.

154. Shorter contributions to general geology, 1928; W. C. Mendenhall, chief geologist. iv, 299 pp., 76 pls. 1929. (Published in April, 1930.) $1.50.

Issued also in separate chapters.

*(b) The fauna of the middle Boone near Batesville, Ark., by G. H. Girty, pp. 73-103, pls. 9-12.

The fauna of the middle Boone chert of Mississippian age is conspicuously different from that of the typical lower Boone and from that of the upper Boone. Relations of the fauna of the middle Boone to those of the upper and lower Boone are shown. Detailed descriptions of species, accompanied by plates. Register of localities cited.

*(f) Water-laid volcanic rocks of early Upper Cretaceous age in southwestern Arkansas, southeastern Oklahoma, and northeastern Texas, by C. S. Ross, H. D. Miser, and L. W. Stephenson, pp. 175-202, pls. 18-27.

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Discussion of old volcanoes near Murfreesboro, Pike County, and discoveries of material ejected from them. Distribution of volcanic rocks. General features of rocks associated with the volcanic material, and descriptions of the formations. Character of igneous rocks, and detailed description of minerals. Chemical relations, and age and deposition of volcanic rocks. Description of tuff beds. Brief discussion of diamonds and of kaolin deposits. Geologic map and cross section of parts of Arkansas, Oklahoma, and Texas. Photomicrographs of igneous rocks, and other illustrations.

165. Shorter contributions to general geology, 1930; W. C. Mendenhall, chief geologist. iv, 180 pp., 43 pls. 1931. $1.25.

Issued also in separate chapters.

*(e) The kaolin minerals, by C. S. Ross and P. F. Kerr, pp. 151-180, i-iv, pls. 39-43.

General discussion of the study and nomenclature of kaolin minerals. Detailed description of the minerals nacrite, dickite, and kaolinite-anauxite with brief notes on occurrence. Dickite and kaolinite-anauxite are found in Arkansas. Comparison of kaolin minerals and mode of origin. Plates showing crystals and x-ray diffraction patterns.

186. Shorter contributions to general geology, 1936; G. F. Loughlin, chief geologist.

Issued only in separate chapters.

(b) Fossil flora of the Wedington sandstone member of the Fayetteville shale, by David White. pp. i-ii, 13-41, pls. 4-9. 1937. 10¢.

The Wedington sandstone is a member of the Fayetteville shale of upper Mississippian age. Summary of the stratigraphy, and distribution of the plant-bearing beds. Plant localities in the Wedington sandstone, general composition of flora, and age. Relations of the Wedington flora to that of the coal-bearing shale of the Morrow Group of Washington County, Ark. Inference as to the environment of the Wedington flora. Descriptions of species, accompanied by plates.

(c) Fossil plants from the Stanley shale and Jackfork sandstone in southeastern Oklahoma and western Arkansas, by David White. pp. i-ii, 43-67, pls. 10-14. 1937. 10¢.

Brief description of the Stanley shale, Jackfork sandstone, and Johns Valley shale. Sources of paleobotanic material studied. Present and former views concerning the age of the formations, and paleobotanic evidence supporting assignment to the Pennsylvanian age. Revision of the boundary between the upper and lower Carboniferous of Europe. Listing of plants from the Stanley and Jackfork formations. The relations of these formations to the Morrow Group of Arkansas and to the Wedington and other Chester floras are given. Systematic descriptions of fossil plants, accompanied by plates.

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BULLETINS

*13. Boundaries of the United States and of the several States and Territories, with a historical sketch of the territorial changes, by Henry Gannett, chief geographer. 135 pp. 1885. (See also Bulletins 171, 226, 689, and 817.)

Early history of the boundary of Arkansaw Territory and of the state of Arkansas. (pp. 106-108.)

*32 Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 235 pp. 1886.

List of mineral springs in Arkansas. Analyses of waters from 5 springs located in different parts of the state. (pp. 118-122.)

*171. Boundaries of the United States and of the several States and Territories, with an outline of the history of all important changes of territory (second edition), by Henry Gannett. 142 pp., 53 pls. 1900. (See also Bulletins 226, 689, and 817.)

Early history of the boundary of Arkansaw Territory and of the state of Arkansas. (pp. 112-114.)

*181. Results of primary triangulation and primary traverse, fiscal year 1900-1901, by H. M. Wilson, J. H. Renshawe, E. M. Douglas, and R. U. Goode. 240 pp., 1 pl. 1901.

Geographic positions in Arkansas (latitude and longitude). (pp. 173-174.)

*185. Results of spirit leveling, fiscal year 1900-1901, by H. M. Wilson, J. H. Renshawe, E. M. Douglas, and R. U. Goode. 219 pp. 1901.

Lists errata in previous reports on Arkansas spirit leveling. (p. 113.)

*201. Results of primary triangulation and primary traverse, fiscal year 1901-2, by H. M. Wilson, J. H. Renshawe, E. M. Douglas, and R. U. Goode. 164 pp., 1 pl. 1902.

Geographic positions in Arkansas along Iron Mountain Railway and along highways from Delight westward, determined by primary traverse in 1901. (p. 80.)

*213. Contributions to economic geology, 1902; S. F. Emmons and C. W. Hayes, geologists in charge. 449 pp. 1903. Contains:

Zinc and lead deposits of northern Arkansas, by G. I. Adams, pp. 187-196.

Position, history, and development of the lead and zinc field. Occurrence of ores in Ordovician dolomites and Mississippian limestones. Geology and structure. Source and classification of ores and deposits. Processes and places of deposition of lead and zinc ores.

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Asphalt deposits of Pike County, Ark., by C. W. Hayes, pp. 353-355.

General discussion of the geology and occurrence of asphalt in the Trinity formation in Pike County, Ark. Character and possible use of the asphalt.

*225. Contributions to economic geology, 1903; S. F. Emmons and C. W. Hayes, geologists in charge. 527 pp., 1 pl. 1904. Contains:

Notes on Arkansas roofing slates, by T. N. Dale, pp. 414-416.

Results of examinations of roofing slate from Polk County, Ark.

*226. Boundaries of the United States and of the several States and Territories, with an outline of the history of all important changes of territory (third edition), by Henry Gannett. 145 pp., 54 pls. 1904. (See also Bulletins 689 and 817.)

History of the boundary of Arkansaw Territory and the state of Arkansas since the forming of the Arkansaw Territory on March 2, 1819, from part of the Missouri Territory. (pp. 113-115.)

*243. Cement materials and industry of the United States by E. C. Eckel. 395 pp., 15 pls. 1905. (See also Bulletin 522.)

General information on the materials and manufacture of portland cement. Description of limestones in Arkansas, available and useable in portland cement. Analyses of samples of some of these. Discussion of Cretaceous chalk beds, accompanied by geologic sections. Map of the chalk area of southwestern Arkansas. Analyses of chalk. Brief discussion of Tertiary and Carboniferous clays and shales, with analyses of clays. General statement concerning the portland cement industry in Arkansas. Bibliography of cement resources of Arkansas. (pp. 88-116.)

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 106 pp. 1905.

Summary of well drilling in Arkansas in 1904. (pp. 42, 43.)

*275. Slate deposits and slate industry of the United States, by T. N. Dale, with sections by E. C. Eckel, W. F. Hillebrand, and A. T. Coons. 154 pp., 25 pls. 1906.

Definition and classification, petrographic characteristics, structure, geologic relations, chemistry, and economic geology of slate. Location and description of Arkansas slate deposits. Chemical and microscopic analyses of slate. (pp. 51-55.)

Production figures for the years 1879 to 1904. (pp. 126-131.)

*285. Contributions to economic geology, 1905; S. F. Emmons and E. C. Eckel, geologists in charge. 506 pp., 13 pls. 1906.

Issued also in separate chapters.

*(1) Clays.—Contains: Clays of Garland County, Ark., by E. C. Eckel, pp. 407-410.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

General statement concerning the clay area in Garland County. Descriptions and analyses of clays.

***298.** Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 299 pp. 1906.

Summary of well drilling in Arkansas in 1905 for water, oil, and gas. (pp. 34-39.)

Log of a water well northeast of Fulton, Hempstead County, Ark. (p. 187.)

***302.** The areas of the United States, the States, and the Territories, by Henry Gannett. 9 pp., 1 pl. 1906.

Land, water, and total area of Arkansas.

***310.** Results of primary triangulation and primary traverse, fiscal year 1905-6, by S. S. Gannett. 248 pp., 1 pl. 1907.

Geographic positions in Crawford, Franklin, Logan, Scott, and Sebastian Counties, Ark., determined by primary traverse in 1905. (pp. 6-10.)

***315.** Contributions to economic geology, 1906, Part I, Metals and nonmetals except fuels; S. F. Emmons and E. C. Eckel, geologists in charge. iv, 505 pp., 4 pls. 1907.

Issued also in separate chapters.

*(p) Phosphate and Phosphorus.—Contains: Developed phosphate deposits of northern Arkansas, by A. H. Purdue, pp. 463-473.

Geographic distribution of phosphate beds. Geology of the region in northern Arkansas. Location, description, and methods of working developed deposits. Origin and age of the phosphates.

***316.** Contributions to economic geology, 1906, Part II, Coal, lignite, and peat; M. R. Campbell, geologist in charge. v, 543 pp., 23 pls. 1907.

Issued also in separate chapters.

*(b) Coal Fields of Illinois and Arkansas.—Contains: The Arkansas coal field, by A. J. Collier, pp. 137-160, pl. ix.

Geography and geology including structure and stratigraphy of the area. Map of Arkansas coal field. Detailed discussion of the coals of the Hartshorne, Charleston, and Paris horizons by district, and brief discussion of coals below the Hartshorne. Character of the coal and table of analyses. Conditions of mining and development.

***326.** The Arkansas coal field, by A. J. Collier, with reports on the paleontology, by David White and G. H. Girty. 158 pp., 6 pls. 1907.

Geography and general geology, including stratigraphy, paleontology, and structure, of the Arkansas coal field in western Arkansas. Economic geology of the various coal horizons and districts, including description of bed, character

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

of coal, special tests and analyses, and conditions of mining and development. Table of mines, openings, and exposures of coal.

***340.** Contributions to economic geology, 1907, Part I, Metals and nonmetals except fuels; C. W. Hayes and Waldemar Lindgren, geologists in charge. 482 pp., 6 pls. 1908.

Issued also in separate chapters.

*(d) Rare Metals.—Contains: The Arkansas antimony deposits, by F. L. Hess, pp. 241-252.

The antimony deposits of Arkansas are in northern Sevier County. Discussion of stratigraphy and structure of the region. Description of antimony veins and locations of mines and shafts. Bibliography of papers on antimony deposits in Arkansas.

***351.** The clays of Arkansas, by J. C. Branner. 247 pp., 1 pl. 1908.

Brief summary of the topography and geology of Arkansas. Character, origin, occurrence, and uses of Arkansas clays. Geologic age and distribution of clays. Detailed report by counties. Tables of clay analyses, production, and producers. Geologic map of Arkansas.

***427.** Manganese deposits of the United States, with sections on foreign deposits, chemistry, and uses, by E. C. Harder. 298 pp., 2 pls. 1910.

Ore from two districts. Batesville district topography and geology. Description of the Paleozoic formations. Ore found in the Cason shale. General relations and forms of the ore. Descriptions of mines and deposits. Analyses and origin of the ore. West-central Arkansas district geography, topography, and geology. Character, occurrence, and analyses of ore.

***430.** Contributions to economic geology (short papers and preliminary reports), 1909, Part I, Metals and nonmetals except fuels; C. W. Hayes and Waldemar Lindgren, geologists in charge. 653 pp., 14 pls. 1910.

Issued also in separate chapters.

*(f) Structural Materials.—Contains: The slates of Arkansas, by A. H. Purdue, pp. 317-334.

Summary of the slate industry in Arkansas. Origin of slate. Geology of the slate area in the Ouachita mountains of Arkansas with columnar and cross sections. Descriptions of the Ouachita shale, Polk Creek shale, Missouri Mountain slate, Fork Mountain slate, and Stanley shale. Results of electric, chemical, and physical tests.

***439.** The fauna of the Moorefield shale of Arkansas, by G. H. Girty. 148 pp., 15 pls. 1911.

General geology of northern Arkansas, and miscellaneous faunal lists. Descriptions of species of the Moorefield shale, accompanied by plates. Register of localities from which the fauna was studied.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

440. Results of triangulation and primary traverse for the years 1906, 1907, and 1908; R. B. Marshall, chief geographer. 688 pp., 1 pl. 1910. 50¢.

Geographic positions (latitude and longitude) in the Caddo Gap, De Queen, Locksburg, and Poteau Mountain quadrangles, in Howard, Polk, and Sevier Counties. Determined by primary traverse. (pp. 26-30.)

***458.** Results of spirit leveling in Arkansas, Louisiana, and Mississippi, 1896 to 1909, inclusive; R. B. Marshall, chief geographer. 79 pp., 1 pl. 1911. (See also Bulletin 636.)

Elevations in Arkansas determined by primary leveling. (pp. 8-26.)

465. The State geological surveys of the United States, compiled under the direction of C. W. Hayes. 177 pp. 1911. 15¢.

History of the Arkansas Geological Survey, 1857 through 1910. (pp. 17-20.)

***494.** The New Madrid earthquake, by M. L. Fuller. 119 pp., 10 pls. 1912.

Detailed study of the earthquake in the New Madrid district in parts of Missouri, Arkansas, Illinois, Kentucky, and Tennessee in 1811. Accompanied by maps and diagrams.

522. Portland cement materials and industry in the United States, by E. C. Eckel, with contributions by E. F. Burchard and others. 401 pp., 19 pls. 1913. 65¢.

Descriptions and analyses of various limestones and of the Cretaceous chalk beds in Arkansas. Brief discussion of Tertiary and Carboniferous clays and shales. Summary of the early portland cement industry in Arkansas. (pp. 92-116.)

530. Contributions to economic geology (short papers and preliminary reports), 1911, Part I, Metals and non-metals except fuels; Waldemar Lindgren, chief geologist. 400 pp., 7 pls. 1913. 30¢.

Issued also in separate chapters.

*(q) Developed deposits of fuller's earth in Arkansas, by H. D. Miser, pp. 207-219, pl. iv.

General discussion of character and occurrence of fuller's earth. Geology of the area in Arkansas in which fuller's earth occurs. Mining and milling. Fuller's earth industry in Arkansas.

***540.** Contributions to economic geology (short papers and preliminary reports), 1912, Part I, Metals and non-metals except fuels; David White, chief geologist. 563 pp., 11 pls. 1914.

Issued also in separate chapters.

*(u) New areas of diamond-bearing peridotite in Arkansas, by H. D. Miser, pp. 534-546, pl. xi.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Geology of the peridotite area in Pike County. Description and occurrence of peridotite and diamonds. Commercial development.

***541.** Contributions to economic geology (short papers and preliminary reports), 1912, Part II, Mineral fuels; M. R. Campbell, geologist in charge. 532 pp., 29 pls. 1914.

Issued also in separate chapters.

*(b) Structure of the Fort Smith-Poteau gas field, Ark.-Okla., by C. D. Smith, pp. 23-33, pl. ii.

Topography, geology, and structure of the Fort Smith-Poteau gas field. Relation of regional structure to the occurrence of oil and gas.

***585.** Useful minerals of the United States, compiled by Samuel Sanford and R. W. Stone. 250 pp. 1914. (See also Bulletin 624.)

Summary of occurrence, use, and description of rocks and minerals of Arkansas. (pp. 19-24.)

586. Slate in the United States, by T. N. Dale and others. 220 pp., 26 pls. 1914. 50¢.

Topography and geology of the slate area of Arkansas, with occurrence, description, and analyses of slates. (pp. 61-65.)

***593.** The fauna of the Batesville sandstone of northern Arkansas, by G. H. Girty. 170 pp., 11 pls. 1915.

Discussion of the Batesville sandstone (Mississippian) fauna and its relation to other fauna. Description of species, accompanied by plates. Register of localities in which the fauna was studied.

595. Fauna of the so-called Boone chert near Batesville, Ark., by G. H. Girty. 45 pp., 2 pls. 1915.

General geology of the area. Lithology and fauna of the chert member of the Boone limestone (Mississippian). Relations to other fauna. Description of species, accompanied by plates. Register of localities from which fauna was studied.

***598.** Faunas of the Boone limestone at St. Joe, Ark., by G. H. Girty. 50 pp., 3 pls. 1915.

Descriptions of faunas from the lower part of the Boone limestone (Mississippian) and from the St. Joe limestone member, accompanied by plates.

***624.** Useful minerals of the United States, compiled by F. C. Schrader, R. W. Stone, and Samuel Sanford (a revision of Bulletin 585). 412 pp. 1916.

Revised and enlarged summary of occurrence, use, and description of rocks and minerals of Arkansas. (pp. 34-41.)

***636.** Spirit leveling in Arkansas, 1896 to 1915, inclusive; R. B. Marshall, chief geographer. 56 pp., 1 pl. 1916.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Elevations in Arkansas determined by primary leveling. Also elevations adjusted by the Coast and Geodetic Survey by precise leveling.

*644. Triangulation and primary traverse, 1913-15; R. B. Marshall, chief geographer. 655 pp., 2 pls. 1916.

Issued also in separate chapters.

*(h) Triangulation and primary traverse in Kentucky, Tennessee, and Arkansas, 1913-15, pp. 391-404, pl. ii.

Geographic positions (latitude and longitude) for the Memphis quadrangle, Ark. and Tenn. (pp. 401-404.)

*659. Cannel coal in the United States, by G. H. Ashley. 127 pp., 8 pls. 1918.

Occurrence and description of Camden coal (lignite) from Camden, Ouachita County, Ark. (pp. 119-121.)

*660. Contributions to economic geology (short papers and preliminary reports), 1917, Part I, Metals and non-metals except fuels; F. L. Ransome, E. F. Burchard, and H. S. Gale, geologists in charge. viii, 304 pp., 11 pls. 1918.

Issued also in separate chapters.

*(b) Notes on the greensand deposits of the eastern United States, by G. H. Ashley, pp. 27-49, pl. ii.

Occurrence, description, and analyses of greensand deposits in Arkansas. (pp. 46-48.)

*(c) Manganese deposits of the Caddo Gap and DeQueen quadrangles, Ark., by H. D. Miser, pp. 59-122, pl. iii.

This includes a brief section on the geography and geology of the area, a discussion of the ore deposits in general, and detailed descriptions of the various mines and prospects. Geologic map of the northern parts of the DeQueen and Caddo Gap Quadrangles.

*689. Boundaries, areas, geographic centers, and altitudes of the United States and the several States, with a brief record of important changes in their territory, by E. M. Douglas. vi, 234 pp., 7 pls. 1923. (See also Bulletin 817.)

History of the boundary of Arkansaw Territory and of the state of Arkansas. (pp. 157-160.)

690. Contributions to economic geology (short papers and preliminary reports), 1918, Part I, Metals and non-metals except fuels; F. L. Ransome, E. F. Burchard, and H. S. Gale, geologists in charge. vi, 147 pp., 5 pls. 1919. 25¢.

Issued also in separate chapters.

*(b) Gravel deposits of Caddo Gap and DeQueen quadrangles, Ark., by H. D. Miser and A. H. Purdue, pp. 15-30, pls. i-iii.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

General discussion of the geography and geology of the southern parts of the Caddo Gap and DeQueen quadrangles, accompanied by a geologic map of the area. Description of the sand and gravel formations. Economic uses of the gravels.

*691. Contributions to economic geology (short papers and preliminary reports), 1918, Part II, Mineral fuels; David White, G. H. Ashley, and M. R. Campbell, geologists in charge. viii, 355 pp., 44 pls. 1919.

Issued also in separate chapters.

*(j) Asphalt deposits and oil conditions in southwestern Arkansas, by H. D. Miser and A. H. Purdue, pp. 271-292, pl. xxxiii.

Geography and geology of the Ouachita Mountain region and the Gulf Coastal Plain of southwestern Arkansas. Occurrence, description, origin, and value of asphalt deposits. Logs of wells drilled for oil.

*697. Gypsum deposits of the United States, by R. W. Stone and others. 326 pp., 37 pls. 1920.

Occurrence of gypsum in Arkansas. (p. 57.)

*708. High-grade clays of the eastern United States, with notes on some western clays, by H. Ries, W. S. Bayley, and others. xiv, 314 pp., 30 pls. 1922.

Brief statement concerning clays in the bauxite areas of Pulaski and Saline Counties, Ark. Brief statement on distribution and character of Arkansas clays. Description and analyses of clay from the Camden Coal and Clay Co. near Lester, Ouachita County. Sections and map. Section near Benton, Saline County, showing clay. (pp. 120-121, 255-259.)

*715. Contributions to economic geology (short papers and preliminary reports), 1920, Part I, Metals and non-metals except fuels; F. L. Ransome, H. S. Gale, and E. F. Burchard, geologists in charge. viii, 230 pp., 20 pls. 1921.

Issued also in separate chapters.

*(g) Preliminary report on the deposits of manganese ore in the Batesville district, Ark., by H. D. Miser, pp. 93-124, pls. vi-viii.

Geography and geology of the Batesville district with history and production of manganese. Descriptions and analyses of ores. Discussion of occurrence and types of ore deposits. Uses of ores and economic possibilities. Geologic map of the Batesville district, Ark., and cross section showing occurrence of manganese deposits.

*734. Deposits of manganese ore in the Batesville district, Ark., by H. D. Miser, with a chapter on the mining and preparation of the ores, by W. R. Crane. xi, 273 pp., 16 pls. 1923.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

History and production of manganese in the Batesville area. Geography. Geology including rock formations and structure. Detailed discussion of ore minerals and deposits. Mining methods and preparation of the ores. Descriptions of mines and prospects in the region by county. Geologic map of mines in Independence County. Geologic map of the Batesville district.

***735.** Contributions to economic geology (short papers and preliminary reports), 1922, Part I, Metals and non-metals except fuels; F. L. Ransome, G. R. Mansfield, and E. F. Burchard, geologists in charge. x, 336 pp., 15 pls. 1923.

Issued also in separate chapters.

*(h) Peridotite dikes in Scott County, Ark., by H. D. Miser and C. S. Ross, pp. 271-278, pl. vii.

Location of peridotite dikes in Scott County. Description of the peridotite and associated rocks. Economic features.

*(i) Diamond-bearing peridotite in Pike County, Ark., by H. D. Miser and C. S. Ross, pp. 279-322, pls. viii-xv.

Location and geography of the area with a brief history of the discovery and development. General geology and description of formations, including detailed descriptions of the peridotites and associated rocks. Comparison of diamond-bearing rocks of Arkansas with those of South Africa. Occurrence, production, and character of the diamonds. Mining and treatment of diamond-bearing material. Bibliography of papers on the peridotite and diamonds of Pike County, Ark.

***736.** Contribution to economic geology (short papers and preliminary reports), 1922, Part II, Mineral fuels; K. C. Heald, geologist in charge. vi, 254 pp., 24 pls. 1923.

Issued also in separate chapters.

*(h) Stratigraphy of the El Dorado oil field, Ark., as determined by drill cuttings, by James Gilluly and K. C. Heald, pp. 241-254, i-vi, pl. xxiv.

Stratigraphic column of Tertiary and Upper Cretaceous rocks of the El Dorado oil field, Ark., and the method of constructing such a column.

808. Geology of the DeQueen and Caddo Gap quadrangles, Ark., by H. D. Miser and A. H. Purdue. xi, 195 pp., 18 pls. 1929. 75¢.

This gives a detailed description of the general, historical, and economic geology of the DeQueen and Caddo Gap quadrangles, Ark., and the geography of the same area. In addition, brief sections are devoted to general geography and geology of the Ouachita Mountain area, Arkansas Valley, and Gulf Coastal Plain. Maps and cross sections.

817. Boundaries, areas, geographic centers, and altitudes of the United States and the several States, with a brief record of important changes in their territory and government (2d edition), by E. M. Douglas. vii, 265 pp., 12 pls. 1930. 75¢.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

History of the boundary of Arkansaw Territory and of the state of Arkansas with confirmation of the report of commissioners on the Arkansas-Tennessee boundary by the Supreme Court in 1925. (pp. 178-182.)

838. Nitrate deposits of the United States, by G. R. Mansfield and Leona Boardman. vi, 107 pp., 11 pls. 1932. 40¢.

Brief summary of nitrate deposits in Baxter, Marion, Newton, Stone, Benton, Carroll, Madison, Johnson, Pope, and Searcy Counties, Ark. (pp. 21-23.)

847. Contributions to economic geology (short papers and preliminary reports), 1934-36; G. F. Loughlin, geologist in charge.

Issued only in separate chapters.

(e) Geology and mineral resources of the western part of the Arkansas coal field, by T. A. Hendricks and Bryan Parks. pp. i-iv, 189-224, pl. 35. 1937. 25¢.

Geography and general geology of the western part of the Arkansas coal field. Mineral resources include coal, natural gas, sand and gravel, shale (suitable for the manufacture of brick), and crushed rock. Map showing geologic structure and mineral resources of the western part of the Arkansas coal field.

853. Zinc and lead deposits of northern Arkansas, by E. T. McKnight. vi, 311 pp., 11 pls. 1935. $1.

Detailed study of the lead and zinc deposits of northern Arkansas. This includes a lengthy report of the stratigraphy and structure of the area as a geologic basis for the occurrence of the ores. Mineralogy and paragenesis of the ores is given. Occurrence of primary ores covers geologic horizon, structural relations of ores, size and type of ore deposits, and origin of ores. Descriptions of mines are given by county. Numerous maps, sections, and other illustrations.

878. Analyses of rocks and minerals from the laboratory of the United States Geological Survey, 1914-36, tabulated by R. C. Wells, chief chemist. x, 134 pp. 1937. 15¢.

Analyses of phonolite and trachyte from Howard County, north and northwest of Nashville. (p. 11.)

886. Contributions to economic geology (short papers and preliminary reports), 1937; H. D. Miser, E. F. Burchard, D. F. Hewitt, and G. R. Mansfield, geologists in charge.

Issued only in separate chapters.

(c) Geology and ore deposits of the southwestern Arkansas quicksilver district, by J. C. Reed and F. G. Wells. pp. i-vi, 15-90, pls. 2-17. 1938. 75¢.

Detailed study of the geology and ore deposits of the southwestern Arkansas quicksilver district. Age and attitude, distribution and character, and structure of rocks are given, and the development of topographic features is discussed. A general statement of the distribution of metallic minerals in the Ouachita region is followed by a discussion of quicksilver deposits including ore and gangue minerals, structural control, and origin and age of mineralization. Eco-

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nomic possibilities, history, production, and treatment of ores. Descriptions of mines and prospects. Numerous maps, sections, and other illustrations.

901. Clay investigations in the Southern States, 1934-35, reports by W. B. Lang, P. B. King, M. N. Bramlette, T. N. McVay, H. X. Bay, and A. C. Munyan, with an introduction by G. R. Mansfield. x, 346 pp., 8 pls. 1940. $1.

Very brief statement concerning the early knowledge of the occurrence and use of fuller's earth (bleaching clay) in Arkansas. (pp. 3-4, 7-8.)

921. Contributions to economic geology, 1940, short papers by H. D. Miser, W. G. Pierce, and D. A. Andrews.

Issued only in separate chapters.

(a) Manganese carbonate in the Batesville district, Ark., by H. D. Miser, with a chapter on minerals of the ores, by D. F. Hewett and H. D. Miser. pp. i-v, 1-97, pls. 1-10. 1941. 60¢.

Location, geography, and geology of the area. Descriptions of minerals of the ores, and types and outcrops of deposits with their relation to structural features. Origin of the ores. Discovery of carbonate ore, its commercial use and economic possibilities. Mines and prospects containing manganese carbonate. Maps, columnar sections, and cross sections.

936. Strategic minerals investigations, 1942.

Issued only in separate chapters.

(h) Quicksilver deposits near the Little Missouri River, Pike County, Ark., by David Gallagher. pp. i-iv, 189-219, pls. 23-35. 1942. 55¢.

General geology, stratigraphy, and structure of the area. Size and shape, distribution, mineralogy, tenor, origin and age, and downward extent of ore deposits. Localization of the ore bodies. Ore reserves and future of the district. Statement on mining and prospecting. Brief descriptions of individual mines and prospects, accompanied by maps and sections.

WATER-SUPPLY PAPERS

***44.** Profiles of rivers in the United States, by Henry Gannett. 100 pp., 11 pls. 1901.

99. Report of progress of stream measurements for the calendar year 1903, by J. C. Hoyt, part 3, Western Mississippi River and western Gulf of Mexico drainage. 422 pp., 1 pl. 1904. 25¢.

Discharge measurements, mean daily gage height, and other information concerning the Ouachita River at Malvern, Ark. for 1903. (pp. 313-315.)

***102.** Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 522 pp. 1904. Contains:

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Arkansas, by A. H. Purdue, pp. 374-388.

General statement on organization and field work in Arkansas of the division of hydrology. (pp. 19-20.)

Discussion of water-bearing formations. Table giving records of 96 wells in Arkansas. Notes on some of the wells and analyses of water. Statement on springs accompanied by table giving miscellaneous spring records, and notes on some springs. (pp. 374-388.)

***110.** Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 211 pp., 5 pls. 1905. Contains:

Summary of the water supply of the Ozark region in northern Arkansas, by G. I. Adams, pp. 179-182.

Brief summary of the Ozark region and its divisions. Classification of springs on the basis of rock formations.

***114.** Underground waters of eastern United States; M. L. Fuller, geologist in charge. 285 pp., 18 pls. 1905. Contains:

Louisiana and southern Arkansas, by A. C. Veatch, pp. 179-187.

General geology and table of the water-bearing value of geologic formations. Discussion of water horizons. Brief statement concerning mineral springs.

Northern Arkansas, by A. H. Purdue, pp. 188-197.

Description of the region. General discussion of resources. Brief geology. Water resources of different areas. Brief statement concerning mineral springs.

***120.** Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879-1904, by M. L. Fuller. 128 pp. 1905.

Bibliography of publications on underground water, including those on underground water of Arkansas.

131. Report of progress of stream measurements for the calendar year 1904, part 8, Platte, Kansas, Meramec, Arkansas, and Red River drainages, by M. C. Hinderlider and J. C. Hoyt. 203 pp., 2 pls. 1905. 15¢.

Discharge measurements, mean daily gage height, rating table, estimated monthly discharge, and other information concerning the Ouachita River near Malvern, Ark. for 1903-04. (pp. 190-193.)

***145.** Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 220 pp., 6 pls. 1905. Contains:

Water resources of the Winslow quadrangle, Ark., by A. H. Purdue, pp. 84-87.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Location, topography, drainage, and geology in brief. Water resources including springs and wells, nature of the water, mineral springs, and uses of water.

Water resources of the contact region between the Paleozoic and Mississippi embayment deposits in northern Arkansas, by A. H. Purdue, pp. 88-119, pls. i-iii.

Topography of the lowlands and highlands, and drainage. Geology of the lowlands including history, erosion, deposits, and description of rocks. Geology of the highlands including description of rock formations and structural geology. Paleozoic-Tertiary contact. Underground-water resources of the highlands. Detailed discussion of the origin of water, water horizons, chemical character of water, uses, springs, and wells of underground water of the lowlands. Geologic map and cross sections.

Notes on certain large springs of the Ozark region, Mo. and Ark., compiled by M. L. Fuller, pp. 207-210.

Brief discussion of Mammoth Spring in northern Fulton County, Ark.

***149.** Preliminary list of deep borings in the United States (second edition, with additions), by N. H. Darton. 175 pp. 1905.

Results of deep borings in Arkansas including depth, diameter, yield per minute, depth to water, and remarks. Given by county. List of publications relating to deep borings. (pp. 11-14.)

***152.** A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 149 pp. 1905.

Statutory restrictions on water pollution in Arkansas. (p. 34.)

***160.** Underground-water papers, 1906; M. L. Fuller, geologist in charge. 104 pp., 1 pl. 1906. Contains:

Drainage of wet lands in Arkansas by wells, by A. F. Crider, pp. 54-58.

Brief statement on well drainage in other states. Report on topography of northeastern Arkansas, character of surface and underlying water, depth of standing surface water, and height of water table. Number of wells necessary, and cost to drain an acre. Value of drainage and sanitary effects.

***163.** Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 130 pp. 1906.

Bibliography of publications on underground water, including those on underground water of Arkansas.

***173.** Report of progress of stream measurements for the calendar year 1905, part 9, Meramec, Arkansas, Red, and lower western Mississippi River drainages, by M. C. Hinderlider, J. M. Giles, and J. C. Hoyt. 105 pp., 1 pl. 1906.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Daily gage height and other information concerning the Ouachita River near Malvern, and at Arkadelphia, Ark. for 1905. (pp. 99-100.)

209. Surface water supply of lower western Mississippi River drainage, 1906; R. I. Meeker and J. M. Giles, district hydrographers. 79 pp., 2 pls. 1907. 15¢.

Discharge measurements in 1906. Daily gage height for 1906, rating table for 1905-06, monthly discharge for 1905-06 of the Ouachita River at Arkadelphia, Ark. (pp. 72-74.)

***236.** The quality of surface waters in the United States, part 1, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 123 pp. 1909.

General information concerning examination of water.

Average percentage of errors of combining weights, and location of sampling stations. Table of mineral analyses of water from the Arkansas River near Little Rock, Ark., 1906-07. (pp. 36, 43, 49, and 116.)

267. Surface water supply of the United States, 1909, part 7, Lower Mississippi basin, prepared under the direction of M. O. Leighton by W. B. Freeman and R. H. Bolster. 99 pp., 2 pls. 1911. 10¢.

Description of White River drainage basin with daily gage height for 1909 taken near Beaver, Ark.; Branson, Mo.; Lead Hill, Ark.; Cotter, Ark.; and Walls Ferry, Ark. Also gage heights of Buffalo River near Gilbert, Ark.; North Fork River near Henderson, Ark., and Little Red River near Pangburn, Ark. (pp. 32-39.)

287. Surface water supply of the United States, 1910, part 7, Lower Mississippi basin, prepared under the direction of M. O. Leighton by W. B. Freeman and J. G. Mathers. 91 pp., 2 pls. 1911. 10¢.

Description of the White River drainage basin with daily gage height for 1910 taken near Beaver, Ark.; Branson, Mo.; Lead Hill, Ark.; Cotter, Ark.; and at Walls Ferry, Ark. Also gage heights of Buffalo River near Gilbert, Ark.; North Fork River near Henderson, Ark.; and Little Red River near Pangburn, Ark.

***340.** Stream-gaging stations and publications relating to water resources, 1885-1913, compiled by B. D. Wood. 195 pp. 1916.

Issued also in separate chapters.

*(g) Part 7: Lower Mississippi River basin, pp. 83-93, i-xxii.

List of stream-gaging stations in the lower Mississippi River basin and dates when they were maintained. List of publications on underground water of this area.

***364.** Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke. 40 pp. 1914.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Analyses of water from Happy Hollow Spring, Potash Sulphur Springs, Two Springs at Hominy Hill, and Mountain Valley Spring in Garland County, Ark. (pp. 15-16.)

*399. Geology and ground waters of northeastern Arkansas, by L. W. Stephenson and A. F. Crider, with a discussion of the chemical character of the waters, by R. B. Dole. 315 pp., 11 pls. 1916.

Bibliography of important contributions to the geology and water resources of northeastern Arkansas. Physiography. General and historical geology of the Paleozoic, Mesozoic, and Cenozoic formations. Brief discussion of surface waters. Source, disposal, quantity, and stratigraphic distribution of ground waters. Springs, non-artesian waters, and artesian waters. Economic uses of ground waters. Descriptions of water resources by county. Chemical character of waters including standards of classification for boiler use, irrigation, and domestic use. Purification, assays, and chemical analyses. Geologic and ground water maps.

*427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 169 pp., 1 pl. 1918.

Bibliography of publications on underground water, including those on underground water of Arkansas.

547. Surface water supply of the United States, 1922, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; E. L. Williams and Robert Follansbee, district engineers. iv, 106 pp., 2 pls. 1925. 15¢.

General information concerning monthly and daily discharge records of the Ouachita River near Hot Springs and Malvern, Ark., for the year ending September 30, 1922. (pp. 99-101.)

*557. Large springs in the United States, by O. E. Meinzer. vii, 94 pp., 17 pls. 1927.

Information concerning Mammoth Spring in Fulton County, Ark. Includes figures on discharge. (pp. 19, 21.)

*558. Preliminary index to river surveys made by the United States Geological Survey and other agencies, by B. E. Jones and R. O. Helland. iv, 108 pp., 2 pls. 1926.

Index to river surveys in Arkansas. (p. 9.)

560. Contributions to the hydrology of the United States, 1925; N. C. Grover, chief hydraulic engineer. iii, 134 pp., 2 pls. 1925. (Published in March, 1926.) 20¢.

Issued also in separate chapters.

*(c) Index of analyses of natural waters in the United States, by W. D. Collins and C. S. Howard, pp. 53-85.

Index to publications which give analyses of natural waters in Arkansas. (p. 60.)

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

567. Surface water supply of the United States, 1923, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; E. L. Williams, H. C. Beckman, Robert Follansbee, and H. B. Kinnison, district engineers. iv, 122 pp., 3 pls. 1926. 15¢.

Information concerning the White River at Beaver, Ark., and the Ouachita River near Hot Springs and Malvern, Ark. Accompanied by tables giving daily and monthly discharge figures for the periods July 17, 1909 to December 31, 1910, and May 16 to September 30, 1923, on the White River. Similar tables on the Ouachita River for the year ending September 30, 1923. (pp. 28-30, 90-94.)

587. Surface water supply of the United States, 1924, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; H. C. Beckman, Robert Follansbee, H. B. Kinnison, and C. E. Ellsworth, district engineers. iv, 123 pp. 1928. 20¢.

General information, and daily and monthly discharge measurements of the White River at Beaver, Ark., for the year ending September 30, 1924, and of the Ouachita River near Hot Springs and at Remmel Dam near Malvern, Ark., for the years ending September 30, 1923 and 1924. (pp. 31-32, 113-117.)

607. Surface water supply of the United States, 1925, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; H. C. Beckman, Robert Follansbee, H. B. Kinnison, and C. E. Ellsworth, district engineers. iv, 113 pp. 1929. 20¢.

General information, and daily and monthly discharge measurements of the White River at Beaver, Ark., and of the Ouachita River near Hot Springs and at Remmel Dam near Malvern, Ark., for the year ending September 30, 1925. (pp. 28-30, 104-107.)

627. Surface water supply of the United States, 1926, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; H. C. Beckman, Robert Follansbee, J. B. Spiegel, and C. E. Ellsworth, district engineers. iv, 98 pp. 1930. 15¢.

General information, and daily and monthly discharge measurements of the White River at Beaver, Ark., and the Ouachita River near Hot Springs and at Remmel Dam near Malvern, Ark., for the year ending September 30, 1926. (pp. 28-30, 93-95.)

647. Surface water supply of the United States, 1927, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; H. C. Beckman, Robert Follansbee, J. B. Spiegel, and C. E. Ellsworth, district engineers. iv, 98 pp. 1930. 20¢.

General information, and daily and monthly discharge measurements of the White River at Beaver, Ark., and the Ouachita River near Hot Springs and at Remmel Dam near Malvern, Ark., for the year ending September 30, 1927. (pp. 28-29, 92-95.)

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

658. The industrial utility of public water supplies in the United States, 1932, by W. D. Collins, W. L. Lamar, and E. W. Lohr. iv, 135 pp., 1 pl. 1934. 15¢.

Information on public water supplies in general. Tabulated data and analyses of water supplies for larger cities in the United States. Cities of Arkansas are included in this report. (pp. 40-41.)

***659.** Contributions to the hydrology of the United States, 1932; N. C. Grover, chief hydraulic engineer. v, 209 pp., 19 pls. 1932.

Issued also in separate chapters.

*(c) Index of analyses of natural waters in the United States, 1926 to 1931, by W. D. Collins and C. S. Howard, pp. 191-209, i-v.

List of publications containing collections of mineral analyses of waters in Arkansas. (p. 198.)

667. Surface water supply of the United States, 1928, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; H. C. Beckman, Robert Follansbee, J. B. Spiegel, and C. E. Ellsworth, district engineers. iv, 80 pp. 1931. 15¢.

General information, and daily and monthly discharge measurements of the following rivers during the year 1927-1928:

St. Francis River
St. Francis River floodway
Big Lake outlet
White River
Little Red River
Cache River
Arkansas River
Red River
Little River
Ouachita River
Little Missouri River
Saline River

679. Contributions to the hydrology of the United States, 1935; N. C. Grover, chief hydraulic engineer.

Issued only in separate chapters.

(b) Thermal springs in the United States, by N. D. Stearns, H. T. Stearns, and G. A. Waring. pp. i-iv, 59-206, pls. 7-16. 1937. 35¢.

Geologic problems relating to thermal springs. Distribution by physiographic divisions. Annotated bibliography of thermal springs in the United States. Tabulated data on thermal springs. Thermal springs in Arkansas are included in this report. (pp. 78-80, 98-99, 117.)

680. Droughts of 1930-34, by J. C. Hoyt. vii, 106 pp., 1 pl. 1936. 20¢.

Tables and maps showing annual precipitation by states, 1881-1934. Also tables showing monthly precipitation for the period June 1929, through December 1931. Arkansas included.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

687. Surface water supply of the United States, 1929, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; H. C. Beckman, W. S. Frame, J. H. Gardiner, J. B. Spiegel, C. E. McCashin, and C. E. Ellsworth, district engineers. iv, 88 pp. 1931. 15¢.

General information, and daily and monthly discharge measurements of the following rivers during the year 1928-29:

St. Francis River floodway
Big Lake outlet
White River
Buffalo River
North Fork of White River
Black River
Little Red River
Cache River
Arkansas River
Red River
Little River
Ouachita River
Little Missouri River
Saline River

702. Surface water supply of the United States, 1930, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; H. C. Beckman, W. R. King, J. H. Gardiner, Robert Follansbee, J. B. Spiegel, C. E. McCashin, and C. E. Ellsworth, district engineers. v, 115 pp. 1932. 20¢.

General information, and daily and monthly discharge measurements of the following rivers during the year 1929-30:

St. Francis River
St. Francis River floodway
Big Lake outlet
White River
Buffalo River
North Fork of White River
Black River
Eleven Point River
Little Red River
Cache River
Arkansas River
Red River
Little River
Ouachita River
Little Missouri River

717. Surface water supply of the United States, 1931, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; H. C. Beckman, C. E. Ellsworth, J. H. Gardiner, W. R. King, C. E. McCashin, and J. B. Spiegel, district engineers. v, 108 pp. 1932. 10¢.

General information, and daily and monthly discharge measurements of the following rivers during the year 1930-31:

St. Francis River
St. Francis River floodway
Big Lake outlet
White River
Buffalo River
North Fork of White River
Black River
Eleven Point River
Little Red River
Cache River
Arkansas River
Lee Creek
Red River
Little River
Ouachita River
Little Missouri River

732. Surface water supply of the United States, 1932, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; H. C. Beckman, C. E. Ellsworth,

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

J. H. Gardiner, Berkeley Johnson, W. R. King, C. E. McCashin, and J. B. Spiegel, district engineers. v, 132 pp. 1933. 10¢.

General information, and daily and monthly discharge measurements of the following rivers during the year 1931-32:

Big Lake outlet
White River
Buffalo River
North Fork of White River
Eleven Point River
Little Red River
Lee Creek
Red River
Little River
Ouachita River

747. Surface water supply of the United States, 1933, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; H. C. Beckman, C. E. Ellsworth, J. H. Gardiner, Berkeley Johnson, W. R. King, C. E. McCashin, and J. B. Spiegel, district engineers. v, 121 pp. 1935. 10¢.

General information, and daily and monthly discharge measurements of the following rivers during the year 1932-33:

Big Lake outlet
White River
Buffalo River
North Fork of White River
Eleven Point River
Little Red River
Arkansas River
Lee Creek
Little River
Ouachita River

762. Surface water supply of the United States, 1934, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; D. H. Barber, H. C. Beckman, C. E. Ellsworth, Robert Follansbee, J. H. Gardiner, Berkeley Johnson, W. R. King, C. E. McCashin, and J. B. Spiegel, district engineers. v, 129 pp. 1936. 20¢.

General information, and daily and monthly discharge measurements of the following rivers during the year 1933-34:

Big Lake outlet
White River
Buffalo River
North Fork of White River
Little Red River
Arkansas River
Lee Creek
Red River
Little River
Ouachita River

777. Water levels and artesian pressure in observation wells in the United States in 1935, with statements concerning previous work and results, prepared under the direction of O. E. Meinzer and L. K. Wenzel. iii, 268 pp. 1936. 30¢.

General information concerning water levels and artesian pressure, accompanied by tables giving the measurements of the depth to water in wells in the Grand Prairie region comprising Arkansas County and parts of Prairie and Lonoke Counties, Ark., through 1935. (pp. 5-17.)

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

787. Surface water supply of the United States, 1935, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; D. H. Barber, H. C. Beckman, C. E. Ellsworth, Robert Follansbee, J. H. Gardiner, Berkeley Johnson, C. E. McCashin, and J. B. Spiegel, district engineers. 150 pp., 1 pl. 1936. 20¢.

General information, and daily and monthly discharge measurements of the following rivers, some given for the year October 1933 to September 1934, others for the year October 1934 to September 1935:

St. Francis River
St. Francis River floodway
White River
Little Red River
Arkansas River
Lee Creek
Red River
Little River

Ouachita River

807. Surface water supply of the United States, 1936, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; D. H. Barber, H. C. Beckman, C. E. Ellsworth, Robert Follansbee, J. H. Gardiner, Berkeley Johnson, C. E. McCashin, and J. B. Spiegel, district engineers. 149 pp., 1 pl. 1937. 25¢.

General information, and daily and monthly discharge measurements of the following rivers during the year October 1935 to September 1936:

St. Francis River
St. Francis River floodway
White River
Buffalo River
Lagrue Bayou
Little Lagrue Bayou
Arkansas River
Lee Creek
Bayou Meto
Red River
Little River
Ouachita River

817. Water levels and artesian pressure in observation wells in the United States in 1936, with statements concerning previous work and results; prepared under the direction of O. E. Meinzer and L. K. Wenzel. iii, 511 pp. 1937. 75¢.

General information concerning water levels and artesian pressure, accompanied by tables giving the measurements of the depth to water in wells in the Grand Prairie region comprising Arkansas County and parts of Prairie and Lonoke Counties, Ark., as measured in 1936. (pp. 3-5.)

820. Drought of 1936, with discussion on the significance of drought in relation to climate, by J. C. Hoyt, iv, 62 pp., 2 pls. 1938. 15¢.

Tables and maps showing precipitation in the United States, with particular attention to the years 1935 and 1936.

827. Surface water supply of the United States, 1937, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; D. H. Barber, H. C. Beckman, C. E.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Ellsworth, Robert Follansbee, J. H. Gardiner, Berkeley Johnson, C. E. McCashin, and J. B. Spiegel, district engineers. iv, 173 pp., 1 pl. 1938 (1939). 25¢.

General information, and daily and monthly discharge measurements of the following rivers during the year October 1936 to September 1937:

St. Francis River
St. Francis River floodway
White River
Buffalo River
North Fork of White River
Lagrue Bayou
Arkansas River
Lee Creek
Frog Bayou
Bayou Meto
Red River
Little River
Ouachita River

840. Water levels and artesian pressure in observation wells in the United States in 1937, prepared under the direction of O. E. Meinzer and L. K. Wenzel. iv, 657 pp. 1938 (1939). $1.

General information concerning water levels and artesian pressure, accompanied by tables giving the measurements of the depth to water in wells in the Grand Prairie region comprising Arkansas County and parts of Prairie and Lonoke Counties, Ark., through 1937.

845. Water levels and artesian pressure in observation wells in the United States in 1938, prepared under the direction of O. E. Meinzer and L. K. Wenzel. iv, 724 pp. 1939. 75¢.

General information concerning water levels and artesian pressure, accompanied by tables giving the measurements of the depth to water in wells in the Grand Prairie region comprising Arkansas County and parts of Prairie and Lonoke Counties, Ark., through 1938.

847. Maximum discharges at stream-measurement stations through December 31, 1937, by G. R. Williams and L. C. Crawford, with a supplement including additions and changes through September 30, 1938, by W. S. Eisenlohr, Jr. iii, 272 pp. 1940 (1941). 30¢.

Tables giving maximum discharges at stream-measurement stations. Stations in Arkansas are included in this report.

857. Surface water supply of the United States, 1938, part 7, Lower Mississippi River basin; N. C. Grover, chief hydraulic engineer; D. H. Barber, H. C. Beckman, C. E. Ellsworth, Robert Follansbee, J. H. Gardiner, Berkeley Johnson, J. L. Saunders, C. E. McCashin, J. B. Spiegel, and F. M. Veatch, district engineers. v, 197 pp., 1 pl. 1939. 25¢.

General information, and daily and monthly discharge measurements of the following rivers during the year October 1937 to September 1938:

St. Francis River
St. Francis River floodway
White River
West Fork of White River
Buffalo River
Black River
Spring River
Strawberry River

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Little Red River
Lagrue Bayou
Arkansas River
Frog Bayou
Petit Jean Creek
Fourche La Fave River
Bayou Meto
Red River
Ouachita River
Little Missouri River
Saline River

877. Surface water supply of the United States, 1939, part 7, Lower Mississippi River basin; C. G. Paulsen, acting chief hydraulic engineer; D. H. Barber, H. C. Beckman, C. E. Ellsworth, Robert Follansbee, Berkeley Johnson, J. L. Saunders, C. E. McCashin, J. B. Speigel, and F. M. Veatch, district engineers. vii, 379 pp., 1 pl. 1940 (1941). 45¢.

[Summary of yearly discharge at gaging stations in the lower Mississippi River basin. pp. i-iv, 349-376. 1940 (1941). Reprinted from Water-Supply Paper 877. 10¢.]

General information, and daily and monthly discharge measurements of the following rivers during the year October 1938 to September 1939:

St. Francis River
St. Francis River floodway
White River
West Fork of White River
Kings River
Buffalo River
North Fork of White River
Black River
Spring River
Eleven Point River
Strawberry River
Little Red River
Lagrue Bayou
Arkansas River
Frog Bayou
Petit Jean Creek
Fourche La Fave River
Bayou Meto
Crooked Creek
Red River
Little River
Cossatot River
Saline River
Ouachita River
Little Missouri River

Yearly discharge summary given for some gaging stations.

886. Water levels and artesian pressure in observation wells in the United States in 1939, by O. E. Meinzer, L. K. Wenzel, and others. v, 933 pp. 1940 (1941). $1.

General information concerning water levels and artesian pressure, accompanied by tables giving the measurements of the depth to water in wells in the Grand Prairie region comprising Arkansas County and parts of Prairie and Lonoke Counties, Ark., through 1939. (pp. 7-16.)

897. Surface water supply of the United States, 1940, part 7, Lower Mississippi River basin; G. L. Parker, chief hydraulic engineer; D. H. Barber, H. C. Beckman, C. E. Ellsworth, Robert Follansbee, J. H. Gardiner, Berkeley Johnson, J. L. Saunders, C. E. McCashin, J. B. Spiegel, F. M. Veatch, and J. V. B. Wells, district engineers. vi, 349 pp., 1 pl. 1941 (1942). 50¢.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

General information, and daily and monthly discharge measurements of the following rivers during the year October 1939 to September 1940:

St. Francis River
St. Francis River floodway
White River
West Fork of White River
Kings River
Buffalo River
North Fork River
Black River
Spring River
Eleven Point River
Strawberry River
Little Red River
Middle Fork of Little Red River
Lagrue Bayou
Arkansas River
Poteau River
Frog Bayou
Mulberry River
Petit Jean Creek
Fourche La Fave River
Bayou Meto
Crooked Creek
Red River
Cossatot River
Saline River
Ouachita River
Little Missouri River

909. Water levels and artesian pressure in observation wells in the United States in 1940, part 4, South-central States, by O. E. Meinzer, L. K. Wenzel and others. iii, 208 pp. 1941 (1942). 25¢.

General information concerning underground-water levels and artesian pressure, accompanied by tables giving the measurements of the depth to water in wells in the Grand Prairie region, comprising Arkansas County and parts of Prairie and Lonoke Counties, Ark., through 1940.

927. Surface water supply of the United States, 1941, part 7, Lower Mississippi River basin; G. L. Parker, chief hydraulic engineer; D. H. Barber, H. C. Beckman, F. M. Bell, H. C. Bolon (acting), C. E. Ellsworth, Robert Follansbee, J. H. Gardiner, Berkeley Johnson, C. E. McCashin, E. B. Rice (acting), J. L. Saunders, J. B. Spiegel, and J. V. B. Wells, district engineers. vi, 355 pp., 1 pl. 1942. 40¢.

General information, and daily and monthly discharge measurements of the following rivers during the year October 1940 to September 1941:

St. Francis River
St. Francis River floodway
White River
West Fork of White River
Kings River
Buffalo River
North Fork River
Black River
Spring River
Eleven Point River
Strawberry River
South Fork of Little Red River
Little Red River
Middle Fork of Little Red River
Lagrue Bayou
Arkansas River
Poteau River
Frog Bayou
Mulberry River
Petit Jean Creek
Fourche La Fave River
Bayou Meto
Crooked Creek
Red River
Cossatot River
Saline River
Ouachita River
Little Missouri River

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GEOLOGIC FOLIOS

***119.** Fayetteville, Ark.-Mo., by G. I. Adams and E. O. Ulrich. 6 pp., 2 maps. 1905.

Physiography and general geology of the Ozark region. Geography of the Fayetteville quadrangle, description of formations, history of physical changes, and discussion of deformation and structure. Mineral resources of the area. Generalized columnar section, and topographic and geologic maps.

***122.** Tahlequah, Ind. T. (Okla.)-Ark., by J. A. Taff. 7 pp., 3 maps. 1905.

***154.** Winslow, Ark.-Ind. T. (Okla.), by A. H. Purdue. 6 (1) pp., 2 maps. 1907.

Location of the Winslow quadrangle. General geography of the Ozark region. Topography of the quadrangle. Geology of the Ozark region and description of formations of the Winslow quadrangle. Sections on structural and historical geology. Discussion of mineral resources, water resources, soils, and timber. Columnar section, and topographic and geologic maps.

***202.** Eureka Springs-Harrison, Ark.-Mo., by A. H. Purdue and H. D. Miser. 22 pp., 2 sheets of illus., 4 maps. 1916.

General relations of the Eureka Springs and Harrison quadrangles, and geography and geology of the Ozark region. Relief, drainage, and culture of the Eureka Springs and Harrison quadrangles. Detailed stratigraphic study of the formations in the area. General structural features, folds, and faults. Geologic history. Discussion of mineral resources, water resources, soils, and timber. Table of equivalent formations in northern Arkansas and adjoining parts of Oklahoma. Generalized columnar section for the Eureka Springs and Harrison quadrangles. Topographic and geologic maps. Structure sections.

***215.** Hot Springs, Ark., by A. H. Purdue and H. D. Miser. 12, (1) pp., 1 sheet of illus., 3 maps. 1923.

Location and general relations of the Hot Springs district. General geography and geology of the Ouachita Mountain region. Topography and geology of the Hot Springs district including stratigraphy and structure. Section on igneous rocks. Mineral resources. Water resources and analyses of water from hot and cold springs. Bibliography of books and articles of the Hot Springs district. Various classifications of the Paleozoic formations of the Ouachita Mountains. Columnar and structure sections. Topographic and geologic maps.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

ANNOTATED LIST

of the

PUBLICATIONS OF THE ARKANSAS GEOLOGICAL SURVEY

Compiled and Annotated by

EDITH ANN PIERCE

Librarian, Arkansas Geological Survey

ANNUAL REPORTS

***1858.** First report of a geological reconnaissance of the northern counties of Arkansas, made during the years 1857 and 1858, by David Dale Owen, assisted by William Elderhorst and Edward T. Cox. 256 pp., 1858.

Geological observations on the following counties:

Benton	Independence	Monroe	Searcy
Carroll	Izard	Newton	Van Buren
Conway	Jackson	Poinsett	Washington
Crawford	Johnson	Pope	White
Franklin	Lawrence	Prairie	
Fulton	Madison	Pulaski	
Greene	Marion	Randolph	

Chemical report of ores, rocks, and mineral waters, with appendix giving methods of analysis.

***1860.** Second report of a geological reconnaissance of the middle and southern counties of Arkansas, made during the years 1859 and 1860, by David Dale Owen, assisted by Robert Peter, M. Leo Lesquereux, and Edward T. Cox. 433 pp. 1860.

Agricultural geology. Artesian wells and cisterns.
Geological observations on the following counties:

Arkansas	Crittenden	Lafayette	Pulaski
Ashley	Dallas	Mississippi	Saline
Benton	Desha	Monroe	Scott
Bradley	Drew	Montgomery	Sebastian
Calhoun	Franklin	Newton	Sevier
Carroll	Hempstead	Ouachita	St. Francis
Chicot	Hot Spring	Perry	Union
Clark	(with list of	Phillips	Yell
Columbia	hot springs)	Pike	
Craighead	Jefferson	Polk	
Crawford	Johnson	Pope	

Survey of Fourche Cove in Pulaski County, Ark., by Joseph Lesley assisted by E. T. Cox.

Report of the chemical analysis of soils, subsoils, underclays, clays, and nitre-earths of Arkansas.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Chemical analyses made for the Geological Survey of Arkansas, by William Elderhorst.

Botanical and paleontological report on the State Geological Survey of Arkansas, including coals and coal banks, recent botany and general distribution of the plants of Arkansas, and a catalog of the plants of Arkansas.

***1887.** Annual report of the Geological Survey of Arkansas for 1887, by John C. Branner. 15 pp. 1887.

Administrative report covering work of the Arkansas Geological Survey.

***1888.** Annual Report.

*Vol. I. A preliminary examination of the geology of western central Arkansas, with especial reference to gold and silver, by Theo. B. Comstock. xxxi, 320 pp., 2 maps. 1888.

Administrative report for 1888, by John C. Branner.

Structural geology of Pulaski, Saline, Garland, Yell, Hot Spring, Montgomery, Pike, Howard, Sevier, Polk, Scott, and Logan Counties. Economic geology covering the origin of gold and the localities and materials said to yield gold, the occurrence of silver and general conclusions regarding it, and assays for gold and silver. Sections on lead, zinc, copper, tin, nickel, cobalt, manganese, and iron, including assays. Chapter on the location of mining claims.

*Vol. II. The Neozoic geology of southwestern Arkansas, by Robert T. Hill, with two appendixes, (1) The northern limits of the Mesozoic rocks of Arkansas, by O. P. Hay, and (2) On the manufacture of portland cement, by John C. Branner. xiv, 319 pp., 1 map. 1888.

Neozoic (Mesozoic and Cenozoic) geology of southwestern Arkansas with detailed reports on the Quaternary, Tertiary, and Cretaceous deposits of that area including stratigraphy and paleontology. Chapters on soil, chalks, and marls, and on economic products of the region.

General features of the northern border of the Mesozoic rocks across Clark, Pike, Howard, and Sevier Counties, Ark.

Raw materials, making, and uses of portland cement.

*Vol. III. The geology of the coal regions; a preliminary report upon a portion of the coal regions of Arkansas, by Arthur Winslow. x, 122 pp., 1 map. 1888.

Physiography and general geology of the coal region of western central Arkansas. Distribution of coal and the coal industry. Composition of Arkansas coals including analyses, classification, and physical properties. Adaptability of Arkansas coal for different uses and the utilization of coal dust or slack. Appendixes on the preparation of Bernice anthracite coal and on a screen especially adapted for use with soft coals. Map of the coal region showing locations of openings.

*Vol. IV. The geology of Washington County, by F. W. Simonds; A list of the plants of Arkansas, by John C. Branner and F. V. Coville. xiv, 262 pp., 1 map. 1891.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Topography and hydrography of Washington County. Description of the rock formations. Descriptions of folds and faults. Soils, brick clays, coal, oil and natural gas, lime, lead, building stone, and road-making material. Columnar sections. General facts about the county. Description of the Fayetteville-Huntsville section, by Gilbert D. Harris.

Bibliography of material on plants of Arkansas. List of plants. Notes on botany, and economic notes.

***1889.** Annual Report.

*Vol. II. The geology of Crowley's Ridge, by R. Ellsworth Call. xix, 283 pp., 2 maps. 1891.

Numerous sections both within and without Crowley's Ridge are given and discussed. Geologic history of Crowley's Ridge comparing northern and southern parts, and giving correlations. Interpretation of the phenomenon of Crowley's Ridge. Descriptions of the silicified woods and lignites and a brief summary of economic geology. The latter part of the book is devoted to the topography, hydrography, and geology of St. Francis County. Notes on the forest trees of the Crowley's Ridge region. Mollusk of Genus Mytilus. Chapters entitled "On the relationship of the Pleistocene to the Pre-pleistocene formations of Crowley's Ridge and adjacent areas south of the limit of glaciation," by R. D. Salisbury, and "Description of fossil woods and lignites from Arkansas," by F. H. Knowlton.

1890. Annual Report.

*Vol. I. Manganese; its uses, ores, and deposits, by R. A. F. Penrose, Jr. xxvii, 642 pp., 16 pls., 3 maps. 1891.

Nature and uses of manganese. Manganese industry including history of mining in the United States and Canada, production in the United States, production of manganiferous iron and silver ores in the United States, and exports and imports of manganese. Descriptions of the ores of manganese. Detailed discussion of the Batesville, Ark., region and of the deposits occurring there. Report on manganese deposits of Pulaski, Garland, Hot Spring, Clark, Pike, Montgomery, and Polk Counties. Manganese of the Appalachian region, Texas, Rocky Mountains, Nevada, California, and Canada. Origin and chemical relations of manganese deposits. Geologic map of the Batesville manganese region.

*Vol. II. The igneous rocks of Arkansas, by J. Francis Williams. xv, 457 pp., 22 pls., 6 maps. 1891.

Detailed report on an original study of the igneous rocks of the Fourche Mountain, Saline County, Magnet Cove, and Potash Sulphur Springs regions, Ark. Brief discussions of other areas of igneous rocks in the state. Tabulation of the dikes of igneous rocks of Arkansas, by J. F. Kemp and J. Francis Williams. Geologic maps of the Fourche Mountain and Saline County areas.

*Vol. III. Whetstones and the novaculites of Arkansas, by Leon S. Griswold. xviii, 443 pp., 9 pls., 2 maps. 1892.

Early history of whetstones, whetstones in North America, geographic distribution, use, manufacturing, and statistics. Economics of Arkansas whetstones. Petrography, chemistry, and origin of Arkansas novaculites. Geography, topography, and detailed geology of the novaculite area including economic features and paleontology. Geologic maps of the novaculite area.

Vol. IV. Marbles and other limestones, by T. C. Hopkins. xxi, 443 pp., 28 pls. Atlas of 6 maps. 1893. $1.25.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

General description of the marble area. Composition, origin, varieties, and uses of limestone, and geologic and geographic distribution. Discussion of the various limestones and of the lime industry. Origin and uses of marble and distribution in the United States and other countries. Detailed report on the marbles of Arkansas with special attention to the St. Clair and St. Joe marbles. Quarrying, cutting, dressing, and polishing of marble. Appendix on faults of the marble area. Atlas of geologic maps of the area.

1891. Annual Report.

*Vol. I. The mineral waters of Arkansas, by John C. Branner. viii, 144 pp., 1 map. 1892.

Discussion and analyses of waters of the hot springs. Quantitative mineral analyses of water from other springs in the state. Qualitative tests and notes of mineral springs and wells. Method of sanitary analysis and reports of analyses. Topographic map of the region about Hot Springs and Potash Sulphur Springs.

Vol. II. Miscellaneous reports. ix, 349 pp., 12 pls., 2 maps. 1894. 50¢.

The geology of Benton County, by F. W. Simonds and T. C. Hopkins.

Elevations in the state of Arkansas, by John C. Branner.

Observations on erosion above Little Rock, by John C. Branner.

Magnetic observations, by John C. Branner.

The Mollusca of Arkansas, by F. A. Sampson.

The Myriapoda of Arkansas, by C. H. Bollman.

The fishes of Arkansas, by Seth E. Meek.

The geology of Dallas County, by C. E. Siebenthal.

Bibliography of the geology of Arkansas, by John C. Branner.

1892. Annual Report.

*Vol. I. The iron deposits of Arkansas, by R. A. F. Penrose, Jr. x, 153 pp., 4 pls., 1 map. 1892.

History and possibilities of iron mining in Arkansas. Distribution, geologic relations, character, and commercial value of ores. Descriptions of iron deposits in northeastern Arkansas, northwestern Arkansas, the Arkansas Valley, the Ouachita Mountains, and southern Arkansas, given by county. Chapter on the origin of the Tertiary iron deposits of southern Arkansas. Map showing regions described in the report.

Vol. II. The Tertiary geology of southern Arkansas, by Gilbert D. Harris. xiv, 207 pp., 7 pls., 1 map. 1894. 50¢.

Detailed report of the formations of southern Arkansas by stage—Midway or Clayton, lignitic, Claiborne and Jackson—including paleontology. Nature of underlying rocks. Chapter on the Claiborne and Jackson stages in Louisiana. Geologic map of southern Arkansas and adjacent regions.

*Vol. V. The zinc and lead region of north Arkansas, by John C. Branner. xiv, 395 pp., 38 pls. Atlas of 7 maps. 1900.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Physiography of northern Arkansas. Character, origin, and distribution of zinc ores, and the relation of geologic structure to existing ore bodies. Faults of northern Arkansas. General geology and notes on mines and mining industries in the Music Creek, Jimmy's Creek, George's Creek, Sugar Orchard, Newton County, Cave Creek, Mount Hersey, St. Joe, Yellville, Rush Creek, Warner's Creek, Baxter County, Lawrence and Sharp Counties regions and districts. Methods of prospecting, list of minerals found in the zinc and lead district of northern Arkansas, Paleozoic faunas, and Carboniferous formations. Bibliography of the geology of northern Arkansas.

***1927.** Annual administrative report of the state geologist of Arkansas for the period December 1, 1926 to December 1, 1927, by George C. Branner. 16 pp. 1928.

Administrative report of the work and personnel of the Survey. Financial report.

***1928.** Annual administrative report of the state geologist of Arkansas for the period December 1, 1927 to December 1, 1928, by George C. Branner. 30 pp. 1929.

Administrative report of the work and personnel of the Survey. Financial report.

***1932.** Annual administrative report of the state geologist of Arkansas for the period December 1, 1931 to November 30, 1932, by George C. Branner. 27 pp. 1932.

Administrative report of the work and personnel of the Survey. Financial report.

***1936.** Annual administrative report of the state geologist of Arkansas for the period December 1, 1935 to November 30, 1936, by George C. Branner. 50 pp. 1936.

Administrative report of the work and personnel of the Survey. Mineral production and list of mineral producers.

***1938.** Annual administrative report of the state geologist of Arkansas for the period December 1, 1937 to November 30, 1938, by George C. Branner. 61 pp. 1938.

Administrative report of the work and personnel of the Survey. Mineral production and list of mineral producers.

***1940.** Annual administrative report of the state geologist of Arkansas for the period December 1, 1939 to November 30, 1940, by George C. Branner. 74 pp. 1940.

Administrative report of the work and personnel of the Survey. Mineral production and list of mineral producers.

BULLETINS

1. Upper Cretaceous formations of southwestern Arkansas, by Carle H. Dane. Co-operative United States Geological Survey and Arkansas Geological Survey report. xv, 215

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

pp., 29 pls., 2 maps. 1929. Cloth bound $1.85, paper bound $1.60.

Geography and general geology of southwestern Arkansas. Detailed description of Cretaceous formations of the Comanche series and Gulf series including historical summary, lithology and outcrops, thickness, fauna and correlation, origin, and physiographic expression of each. Brief discussion of the Tertiary Midway formation and post-Midway events. Structure of the area, development of the Mississippi embayment, and physiography. Economic geology with sections on chalk and chalk marl, clay, sand, gravel, glauconite, lignite, artesian water, oil and gas. Appendixes including well records.

*2. Oil and gas geology of the Gulf Coastal Plain in Arkansas, by W. C. Spooner. xxxii, 516 pp., 22 pls. 1935. Contains: Upper Cretaceous Ostracoda of Arkansas, by Merle C. Israelsky. pp. 475-497, 4 pls.

List of papers relating to the geology of the Gulf Coastal plain. Detailed stratigraphy and structural geology of the area with numerous cross sections, columnar sections, and well logs. List of wells penetrating Paleozoic basement rock. Historical summary of production of oil and gas, and age and character of reservoir rocks. Detailed description of fields and pools including location and extent, history of development, topography, stratigraphy, structure, and production of each. County by county discussions giving location, general features, stratigraphy, structure, and list of wells drilled. Appendix on Upper Cretaceous Ostracoda of Arkansas. Numerous maps, sections, and production tables.

2. Extract from Bulletin 2: Upper Cretaceous Ostracoda of Arkansas, by Merle C. Israelsky. 29 pp., 4 pls. 1929. 20¢.

Descriptions of species of Ostracoda of Arkansas.

3. The geology of the Arkansas Paleozoic area with especial reference to oil and gas possibilities, by Carey Croneis. xx, 457 pp., 45 pls. 1930. $1.

Geography and physiography of the Paleozoic area. Stratigraphy of the Ozark Plateaus, Arkansas Valley, and Ouachita Mountains, and discussion of the igneous rocks of central Arkansas. Detailed structure. General facts concerning oil and gas, and exploration in the Paleozoic area. Oil and gas geology of the Paleozoic area, and production of natural gas. Numerous maps and sections. Analyses of gas. Well records.

4. St. Peter and older Ordovician sandstones of northern Arkansas, by Albert W. Giles. Contains a section on possible economic values of the St. Peter and older Ordovician sandstones of northern Arkansas, by E. E. Bonewits. xvi, 187 pp., 13 pls. 1930. $1.80.

Detailed discussion of the St. Peter sandstone including distribution, thickness, topographic expression, stratigraphic relations, correlation, fossils, structural features, origin, geologic history, lithologic features, uses, and mining and preparation. Also extensive report on Calico Rock sandstone and Kings River sandstone. Section on possible economic value of the St. Peter and older Ordovician sandstones in northern Arkansas covers glass sand, molding and similar sand, chemical sand, and sand for other uses. Numerous maps, tables, composition pyramids, microscopic views, and other illustrations.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

5. A geomagnetic survey of the bauxite region in central Arkansas, by Noel H. Stearn. 16 pp., 4 pls. 1930. 75¢.

Location and geology of the bauxite region. Origin of bauxite deposits. The magnetic method of exploration and its application to the region. Procedure and results of the magnetic survey in determining general extent of the bauxite area. Bibliography on the bauxite of Arkansas.

6. Mineral resources of Arkansas, by George C. Branner. 101 pp. 1942. 30¢. (Republished version of Chapter III, Arkansas' Natural Resources.)

General physiography, topography, and geology of Arkansas. Summary of the distribution and production of mineral fuels, metals, and non-metallic minerals. List of selected references. 25 tables and numerous charts on production, value, and occurrence of the mineral resources.

7. Kaolin deposits of southern Pike County, Ark., by Paul G. Herold and George R. Heyl. 38 pp., 3 pls. 1942. 25¢.

Geology, distribution, analyses, and commercial possibilities of Pike County kaolin. Geologic and index maps of the kaolin area.

8. Pitkin limestone of northern Arkansas, by William H. Easton. 115 pp., 12 pls. 1942. 60¢.

General geology, geography, and physiography of the area in which the Pitkin limestone occurs, followed by a detailed description of the Pitkin, including numerous columnar sections and a complete faunal list. Faunal plates. Bibliography.

9. Arkansas Mining and Mineral Law, by George Rose Smith. 120 pp. 1942. Cloth bound $1, paper bound 75¢.

A compilation and explanation of the state's statutes governing the exploitation of mineral resources. This covers lode and placer locations, miscellaneous locations and leases including mill site locations, coal leases and permits, oil and gas leases, locations, locations and leases within national forests, and miscellaneous minerals; purchasing and leasing of lands, and acquisition of private lands; and lessee's duties to lessor, rights and duties of mineral owner, mining and drill legislation, the oil and gas conservation program, and taxation. It is primarily for those engaged in mineral industries, but also provides a ready reference manual for the practicing lawyer.

INFORMATION CIRCULARS

(Note: Information circulars lithoprinted or mimeographed.)

*1. A barite deposit in Hot Spring County, Ark. Field work by Bryan Parks. Text by Bryan Parks with the assistance of George C. Branner. vii, 52 pp., 6 pls. 1932.

Nature, uses, and production of barite. Discovery and investigation of barite in Arkansas. Geographic, topographic, and geologic relations of the barite area. Discussion of barite deposits including estimate of tonnage. Mining methods. Possibility of other deposits. Geologic and topographic map of the area. Appendix giving results of tests.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

*2. Cinnabar in southwestern Arkansas, by George C. Branner. iv, 51 pp., 38 pls. 1932. List of mining and prospecting developments, by J. M. Hansell, and production figures, added in 1934. 4 pp.

Location, topography, and drainage of the cinnabar region. Discovery of cinnabar, distribution of deposits, and occurrence in place. Geology of the area and of deposits. Mineralogy. List of operators and developments. Discussion of commercial possibilities and suggestions for prospecting and development. List of occurrences of cinnabar in place. Summary of mining development of the Arkansas quicksilver district to July 1, 1934, by J. M. Hansell. Quicksilver production figures. Maps, microphotographs, and other illustrations.

3. Black marbles of northern Arkansas, by Bryan Parks and J. M. Hansell, with a section on their economic possibilities, by E. E. Bonewits. vi, 51 pp., 5 pls. 1932. (Reprinted 1937.) $1.

History of development and description of the black marble region. Geology including occurrence and description of black marble in the Fayetteville and Pitkin formations. Characteristics of black marble. Comparison of the marble of the two formations and of Arkansas black and fossil marbles with competitive marbles. Commercial use, supply, and quarrying. Section on economic value of black marble in Arkansas including foreign and domestic sources, and discussion of marketing, uses, and developments. List of marble importers, dealers, and manufacturers in the United States. Map of the area, vertical sections, results of tests.

4. Earthquake risks in Arkansas, by George C. Branner and J. M. Hansell. iii, 13 pp., 4 pls. 1933. 50¢.

General considerations regarding earthquakes. Earthquakes affecting the central Mississippi Valley with a list of those occurring from 1811 to 1931 inclusive. Distribution, intensity, periodicity, and cause of earthquakes affecting Arkansas. Conclusions. Maps, tables, and chart on earthquakes.

*5. Discovery of rock salt deposit in deep well in Union County, Ark., by H. W. Bell. iii, 21 pp. 1933.

Producing horizon in the Smackover field. Deep tests near Hays and table containing information on wells drilled below 2,900 feet in the east Smackover field. Log of formations penetrated, showing discovery of salt. Discussion and paleontological interpretation. Character, age, and structure of salt deposit. Mechanical procedure of drilling.

6. Elevations in Arkansas, compiled under the direction of George C. Branner. Introduction by George A. Rogers.

*Vol. I. Containing elevations of towns and community centers in Calhoun, Clark, Columbia, Dallas, Hempstead, Lafayette, Little River, Miller, Nevada, Ouachita, and Union Counties. ix, 151 pp., 16 pls. 1936. (Revision of Vol. I now in progress.)

*Vol. II. Containing elevations of towns and community centers in Ashley, Bradley, Chicot, Desha, and Drew Counties. ix, 131 pp., 10 pls. 1936.

Vol. III. Containing elevations of towns and community centers in Arkansas, Cleveland, Grant, Jefferson, and Lincoln Counties. ix, 131 pp., 10 pls. 1936. 75¢.

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Vol. IV. Containing elevations of towns and community centers in Lee, Lonoke, Monroe, Phillips, and Prairie Counties. ix, 174 pp., 10 pls. 1936. 75¢.

Vol. V. Containing elevations of towns, mountains, and community centers in Crittenden, Cross, Jackson, St. Francis, and Woodruff Counties. ix, 179 pp., 10 pls. 1936. 75¢.

Vol. VI. Containing elevations of towns and community centers in Clay, Craighead, Greene, Lawrence, Mississippi, Poinsett, and Randolph Counties. ix, 199 pp., 12 pls. 1936. 75¢.

Vol. VII. Containing elevations of towns, mountains, and community centers in Baxter, Benton, Boone, Carroll, Cleburne, Crawford, Fulton, Independence, Izard, Madison, Marion, Newton, Searcy, Sharp, Stone, Van Buren, and Washington Counties. x, 203 pp., 22 pls. 1936. 75¢.

Vol. VIII. Containing elevations of towns, mountains, and community centers in Conway, Faulkner, Franklin, Johnson, Logan, Pope, Sebastian, and White Counties. ix, 176 pp., 13 pls. 1936. 75¢.

Vol. IX. Containing elevations of towns, mountains, and community centers in Garland, Hot Spring, Howard, Montgomery, Perry, Pike, Polk, Pulaski, Saline, Scott, Sevier, and Yell Counties. x, 161 pp., 17 pls. 1937. 75¢.

7. Directory of Arkansas mineral producers for 1935. Compiled by Mary L. Gibson. iv, 39 pp. 1936. 90¢.

Alphabetical list of mineral operators, list of mineral operators by minerals, and list of mineral operators by counties, for 1935.

8. Geology of the Arkansas bauxite region, by M. N. Bramlette. iv, 68 pp., 8 pls. Map in pocket. 1936. $1.

Location and general geology of the bauxite area in Arkansas. History of the development and production of bauxite. Occurrence, general character, and chemical and mineral features of bauxite. Location of test holes and interpretation of logs and results. Detailed discussion of the origin of the bauxite. General conclusions and estimate of reserves. Logs of test holes.

9. Mineral production statistics of Arkansas for the period 1880-1935, compiled by Mary L. Gibson. x, 117 pp. 1937. $1.20.

Compilation of Arkansas mineral production statistics for the period 1880-1935 from published and unpublished statistics of the United States Geological Survey and the United States Bureau of Mines, and all state severance tax and sand and gravel sales records. Covers metallic and non-metallic minerals, stones, and fuels. By county, mineral, and year.

10. List of Arkansas oil and gas wells, compiled under the direction of George C. Branner. 11x14 inches. iv, 103 pp., 23 pls. 1937. $1.35.

History of the development of oil and gas in Arkansas. Oil and gas possibilities in the state. Use of data and list of abbreviations. Table containing information on oil and gas wells listed by counties. County maps locating oil and gas wells and dry holes. Other tables, maps, graphs, and charts.

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11. List of Arkansas water wells, compiled under the direction of George C. Branner. 11x14 inches. iv, 142 pp., 23 pls. 1937. $2.25.

Ground water provinces. Use of data. Abbreviations. List of Arkansas water wells by counties, and individual county maps showing water wells.

12. Lower Cretaceous and Jurassic formations of southern Arkansas and their oil and gas possibilities, by Ralph W. Imlay. vii, 64 pp., 26 pls. 1940. $1.25.

General stratigraphy of southern Arkansas. Detailed descriptions of the formations of the Jurassic and Lower Cretaceous systems. Stratigraphy by counties. Major structural features, history, and oil and gas possibilities. Selected bibliography. Numerous structural sections and maps. Other maps, columnar sections, and illustrations.

13. Tertiary limestones of Pulaski and Saline Counties, Ark., by Milton W. Corbin and George R. Heyl. iv, 28 pp., 6 pls. 1941. 50¢.

Brief discussion of the geology of the area, limestone deposits, and economic considerations. Logs of 130 test holes drilled in Pulaski and Saline Counties.

COUNTY MINERAL REPORTS

(Note: County Mineral Reports lithoprinted.)

1. Mineral resources of Polk County, compiled under the direction of George C. Branner from field data collected by WPA State Mineral Survey and from state and federal reports. vi, 41 pp., 9 pls. 1940. $1.25.

Geology, including description and sequence of formations, and structure, in Polk County. Composition and properties, uses, prices, occurrence in Polk County, economic importance, and production of copper, iron, lead, manganese, zinc, barite, building stone, clay, novaculite, road materials, slate, tripoli, oil and gas, and coal. Summary of springs. Bibliography. Tables of production, occurrence, price, and analyses. Columnar and structure sections, and maps.

2. Mineral resources of Benton, Carroll, Madison, and Washington Counties, compiled under the direction of George C. Branner from field data collected by the WPA State Mineral Survey and from state and federal reports. vii, 55 pp., 10 pls. 1940. $1.25.

Geology including description and sequence of formations, and structure in Benton, Carroll, Madison, and Washington Counties. Composition and properties, uses, prices, occurrence in the four-county area, economic importance, and production of iron, lead, zinc, clay, glass sand, pyrite, quartz, tripoli, building stone, dolomite, limestone, marble, road materials, coal, and oil and gas. Table and map locating 230 springs and giving discharge. Bibliography. Tables of production, occurrence, prices, and analyses and tests. Columnar and cross sections. Maps showing geology, physiography, and mineral deposits.

3. Mineral resources of Montgomery, Garland, Saline, and Pulaski Counties, prepared by the Arkansas Geological Sur-

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vey from field data collected by the WPA State Mineral Survey and from information in state and federal reports. viii, 101 pp., 5 pls. 1942. $1.25.

Geology, including description and sequence of formations and structure in Pulaski, Saline, Garland, and Montgomery Counties. Composition and properties, uses, prices, occurrence in the four-county area, economic importance, and production of bauxite, iron, zinc, gold, silver, copper, manganese, barite, bentonite, building stone, clay, fuller's earth, gravel and sand, limestone, novaculite, quartz crystals, slate, soapstone, tripoli, wavellite, oil and gas, lignite, coal, and mineral waters. Bibliography. Tables of production, occurrence, prices, and analyses and tests. Columnar section. Chart of bauxite production and price. Maps.

ARKANSAS STREAM GAGING REPORTS

1. Stream gaging in Arkansas from 1857 to 1928, by W. S. Frame, acting United States District Engineer. Published co-operatively with the United States Geological Survey. viii, 141 pp., 2 pls. 1930. Cloth bound $1.80, paper bound $1.30.

Nature, uses, and value of records of stream flow. Lists and map of gaging stations. Discharge measurements and gaging station records for the St. Francis, White, Arkansas, Ouachita, and Red River basins. Discharge measurements of the Mississippi river and its tributaries. Map showing average annual precipitation and table showing mean monthly and annual precipitation in Arkansas.

MISCELLANEOUS REPORTS

1909. The slates of Arkansas, by A. H. Purdue; Bibliography of the geology of Arkansas, by J. C. Branner. xii, 170 pp., 7 pls. 1909. 50¢.

Historical data and general considerations relating to slate and the slate industry. Geology of the Arkansas slate area. Descriptions and tests of Arkansas slates, and notes on quarries, prospects, and outcrops. Glossary of geological and slate-quarrying terms. Bibliography of the geology of Arkansas including nearly all titles referring to geology, mineralogy, and paleontology of the state.

1910. Coal mining in Arkansas, Part I, by A. A. Steel. xxvii, 632 pp., 14 pls. 1910. $1.70.

General conditions relating to coal and coal mines including a brief discussion of the geology. Details of mining, conditions at the mines, work and wages of the miners, relations between miners and operators, mining laws of Arkansas, the mine-run law, general condition of the mining industry, glossary of coal mining terms, conservation of the health and safety of miners, conservation of coal, and conservation of expense. Maps, sketches, sections, and other illustrations.

***1911.** Water powers of Arkansas: a preliminary report on White River and some of its tributaries, by W. N. Gladson. x, 98 pp., 38 pls., 22 maps. 1911.

Explanation of terms, tables, and curves. Topography and geology of the region. Stream-gaging data on the White River at various points, on the North Fork of White River, the Little Red River, and the Buffalo Fork of White River. Numerous maps, tables, sections, charts, and graphs.

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***1924.** Answers to questions about Arkansas' mineral resources, by George C. Branner. Published jointly by the State Geological Survey and the Bureau of Mines, Manufactures and Agriculture. 48 pp., 1 map. 1924.

Information on the State Geological Survey and its work, on general geology and its application in Arkansas, and on the numerous mineral resources of Arkansas presented simply in question and answer form. Geologic map of Arkansas. Numerous other maps, charts, graphs, and tables.

***1927.** Outlines of Arkansas' mineral resources, by George C. Branner. Published jointly by the Arkansas Bureau of Mines, Manufactures and Agriculture and the State Geological Survey. 352 pp. 1927.

General physiography, topography, geology, soil surveys, and water power. Discussion of mineral distribution, value, and production. Reports on antimony, asphalt, bauxite, building and structural stone, chalk, clays, coal, copper, diamonds, fuller's earth, glass sand, gold and silver, gypsum, iron, limestone for burning, lithographic stones, manganese, mineral waters, mineral fertilizers, novaculite, ochre, petroleum and natural gas, onyx marble, portland cement materials, road-making materials, sand and gravel, slate, soapstone, tripoli, and zinc and lead. Geologic map of Arkansas. Numerous other maps, tables, and charts.

68 pages summarizing state and federal mining laws.

***1927.** An outline of the physical features of Arkansas; revised reprint from Outlines of Arkansas' mineral resources, by George C. Branner. 24 pp. 1927.

General physiography, topography, and geology of Arkansas. Discussion of topographic and geologic mapping and lists of maps. Statement concerning soil surveys and list of soil survey bulletins. Discussion of water power including stream gaging.

***1927.** An outline of the petroleum and natural gas resources of Arkansas; revised reprint from Outlines of Arkansas' mineral resources, by George C. Banner. 47 pp. 1927.

Nature and distribution of oil. Possibilities in both the Coastal Plain and Paleozoic Upland. Discussion of producing fields including the El Dorado, East El Dorado, Lisbon, Smackover, Stephens, and Irma fields. Production tables and charts. Analyses of Arkansas Petroleum. List of oil operators. Natural gas of the Arkansas Valley and southern Arkansas areas. Production figures. Producers. Bibliographies of Arkansas oil and gas.

***1928.** An outline of the metallic minerals of Arkansas; revised reprint from Outlines of Arkansas' mineral resources, by George C. Branner. 62 pp. 1928.

Brief discussions including composition, uses, occurrence, production, and bibliographies of antimony, bauxite, copper, gold and silver, iron, lead and zinc, manganese, pyrite and marcasite, and rutile and brookite. Directory of geological and mining officials.

1939. Wealth of Arkansas, by George C. Branner. 135 pp. 1939. $1.

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Graphic and pictorial portrayal of the wealth of Arkansas as indicated by its natural resources and their development and exploitation.

1940. Oil and gas possibilities in Arkansas, by George C. Branner. 2 pp., 1 pl. 1940. Free.

Brief summary of oil and gas possibilities in the Gulf Coastal Plain of southern and eastern Arkansas and in the Paleozoic area of northern and western Arkansas. Map and cross sections.

1940. Manganese minerals of Arkansas, by George C. Branner. Advance chapter from An outline of the metallic minerals of Arkansas. 20 pp., 2 pls. 1940. Free.

Description and analyses of manganese and manganiferous ores from the Batesville and west-central Arkansas districts. Discussion of uses and occurrence, and list of manganese mines in Arkansas. History of development. Price and production information. Lists of producers and consumers. Estimate of reserves. Bibliography.

1941. Limestones of northern Arkansas, by George C. Branner. Advance chapter from An outline of the non-metallic minerals of Arkansas. 24 pp. 1941. Free.

Discussion of composition and properties of limestone. Uses and occurrence in northern Arkansas. Price, production, and producers. Maps, charts, columnar sections, and tables on the occurrence of limestone and on the limestone industry. Brief section on black marble. Bibliography.

Note: Attention is called to the reduction in price of the following items:

Annual report for 1891—Vol. II. Miscellaneous reports.

Annual report for 1892—Vol. II. The Tertiary geology of southern Arkansas.

1909—The slates of Arkansas.

Bulletin 3—The geology of the Arkansas Paleozoic area with especial reference to oil and gas possibilities.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

ANNOTATED LIST OF MAPS AND DIAGRAMS

Published by the

ARKANSAS GEOLOGICAL SURVEY
and COOPERATING AGENCIES

Geologic map of Arkansas prepared by the Arkansas Geological Survey. 51½x36 in. Scale 1:500,000 (about 8 miles to the inch). 1929. Paper, $1.50; mounted on linen, $3.50; cut into sections 5⅛x8½ in. and mounted on linen, $5.75; cut into sections 8¼x11½ in. and mounted on linen, $5.25. Compiled as follows:

Geology of the Ozark region based on published maps by many authors and unpublished data by E. O. Ulrich, C. L. Dake, Josiah Bridge, E. T. McKnight, A. W. Giles, and Bryan Parks.

Geology of the Arkansas Valley from published maps of several authors and from unpublished data by A. J. Collier, H. D. Miser, and Carey Croneis.

Geology of the Ouachita Mountains from maps, mostly unpublished, by L. S. Griswold, A. H. Purdue, H. D. Miser, and R. D. Mesler.

Geology of the Coastal Plain from published maps of several authors and from unpublished data by A. H. Purdue, H. D. Miser, R. D. Mesler, C. H. Dane, P. D. Torrey, and W. C. Spooner.

Edited by H. D. Miser and George W. Stose.

Geologic drafting by Pearle L. Blackman and C. A. Weekerly.

Engraved and printed by the United States Geological Survey, S. J. Kubel, chief engraver.

Geologic map of the state printed on the Arkansas base map compiled by the United States Geological Survey in 1928. Includes culture, drainage, and some economic data. Two cross sections. Columnar section.

*Geologic map of Arkansas, as above, with highways superimposed. 1929.

Topographic map of the state of Arkansas. 34½x39 in. Scale: 1:500,000 (about 8 miles to the inch). 1930. $1. Compiled as follows:

Topographic mapping by the United States Geological Survey in cooperation with the Arkansas Geological Survey.

Highway data by the Arkansas State Highway Commission.

Industrial data by the Arkansas Geological Survey.

Base by the United States Geological Survey.

Contours compiled by R. W. Berry.

Lambert conformal conic projection. North American datum.

Shows culture in black, drainage in blue, and national forests in light green. Contour interval 250 feet. Gives numerical elevations of a majority of the cities and towns.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Topographic map of the state of Arkansas showing power-transmission lines. Compilation as above, with over-print of power-transmission lines.

Topographic map of the state of Arkansas showing oil and gas fields and pipe lines. Compilation as above, with over-print of oil and gas fields and pipe lines.

Topographic map of the state of Arkansas showing highways, mineral industries, power-transmission lines, and oil and gas pipe lines. Compilation as above with over-print of highways, mineral industries, power-transmission lines, and oil and gas pipe lines.

Topographic map of the Gulf Coastal Plain of Arkansas showing highways and oil and gas fields. 34½x39 in. Scale 1:500,000 (about 8 miles to the inch). 1930. 75¢. Compiled as follows:

Topographic mapping by the United States Geological Survey in cooperation with the Arkansas Geological Survey.

Highway data by the Arkansas State Highway Commission.

Oil and gas field information by the Arkansas Geological Survey.

Base by the United States Geological Survey.

Contours compiled by R. W. Berry.

Lambert conformal conic projection. North American datum.

Shows topography of the lowlands of southern and eastern Arkansas, printed on the state base map. Contour interval 100 feet.

Base map of the state of Arkansas. 34½x39 in. Scale 1:500,000 (about 8 miles to the inch). Edition of 1928 reprinted in 1940. 25¢. Compiled as follows:

A. F. Hassan, cartographer.

Published by the United States Geological Survey.

Compiled in 1913, revised in 1928. Edition of 1928 reprinted in 1940.

Lambert conformal conic projection. North American datum.

Shows counties, townships, towns, and railroads in black. Drainage in blue.

Base map of the state of Arkansas. 18x20 in. Scale 1:1,000,000 (about 16 miles to the inch). Edition of 1935. 15¢. Compiled as above in black and white.

Map of Arkansas transportation facilities, mineral resources, principal streams, and streamflow data. 17x22 in. Scale approximately 17 miles to the inch. 1941. 25¢.

Prepared by the Arkansas Geological Survey and the State Planning Board.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

Shows culture in black, principal drainage in blue, and mineral resources in brown.

Outline map of Arkansas. 8½x11 in. 1941. 5¢.

Published by the Arkansas Geological Survey.

Shows counties, county seats, and principal drainage.

Index map of topographic quadrangles in Arkansas. 11x14 in. 1942. Free.

Published by the Arkansas Geological Survey.

Shows topographic quadrangles published by the United States Geological Survey and the Mississippi River Commission.

Block diagram showing the geology of Arkansas, surface and below. 16½x20½ in. 1941. 10¢. Compiled as follows:

Information by George C. Branner.

Drawn by Albert Hess.

Published by the Arkansas Geological Survey.

Block diagram showing surface and subsurface geology. Table of geologic ages. Explanatory text giving general geology of Arkansas. Lithographed in 10 colors.

Useful land chart; United States sub-division of land, chain equivalents, calculations, and tables. 8½x11. 1942. Free. Compiled as follows:

Compiled and drawn by Albert Hess.

Published by the Arkansas Geological Survey.

Diagrams showing township and ranges, standard township, and section. Tables of equivalents and measures. Calculations.

An asterisk (*) indicates that the report is out of print. Individual sections may be in print although the entire volume is not available. In some cases, a complete volume may be available when individual sections are out of print.

APPENDIX A

PETROLEUM AND NATURAL GAS PRODUCERS IN ARKANSAS

1942

Company	Address	Location of Fields
Alice Sidney Oil Co.	Armstrong Bldg., El Dorado, Ark.	Champagnolle, Union County Magnolia, Columbia County Schuler-Jones, Union County Schuler-Morgan, Union County Smackover, Ouachita & Union Counties
Alford, E. H.	Box 265, Stephens, Ark.	Stephens, Columbia & Ouachita Counties
Alston, Phillip	Texarkana, Ark.	Stephens, Columbia & Ouachita Counties
Anding & Byrd	Kilgore, Tex.	Rodessa, Miller County
Anding & Kraker	Kilgore, Tex.	Rodessa, Miller County
Arkansas Pipe & Scrap Metal Co.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Arkansas Southern Oil Co.	% Robert Wallingsford, El Dorado, Ark.	Urbana, Union County
Arkansas Valley Gas Co.	107 W. 2nd Street, Little Rock, Ark.	Gas Fields of Northern Ark.
Atlantic Refg. Co.	Box 2819, Dallas, Tex.	Dorcheat, Columbia County Dorcheat-Cotton Valley, Columbia County Macedonia, Columbia County Magnolia, Columbia County McKamie, Lafayette County Mt. Holly, Union County Schuler-East, Union County

Company	Address	Location of Fields
Arkansas Fuel Oil Co.	Slattery Bldg., Shreveport, La.	Dorcheat, Columbia County El Dorado-South, Union County El Dorado-West, Union County Magnolia, Columbia County Midway, Lafayette County Smackover, Ouachita & Union Counties Stephens, Columbia & Ouachita Counties
Arkansas-Louisiana Gas Co.	Slattery Bldg., Shreveport, La.	Clarksville, Johnson County Tate's Island, Pope County
Arkansas Western Gas Co.	Paris, Ark.	Collier well, Winn well, Johnson County Missouri Pacific well, Franklin County
Arkla Oil Corp.	Box 2519, Dallas, Tex.	Rodessa, Miller County
Barnsdall Oil Co.	Box 2039, Tulsa, Okla.	McKamie, Lafayette County Midway, Lafayette County
Beebe, J. S.	Smackover, Ark.	El Dorado-South, Union County
Benedum & Trees	Benedum & Trees Bldg., Pittsburgh, Pa.	Troy, Nevada County
Berg, Laney & Brown	Camden, Ark.	El Dorado-South, Union County Smackover, Ouachita & Union Counties
Berkshire Oil Co.	608 Nat'l Standard Bldg., Houston, Tex.	Magnolia, Columbia County Rodessa, Miller County
Berry Asphalt Co.	Waterloo, Ark.	Troy, Nevada County Irma, Nevada County
Bibby, C. W.	Smackover, Ark.	Smackover, Ouachita & Union Counties

Company	Address	Location of Fields
Bibby, Ida L.	Box 293, Smackover, Ark.	Smackover, Ouachita & Union Counties
Bibby, L. M.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Bradham, E. G.	First Nat'l Bank Bldg., El Dorado, Ark.	Buckner, Columbia & Lafayette Counties El Dorado-South, Union County Village, Columbia County
Brazil, W. H.	Rt. No. 1, Box 11, Smackover, Ark.	Smackover, Ouachita & Union Counties
Brinson, B. C.	City Bank & Trust Co., Camden, Ark.	Smackover, Ouachita & Union Counties
Brooks, Zack	El Dorado, Ark.	Champagnolle, Union County
Brown Oil Corp.	El Dorado, Ark.	El Dorado-South, Union County
Buercklin, H. R. (Rec.)	El Dorado, Ark.	Champagnolle, Union County
Buffalo Oil Co.	Stephens, Ark.	Stephens, Columbia & Ouachita Counties
Callaway, N. K.	Nat'l Bank of Commerce, El Dorado, Ark.	El Dorado-South, Union County
Cararas, J. A.	Ardie Bldg., Shreveport, La.	Rodessa, Miller County
Carter Oil Co., The	Box 801, Tulsa, Okla.	Big Creek, Columbia County Buckner, Columbia & Lafayette Counties El Dorado-South, Union County Fouke, Miller County Irma, Nevada County Magnolia, Columbia County McKamie, Lafayette County McKamie-Cotton Valley, Lafayette County Village, Columbia County

Company	Address	Location of Fields
Cherry, C. C.	El Dorado, Ark.	El Dorado-South, Union County
Clark, Dr. O. W.	Pine Bluff, Ark.	Smackover, Ouachita & Union Counties
Coffman, H. G.	Rt. No. 4, El Dorado, Ark.	Smackover, Ouachita & Union Counties
Collums, W. H. Tr.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Cook, Jim	Smackover, Ark.	Smackover, Ouachita & Union Counties
Cook & Lambert	Smackover, Ark.	Smackover, Ouachita & Union Counties
Conklin, G. V.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Consolidated Pet. Co.	El Dorado, Ark.	El Dorado-East, Union County
Corley, W. E.	Box 73, Louann, Ark.	El Dorado-West, Union County Smackover, Ouachita & Union Counties
Creslenn Oil Co.	Box 866, Dallas, Tex.	Urbana, Union County
Crosbie, J. E. Inc.	Tulsa, Okla., or % Zack Brooks, El Dorado, Ark.	Smackover, Ouachita & Union Counties
Cross, H. H. Co.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Crotty, C. H.	El Dorado, Ark.	Champagnolle, Union County
Crotty, C. M.	El Dorado, Ark.	Smackover, Ouachita & Union Counties

Company	Address	Location of Fields
Crow, R. H., et al.	422 Commercial Nat'l Bank Bldg., Shreveport, La.	Buckner, Columbia & Lafayette Counties Stephens, Columbia & Ouachita Counties
Cumberland Petroleum Co.	1524 Hanna Bldg., Cleveland, Ohio	Smackover, Ouachita & Union Counties
Delta Drlg. Co.	Box 2012, Tyler, Tex.	Dorcheat, Columbia County
Evans, H. W.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Feazel, W. C., et al.	Monroe, La.	Rodessa, Miller County
Frankel, Frank, et al.	1907 Commerce Bldg., Houston, Tex.	Magnolia, Columbia County McKamie, Lafayette County Midway, Lafayette County
Fohs Oil Co.	923 Esperson Bldg., Houston, Tex.	Nick Springs, Union County Village, Columbia County
General Crude Oil Co.	Box 2252, Houston, Tex.	Macedonia, Columbia County
Gerhig Co. of Ark., The	City Bank Bldg., Shreveport, La.	Rodessa, Miller County
Goldston, W. L.	Oil & Gas Bldg., Houston, Tex.	Magnolia, Columbia County
Green, Mrs. Claudie	Box 72, Stephens, Ark.	Stephens, Columbia & Ouachita Counties
Griffin, B. W.	El Dorado, Ark.	Smackover, Ouachita & Union Counties
Grimes Brothers, Inc.	El Dorado, Ark.	El Dorado-East, Union County
Gulf Refining Co.	Box 2100, Houston, Tex.	El Dorado-South, Union County El Dorado-West, Union County Smackover, Ouachita & Union Counties

Company	Address	Location of Fields
Hammonds, G. Scott	Hotel Marshall, Marshall, Tex.	Atlanta, Columbia County Buckner, Columbia & Lafayette Counties
Harr, H. M.	El Dorado, Ark.	Champagnolle, Union County
Harris, Lamar, et al.	Box 294, Smackover, Ark.	Smackover, Ouachita & Union Counties
Haynes, B. Ownby Drlg. Co.	Gulf State Bldg., Dallas, Tex.	Stephens, Columbia & Ouachita Counties
Henderson & Primm	Smackover, Ark.	Smackover, Ouachita & Union Counties
Hollyfield & McFarlane	Armstrong Bldg., El Dorado, Ark.	El Dorado-East, Union County Magnolia, Columbia County Smackover, Ouachita & Union Counties
Hood, F. M., et al.	Box 988, Shreveport, La.	Buckner, Columbia & Lafayette Counties
Huffman, M. J.	308 N. Smith Ave., El Dorado, Ark.	Smackover, Ouachita & Union Counties
Hunt, Bruce, Estate	El Dorado, Ark.	El Dorado-East. Union County
Hunt, H. L., Inc.	1608 Santa Fe Bldg., Dallas, Tex.	Smackover, Ouachita & Union Counties
Hunt, Hassie	1608 Santa Fe Bldg., Dallas, Tex.	Magnolia, Columbia County
James, G. W., Estate	Exchange Bldg., El Dorado, Ark.	Champagnolle, Union County
Industrial Oil & Gas Co.	Fort Smith, Ark.	Alma East, Shibley, Williams, Kibler, Section 10, Crawford County
Johnson, W. P., et al.	El Dorado, Ark.	El Dorado-South, Union County Smackover, Ouachita & Union Counties

Company	Address	Location of Fields
Jones, E. M.	Frost Nat'l Bank Bldg., San Antonio, Tex.	Schuler-Reynolds, Union County
Keever, W. R., et al.	Box 986, El Dorado, Ark.	El Dorado-East, Union County Smackover, Ouachita & Union Counties
Killingsworth, S. H.	Longview, Tex.	Rodessa, Miller County
Koury, George	Camden, Ark.	Smackover, Ouachita & Union Counties
Lambert, J. L.	Smackover, Ark.	Smackover, Ouachita & Union Counties
La Rabodiere, J. A.	El Dorado, Ark.	El Dorado-South, Union County
Larson & Spiers	Norphlet, Ark.	Smackover, Ouachita & Union Counties
Lee, Roy, Trustee	1608 Santa Fe Bldg., Dallas, Tex.	Atlanta, Columbia County
Liberty Oil Co.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Lion Oil Refg. Co.	Exchange Bldg., El Dorado, Ark.	Atlanta, Columbia County Dorcheat, Columbia County El Dorado-East, Union County Magnolia, Columbia County Schuler-Morgan, Union County Schuler-Reynolds, Union County Smackover, Ouachita & Union Counties Schuler-Jones, Union County
Love, J. W., et al.	No. 8 McKay Bldg., Magnolia, Ark.	Big Creek, Columbia County Buckner, Columbia & Lafayette Counties
Lyons, C. H.	Giddens-Lane Bldg., Shreveport, La.	Dorcheat, Columbia County
Lyons & Merritt	Giddens-Lane Bldg., Shreveport, La.	Rodessa, Miller County

Company	Address	Location of Fields
McAlester Fuel Co.	Box 1828, Longview, Tex., and McAlester, Okla.	Dorcheat, Columbia County Macedonia, Columbia County Village, Columbia County
McClanahan, W. L., et al.	Ardis Bldg., Shreveport, La.	Rodessa, Miller County
McDermott, A. P., Jr.	Des Moines, Iowa	Champagnolle, Union County
McDonald, L. L.	Smackover, Ark.	Smackover, Ouachita & Union Counties
McFann, H. H., et al.	418 W. Elm, El Dorado, Ark.	Smackover, Ouachita & Union Counties
McLeon, R. A.	Box 212, Louann, Ark.	Smackover, Ouachita & Union Counties
Mahoney, J. K., et al.	Armstrong Bldg., El Dorado, Ark.	Atlanta, Columbia County
Magnolia Petroleum Co.	Magnolia Bldg., Dallas, Tex.	Champagnolle, Union County El Dorado-South, Union County El Dorado-West, Union County Garland City, Miller County Macedonia, Columbia County Smackover, Ouachita & Union Counties
Marine Oil Co.	First Nat'l Bank Bldg., El Dorado, Ark.	Magnolia, Columbia County Schuler-Morgan, Union County Schuler-Reynolds, Union County Smackover, Ouachita & Union Counties Urbana, Union County
Maritzky, M.	Box 486, Homer, La.	El Dorado-South, Union County
Maritzky & Bibby	Box 486, Homer, La.	Stephens, Columbia & Ouachita Counties

Company	Address	Location of Fields
Martin, Alma, et al.		Rodessa, Miller County
Mason, Don	Norphlet, Ark.	Smackover, Ouachita & Union Counties
Maxwell, R. L.	Louann, Ark.	Smackover, Ouachita & Union Counties
Maxwell, R. M.	Louann, Ark.	Smackover, Ouachita & Union Counties
Mid-Continent Pet. Corp.	Box 2040, Tulsa, Okla.	Magnolia, Columbia County
Mitchell, A. J.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Murphy, C. H., Jr.	First Nat'l Bank Bldg., El Dorado, Ark.	Dorcheat, Columbia County El Dorado-South, Union County
Murphy, O. G.	First Nat'l Bank Bldg., El Dorado, Ark.	Smackover, Ouachita & Union Counties
Murry, Ethel Mae	Texarkana, Ark.	Garland City, Miller County
Nadel, L.	Box 996, Tulsa, Okla.	Smackover, Ouachita & Union Counties
North Central Texas Oil Co.	44 Beaver St., New York, N. Y.	Stephens, Columbia & Ouachita Counties
Ohio Oil Co., The	Findlay, Ohio, and Shreveport, La.	Champagnolle, Union County El Dorado-West, Union County Stephens, Columbia & Ouachita Counties
Oliphant, A. G.	1905 Nat'l Bank of Tulsa Bldg., Tulsa, Okla.	Magnolia, Columbia County
Oswalt, J. A.	Smackover, Ark.	Smackover, Ouachita & Union Counties

Company	Address	Location of Fields
Ozark Natural Gas Co.	Fort Smith, Ark.	Greenwood Junction, Crawford County Lavaca, Ewing, Beverly, Sebastian, Vest, Ozark & Anderson, Franklin County
Patterson, Earl	Exchange Bldg., El Dorado, Ark.	El Dorado-East, Union County
Patterson & Smith	El Dorado, Ark.	El Dorado-East, Union County
Pesnell, A. H.	Louann, Ark.	Smackover, Ouachita & Union Counties
Pesses, I. L., La. Iron & Supply	El Dorado, Ark.	El Dorado-East, Union County El Dorado-South, Union County
Petroleum Finance Corp.	Continental Bldg., Dallas, Tex.	Magnolia, Columbia County
Phillips, A. C.	Rt. No. 6, Box 11, El Dorado, Ark.	El Dorado-South, Union County
Phillips, Mrs. Hattie	Rt. No. 6, Box 11, El Dorado, Ark.	El Dorado-South, Union County
Phillips Petroleum Co.	Bartlesville, Okla.	Schuler-Morgan, Union County Schuler-Reynolds, Union County Smackover, Ouachita & Union Counties
Placid Oil Co.	1608 Santa Fe Bldg., Dallas, Tex.	Champagnolle, Union County El Dorado-South, Union County El Dorado-West, Union County Magnolia, Columbia County Schuler-East, Union County Smackover, Ouachita & Union Counties

Company	Address	Location of Fields
Reynolds, J. D.	Camden, Ark.	El Dorado-West, Union County Smackover, Ouachita & Union Counties Stephens, Columbia & Ouachita Counties
Reynolds, Dave, Corp.	Camden, Ark.	Smackover, Ouachita & Union Counties
Richardson, Sam	El Dorado, Ark.	Smackover, Ouachita & Union Counties
Richardson & Murphy	First Nat'l Bank Bldg., El Dorado, Ark.	Champagnolle, Union County
Roberts, J. I.	302 Commercial Nat'l Bank Bldg., Shreveport, La.	Midway, Lafayette County
Rogers, J. G.	Rt. No. 6, El Dorado, Ark.	El Dorado-East, Union County El Dorado-West, Union County
Root Petroleum Co.	Box 971, El Dorado, Ark., and Shreveport, La.	Nick Springs, Union County Schuler-East, Union County
Rushing, J. S. Tr.	Armstrong Bldg., El Dorado, Ark.	Rodessa, Miller County
Shell Oil Co., Inc.	Box 2099, Houston, Tex.	Dorcheat, Columbia County Magnolia, Columbia County
Sklar Oil Corp.	Shreveport, La.,and Box 189, El Dorado, Ark.	El Dorado-South, Union County El Dorado-West, Union County Rodessa, Miller County Smackover, Ouachita & Union Counties
Skelly Oil Co.	Box 1650, Tulsa, Okla.	Lewisville, Lafayette County Rodessa, Miller County Smackover, Ouachita & Union Counties

Company	Address	Location of Fields
Smart, C. C.	Stephens, Ark.	Stephens, Columbia & Ouachita Counties
Southern Gas Producing Co.	Sebastian County	Massard Prairie, Sebastian County
Southern Production Co.	1905 Rand Tower, Minneapolis, Minn., % George B. Graves	Smackover, Ouachita & Union Counties
Southwood Oil Co.	410 Continental Bldg., Dallas, Tex.	Dorcheat, Columbia County Magnolia, Columbia County
Spence, H. M.	El Dorado, Ark.	Smackover, Ouachita & Union Counties
Stacy & Erwin	Marks Bldg., El Dorado, Ark.	Nick Springs, Union County
Spears Oil Co.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Spiers, R. H.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Steele, Will	Texarkana, Ark.	Garland City, Miller County
Steffen, Harry	Smackover, Ark.	Smackover, Ouachita & Union Counties
Sugar, L. L.	Giddens-Lane Bldg., Shreveport, La., and 325 Lester St., El Dorado, Ark.	El Dorado-South, Union County Smackover, Ouachita & Union Counties
Superior Oil Co.	Oil & Gas Bldg., Houston, Tex.	Dorcheat, Columbia County
The Texas Co.	Houston, Tex.	El Dorado-South, Union County Smackover, Ouachita & Union Counties

Company	Address	Location of Fields
Thompson, Mrs. S. O.	Grim Hotel, Texarkana, Ark.	Rodessa, Miller County
Tidewater Oil Co.	Box 1404, Houston, Tex.	Atlanta, Columbia County
Tillery, R. A.	El Dorado, Ark.	Smackover, Ouachita & Union Counties
Tirk, H. L.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Turnage, W. H.	Smackover, Ark.	Smackover, Ouachita & Union Counties
United Producing Corp.	Texarkana, Ark.	Garland City, Miller County
Vaughn, G. H.	601 Dallas Nat'l Bank Bldg., Dallas, Tex.	Atlanta, Columbia County Magnolia, Columbia County Stephens, Columbia & Ouachita Counties
Vickers, R. M.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Vickers & Spears	Smackover, Ark.	Smackover, Ouachita & Union Counties
Washington Brothers	Norphlet, Ark.	Smackover, Ouachita & Union Counties
Wesson & Bonner	Stephens, Ark.	Stephens, Columbia & Ouachita Counties
Western Oil Corp.	Smackover, Ark.	Smackover, Ouachita & Union Counties
Whitaker, O. F.	Box 261, Stephens, Ark.	Smackover, Ouachita & Union Counties Stephens, Columbia & Ouachita Counties

Company	Address	Location of Fields
White, E. D.	Norphlet, Ark.	Smackover, Ouachita & Union Counties
Wilson, J. M., et al.	Box 136, Norphlet, Ark.	Smackover, Ouachita & Union Counties
Wisinger, A. L.	901 W. Faulkner St., El Dorado, Ark.	El Dorado-South, Union County
Woodward, W. A. G.	Magnolia, Ark.	Stephens, Columbia & Ouachita Counties
Woodley Petroleum Co.	Box 1403, Houston, Tex.	El Dorado-South, Union County Smackover, Ouachita & Union Counties

BULLETINS OF THE ARKANSAS GEOLOGICAL SURVEY

1. Upper Cretaceous Formations of Southwestern Arkansas, by Carle H. Dane. 1929. Cloth bound, price $1.85, mailing charge 10¢, total $1.95. Paper bound, price $1.60, mailing charge 10¢, total $1.70.

2. Oil and Gas Geology of the Gulf Coastal Plain in Arkansas, by W. C. Spooner. 1935. (Out of print.) Extract from Bulletin 2: Upper Cretaceous Ostracoda of Arkansas, by Merle C. Israelsky. 1929. Paper bound, price 20¢, mailing charge 3¢, total 23¢.

3. The Geology of the Arkansas Paleozoic Area with Especial Reference to Oil and Gas Possibilities, by Carey Croneis. 1930. Cloth bound, price $1.00, mailing charge 25¢, total $1.25.

4. St. Peter and Older Ordovician Sandstones of Northern Arkansas, by Albert W. Giles. 1930. Cloth bound, price $1.80, mailing charge 15¢, total $1.95.

5. A Geomagnetic Survey of the Bauxite Region in Central Arkansas, by Noel H. Stearn. 1930. Paper bound, with map in pocket, price 75¢, mailing charge 5¢, total 80¢.

6. Mineral Resources of Arkansas, by George C. Branner. 1942. Paper bound, price 30¢, mailing charge 5¢, total 35¢.

7. Kaolin Deposits of Southern Pike County, Arkansas, by Paul G. Herold and George R. Heyl. 1942. Paper bound, price 25¢, mailing charge 5¢, total 30¢.

8. Pitkin Limestone of Northern Arkansas, by William H. Easton. 1942. Paper bound, price 60¢, mailing charge 10¢, total 70¢.

9. Arkansas Mining and Mineral Law, by George Rose Smith. 1942. Cloth bound, price $1.00, mailing charge 10¢, total $1.10. Paper bound, price 75¢, mailing charge 5¢, total 80¢.

10. Annual Report of the State Geologist, and the Mineral Industries of Arkansas in 1942. 1943.