Economic Minerals of Mississippi

ALVIN R. BICKER, JR.

BULLETIN 112

MISSISSIPPI GEOLOGICAL, ECONOMIC AND TOPOGRAPICAL SURVEY

WILLIAM HALSELL MOORE
DIRECTOR AND STATE GEOLOGIST

JACKSON, MISSISSIPPI
1970

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STATE OF MISSISSIPPI

Hon. John Bell Williams ..... Governor

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LETTER OF TRANSMITTAL

Office of the Mississippi Geological, Economic and
Topographical Survey
Jackson, Mississippi
August 6, 1970

Mr. S. F. Thigpen, Jr., Chairman, and
Members of the Board
Mississippi Geological, Economic and Topographical Survey

Gentlemen:

I am pleased to transmit to you Mississippi Geological Survey Bulletin 112, "Economic Minerals of Mississippi," by Alvin R. Bicker, Jr.

The value of mineral production in Mississippi continues to increase reaching an all time high of $243,000,000 in 1969. There is a steady and increasing demand for information on the mineral deposits of the State. This Buletin updates material published in previous Survey Bulletins and adds material on new areas of interest. Bulletin 112 will be most helpful in providing generalized information on mineral deposits and pointing out sources of more detailed data.

Respectfully submitted,

William H. Moore
Director and State Geologist

WHM:js

ECONOMIC MINERALS OF MISSISSIPPI

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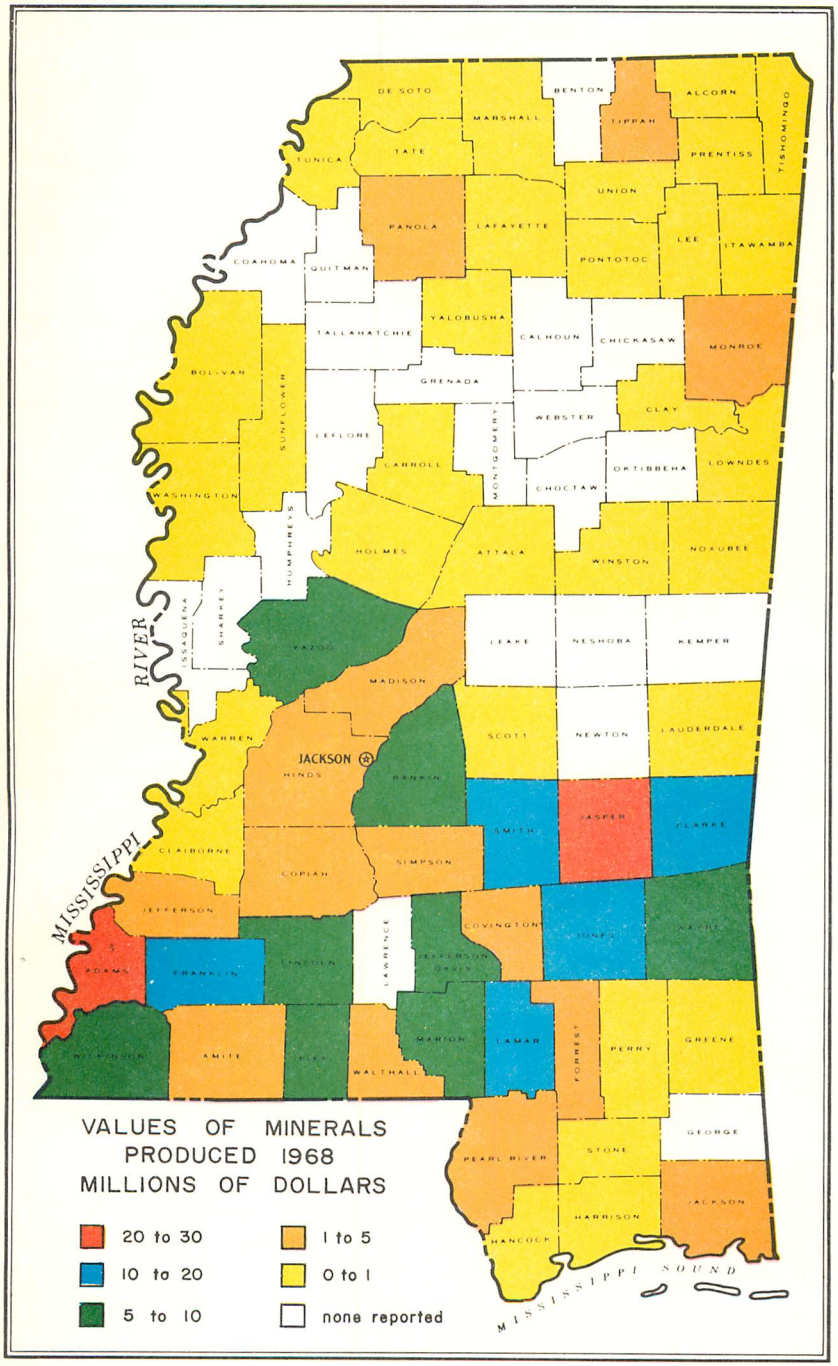
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CALHOUN
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TALLAHATCHIE
BOLIVAR
SUNFLOWER
GRENADA
CLAY
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LEFLORE
CARROLL
MONTGOMERY
OKTIBBEHA
LOWNDES
WASHINGTON
CHOCTAW
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
ISSAQUENA
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YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
JACKSON
HINDS
RANKIN
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
COVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
LINCOLN
LAWRENCE
JEFFERSON DAVIS
MARION
LAMAR
FORREST
PERRY
GREENE
WILKINSON
AMITE
PIKE
WALTHALL
PEARL RIVER
STONE
GEORGE
HARRISON
JACKSON
HANCOCK
MISSISSIPPI RIVER
MISSISSIPPI SOUND
VALUES OF MINERALS
PRODUCED 1968
MILLIONS OF DOLLARS
20 to 30
10 to 20
5 to 10
1 to 5
0 to 1
none reported

ECONOMIC MINERALS OF MISSISSIPPI

ALVIN R. BICKER, JR.

ABSTRACT

Mineral commodities which may have some economic value to the State's economy are discussed in this report. Commodities of more economic significance are treated in greater detail. Minor minerals are included even though commercial production of these commodities is non-existent. Geographic and geologic distribution of the minerals are given and where applicable sketch maps showing these distributions are included. An index of the minerals as reported in Bulletins of the Mississippi Geological Survey is provided as a source for obtaining additional or more detailed information for the commodities.

In 1969 the value of Mississippi mineral production attained the highest figure ever recorded, $243,184,000. Petroleum and allied products represented 87.6% of the total value. During the past decade the petroleum industry expanded greatly and contributed related industries to the economy, mainly sulfur extraction, refining and a growing petrochemical industry. Although the nonmetallic minerals make up only a small part of the total value of mineral production, the group also experienced tremendous growth and contributed much to the overall economy of Mississippi.

The prospect of increased mineral production in the future is excellent. The success ratio of petroleum exploration in Mississippi is among the highest in the nation making the State an attractive exploration area. Expanded uses of petroleum products and a growing petrochemical industry enhances the prospects of increased demands for petroleum. Prospective growth in the construction industry will result in a parallel increase in the production of nonmetallic minerals which supply the industry. Continued improvements in processing technology will result in lower production costs leading to exploitation of minerals which are now considered noncommercial.

INTRODUCTION

The history of the mineral industry in Mississippi reflects several periods of slow irregular growth interrupted by two decades of accelerated increase. Prior to the discovery of oil in 1939 the value of minerals produced in the State was low. Mississippi ranked 47th among the states as a mineral producing state. Pre-1940 mineral production was limited to chiefly nonmetallic minerals such as clay, sand, gravel and stone. Near the end of this period natural gas production assumed a large part of the total value of mineral production.

Beginning in 1940 the annual monetary return from mineral production increased at an unprecedented rate. Between 1940

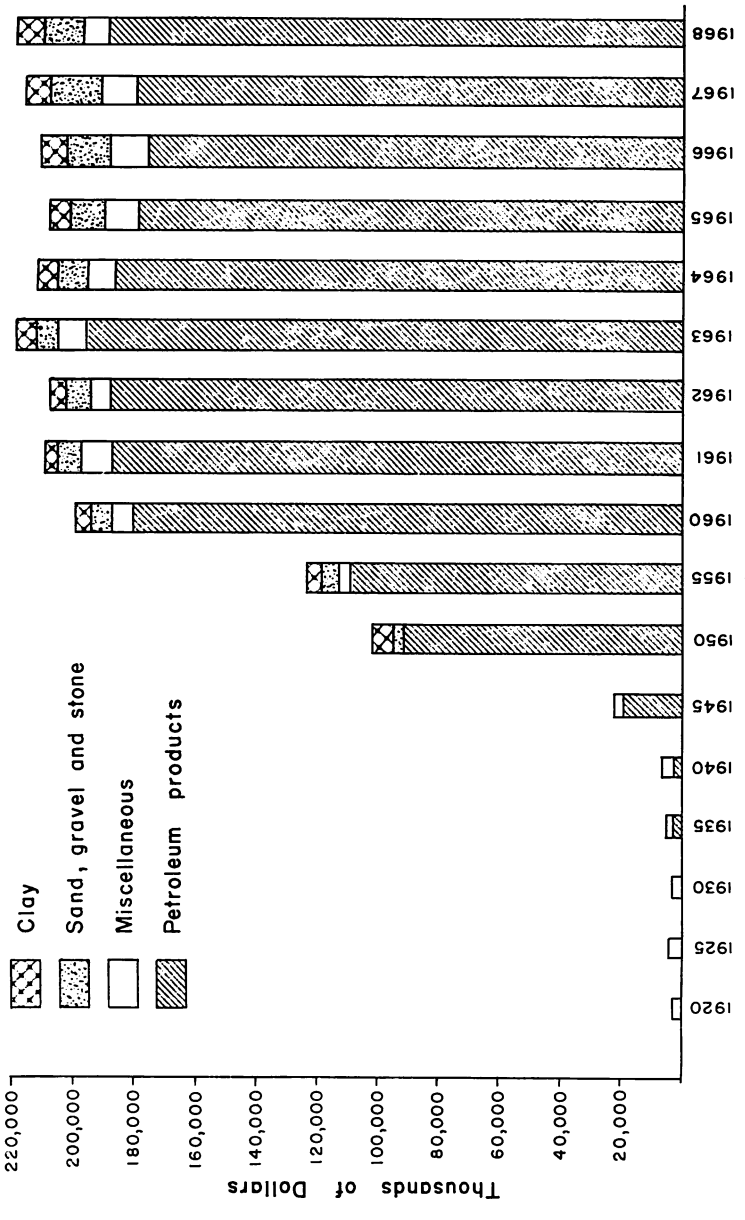


Figure 1.—Value of Mississippi mineral production.

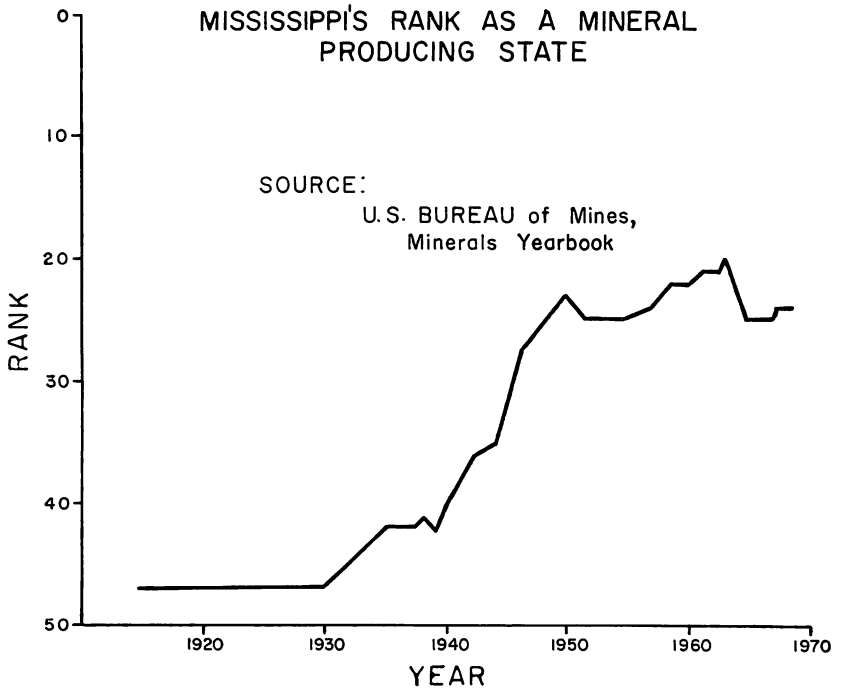


Figure 1-A.

and 1950 production of petroleum products increased the annual value of all minerals produced to more than 10 times the 1940 figure. Although the non-metallic mineral production increased also, the value of petroleum related products assumed an increasingly larger share of the total mineral production. By 1960 the mineral fuels accounted for approximately 85 per cent of the total mineral production.

Since 1960 the value of the total mineral production has been more or less static with slight increases or declines. With such a large percentage of the total mineral production based on mineral fuels these increases or declines reflect activity in the mineral fuels field rather than being an indicator of over-all mineral production. For example, during 1968 the value of mineral production in Mississippi, as reported by the Bureau of Mines, reached an all time high of $221,000,000. This figure was an increase of 2 per cent over the previous years' value. Production of mineral fuels increased $7,000,000 over he reported figure

for 1967, whereas the value of other minerals produced decreased approximately $3,000,000.

Although mineral fuels are the dominant factor in the Mississippi mineral production, non-metallic minerals are an important part of the economic development of the State. Sand, gravel and clay are the major mineral commodities of the non-metallic group. Deposits of these minerals are widespread throughout the State but not necessarily uniformly distributed. Other non-metallic minerals found in Mississippi are shell, stone, limestone, chalk, chert, tripoli, salt, glauconite, water and minor commodities. Limited production has been reported for a number of these minerals.

Ores of aluminum and iron are the metallic minerals found in Mississippi. The aluminum ore is of such quality that it is not commercially feasible to exploit until extractive and processing costs are reduced to more acceptable levels. Iron ores have been produced at several locations within the State. Locations and descriptions of the ores are well documented in bulletins published by the Mississippi Geological Survey.

SURFACE AND SUBSURFACE GEOLOGY OF MISSISSIPPI

A generalized stratigraphic column applicable to the Mississippi surface and subsurface is shown in Figure 2. The oldest rocks present at the surface are those of Devonian age exposed in Tishomingo County. The youngest are those of Recent age found along the rivers and streams and the coastal area. The oldest rocks penetrated in the subsurface are of Cambrian age. Plate 1 is a cross section from the Mississippi-Tennessee State Line to Horn Island in the Gulf of Mexico and shows the influence of surface and subsurface structures on the beds of various ages. The subsurface features of the remainder of the State are shown in the small map at the south end of the section. (This cross section is available at a scale of one inch equals four miles in 9 colors from the Mississippi Geological Survey at a price of $6.00, plus 50¢ postage.)

The Paleozoic rocks exposed in Tishomingo County dip into the Warrior Basin. Cretaceous beds form arcuate bands across the northeastern portion of the State and dip gently into the Gulf Coast Embayment. Beds of older tertiary age form arcuate

GENERAL STRATIGRAPHIC SECTION

ERA	SYSTEM	SERIES	GROUP or FORMATION
	Quaternary	Recent Pleistocene	Alluvium Citronelle
CENOZOIC	Tertiary	Miocene	Pascagoula Hattiesburg Catahoula
		Oligocene	Vicksburg Forest Hill
		Eocene	Jackson Claiborne Wilcox
		Paleocene	Midway Clayton
MESOZOIC	Cretaceous	Gulf	Selma Eutaw Tuscaloosa
		Comanche	Washita- Fredericksburg Paluxy Mooringsport Ferry Lake Rodessa Pine Island Sligo
		Coahuila	Hosston
	Jurassic		Cotton Valley Haynesville- Buckner Smackover Norphlet Louann Werner
	Triassic		Eagle Mills
PALEOZOIC	Pennsylvanian Mississippian Devonian Silurian Ordovician Cambrian		

Figure 2


PHYSIOGRAPHIC PROVINCES
COASTAL MEADOWS
PINEY WOODS
JACKSON PRAIRIE
NORTH CENTRAL HILLS
FLATWOODS
PONTOTOC RIDGE
BLACK PRAIRIE
TOMBIGBEE HILLS
SOUTH
NORTH
PERRY BASIN
Sea Level
CROSS SECTION FROM MISSISSIPPI - TENNESSEE STATE
LINE TO HORN ISLAND IN GULF OF MEXICO
GEOLOGY BY CHARLES H. WILLIAMS, JR.
MISSISSIPPI GEOLOGICAL SURVEY
WILLIAM H. MOORE, DIRECTOR AND STATE GEOLOGIST
JACKSON, MISSISSIPPI
Grateful acknowledgement is extended to the many geologists and geophysicists who contributed to the construction of this section by their generous offer of knowledge, data, suggestions and criticisms.
1969
PREPARED BY
MERCURY MAPS INC.
JACKSON, MISSISSIPPI
STRUCTURAL FEATURES OF MISSISSIPPI
DOMINANT LITHOLOGY
ADMIXTURES, THIN BEDS, MINOR ELEMENTS
WELL INDEX
INDEX MAP
TRUE SCALE SECTION
TOP CRETACEOUS (SELMA)

bands of the west of the Cretaceous, also dipping into the embayment. Younger Teritary beds form bands across the southern half of the State dipping south-southwest and southwest into the embayment. Pleistocene Terraces cover the bedrock in many areas.

In northwestern Mississippi lies the great illuvial plain of the Mississippi and Yazoo Rivers called the "Delta." In this area several hundred feet of bedrock sediments have been removed and replaced by thick alluvial deposits.

Exposed sediments in Mississippi are sands and gravels, clays, silts, limestones, chalk and marls with some other surface minerals. These sediments are products of environments such as shallow marine, littoral, lacustrine, estuarine and fluvial.

The subsurface rocks are largely of the same types as the surface sediments but do contain anhydrite, salt, dolomite and rock types. There are some igneous rocks both intrusive and extrusive present in the subsurface, particularly in the Cretaceous.

SOURCES OF INFORMATION

Most of the information on mineral commodities is from reports and bulletins published by the Mississippi Geological Survey. Statistical data on mineral production has been obtained from the Minerals Yearbook published by the Bureau of Mines and from bulletins of the Mississippi Oil and Gas Board. Other information is from the Mississippi Department of Agriculture, Mississippi State Highway Department and individual companies.

Thirty-four of the eighty-two counties in Mississippi have been the objective of individual mineral surveys for which reports are available. Most of the reports contain detailed information on the economic minerals found in each county. Figure 3 shows the counties which have been surveyed and lists the Geological Survey Bulletin number of each report. Information on mineral commodities in other counties may be found in reports which cover certain areas or specific minerals. To aid the reader in locating information on specific mineral commodities in Bulletins published by the Mississippi Geological Survey an index of the minerals is hereby included.

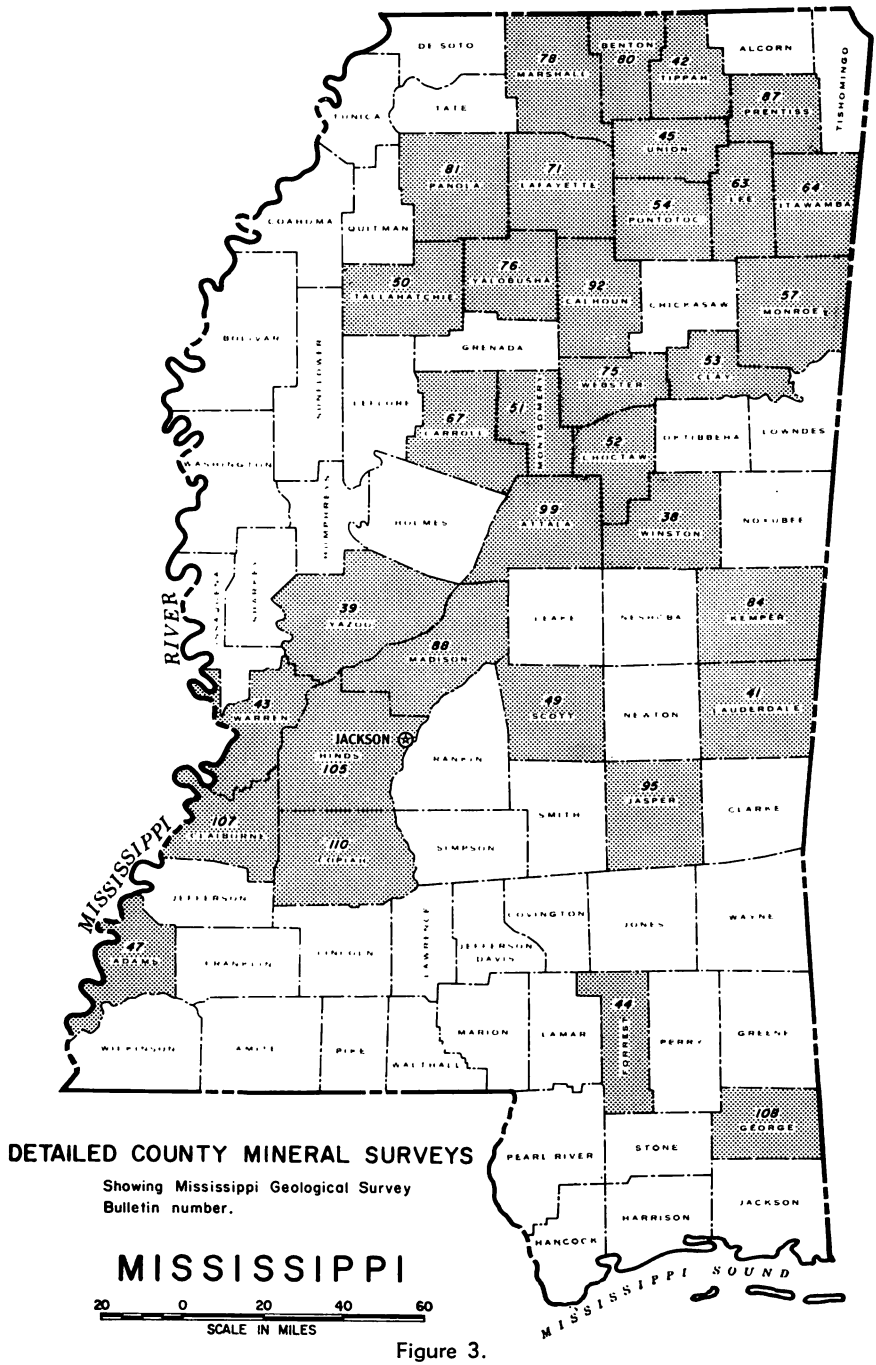

DE SOTO
78 MARSHALL
BENTON
80
42 TIPPAH
ALCORN
TISHOMINGO
97 PRENTISS
TUNICA
TATE
45 UNION
81 PANOLA
71 LAFAYETTE
63 LEE
64 ITAWAMBA
54 PONTOTOC
COAHOMA
QUITMAN
50 TALLAHATCHIE
76 YALOBUSHA
92 CALHOUN
CHICKASAW
57 MONROE
BOLIVAR
GRENADA
53 CLAY
75 WEBSTER
SUNFLOWER
LEFLORE
67 CARROLL
61 MONTGOMERY
52 HOWARD
OKTIBBEHA
LOWNDES
HUMPHREYS
HOLMES
99 ATTALA
38 WINSTON
NOXUBEE
SHARKEY
39 YAZOO
84 KEMPER
LEAKE
NESHOBA
88 MADISON
49 SCOTT
NEWTON
41 LAUDERDALE
43 WARREN
JACKSON
HINDS
109
NASHOBA
95 JASPER
CLARKE
107 CLAIBORNE
110 COPIAH
SIMPSON
SMITH
JEFFERSON
COVINGTON
JONES
WAYNE
47 ADAMS
FRANKLIN
LINCOLN
LAWRENCE
JEFFERSON DAVIS
MARION
LAMAR
44 FORREST
PERRY
GREENE
WILKINSON
AMITE
PIKE
WALTHALL
108 GEORGE
PEARL RIVER
STONE
HARRISON
JACKSON
HANCOCK
MISSISSIPPI RIVER
MISSISSIPPI SOUND
DETAILED COUNTY MINERAL SURVEYS
Showing Mississippi Geological Survey Bulletin number.
MISSISSIPPI
20 0 20 40 60
SCALE IN MILES

Figure 3.

Each mineral commodity listed in the index is followed by the Bulletin number, in italics, and by the page or pages in reference. Tables (T), Plates (P) or Figures (F) which contain pertinent data are commonly followed by their page numbers in parentheses. References to an entire Bulletin are entered showing total number of pages. Bold type entries indicate important references to a particular subject or area.

TABLE 1

INDEX OF MINERAL COMMODITIES MISSISSIPPI GEOLOGICAL SURVEY BULLETINS

Phosphate: *34*, 20-22; *42*, 69; *84*, 226.
Pigmenting materials and ochre: *12*, 141-142; *14*, 147-148; *20*, 128-129; *24*, 18; *42*, 64-65; *47*, 188; *86*, 50.
Quartzitic rock: *9*, 26, 34-36; *16*, 41, 50, 51, 59-60, 62-63, 82; *48*, 43; *99*, 68-71.
Road-making materials: *12*, 130-136; *14*, 137-143; *16*, **139 pp.**; *20*, 119-124.
Rock wool: *39*, 90-91; *43*, 59, 127-128; *45*, 64, 147-148; *53*, 56, 82; *57*, 136-137, 202; *62*, **19 pp.**; *63*, 85-101; *86*, 60-61, 91; *87*, 89.
Salt and saline waters: *86*, 63, 64, 66, 71, 72, 74, F. 37 (65), T. 5 (67-69), F. 38 (72), T. 6 (73); *105*, 108; *107*, 49-50; *108*, 128; *110*, 51.
Sand and gravel: *9*, **78 pp.**; *16*, **139 pp.**; *24*, 18; *25*, 74; *38*, 84-85; *41*, 94-95; *42*, 67-68; *44*, 29, 3-33; *45*, 63; *47*, 82-87; *49*, 70-72; *52*, 86-92; *53*, 57; *57*, 107-112; *63*, 122-129; *64*, 94-98; *67*, 92-97; *71*, 24, 41; *75*, 123-127; *76*, 42, 44; *78*, 175-180; *80*, 93; *81*, 136-142; *84*, 215-217; *86*, **28-33; F. 12 (27), T. 2 (29)**; *87*, 89; *92*, 57-60; *95*, 48; *98*, 37-38; *99*, 52-68; *105*, 99-103, 239-241; *107*, 46-49; *108*, 125-128; *110*, 47-50.
Sand lime brick: *43*, 128-130.
Structural materials: *9*, **78 pp.**; *12*, 127-136; *14*, 134-143; *16*, 26-30; *20*, 117-124.
Sulphur and sulfurous gases: *86*, 78, 80, 81, F. 40 (79), T. 9 (80).
Underground storage: *86*, 26, 28.
Unusual gases—carbon dioxide, hydrogen sulfide, et al: *86*, 80, 81, F. 40 (79), T. 9 (80).
Uranium: *86*, 85-86.

AGRICULTURAL LIME

Prior to 1945 the production of agricultural lime in Mississippi was by a number of small operators. Production of lime at

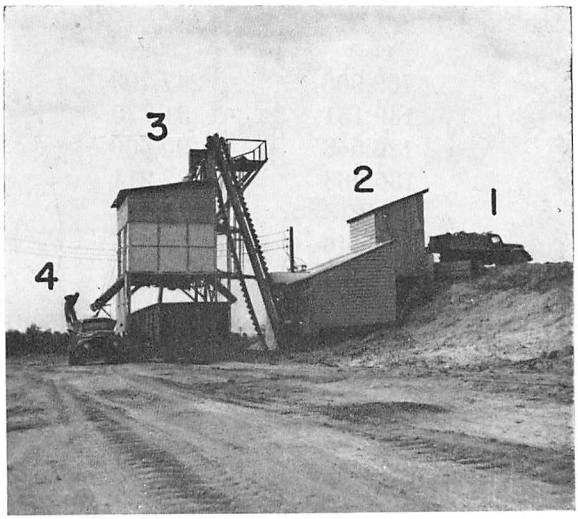


Figure 4.—Mississippi State Department of Agriculture agricultural lime plant near Cedar Bluff, Clay County. (1) unloading raw material, (2) crusher shed, (3) storage and loading bin, (4) rail and highway transportation. (M.G.S. Bull. 86 Fig. 33).

these plants was small and delivery was limited to local consumers. Consumers far removed from these plants had to rely on supplies imported from out of state.

In 1945 the State Department of Agriculture initiated a successful lime plant in Clay County. During the first five years of operation the production of the plant ranged from approximately 24,000 tons to 60,000 tons of lime per year. In 1950 the annual production approximately doubled the previous high figure. In 1951 the Department of Agriculture established a second plant which is located near Macon in Noxubee County. Production from the plants show an over all increase during the past decade despite several annual declines.

Several small commercial plants are being operated in the area of outcrop of the Vicksburg limestone in east central Mississippi. The individual annual production of these plants is reported to be less than 10,000 tons.

TABLE 2

BIANNUAL PRODUCTION OF LIME AT STATE OPERATED PLANTS

Year	Clay Co. Plant	Noxubee Co. Plant	Total Tons
1945-1958	769,903	247,703	1,017,606
1959-1961	149,151	91,770	240,921
1961-1963	126,558	90,600	217,158
1963-1965	136,968	132,211	269,179
1965-1967	180,213	174,444	354,657
1967-1969	196,446	152,525	394,971
Totals	1,561,461	889,253	2,494,492

Data from Department of Agriculture, Feed and Fertilizer Division.

CEMENT

Production of cement in Mississippi began in 1950 when Marquette Cement Manufacturing Company commenced operations at their Brandon plant in Rankin County. Rated capacity of the Brandon plant is reported to be 1,250,000 barrels of cement per year.

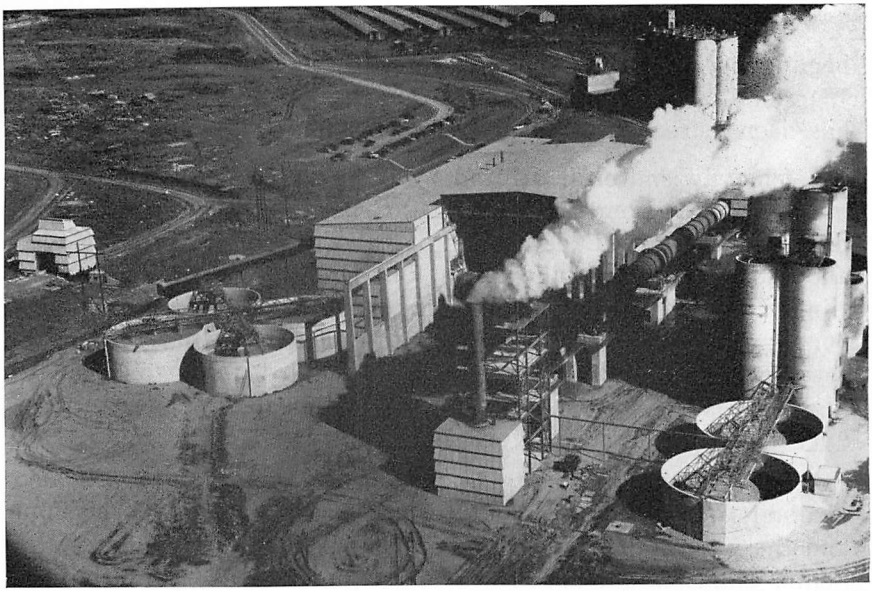


Figure 5.—Marquette Cement Manufacturing Company plant at Brandon, Rankin County. Photo by Bob Hand.

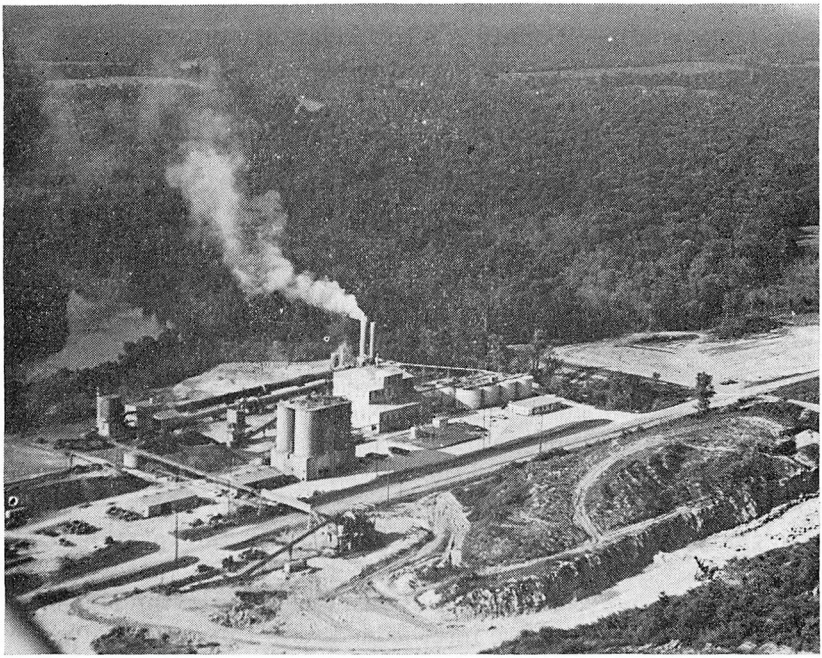


Figure 6.—Mississippi Valley Portland Cement Company plant at Redwood, Warren County, Mississippi. Photo courtesy Mississippi Valley Cement Company.

In 1959 the Mississippi Valley Portland Cement Company began operations at the Redwood plant north of Vicksburg in Warren County. Rated annual capacity of the Redwood plant has been increased to a reported 1,500,000 barrels of cement.

The raw material utilized by both plants is the limestone, marl and clay from the Vicksburg Group of Oligocene age. The materials are mixed and ground by the wet process, proportioned and blended then calcined in a kiln fired by natural gas. The clinker is then ground to the final product. Both plants produce portland and masonary cements. Statistics show that the greatest users of the product are the ready-mix dealers, followed by highway contractors, building material dealers, concrete product manufacturers and other users.

Raw materials adaptable to cement manufacture are also available in the Paleozoic outcrop area of Northeast Mississippi and the outcrop belt of the Selma chalk. Of the two sources the Selma chalk would appear to offer the greatest potential for future development because of advantages offered in mining and processing the raw material. By contrast the Paleozoic limestone of Tishomingo County has the advantage of excellent water and rail transportation to a more varied market outlet.

CHERT AND TRIPOLI

Chert and tripoli are abundant in the Paleozoic strata which outcrops in northeastern Tishomingo County. Where the rocks are unaltered by weathering the chert can be found as solid layers, nodules or stringers interbedded in layers of carbonate rock. Most commonly however the chert has weathered from the parent rock and formed a residual accumulation of angular and nodular fragments. Many of these fragments may be porous or rotten. Such is the case of the chert found in northeast Mississippi. Morse in 1930 named these beds of chert material the Iuka terrane and described the section as a mantle of angular blocks. In some places the section measures more than 100 feet in thickness. In many localities the chert is in the form of white pulverulent silica or tripoli. The tripoli, which is more than 98 percent SiO_2, sometimes attains a thickness exceeding 15 feet. Zones of tripoli usually are interbedded with thin layers of chert.

Amorphus silica and tripoli are mined in Arkansas and several other states. Most of the production is sold or used for

abrasives but a small quantity is utilized for filler, filter and other uses.

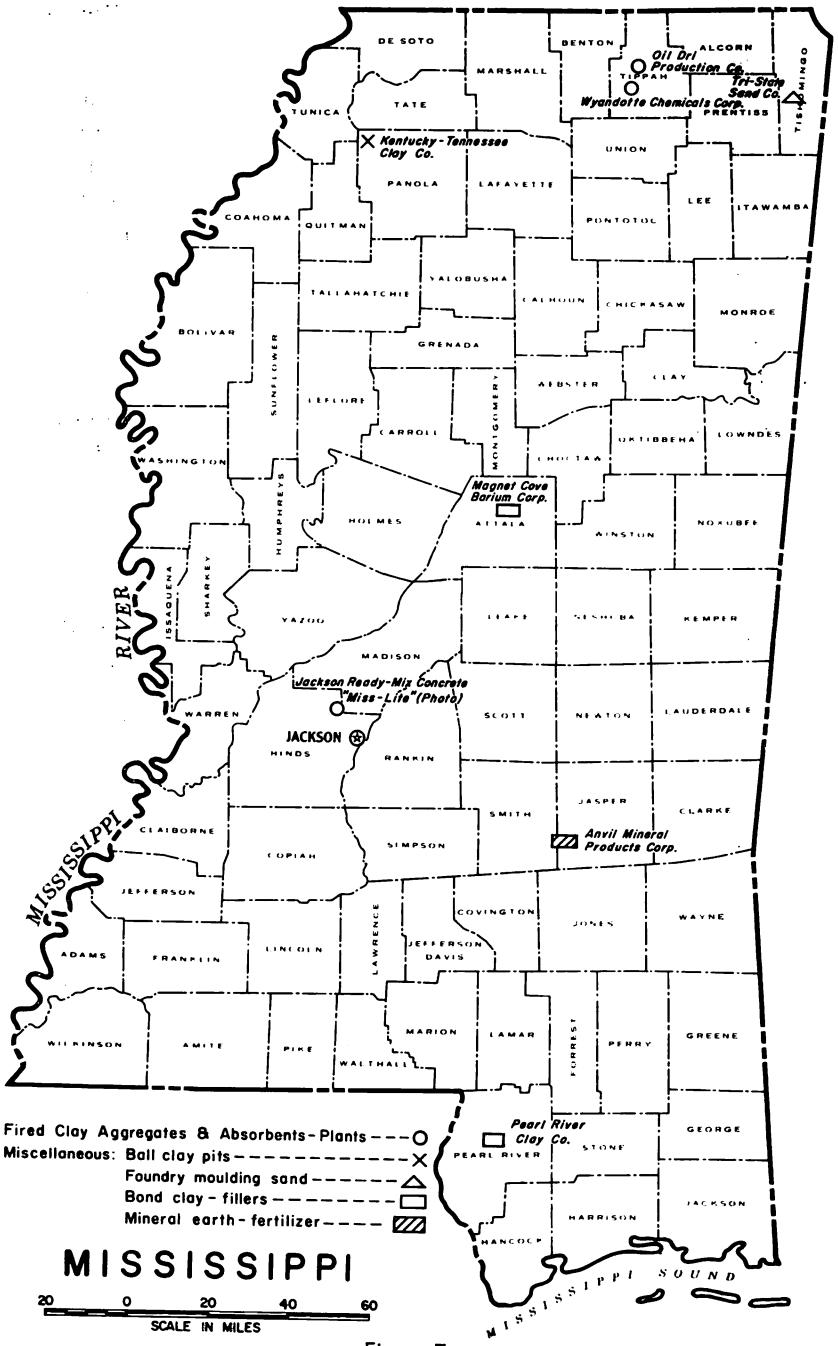
Tripoli was reported to have been produced in Tishomingo County during the early 1900's. The mine was located in Section 26, Township 2 South, Range 1 East. Raw material from the mine was transported to Alabama where it was prepared for market. The tripoli of Mississippi is of the soft silica variety. The material is very soft and crumbles easily in the fingers. The dry powder, which results from handling, will readily pass through a 100-mesh screen. The material is almost pure white in color and when dry is very light in weight.

The chert found in Mississippi would be excellent material for road fill and road base metal. Larger blocks of chert would be well suited for rip-rap.

CLAYS

Clay and clay mixtures abound in the surface strata of Mississippi. In popular terminology clay refers to any earthy, fine-grained material which becomes plastic when mixed with water and which can be moulded to retain definite shapes. By chemical analysis clay minerals are hydrous aluminum silicates. These minerals are most usually found in nature mixed with varying quantities of iron, alkalies and other compounds to form different clay types. The principal types of industrial clays are ball clay, bentonite, fire clay, fuller's earth, kaolin and miscellaneous clays.

From the early day manufacture of brick and pottery, commercial clay production in Mississippi has grown to include all the principal industrial types except kaolin. In 1968 the total value for clay production in the State was reported to be $9,075,000. This figure does not include clay used in the manufacture of cement. The quantity of clay produced during 1968 is somewhat lower than the amount produced in 1966, when a record 1,727,000 tons of all types of clay was mined. The greater value of the 1968 production reflects increased prices and higher production of ball clay, fire clay and fuller's earth. Table 3 shows quantity and value of clays produced for the period 1955-1968.


DE SOTO
BENTON
ALCORN
MARSHALL
Oil Dri Production Co.
TIPPAH
Tri-State Sand Co.
Wyandotte Chemicals Corp.
PRENTISS
TISHOMINGO
TUNICA
TATE
Kentucky-Tennessee Clay Co.
UNION
PANOLA
LAFAYETTE
LEE
ITAWAMBA
COAHOMA
QUITMAN
PONTOTOC
YALOBUSHA
TALLAHATCHIE
CALHOUN
CHICKASAW
MONROE
BOLIVAR
SUNFLOWER
GRENADA
LEFLORE
CARROLL
MONTGOMERY
WEBSTER
CLAY
OKTIBBEHA
LOWNDES
WASHINGTON
CHOCTAW
Magnet Cove Barium Corp.
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
ISSAQUENA
SHARKEY
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
Jackson Ready-Mix Concrete
"Miss-Lite" (Photo)
WARREN
SCOTT
NEWTON
LAUDERDALE
JACKSON
HINDS
RANKIN
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
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Anvil Mineral Products Corp.
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LAMAR
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PERRY
GREENE
Pearl River Clay Co.
PEARL RIVER
STONE
GEORGE
HARRISON
JACKSON
HANCOCK
MISSISSIPPI SOUND
MISSISSIPPI RIVER
Fired Clay Aggregates & Absorbents - Plants
Miscellaneous: Ball clay pits
Foundry moulding sand
Bond clay - fillers
Mineral earth - fertilizer
MISSISSIPPI
20 0 20 40 60
SCALE IN MILES

Figure 7.

TABLE 3

CLAY PRODUCTION

Year	Bentonite		Ball clay, fire clay, fuller's earth		Miscellaneous clays		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1955-59	209	2,373	100	992	342	343	651	3,708
1960	238	2,900	181	1,287	598	599	1,017	4,786
1961	228	2,836	226	1,547	650	651	1,104	5,034
1962	276	3,429	207	1,666	646	647	1,129	5,742
1963	280	3,480	230	1,761	725	727	1,235	5,968
1964	270	3,352	286	2,003	775	775	1,331	6,130
1965	280	3,477	299	2,570	923	950	1,502	6,997
1966	291	3,615	280	2,673	1,156	1,201	1,727	7,489
1967	259	3,067	306	3,306	1,089	1,479	1,654	7,852
1968	277	3,128	353	4,525	1,063	1,422	1,693	9,075

Quanity thousands of tons.
Value thousands of dollars.

BENTONITE

Mississippi is one of the chief bentonite producing areas in the United States. During 1967 the annual production of Mississippi bentonite along with that of Texas and Wyoming accounted for 90% of the total national production. Mining of bentonite in Mississippi began during the early 1930's with a small operation in Prentiss County. Presently commercial deposits are being mined in Itawamba, Monroe and Smith Counties. Of these three counties Monroe is the leading producer. Bentonite has been found at other localities in the State, but the deposits are not of commerical value or have been depleted.

In Itawamba and Monroe counties the bentonite deposits occur in layers in strata of the Eutaw formation of Cretaceous age. Thicknesses of these deposits vary greatly, but generally they are thicker than deposits found elsewhere in the State. Overburden in some areas becomes excessive for profitable mining.

The deposits located in Smith County are interbedded with limestone ledges of the Vicksburg group of Oligocene age. Average thickness of the bentonite deposits in Smith County is about three feet. Maximum overburden approaches 50 feet. Most difficulty experienced with overburden, however, is where the bentonite is overlain by limestone ledges.

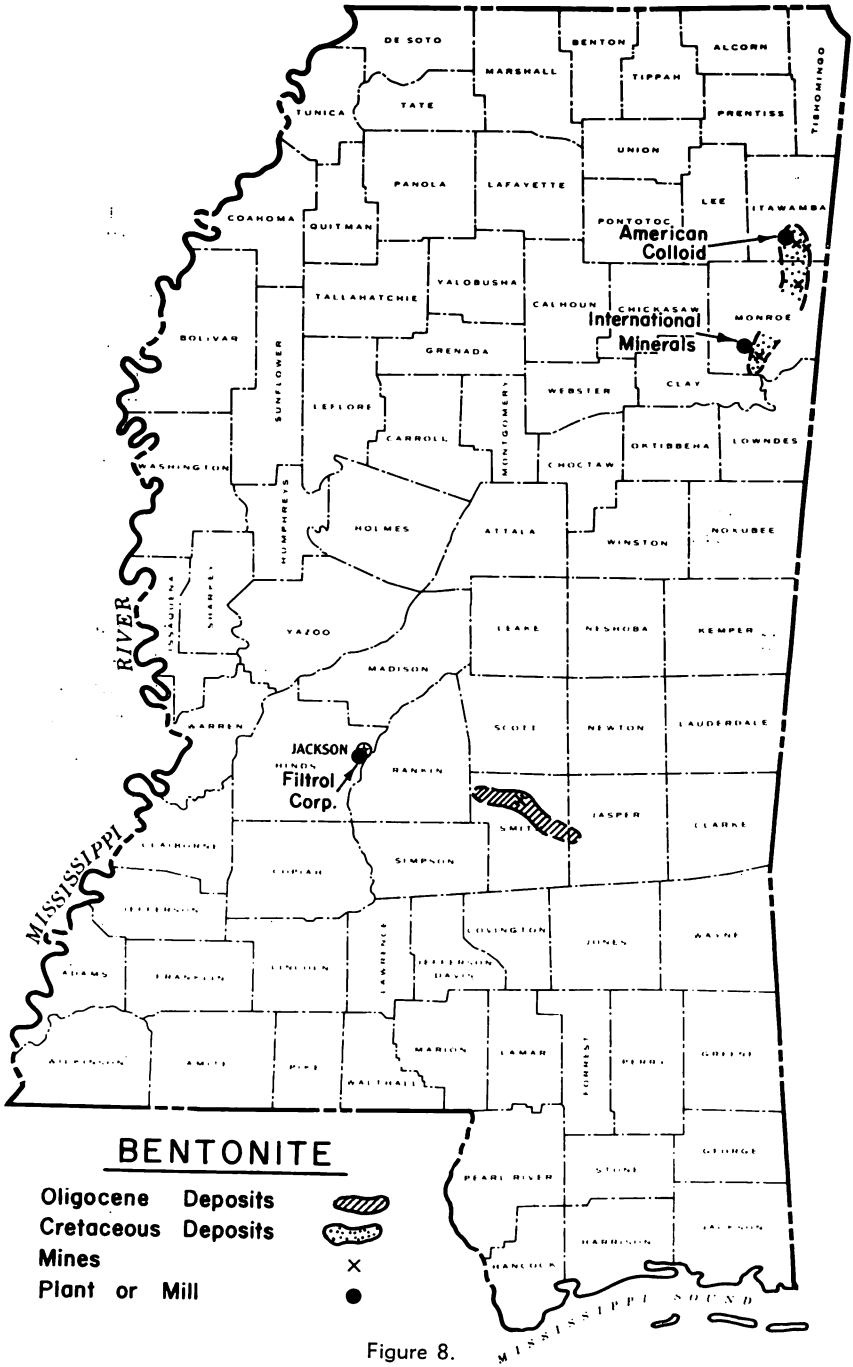

DE SOTO
MARSHALL
BENTON
TIPPAH
ALCORN
TISHOMINGO
TUNICA
TATE
PRENTISS
UNION
PANOLA
LAFAYETTE
LEE
ITAWAMBA
COAHOMA
QUITMAN
PONTOTOC
American Colloid
TALLAHATCHIE
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
International Minerals
BOLIVAR
GRENADA
CLAY
SUNFLOWER
LEFLORE
CARROLL
MONTGOMERY
WEBSTER
OKTIBBEHA
LOWNDES
WASHINGTON
CHOCTAW
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
JACKSON
HINDS
Filtrol Corp.
RANKIN
JASPER
CLARKE
SIMPSON
COPIAH
JEFFERSON
LOVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
LINCOLN
LAWRENCE
JEFFERSON DAVIS
MARION
LAMAR
FORREST
PERRY
GREENE
AMITE
PIKE
WALTHALL
PEARL RIVER
STONE
GEORGE
HARRISON
JACKSON
HANCOCK
MISSISSIPPI SOUND
MISSISSIPPI RIVER
BENTONITE
Oligocene Deposits
Cretaceous Deposits
Mines
Plant or Mill

Figure 8.

Figure 9.—Filtrol Corporation's bentonite activation plant at Jackson, Hinds County. Plant processes Mississippi and out-of-state clay for absorbent and other uses. Photo by Manley, Tucson.

Figure 10.—American Colloid Company's plant at Aberdeen, Monroe County. NW ¼, NW ¼, SW ¼, Sec. 2, T. 15 S., R. 7 E. Plant processes Eutaw bentonite for use as foundry bonding clay. Photo by American Colloid Company.

Two other areas of the State produce clays that are reported as bentonite. In Attala County, Magna Cove Barium Corporation produces a product which is used as a foundry bonding clay. The material mined is a montmorillonitic clay from the lower Zilpha formation of Eocene age. The other operation is in Pearl River County. At this location a clay reported to be from the Graham Ferry formation of Miocene age is mined and sold for drilling mud and as a carrier or filler for insecticides.

Approximately 69% of the bentonite produced in Mississippi is utilized in foundry and other steelwork. The largest part of the remaining production is used in clarifying mineral and vegetable oils. Other uses are as filler in animal feed, carriers for insecticides, filter material and other fillers.

BALL CLAY

Data compiled by the Bureau of Mines in 1967 shows that Mississippi ranks third in the nation in the production of ball clay. This type of clay consists principally of kaolinite, but has more silica and less alumina than most kaolins. Ball clays usually are more fine grained than kaolins and are very plastic. Fired products made from ball clays are generally not as white as those made from kaolin.

Figure 11.—Clay pit of the Kentucky-Tenessee Clay Company located in NW ¼, Sec. 21, T. 7 S., R. 9 W., Panola County. (M.G.S. Bull. 81 Figure 42).

Mining of ball clays progressed intermittently during the early years of clay production in Mississippi. Ball type clays were mined at several localities by small companies as late as the early 1940's. Present commercial mining of ball clay, however, is limited to one company whose quarry is located in western Panola County. The clay is present as lenticular deposits in the Zilpha formation of Eocene age. Most of the production is utilized in refractory products and wall and floor tile. Some other uses are as fillers and bonding materials.

Other deposits of ball clay can be found at different geological horizons. All known deposits are located in northern Mississippi. These deposits are found at the base of the Cretaceous and at the base of the Wilcox strata.

FIRE CLAY

Fire clay is used for refractories, heavy clay products and stoneware. This type of clay is basically kaolinitic but usually includes other clay minerals and impurities. The physical characteristics of plasticity and hardness can vary over a wide range. During 1968 fire clay production on a commercial scale was limited to Marshall County in north Mississippi. Data compiled by the Bureau of Mines show that for the year 1968 Mississippi ranked as a major producer of fire clay, only two other states produced more tonnage. Southern Brick and Tile Company, located in Byhalia, produced brick from a local clay. The Holly Springs Brick and Tile Company located in Holly Springs produces wall and floor tile as well as fire brick from a local clay.

Fire clays and stoneware clays can be found at other locations within the State. Some early reports of clay analyses have been made with clay sample referred to as a bond clay, in many instances the clay tested was usuable as a fire clay. As late as 1959 there were eight potteries operating in Mississippi, producing the usual stoneware items such as crocks, jugs and jars. As demands for their products declined the potteries ceased production.

FULLER'S EARTH

The term fuller's earth is used to describe that type of clay which was originally used as a declarifier for mineral and vegetable oils. This type of clay may be primarily montmorillonite or attapulgite. The montmorillonitic fuller's earth is found in Mis-

sissippi. Present production is limited to Tippah County where two companies are mining fuller's earth from the Porters Creek formation of Paleocene age.

Figure 12.—Wyandotte Chemical Corporation plant located at Blue Mountain, Tippah County. Plant produces a fired clay aggregate from the Porters Creek formation used for absorbent purposes. Photo by Wyandotte.

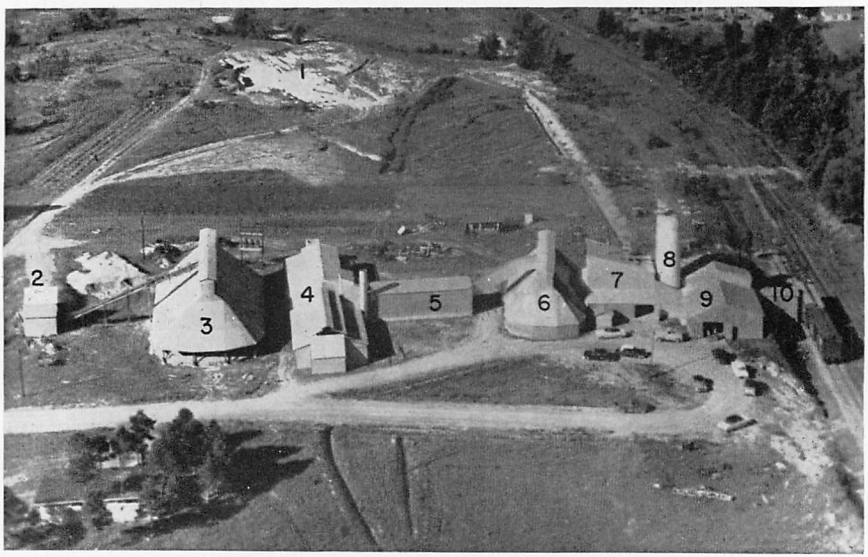


Figure 13.—Oil-Dri Corporation plant located in Ripley, Tippah County. Products include a fired clay aggregate used for absorbent and deodorizing purposes: (1) clay pit in Porters Creek formation, (2) shredding shed, (3) drying shed, (4) kiln building, (5) cooler, (6) storage shed, (7) crushing and sizing, (8) silos, (9) packaging, and (10) loading. Photo by Richard Allin.

Fuller's earth is used primarily as an absorbent material and in mineral and vegetable oil refining and as a carrier for insecticides and fungicides. Tests conducted on the Mississippi clay show that it is adaptable for manufacture of lightweight expanded aggregate.

MISCELLANEOUS CLAYS

The term miscellaneous clay is used to group those clays that have commercial value but are not included with other clay types. These clays may contain kaolinite, montmorillonite or other clay minerals. In Mississippi many of the clays are montmorillonite. The clays are generally grouped by usage. They are used most commonly in the manufacture of brick and tile and heavy clay products. Expandable clay is used in production of light weight aggregate. A clay containing a high percentage of iron sulfide is used in the preparation of an animal feed supplement.

The most widespread use of miscellaneous type clay in Mississippi is the manufacture of brick. The Mississippi-Louisiana Brick Manufacturers Association lists 16 companies operating in Mississippi during 1969. Common and some face brick are produced from local clay deposits. However, some companies have to obtain their fire clay or light burning clay from sources outside their immediate area. The combined production of all companies operating in the State is reported to be approximately 1800 bricks per hour.

TABLE 4

MISSISSIPPI BRICK MANUFACTURERS

Company	Location
Atlas Brick Company	Shuqualak
Brookhaven Pressed Brick Company	Brookhaven
Clay Products, Inc.	Holly Springs
Columbus Brick Company	Columbus
Corinth Brick and Tile Company	Corinth
Delta Brick and Tile Company	Indianola
Delta-Macon Brick and Tile Company	Macon
Hattiesburg Brick Works	Hattiesburg
Holly Springs Brick and Tile Company	Holly Springs

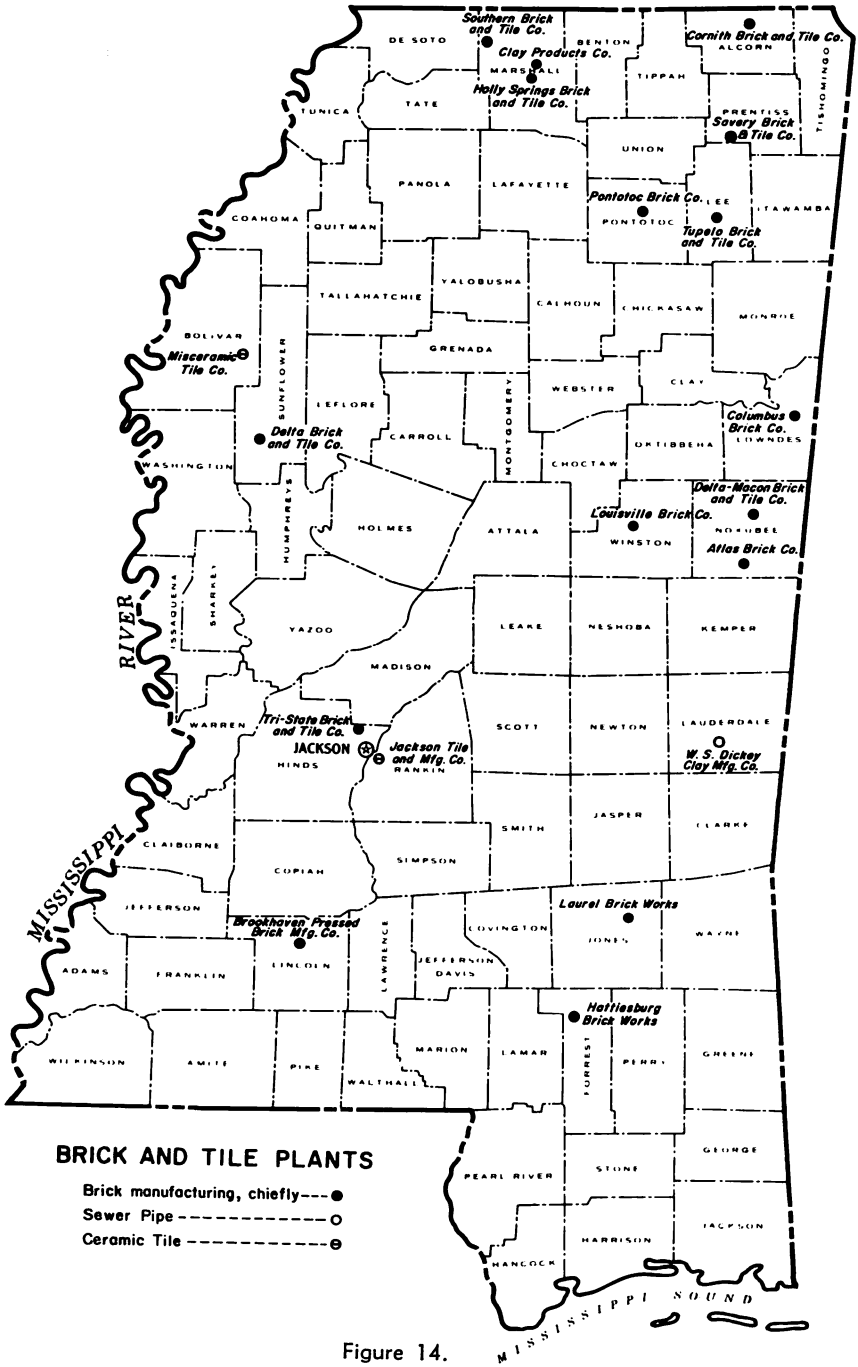

Southern Brick and Tile Co.
Clay Products Co.
Holly Springs Brick and Tile Co.
Cornith Brick and Tile Co.
Savery Brick & Tile Co.
Pontotoc Brick Co.
Tupelo Brick and Tile Co.
Misceramic Tile Co.
Delta Brick and Tile Co.
Columbus Brick Co.
Delta-Macon Brick and Tile Co.
Louisville Brick Co.
Atlas Brick Co.
Tri-State Brick and Tile Co.
JACKSON
Jackson Tile and Mfg. Co.
W. S. Dickey Clay Mfg. Co.
Laurel Brick Works
Brookhaven Pressed Brick Mfg. Co.
Hattiesburg Brick Works
DE SOTO
BENTON
ALCORN
TISHOMINGO
TUNICA
TATE
MARSHALL
TIPPAH
PRENTISS
UNION
PANOLA
LAFAYETTE
LEE
ITAWAMBA
COAHOMA
QUITMAN
PONTOTOC
TALLAHATCHIE
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
BOLIVAR
GRENADA
SUNFLOWER
WEBSTER
CLAY
LEFLORE
CARROLL
MONTGOMERY
OKTIBBEHA
LOWNDES
WASHINGTON
CHOCTAW
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
ISSAQUENA
SHARKEY
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
HINDS
RANKIN
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
LOVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
LINCOLN
LAWRENCE
JEFFERSON DAVIS
WILKINSON
AMITE
PIKE
WALTHALL
MARION
LAMAR
FORREST
PERRY
GREENE
PEARL RIVER
STONE
GEORGE
HARRISON
JACKSON
HANCOCK
MISSISSIPPI RIVER
MISSISSIPPI SOUND
BRICK AND TILE PLANTS
Brick manufacturing, chiefly---●
Sewer Pipe----------○
Ceramic Tile----------⊖

Figure 14.

Laurel Brick Company	Laurel
Louisville Brick Company	Louisville
Pontotoc Brick Company	Pontotoc
Savery Brick and Tile Company	Baldwyn
Southern Brick and Tile Company	Byhalia
Tri-State Brick and Tile Company	Jackson
Tupelo Brick and Tile Company	Tupelo

In 1958 the Miss-Lite Division of Jackson Ready-Mix Concrete began operation of an expanded lightweight aggregate plant. Raw material for the expanded product is the Yazoo clay which crops out in the area of the plant. Rated capacity of the plant in 1969 is reported by company officials to be approximately 600 tons of aggregate per day. Other clays suitable for manufacture of lightweight aggregate can be found at different localities in the State.

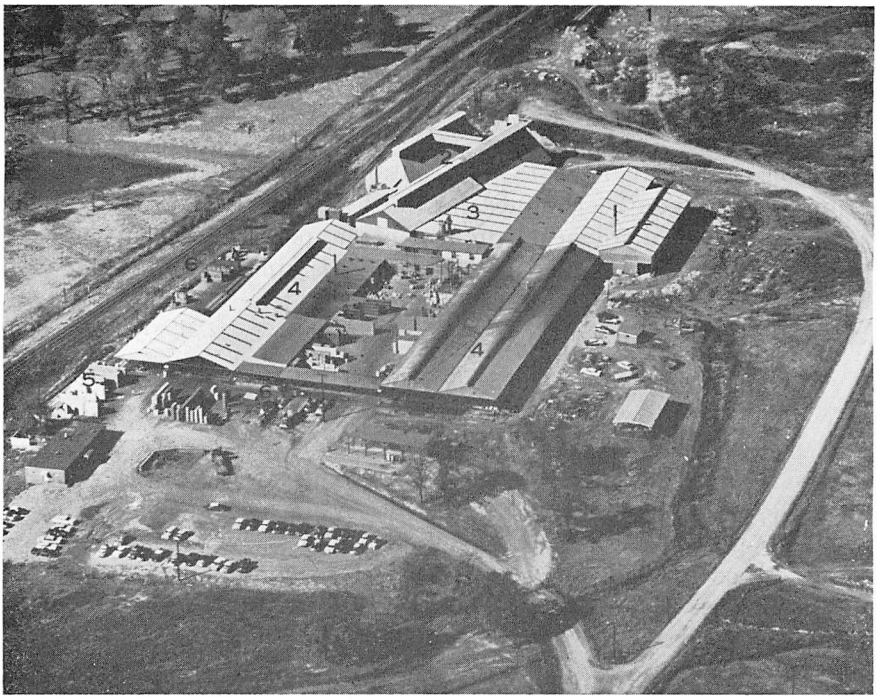


Figure 15.—Tri-State Brick & Tile Company Plant near Jackson: (1) pit opened in clay loam, (2) dry clay storage, (3) clay preparation facilities, (4) driers and tunnel kilns, (5) finished bricks, (6) rail and truck loading areas. Photo by Hand Portraits, December 1963.

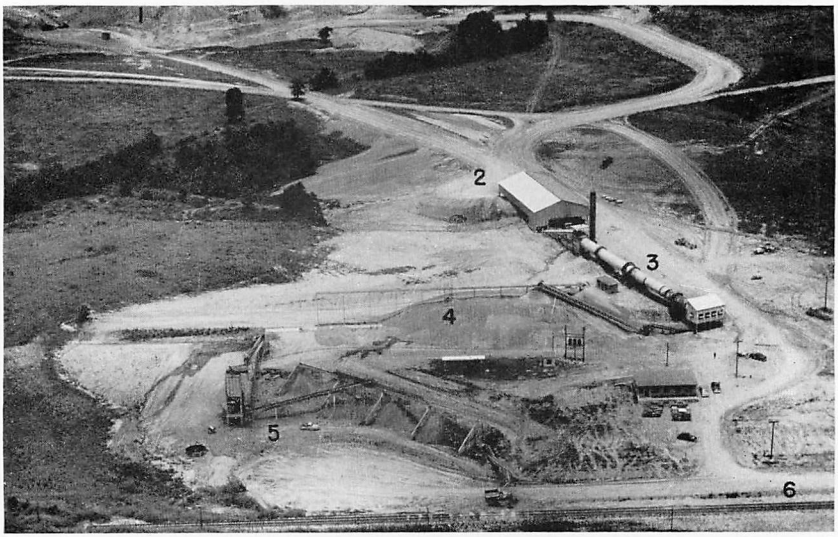


Figure 16.—Lightweight Aggregate Division plant of Jackson Ready-Mix Concrete at Cynthia: (1) pits opened in the Yazoo clay. (2) Clay dry shed, (3) rotary kiln, (4) cinder storage area, (5) grinding, screening and storage of graded aggregates, and (6) rail or truck shippin facilities. (M.G.S. Bull. 86, Fig. 24).—Frank Noone photo, July 2, 1958.

For a number of years clay containing a high percentage of iron sulphide has been mined in Smith County and used in the preparation of a mineral supplement in poultry and livestock feed and as a soil conditioner. The clay is mined from strata of the Bucatunna member of Oligocene age.

KAOLINITIC AND BAUXITIC CLAY

Kaolinitic and bauxitic clays are present in Mississippi. The clays are most generally associated with the Midway-Wilcox contact. Lesser amounts can be found in association with the Paleozoic-Cretaceous contact. The contact of the Midway and Wilcox strata crops out in northeast Mississippi as an arcuate band that extends from Tennessee to Alabama. Figure 18 shows the outcrop area of the contact and the distribution of the alumina-rich material.

In areas where they are present, the bauxitic clays are intimately associated with kaolin. However, many deposits of kaolinitic clays contain no bauxitic material. Depositional sequence

Figure 17.—Open-cut pit of the Lightweight Aggregate Division, Jackson Ready-Mix Concrete (NE. ¼, NW. ¼, Sec. 36, T. 7 N., R. 1 W.). The mine is over 60 feet deep. Note the several tiered benches from which the clay is worked.—Bob Hand photo.

usually grades downward from bauxitic clay, through kaolin into underlying clay. In many places the kaolin is essentially pure, in others it contains silt, sand and siderite.

TABLE 5

CHEMICAL ANALYSES OF SELECTED MISSISSIPPI CLAYS

Sample	Al_2O_3	Fe_2O_3	SiO_2	TiO_2	ign-loss	n-vHF	Total
			Bauxites				
S-1	47.75	2.15	27.24	2.40	19.76	0.78	100.50
S-97	57.68	0.14	15.36	1.68	25.22	0.30	100.98
X-1	55.84	4.56	15.04	1.80	21.92	1.60	101.08
X-2	54.95	0.15	16.94	1.60	23.45	3.70	101.39
			Kaolins				
A-87	39.05	0.40	41.73	3.00	13.52	2.09	99.79
D-186	43.15	0.85	38.91	2.10	15.08	0.78	100.87
A-8	41.87	0.48	42.62	0.95	13.16	0.78	100.30
13-P1	38.51	1.61	41.76	1.65	14.34	2.01	99.88

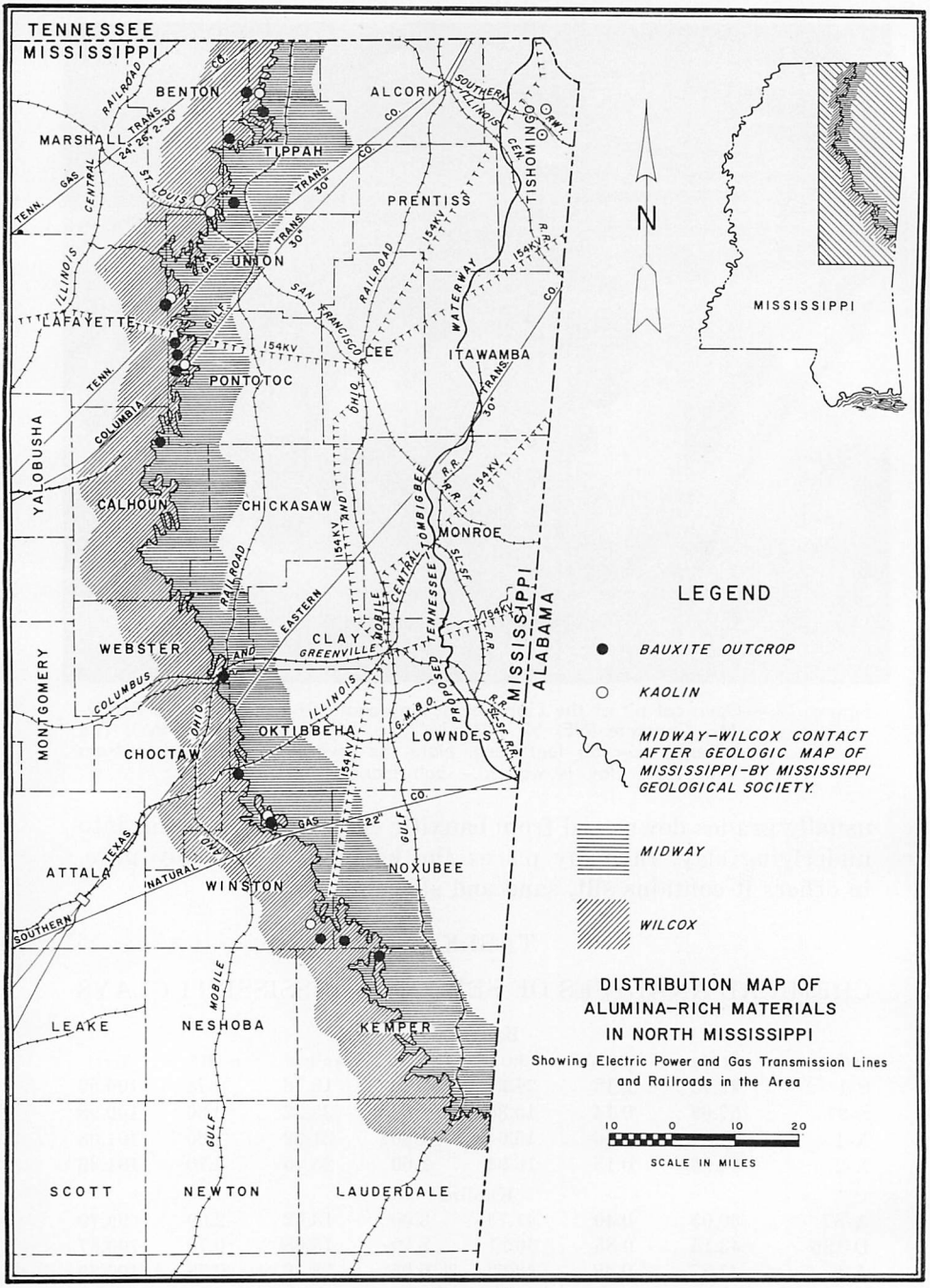

TENNESSEE
MISSISSIPPI
ALABAMA
BENTON
ALCORN
MARSHALL
TIPPAH
PRENTISS
TISHOMINGO
UNION
LAFAYETTE
LEE
ITAWAMBA
PONTOTOC
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
WEBSTER
CLAY
MONTGOMERY
CHOCTAW
OKTIBBEHA
LOWNDES
ATTALA
WINSTON
NOXUBEE
LEAKE
NESHOBA
KEMPER
SCOTT
NEWTON
LAUDERDALE
N
MISSISSIPPI
LEGEND
BAUXITE OUTCROP
KAOLIN
MIDWAY-WILCOX CONTACT AFTER GEOLOGIC MAP OF MISSISSIPPI-BY MISSISSIPPI GEOLOGICAL SOCIETY.
MIDWAY
WILCOX
DISTRIBUTION MAP OF ALUMINA-RICH MATERIALS IN NORTH MISSISSIPPI
Showing Electric Power and Gas Transmission Lines and Railroads in the Area
10 0 10 20
SCALE IN MILES

Figure 18.

			Ball and Fire Clays				
N-199-1	32.56	4.80	47.25	1.56	11.40	2.30	99.87
M-1	24.91	2.04	61.69		8.07	1.37	99.59
HC	27.06	1.97	58.25	1.28	9.41	1.48	99.45
153-P1	31.61	1.44	51.11	1.14	11.60	4.49	101.39
B-64, P1	34.24	0.84	51.77	1.17	10.43	1.87	100.32
AE-4	25.27	0.94	61.70	1.11	8.52	0.55	99.52
			Bentonitic Clay and Fuller's Earth				
No. 3	23.29	5.92	59.53		8.14	3.16	100.04
No. 6	17.14	5.38	60.60		9.38	7.70	100.98
A-1	15.66	6.40	60.68	1.00	11.74	2.04	97.52
AE-3	19.07	2.57	65.01	1.08	7.38	4.17	99.28
LWA-14	13.60	4.33	70.32		9.20	3.86	101.31

Bauxites

- S-1 Tippah County (Bull. 19, p. 155)
- S-97 Pontotoc County (Bull. 19, p. 93)
- X-1 Winston County (Bull. 19, p. 172)
- X-2 Kemper County (Bull. 19, p. 174)

Kaolins

- A-87 Tippah County (Bull. 42, p. 147)
- D-186 Union County (Bull. 45, p. 126)
- A-8 Benton County (Bull. 80, p. 86)
- 13-P1 Winston County (Bull. 38, p. 93)

Ball and Fire Clays

- N-199-1 Pontotoc County (Bull. 54, p. 96)
- M-1 Marshall County (Bull. 78, p. 154)
- HC Tallahatchie County (Bull. 80, p. 128)
- 153-P1 Winston County (Bull. 38, p. 126)
- B-64, P1 Lauderdale County (Bull. 41, p. 204)
- AE-4 Attala County (Bull. 99, p. 108)

Bentonitic Clay and Fuller's Earth

- No. 3 Itawamba County (Bull. 86, p. 36)
- No. 6 Smith County (Bull. 86, p. 36)
- A-1 Marshall County (Bull. 22A, p. 8)
- AE-3 Attala County (Bull. 99, p. 104)
- LWA-14 Pearl River County (Bull. 103, p. 44)

GLAUCONITE

Glauconite or greensand is abundant in a number of formations in Mississippi. Although the mineral is present throughout the geologic column, the most abundant horizons are found in the Tombigbee sand member of the Eutaw formation, the Winona formation and the Moody's Branch formation. Lesser amounts can be found in restricted deposits in the Midway, the Tallahatta, the Archusa and Potterchitto marls and the Mint Spring and Byram marls. Figure 19 shows the areal distribution of the more prolific glauconite bearing units.

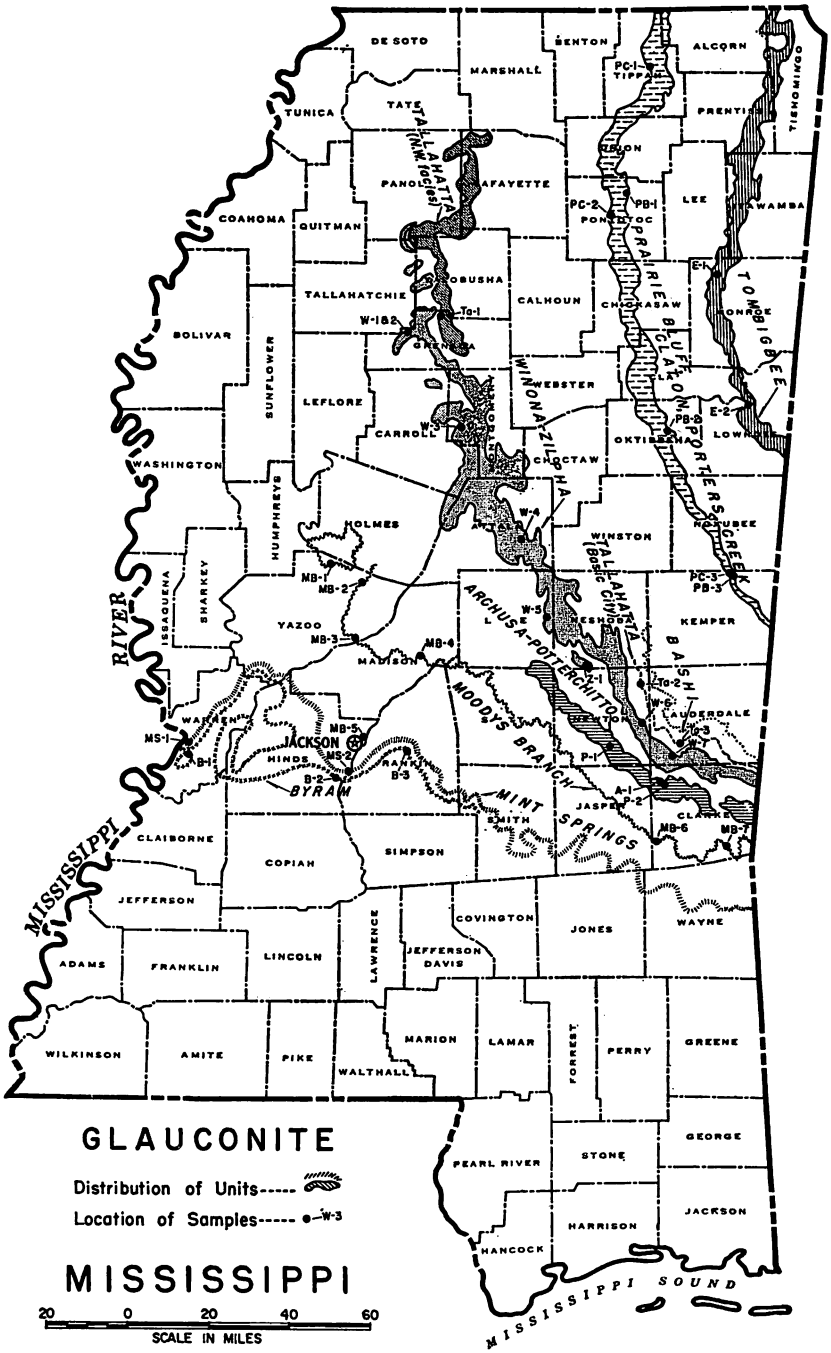

DE SOTO
MARSHALL
BENTON
ALCORN
TUNICA
TATE
PRENTISS
TALLAHATTA (N.W. ridges)
PANOLA
LAFAYETTE
LEE
COAHOMA
QUITMAN
PRAIRIE BLUFF ON PORTERS CREEK
TOMBIGBEE
OBUSHA
TALLAHATCHIE
CALHOUN
CHICKASAW
BOLIVAR
W-182
To-1
WEBSTER
WINONA-ZILPHA
SUNFLOWER
LEFLORE
CARROLL
OKTIBBEHA
WASHINGTON
CHOCTAW
HUMPHREYS
HOLMES
WINSTON
NOXUBEE
ISSAQUENA
SHARKEY
YAZOO
KEMPER
RIVER
MADISON
ARCHUSA-POTTERCHITTO
MOODYS BRANCH
LAUDERDALE
JACKSON
HINDS
RANKIN
BYRAM
MINT SPRINGS
SMITH
JASPER
CLARKE
MISSISSIPPI
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
COVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
LINCOLN
LAWRENCE
JEFFERSON DAVIS
WILKINSON
AMITE
PIKE
WALTHALL
MARION
LAMAR
FORREST
PERRY
GREENE
GEORGE
PEARL RIVER
STONE
HARRISON
JACKSON
HANCOCK
MISSISSIPPI SOUND
GLAUCONITE
Distribution of Units-----
Location of Samples-----
MISSISSIPPI
20 0 20 40 60
SCALE IN MILES

Figure 19.

Glauconite is a hydrous silicate of ferric iron and potassium which is characteristically green to dark green but may be lighter in color. In unweathered exposures high percentages of glauconite contributes to the green color of the host rock. However, weathered outcrops are generally deep-red in color. Decomposition of the glauconite generally contributes to the fertility of the surrounding soil.

Table 6 shows the chemical analyses of a number of glauconite concentrates as determined by Dr. R. R. Priddy of Millsaps College. Location of eacr sample is shown on the map in Figure 19. The analyses do not include potassium or sodium oxides which may have been lost as volatile material during lost-on-ignition procedures. Percentages of potassium oxide and sodium oxide for some of the samples are shown in Table 7. The amounts of the oxides were determined by the flame photometer. Most of the marl and sand units which contain the larger percentages of glauconite vary in thickness from a few feet to as much as 60 feet. The greatest measured thickness of these units is found in the Tombigbee sand member of the Eutaw formation. The ratio of the glauconite mineral to other constituents of the host rock varies. However, there are reports that the Winona formation contains as much as 90% glauconite at some localities.

TABLE 6
ANALYSES OF SOME MISSISSIPPI GLAUCONITES

	Stratigraphic Order	Sample Number	Grain Size in Mesh	H_2O by Ignition	% SiO_2	% CaO	% MgO	% Fe_2O_3 & FeO	% Al_2O_3	% TiO_2	% MnO	Total in Percent
By-1					40.00	2.00	2.00	16.00	13.00			
	22	MS-1		17.34	40.85	9.21	1.52	14.00	15.78	0.25	0.001	98.95
MB-1	21	MB-1	60	14.62	44.60	1.68	2.02	15.90	19.58	0.35	0.001	98.75
	20	MB-1	80	13.44	43.49	0.88	3.04	16.92	21.65	0.36	0.001	99.77
	19	MB-3	40	16.09	40.91	0.63	2.50	14.13	25.01	0.28	0.001	99.55
MB-3	18	MB-3	60	19.66	38.16	2.33	2.39	13.33	23.82	0.22	0.002	99.91
	17	MB-4		14.08	33.41	3.28	2.25	17.87	29.04	0.25	0.002	100.18
MB-5	16	MB-5	60	15.71	45.96	3.95	1.49	15.32	17.27	0.27	0.001	99.97
	15	MB-5	100	14.33	45.93	0.15	0.65	14.68	27.05	0.36	0.001	103.15
MB-7	14	MB-7	60	13.20	41.75	0.56	2.22	17.73	22.48	0.26	0.001	98.20
	13	P-1	30	13.31	36.99	1.14	2.46	17.63	28.26	0.31	0.001	100.10
P-1	12	P-1	40	13.98	44.43	0.48	1.75	16.17	23.33	0.25	0.001	100.39
	11	P-2	20	13.63	38.91	1.42	2.04	22.05	20.71	0.25	0.002	99.01
	10	P-2	30	13.10	37.21	0.27	0.03	22.73	25.23	0.27	0.002	98.84
	9	P-2	40	11.93	44.60	1.44		20.01	18.75	0.21	0.001	96.94
P-2	8	P-2	60	14.21	43.05	0.74	0.05	16.16	24.90	0.31	0.001	99.43
	7	P-2	mag-netic	12.31	44.81	1.12	3.60	29.38	7.99	0.27	0.001	99.48
Z-1	6	Z-1	60	14.49	48.44	3.20	0.22	13.70	21.71	0.26	0.001	102.02
W-1	5	W-1		14.80	39.28	1.82	1.90	14.11	29.57	0.20	0.002	101.68
	4	W-2	60	13.88	45.81	2.09	2.62	15.07	19.02	0.31	0.001	98.80
W-3	3	W-5	40	15.59	36.44	2.72	1.88	13.36	29.02	0.22	0.001	99.23
	2	W-5	40	15.79	41.92	2.78	1.94	13.51	23.76	0.18	0.002	99.88
W-7	1	W-7	40	13.29	44.28	0.02	1.96	21.10	18.12	0.32	0.001	99.09
(Ta_2 data from clay)					56.00	1.00	4.00	16.00	3.00		.01	

TABLE 7

POTASSIUM OXIDE AND SODIUM OXIDE
OF SOME GLAUCONITE SAMPLES

Sample No.	% K_2O	% Na_2O
MB-7	2.93	0.28
P-2	3.27	
Z-1	3.09	0.69
W-1	2.51	0.15
W-3	3.71	0.71
W-7	4.08	0.37
Ta-2	3.36	0.34

GRAVEL

A total of 43 counties reported gravel production during 1968. This reported production included 95 commercial operations, two federal operations and one local governmental operation. Undoubtedly other operations existed as many pits are operated for local construction purposes and for maintenance of county road systems. Figure 20 shows the approximate location of active plants whose product has been approved by the State Highway Department for use in construction of state and federal roads. Other plant locations are shown where data was available.

The principal sources of gravel from sedimentary strata are the Tuscaloosa formation of the Cretaceous system and the Citronelle formation of the Pleistocene system. Terrace and alluvial deposits also furnish abundant gravel in some areas of the State. The Tuscaloosa formation occupies a narrow band extending north and south through Tishomingo, Itawamba, Monroe and Lowndes Counties in northeastern Mississippi. The formation also affords gravel for a number of plants in that area which are mining terrace and alluvial deposits on the Tombigbee River and its tributaries.

Many areas of southern Mississippi are underlain by the Citronelle formation which contains large quantities of aggregate material. Gravel deposits exceeding 70 feet in thickness are known to exist in the Citronelle formation. The drainage basins of the larger streams in the area contain alluvial and terrace

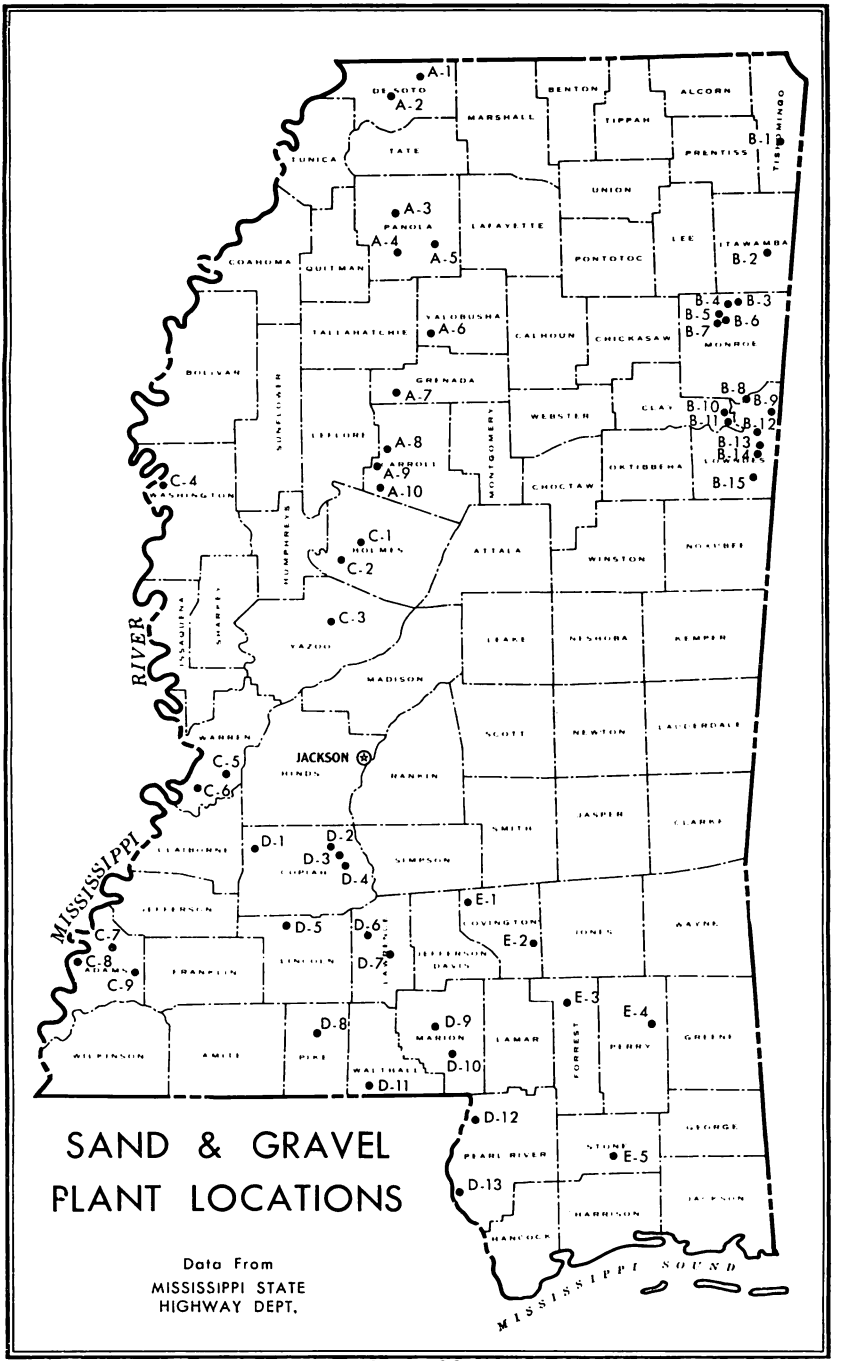
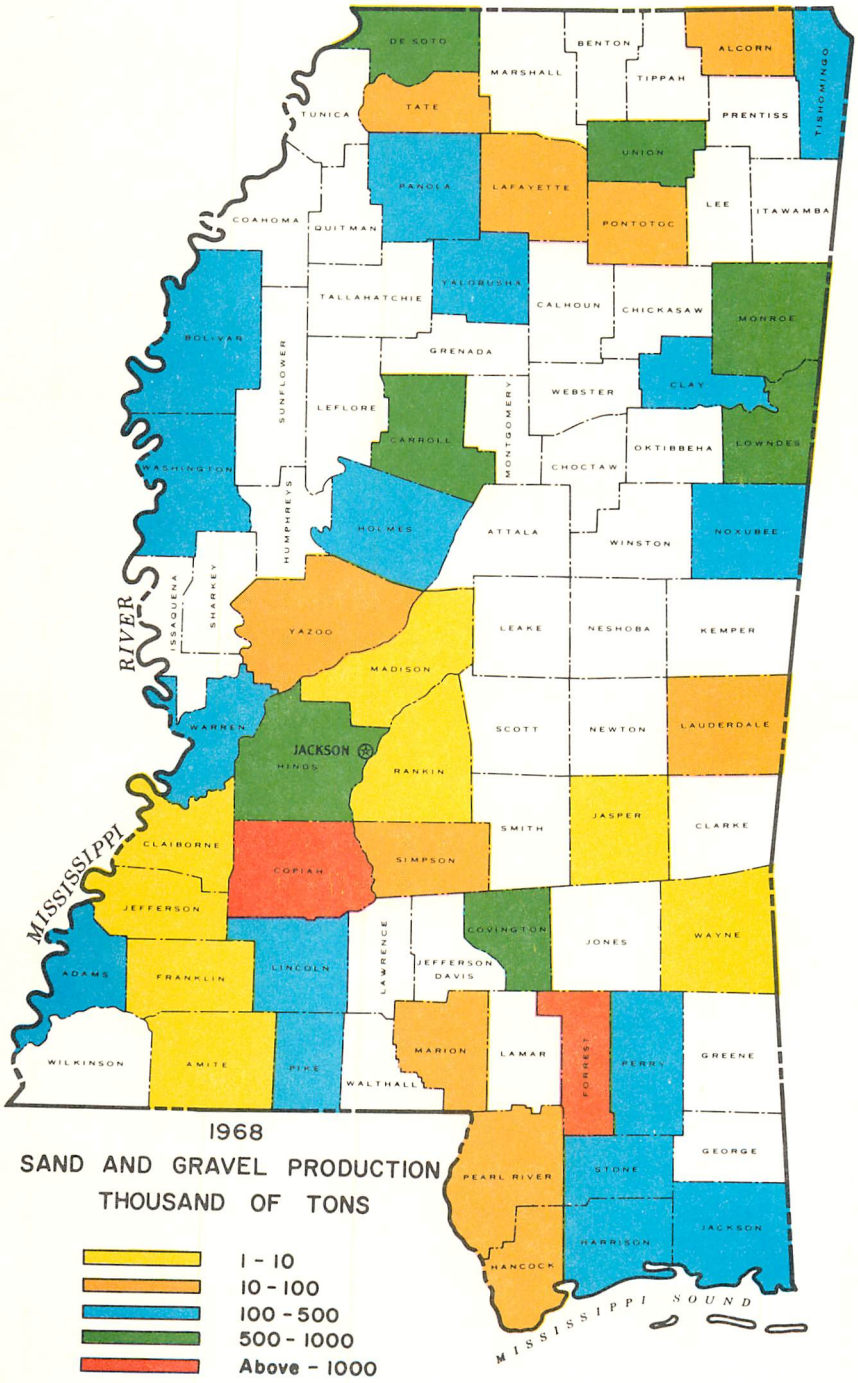

A-1
DE SOTO
A-2
MARSHALL
BENTON
TIPPAH
ALCORN
TISHOMINGO
TUNICA
TATE
PRENTISS
B-1
UNION
A-3
PANOLA
LAFAYETTE
LEE
ITAWAMBA
A-4
A-5
PONTOTOC
B-2
COAHOMA
QUITMAN
B-4
B-3
B-5
B-6
B-7
YALOBUSHA
A-6
CALHOUN
CHICKASAW
MONROE
TALLAHATCHIE
BOLIVAR
GRENADA
A-7
B-8
B-9
B-10
B-11
B-12
WEBSTER
CLAY
SUNFLOWER
LEFLORE
A-8
MONTGOMERY
B-13
B-14
CARROLL
A-9
OKTIBBEHA
LOWNDES
C-4
WASHINGTON
A-10
B-15
CHOCTAW
C-1
HOLMES
ATTALA
WINSTON
NOXUBEE
HUMPHREYS
C-2
ISSAQUENA
SHARKEY
C-3
YAZOO
LEAKE
NESHOBA
KEMPER
RIVER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
C-5
JACKSON
HINDS
RANKIN
C-6
JASPER
CLARKE
MISSISSIPPI
CLAIBORNE
D-1
D-2
SMITH
D-3
COPIAH
SIMPSON
D-4
E-1
JEFFERSON
LOWNDES
JONES
WAYNE
D-5
D-6
E-2
C-7
JEFFERSON DAVIS
D-7
C-8
FRANKLIN
LINCOLN
C-9
E-3
E-4
D-8
D-9
MARION
LAMAR
FORREST
PERRY
GREENE
WILKINSON
AMITE
PIKE
WALTHALL
D-10
D-11
D-12
GEORGE
PEARL RIVER
STONE
E-5
D-13
HARRISON
JACKSON
HANCOCK
MISSISSIPPI SOUND
SAND & GRAVEL
PLANT LOCATIONS
Data From
MISSISSIPPI STATE
HIGHWAY DEPT.

Figure 20.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SUNFLOWER
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OKTIBBEHA
CHOCTAW
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
ISSAQUENA
SHARKEY
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
JACKSON
HINDS
RANKIN
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
COVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
LINCOLN
LAWRENCE
JEFFERSON DAVIS
WILKINSON
AMITE
PIKE
WALTHALL
MARION
LAMAR
FORREST
PERRY
GREENE
GEORGE
PEARL RIVER
STONE
HARRISON
JACKSON
HANCOCK
MISSISSIPPI SOUND
MISSISSIPPI RIVER
1968
SAND AND GRAVEL PRODUCTION
THOUSAND OF TONS
1 - 10
10 - 100
100 - 500
500 - 1000
Above - 1000

gravel deposits which are suitable for commercial mining. These alluvial and terrace deposits are primarily redeposited Citronelle sediments. Some of the alluvial deposits which are located on highly active streams have a unique feature in that after depletion of the aggregate by mining the deposits will be replenished by the continual depositional action of the stream. Some of the leading gravel producing counties in the State are located in the area overlain by Citronelle deposits. The gravel production of these counties reflect local or area demands of the construction industry and serve as an index to economic growth of that area.

Figure 20 shows a group of gravel plants which appear as a north-south line in west central Mississippi extending from near the Louisiana boundary near Natchez northward to Tennessee. These plants are identified by the index letters A, B and C. The location of these plants roughly parallels the Loess Bluffs. Many geologists refer to these gravel deposits as belonging to the Citronelle age. They are closely related to the Citronelle formation but are most probably younger stream terrace deposits.

The alluvial plain of the Mississippi River contains large quantities of gravel. Deposits of gravel in this area may vary greatly in thickness and in depths beneath the surface. Difficulty in identifying these deposits in this area causes many such deposits to be neglected. Present production of gravel in the area of the alluvial plain is from dredging of recent point bar deposits.

Table 8 shows the active sand and gravel producers whose product has been approved for use by the Mississippi Highway Department. The producers are indexed by letter and number which shows the approximate location of the producers' plant on Figure 20. Some of these are temporary types and the location of these plants is subject to change.

TABLE 8

SAND AND GRAVEL PRODUCERS

Plant Index	Producer	County
A-1	Tennessee Gravel Company	DeSoto
A-2	Memphis Stone & Gravel Company	DeSoto
A-3	Yazoo Valley Gravel and Materials Company	Panola

A-4	Farrish Sand & Gravel Company	Panola
A-5	Hotopohia Gravel Company	Panola
A-6	Grenada Gravel Company	Yalobusha
A-7	Delta Sand & Gravel Company	Grenada
A-8	J. J. Ferguson Sand & Gravel Company	Carroll
B-1	Worsham Brothers	Tishomingo
B-2	Warren Brothers Roads Company	Itawamba
B-3	River Hill Sand & Gravel Company	Monroe
B-4	North Mississippi Sand & Gravel Company	Monroe
B-5	Amory Sand & Gravel Company	Monore
B-6	North Mississippi Sand & Gravel Company	Monroe
B-7	River Hill Sand & Gravel Company	Monroe
B-8	Warren Brothers Road Company	Lowndes
B-9	Hamilton Sand & Gravel Company	Lowndes
B-10	West Point Sand & Gravel Company	Clay
B-11	Hamilton Sand & Gravel Company	Clay
B-12	Contractors Gravel Company	Lowndes
B-13	Columbus Gravel Company	Lowndes
B-14	Contractors Gravel Company	Lowndes
B-15	Valley Gravel Company	Lowndes
C-1	Hammett Gravel Company	Holmes
C-2	Peterman Gravel Company	Holmes
C-3	Peterman Gravel Company	Yazoo
C-4	Greenville Gravel Company	Washington
C-5	Runyon Gravel Company	Warren
C-6	Fodice Gravel Company	Warren
C-7	St. Catherine Gravel Company	Adams
C-8	St. Catherine Gravel Company	Adams
C-9	Natchez Gravel Company	Adams
D-1	Traxler Gravel Company	Copiah
D-2	Traxler Gravel Company	Copiah
D-2	Blain Sand & Gravel Company	Copiah
D-2	J. J. Ferguson Sand & Gravel Company	Copiah
D-3	Traxler Gravel Company	Copiah
D-4	Green Brothers Gravel Company	Copiah
D-5	Blain Sand & Gravel Company	Lincoln
D-6	Green Brothers Gravel Company	Lawrence
D-7	Green Brothers Gravel Company	Lawrence
D-8	Riverside Gravel Company	Pike
D-9	Pearl River Sand & Gravel Company	Marion
D-10	Perry County Sand & Gravel Company	Marion

D-11	Walthall Gravel Company	Walthall
D-12	Williams Gravel Company	Pearl River
D-13	Williams Gravel Company	Pearl River
E-1	Blain & Son Gravel Company	Covington
E-2	Van Grady Gravel Company	Covington
E-3	American Sand & Gravel Company	Forrest
E-4	Underwood Sand & Gravel Company	Perry
E-5	Perkinston Sand & Gravel Company	Stone

Production data shown in Table 9 is from material compiled by the Bureau of Mines from voluntary reporting. The figures probably reflect the trend in the annual production of gravel but are not to be construed to be accurate. The erratic nature and large changes of production which appear between the years 1965 and 1966 cast suspicion on the accuracy of the data.

TABLE 9

GRAVEL SOLD OR USED BY PRODUCERS

YEAR	QUANTITY Tons	VALUE Dollars
1960	3,911,000	3,836,000
1961	3,769,000	3,705,000
1962	4,360,000	4,601,000
1963	4,330,000	4,555,000
1964	5,211,000	5,828,000
1965	4,857,000	5,633,000
1966	7,270,000	8,033,000
1967	8,987,000	9,782,000
1968	7,404,000	8,439,000

SAND

Sand and gravel constitute a major mineral commodity for the State of Mississippi. Immense quantities of quartz sand are present in various intervals throughout post-Paleozoic sediments that form the bedrock. At or near the surface, most sands are commonly stained yellow or red by iron oxide. Below the zone of oxidation the sands may be white to light gray in color. The sands have a wide range of grain size, from fine-grained to coarse-grained. The chief impurities commonly present in most deposits are clay, silt and iron oxide. Other substances found in many deposits include glauconite, kaolinite, lignite, mica and heavy minerals.

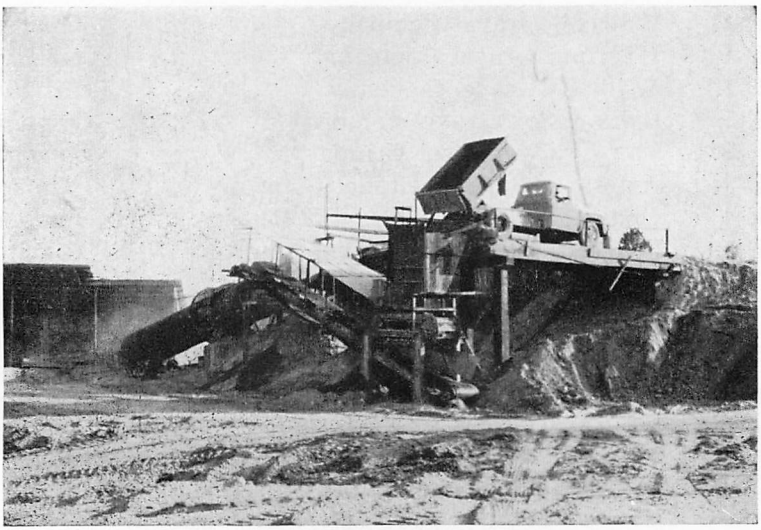


Figure 21.—Tri-State Sand Company's plant located in Tishomingo County. Plant produces foundry sand from the Eutaw formation. (M.G.S. Bull. 86, Fig. 14).

Figure 22.—Sand pit of Tri-State Sand Company near Tishomingo City, Tishomingo County. (M.G.S. Bull. 86, Fig. 15).

Uses of sand can be divided into two categories, construction and industrial. Construction sand may be employed for such purposes as building, paving, fill and railroad ballast. Industrial

uses are many. Glass production and moulding utilized more than 75% of the total United States production in 1967. Other uses are for grinding, polishing, blast sand, fire or furnace, engine filtration and other minor industries.

Production of sand in Mississippi for the preceeding eight years as reported in the Bureau of Mines Minerals Yearbook is given in Table 10. Data included represents production figures for only those producers who submitted data to the Bureau.

TABLE 10

SAND SOLD OR USED BY PRODUCERS

YEAR	QUANTITY Tons	VALUE Dollars
1961	1,767,000	1,609,000
1962	2,034,000	1,735,000
1963	1,976,000	1,711,000
1964	2,268,000	2,043,000
1965	2,335,000	2,152,000
1966	5,037,000	4,782,000
1967	4,588,000	4,517,000
1968	4,256,000	4,256,000

Figures shown in Table 10 include sand sold or used both as construction and industrial sand. By far the greater percentage of sand produced in the State is utilized by the construction industry. Much of the sand is mined in conjunction with gravel excavation and at times presents storage and waste problems to gravel producers.

Complete data of industrial sand production for Mississippi is not available. However, reported figures show that industrial sands represent only a small part of the total sand production. Tri-State Sand Company mines a sand in Tishomingo County that is used as a foundry moulding sand. The quarry is located in the south central part of the County in strata of Eutaw age. The sands contain a natural admixture of clay and require no additional bonding agent.

Although no production of glass sands was reported for 1968, intermittent production has been reported in the past. Sand utilized is dredged from the Mississippi Sound adjacent to Hancock and Harrison Counties. Destination of the glass sand is out of state manufacturers.

Glass sand requirements are very stringent, only minute quantities of impurities can be tolerated. In as much as most sand deposits in Mississippi contain varying amounts of impurities, their use for manufacture of glass is limited. However, there are sands in the State other than the coastal deposits which are applicable for the manufacture of certain types of glass. Most of these sands occur as alluvial deposits in areas of major streams. Table 11 shows the chemical analyses of several alluvial sands.

TABLE 11

CHEMICAL ANALYSES OF SANDS

SAMPLE LOCATION	HEAVY MINERAL CONSTITUENTS	SILICA SiO_2	IRON Fe_2O_3
Forrest Co.	.010	96.240	0.110
George Co.	.090	99.560	0.046
George Co.	.282	99.740	0.039
Copiah Co.	.556	98.340	0.246

HEAVY MINERALS

Heavy minerals are found in many formations in the State. The largest concentrations thus far described are those found in the recent beach sands of the Gulf Coast area and associated offshore islands.

Foxworth in 1962 reported the average concentrations of heavy minerals in the beach sands to range from 2 to 6 per cent. Some concentrations, particularly those on the gulf side of the offshore islands, may average as much as 60 per cent heavy minerals. Table 12 shows the average heavy mineral composition of the beach area and associated islands according to Foxworth. These concentrations compare favorably with concentrations found elsewhere in the Gulf Coast area where commercial mining of heavy minerals is now in progress. Ilmenite, kyanite, staurolite and zirconium are being produced at several locations in Florida. These minerals form the largest percentage of the heavy minerals constituents found in the Mississippi Gulf Coast area.

Heavy minerals are found in strata of Cretaceous and Eocene age. Grim in 1936 reported the heavy mineral fraction of sands from Eocene age to range from near 0 to as much as 66 per cent. Heavy mineral fractions of some Cretaceous sands in Tennessee have been reported to average as high as 20 per cent. As these sands extend into Mississippi it is logical to expect similar deposits to be present in the State.

TABLE 12

AVERAGE HEAVY MINERAL COMPOSITION OF THE BEACH OF EACH AREA AND THE TOTAL AREA

Minerals	Average Frequency for Total Area	Mainland	Deer Island	Round Island	Cat Island	Ship Island	Horn Island	Petit Bois Island
Andalusite	x	x	----	----	x	x	----	x
Apatite		x	----	----	----	----	----	----
Augite & Diopside		x	----	----	----	x	----	----
Dolo. & Sid	x	x	----	----	----	x	0.1	----
Epidote	----	----	----	----	x	----	----	----
Garnet	x	x	----	----	x	x	x	----
Hornblende (Brn)	0.1	0.1	x	x	x	0.2	0.2	x
Hypersthene	----	----	----	----	----	x	----	----
Ilmenite	13.4	13.1	3.1	6.1	8.9	24.8	10.8	11.4
Kyanite	27.4	26.3	25.5	32.9	30.5	22.1	31.3	26.7
Leucoxene	2.5	3.5	3.5	2.2	3.3	1.7	1.5	0.1
Lim. & Hem.	3.2	5.3	3.7	3.3	2.2	2.1	2.4	1.0
Mineral X	0.2	x	x	x	0.5	x	x	0.7
Pigonite	----	----	----	----	x	x	0.1	x
Pyrite & Marc.	0.2	0.2	0.3	0.2	0.2	0.4	----	0.1
Rutile	1.8	1.4	2.2	0.4	1.2	6.0	0.2	0.3
Sillimanite	1.2	1.5	0.5	0.7	1.2	0.3	1.6	1.5
Spinel	x	x	----	----	x	x	----	----
Staurolite	26.2	24.6	20.5	22.5	28.7	25.2	31.0	30.8
Titanite	x	x	x	----	x	x	----	x
Tourmaline (Brn)	18.9	18.2	27.4	28.2	19.8	8.6	17.9	24.2
Blue	0.2	0.3	----	0.1	x	0.2	0.1	0.5
Green	0.9	1.4	1.2	1.7	0.6	0.7	0.7	1.1
Colorless	0.4	0.3	0.5	1.2	0.6	0.1	0.6	0.4
Zircon	1.6	1.6	0.9	0.2	0.5	6.3	0.1	0.4

IRON ORE

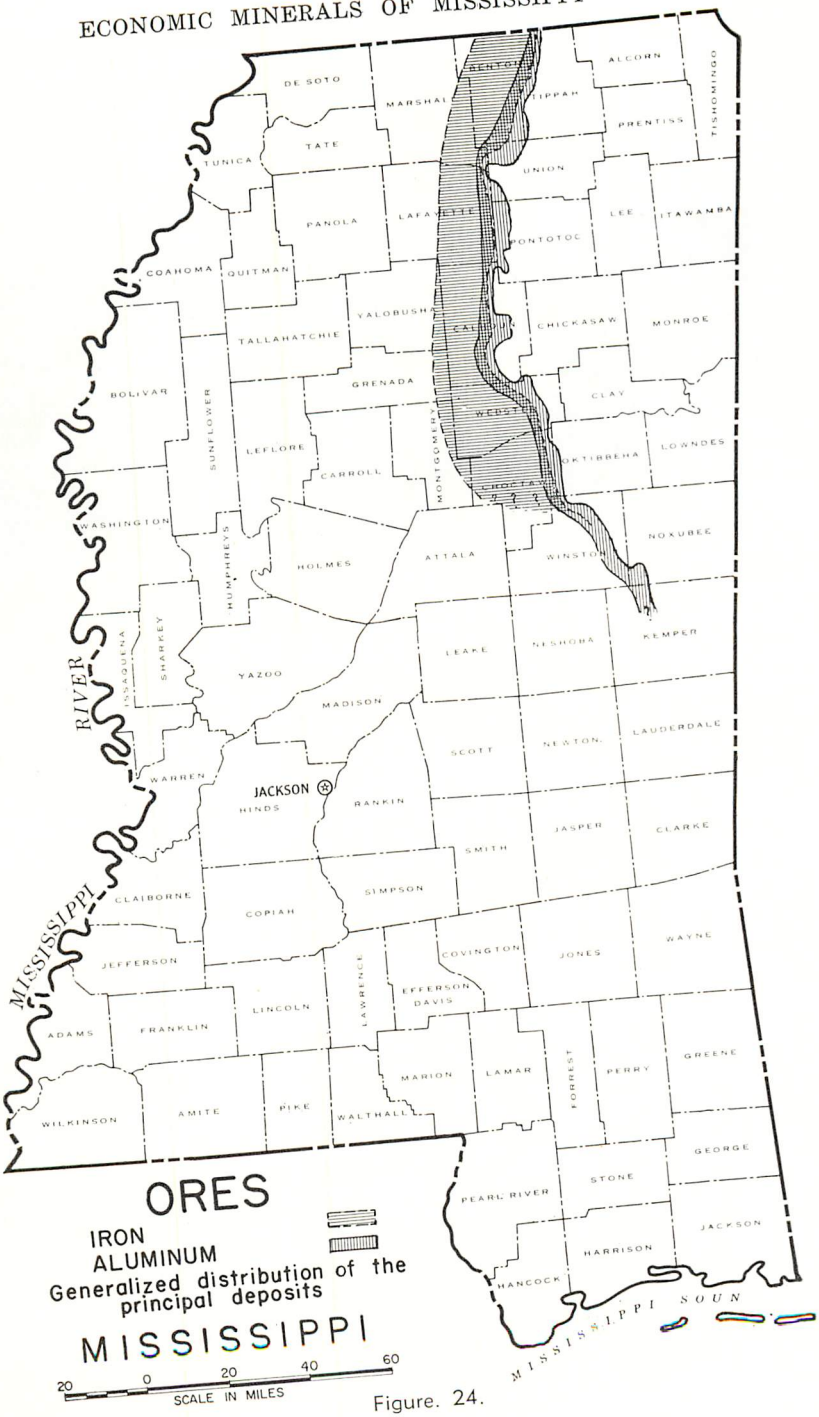
The first reported mining of iron ore occured in the year 1887 when a car load of iron ore was mined in Clarke County. The ore was shipped to Birmingham where is was smelted. Since that time there has been intermittent interest developed in ores located in different areas of the State as small amounts of iron ore were mined and shipped to smelters. A small smelter was

constructed near Winborn in Benton County in an attempt to produce pig iron locally. In 1913 a reported 125 tons of pig iron was produced at the Winborn smelter before operations were

Figure 23.—Iron concretions in a ditch near old mine pits about 1 mile west of Flat Rock Church, NE ¼, Sec. 17, T. 5 S., R. 2 E., Benton County (M.G.S. Bulletin 80, Fig. 29).

discontinued. That same year the Bureau of Mines reported 20,000 tons of iron ore production for the State. Between 1950 and 1959 approximately 2,000 tons of iron ore was mined and shipped from Webster County. During 1968 approximately 13,000 tons of ore was shipped from Kemper County. The Kemper County operations were discontinued during 1969 and no further mining has been reported within the State.

Investigations indicate potentially commercial iron ore deposits can be found in the Porters Creek-Naheola formations of the Midway group, formations of the Wilcox group and the Winona-Zilpha formations of the Claiborne group. The types of ore found in these deposits are chiefly siderite and limonite with small amounts of hematite contained in some of the deposits. The limonite and hematite are formed by oxidation and alteration of the siderite. The ores found in the Midway and Wilcox group average approximately 48 to 50 per cent iron content. Ores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SMITH
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CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
COVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
LINCOLN
LAWRENCE
JEFFERSON DAVIS
MARION
LAMAR
FORREST
PERRY
GREENE
WILKINSON
AMITE
PIKE
WALTHALL
GEORGE
STONE
PEARL RIVER
HARRISON
JACKSON
HANCOCK
MISSISSIPPI RIVER
MISSISSIPPI SOUN
ORES
IRON
ALUMINUM
Generalized distribution of the principal deposits
MISSISSIPPI
20 0 20 40 60
SCALE IN MILES

Figure. 24.

Figure 25.—Pig iron smelted by a hot blast charcoal furnace located at Winborn, Benton County, during the year 1913. (M.G.S. Bull. 12, Fig. 13).

from the Claiborne group average approximately 29 per cent iron.

Manganese is present in varying amounts in most of the iron ores. Some of the ores located in north Mississippi are reported to have a manganese content as high as 12 per cent with the average manganese content much lower. The lowest manganiferous ore now produced in the United States contains 10 to 35 per cent manganese. However, manganiferous iron ore is produced which averages 5 to 10 per cent manganese.

MINERAL FUELS

The search for oil and gas in Mississippi began in 1903. Sketchy records show that either Clarke or Tishomingo County had the distinction of the location for the first wildcat well drilled for oil and gas. Numerous wells followed these two tests and many reported shows of oil and/or gas appear in the records of the early wells. During the first twenty-three years of the search for petroleum in Mississippi, exploratory wells were fairly well distributed about the State. There was some concentration around Jackson with published reports of surface structure and the probability of oil accumulation on the said structure.

The first commercial production of hydrocarbons, however, came with the discovery of gas in Monroe County in the year

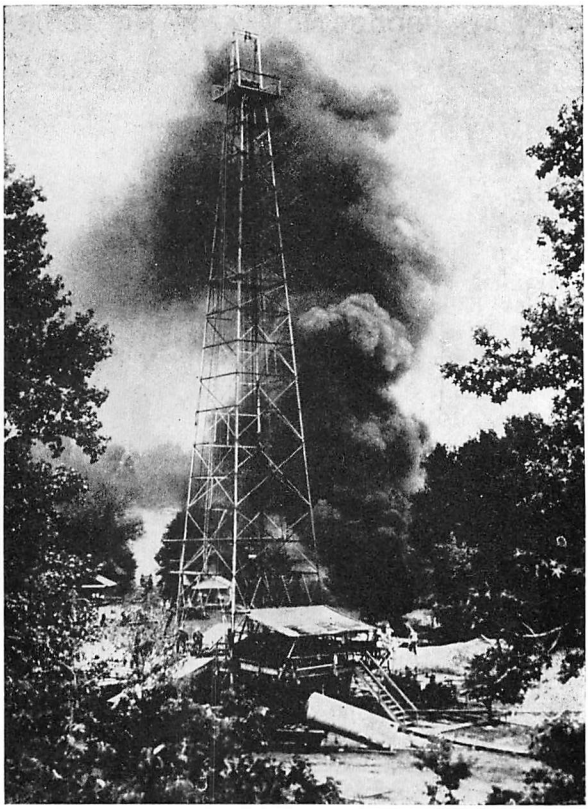


Figure 26.—Union Producing Company No. 1 G. C. Woodruff, discovery well of Tinsley Field, Yazoo County. Mississippi's first commercial oil production. (M.G.S. Bull. 86, Fig. 5).

1926. In 1930 gas was discovered on the Jackson dome and started a flurry of drilling in the area. By 1937 a total of 137 gas wells had been completed in the Jackson field. Although oil in commercial quantities had not been found at the Jackson Gas Field some of the wells produced a small amount of heavy oil.

The first commercial oil production in Mississippi was at the Tinsley Field in Yazoo County. The field was opened in 1939 when Union Producing Company completed the No. 1 Woodruff. Production was established in sands of the Upper Cretaceous and after a search of 36 years another industry was added to the mineral production of the State.

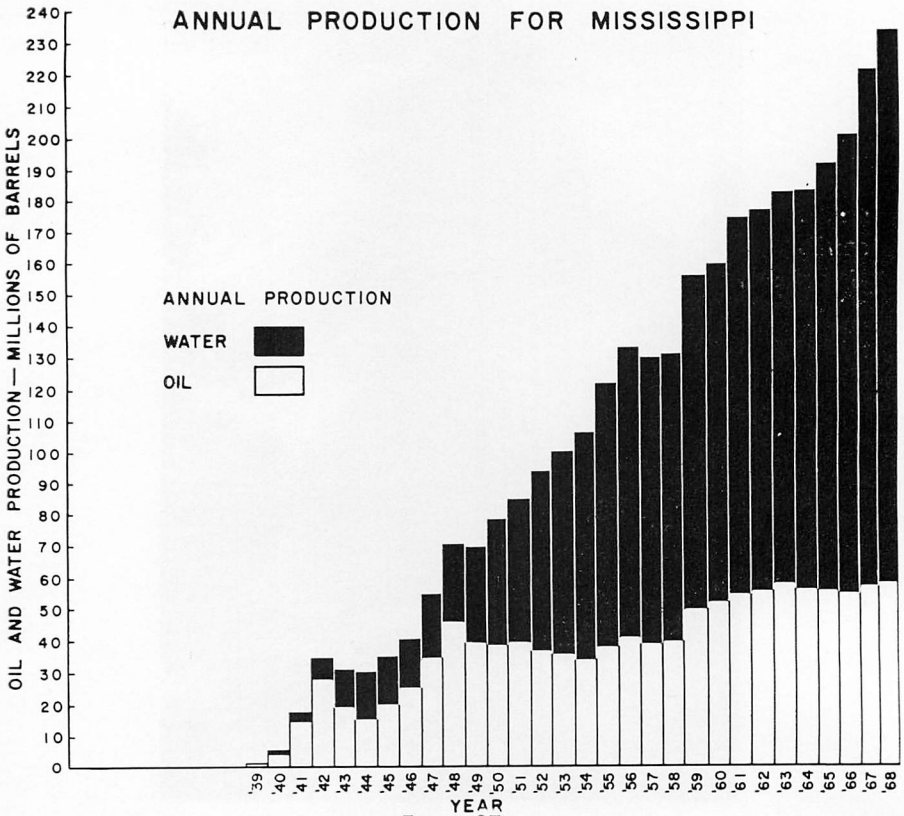


Figure 27.

OIL

After a slow beginning in which new fields were added at the rate of one a year until 1943, exploration increased at a more rapid pace and within five years after the discovery of the first commercial production 15 fields were producing. In ten years the total had risen to 57 fields. As of December 31, 1968, 361 oil pools and 55 gas pools were producing in 342 fields. In 1968 annual production of oil reached a record high of 58,708,489 barrels. The 1968 production surpassed the previous high of 1963 by 89,582 barrels. Table 13 shows the annual and cumulative production for the period 1958-1968. Figures from the table show a steady substantial increase in production for the first six years of the period followed by decline during the middle 1960's, then a slight increase over the last two years.

Table 13

ANNUAL AND CUMULATIVE
PRODUCTION
1958-1968

YEAR	ANNUAL		CUMULATIVE	
	OIL-BBLS.	GAS-MCF	OIL-BBLS.	GAS-MCF
1958	39,313,456	235,727,539	585,102,764	2,347,725,778
1959	49,620,291	232,985,859	634,503,564	2,581,208,501
1960	51,672,767	232,540,370	686,384,663	2,812,693,153
1961	54,688,012	221,725,929	741,061,776	3,034,581,464
1962	55,385,853	216,533,638	796,447,629	3,251,115,102
1963	58,618,907	219,386,043	855,066,536	3,470,501,145
1964	56,866,239	202,959,813	911,319,247	3,664,969,926
1965	56,021,546	184,246,276	967,217,593	3,856,843,230
1966	55,095,963	180,542,539	1,022,041,387	4,041,265,225
1967	57,148,713	177,749,325	1,078,622,042	4,218,900,548
1968	58,708,489	170,701,719	1,137,330,531	4,389,602,267

Data from State Oil and Gas Board bulletin.

Production of petroleum products was reported from 31 counties. The ten leading counties in descending order of production were: Jasper, Adams, Smith, Franklin, Lamar, Clarke, Jones, Wayne, Yazoo, and Wilkinson. All but three of the producing counties are located in the southern half of the State. The counties located in northern Mississippi are Clay, Itawamba and Monroe. Table 14 shows the annual production of oil and gas for the 31 producing counties. The number of producing wells shown in the table reflects wells that may have produced for part of the year and wells that may have shut-in status though not plugged and abandoned.

Initial commercial oil production in Mississippi was from Cretaceous strata. Five years later oil was discovered in a Wilcox sand at the Cranfield Field in Adams County. During March 1952 commercial oil production was established from sands of

Table 14

PETROLEUM PRODUCTION BY COUNTY, 1968

COUNTY NAME	NUMBER OF PRODUCING WELLS	OIL - BBLS PRODUCTION	WATER-BBLS PRODUCTION	GAS - MCF PRODUCTION
ADAMS	546	7,689,506	42,612,595	1,966,086
AMITE	53	775,225	1,081,059	534,664
CLARKE	164	4,189,442	3,014,760	1,710,789
CLAY	8	415	192	868,344
COVINGTON	7	248,567	183,949	31,211
FORREST	112	221,737	621,954	18,445,436
FRANKLIN	295	4,942,112	26,698,595	509,035
GREENE	9	121,320	193,214	0
HANCOCK	2	21,899	15,676	1,005,001
HINDS	41	544,455	973,212	234,614
ITAWAMBA	9	0	0	344,271
JASPER	328	8,980,899	17,501,105	3,861,972
JEFFERSON	74	535,078	6,033,451	420,838
JEFFERSON DAVIS	89	164,800	122,934	38,967,768
JONES	230	3,961,131	7,188,856	1,641,245
LAMAR	160	4,564,177	15,287,480	7,386,888
LINCOLN	242	1,888,937	3,678,218	5,883,449
MADISON	45	638,727	5,927,582	1,852,169
MARION	111	956,714	1,139,257	34,140,141
MONROE	11	4,149	10,480	2,585,128
PEARL RIVER	41	55,105	232,357	5,955,105
PERRY	2	11,580	206,523	0
PIKE	234	2,231,703	2,493,730	1,421,450
RANKIN	33	600,416	793,822	920,151
SCOTT	2	48,692	15,302	7,050
SIMPSON	57	1,072,521	204,479	4,566,375
SMITH	168	4,950,303	1,820,508	13,652,746
WALTHALL	114	509,266	810,248	20,696,975
WAYNE	348	3,458,643	11,374,791	835,941
WILKINSON	159	2,565,037	11,020,879	116,476
YAZOO	321	2,755,933	13,920,563	140,401
TOTAL PRODUCTION	4,015	58,708,489	175,177,771	170,701,719

Mississippian age in Monroe County. The first oil produced from strata of Jurassic age was in 1954 with the completion of a condensate well at the Loring Field in Madison County. Strata of the Pennsylvanian age was added to the list of producing horizons in 1961 when a well was completed in the Siloam Field in Clay County.

The figures shown below give the comparative stratigraphic distribution of petroleum production. Previous to 1950 as much as 85% of the oil produced in Mississippi was from Upper Cretaceous reservoirs. The 1958 figures reflect more recent discoveries in the Lower Cretaceous and Wilcox strata. Productive horizons in these two ages added materially to the petroleum reserves. Although more than 55% of the total 1958 production was from the Upper Cretaceous, the Lower Cretaceous contributed 22% and the Wilcox 21.9%.

TABLE 15

STRATIGRAPHIC DISTRIBUTION MISSISSIPPI OIL PRODUCTION

AGE	1958	1968
SPARTA	.044%	.037%
WILCOX	21.972%	26.113%
UPPER CRETACEOUS	55.318%	34.513%
LOWER CRETACEOUS	22.022%	19.529%
JURASSIC	.506%	19.801%
PALEOZOIC	.138%	.007%

As deeper drilling progressed the Jurassic strata became an increasingly attractive objective. Successful completions during 1964 and 1965 gave impetus to the Jurassic exploration. By 1968 Jurassic production had become an important factor in the total production of petroleum in the State. The figures in Table 16 show that by 1968 the production from the upper Cretaceous had declined from the 1958 figure of 55% to 34% of the total. There was also a decline in the amount of production from formations in the Lower Cretaceous. Production from the Jurassic increased to 19% of the total. Wilcox production increased from about 21% to 26% of the total. While there was a decline in the amount of production from Upper Cretaceous formations, still over 20 million barrels of oil were produced from these horizons during 1968.

The Baxterville Field, which produces from the Upper Cretaceous and Wilcox horizons is the largest and most productive field, with a 1968 total of over 5 million barrels of oil. The outlook for future development is very bright. The Jurassic exploration should play an increasingly important role in the search for new reserves. The relatively shallow depths of the Wilcox producing horizons should encourage continuing exploration by large numbers of independent operators and remain a favorite objective for several years. New pool discoveries will keep interest in exploration of the Cretaceous, although at a declining rate.

In 1968 four refineries operating in the State had the processing capacity of 181,500 barrels per stream day. The Standard Oil Refinery in Pascagoula, which has a 145,000 barrel per stream day capacity, processed Louisiana crude exclusively. The other three plants processed approximately 22% of the crude

Table 16

MISSISSIPPI DRILLING ACTIVITY
1958-1968

Year	Total Wells	Wildcat Wells	New Discoveries	Field Wells	Productive Oil	Productive Gas	Total Dry Holes
1958	445	203	13	242	156	23	253
1959	645	268	13	377	239	32	361
1960	700	265	23	435	286	38	353
1961	607	208	10	399	249	50	348
1962	622	230	17	392	200	34	369
1963	799	282	18	517	263	23	495
1964	805	374	20	431	208	21	556
1965	795	341	26	454	200	23	546
1966	809	369	28	440	221	38	522
1967	738	335	22	403	208	16	492
1968	723	396	18	327	169	16	520

oil produced in Mississippi during 1968. The largest of these three refineries is located near Purvis, Lamar County in south central Mississippi and is operated by a subsidiary of Gulf Oil Corporation. The Mississippi Gulf Refinery produces a wide variety of petroleum products. Gasoline, crude oil and condensate were also produced at a number of gas extracting plants located at oil and gas fields distributed about the State. The refineries are shown in Table 18 and the gas extraction plants in Table 19.

Table 17

STRATIGRAPHIC DISTRIBUTION
NEW FIELD AND POOL DISCOVERIES
1958-1968

Year	Sparta	Wilcox	Cretaceous Upper	Cretaceous Lower	Cotton Valley	Smackover	Paleozoic	New Field Discoveries	Total Discoveries
1958	1	10	5	20	1			13	37
1959		8	10	20	1			13	39
1960	2	5	16	29			4	23	56
1961	1	3	9	28				10	41
1962		10	8	26			1	17	45
1963	2	15	11	17			2	18	47
1964	1	23	6	14	1	1	1	20	47
1965		31	8	14	2	3	1	26	59
1966		39	6	24	5	4		28	78
1967	1	26	1	8	2	6		22	44
1968	1	29	2	12	3	9		18	56

TABLE 18

MISSISSIPPI REFINERIES

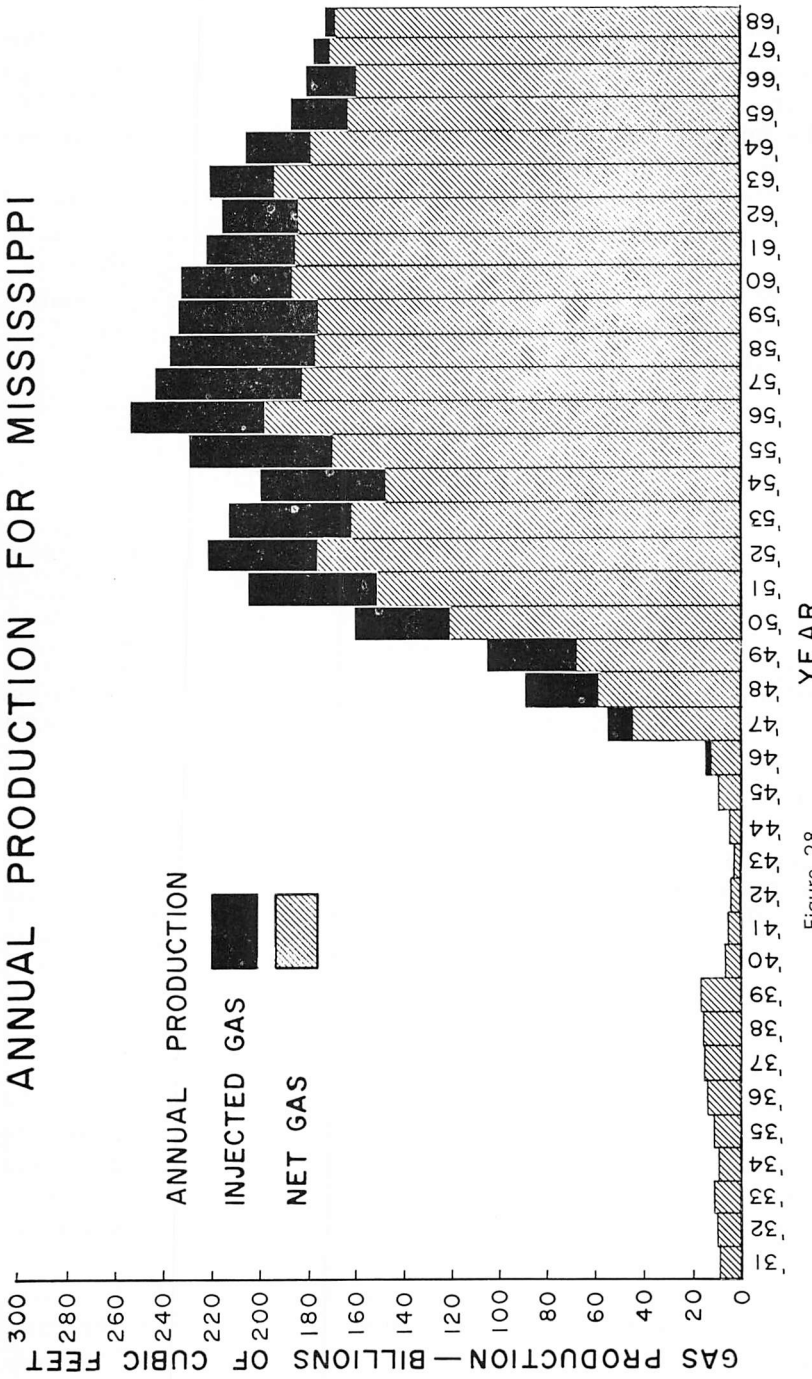
REFINERY	LOCATION	TOTAL RUNS BARRELS
Mississippi Gulf Refining Co.	Purvis, Lamar County	9,832,907
Paluxy Asphalt Co.	Crump Station, Yazoo County	673,598
Southland Oils, Inc.	Rogers Lacy, Jones County	2,292,302
Standard Oil Co.	Pascagoula, Jackson County	54,383,620
1967 Total		67,182,427

The Mississippi State Oil and Gas Board administers all laws governing oil and gas activities within the State. The agency publishes monthly and annual bulletins compiling basic data concerning the oil industry.

NATURAL GAS

Production of natural gas in Mississippi recorded an almost steady decline during the last decade. Only in 1963 was the trend reversed when production increased about 3 billion cubic feet. The last four years the decline has been at a less rapid rate. Data released by the American Gas Association show reserves to be 1,434 billion cubic feet at the end of 1968. This is approximately half the 1961 reserve figure. During the period 1958-1968 there was a total of 339 gas wells completed in the State. Of this figure 51 were wildcat wells which added new pools or fields to the known reserves.

The leading gas producing counties listed in descending order of amount of production in 1968 were Jefferson Davis, Marion, Walthall, Forrest and Smith. These five counties produced over 72% of the total gas. Table 14 gives the gas production of all counties in Mississippi. Stratigraphically, rocks of the Cretaceous age supplied the bulk of the gas produced. The Upper Cretaceous claimed 34% and the lower Cretaceous 42% of the 1968 annual production. The Wilcox supplied 15% and Sparta, Jurassic and Paleozoic lesser amounts.


ANNUAL PRODUCTION FOR MISSISSIPPI
ANNUAL PRODUCTION
INJECTED GAS
NET GAS
GAS PRODUCTION — BILLIONS OF CUBIC FEET
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
'31
'32
'33
'34
'35
'36
'37
'38
'39
'40
'41
'42
'43
'44
'45
'46
'47
'48
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'50
'51
'52
'53
'54
'55
'56
'57
'58
'59
'60
'61
'62
'63
'64
'65
'66
'67
'68
YEAR

Figure 28.

Of the 170 billion cubic feet of gas produced during 1968 there is no designation as to its ultimate usage. A small amount of the gas produced is used in repressuring in some oil fields. The bulk of the marketed gas goes to distribution companies for fuel for municipal and industrial supplies.

The 1968 annual of the Mississippi State Oil and Gas Board lists 12 gas extracting or processing plants in operation as of December 31, 1968. These plants produced nearly one million barrels of gasoline, crude oil and other liquid hydrocarbons, mainly butane and propane. The location and production of the plants are listed in Table 19.

TABLE 19

GAS PROCESSING PLANTS

Plant Name	Location By County	Gas Runs MCF	Gasoline Produced Barrels	Total Liquids Barrels
Bay Springs Gasoline Plant	Jasper	1,734,592	81,811	275,184
Brookhaven Gas Cycling Plant	Lincoln	9,432,306	33,789	56,493
Laurel Processing Plant	Jones	570,748*	17,480	50,547
Little Creek Processing Plant	Pike	3,386,669	95,898	140,560
Locust Ridge Processing Plant	Jefferson	94,598*		8,851
McComb Processing Plant	Pike	4,984,401	65,435	156,997
Mercer Processing Plant	Adams	239,036	11,265	28,768
Pistol Ridge Processing Plant	Forrest	2,363,412*		2,385
Quitman Processing Plant	Clarke	147,188	6,092	19,934
Quitman Bayou Processing Plant	Adams	324,548	7,966	11,339
Soso Processing Plant	Jones	7,020,996*		44,744
Tallahala Creek Plant	Smith	2,057,528*	40,627	170,150
TOTAL		32,346,022	360,363	965,952

*Incomplete records or plant not operating for entire year.

PETROCHEMICALS

The petrochemical industry in Mississippi began with the manufacture of ammonia for fertilizer and now has grown to include commercially important organic chemicals and derivatives. General classification of these chemicals and derivatives exclusive of fertilizers are termed basic, intermediate and polymers/elastomers. The basic petrochemical group includes acetylene, ethylene, propylene, benzene, and xylenes. Petrochemicals of the intermediate group are commodities made from the basic petrochemicals. This group includes alcohols, acids, oxides, ace-

tates and many other chemicals. The third classification, polymers/elastomers, may be produced directly from a basic petrochemical. For example, polyethylene is produced from the basic commodity ethylene. Others may be produced from intermediate petrochemicals. The polymers and elastomers are used to produce a wide range of synthetic fibers, rubber goods and plastics.

All classifications of petrochemicals are produced at one or more plants located in Mississippi. In 1968 ten plants were operating within the State, producing chemicals or derivatives to be utilized in synthetic rubber and fibers, resins for paints and adhesives, plastics for film and moulded articles, plasticizers, solvent and absorption agents, acids and fertilizers. The following table lists those plants that manufacture fertilizers or one or more classification of petrochemicals directly from some petroleum base. These plants contribute greatly to the economy as they have given rise to a number of manufacturing concerns that utilize the end product.

TABLE 20

PETROCHEMICAL PLANTS

PLANT	FEED	PRODUCTS
Chevron Chemical Co. Pascagoula, Miss.	Natural and refinery gases	Ammonia (1500 T/D)
	Petroleum base stocks	Paraxylene and toluene (250 MM lb/y)
Coastal Chemical Pascagoula, Miss.	Natural gas	Ammonia (525 T/D), phosphoric acid (450 T/D), sulfuric acids (1000 T/D) and fertilizers
Conoco Plastics Aberdeen, Miss.		Vinyl chloride polymers and copolymers, vinyl plasticizers
Gulf Oil Company (Agricultural Chemical Div.) Vicksburg, Miss.	Ammonia	Nitric acid and fertilizers
Gulf Oil Company (Petrochemicals Div.) Vicksburg, Miss.	Methanol	Formaldehyde (45 MM lb/y)
Miscoa (Miss. Chemical Corp. & Coastal Chemical Corp. joint operation) Yazoo City, Miss.	Natural gas	Ammonia (1000 T/D)
Mississippi Chemical Corp. Yazoo City, Miss.	Natural gas	Ammonium nitrate (750 T/D) nitric acid (1,100 T/D) and urea (280 T/D)
Reichhold Chemicals, Inc., Gulfport, Miss.	Benzene, phenol, petroleum unsaturates	Hydrocarbon resins
Thiokol Chemical Co. Moss Point, Miss.	Petroleum gases	Fluoro-carbon-resin, polytetrafluoroethlyene

UNDERGROUND STORAGE

The first two gas fields discovered in Mississippi were abandoned when commercial production became unfeasible. The Amory Field was abandoned in 1937 and the last production at the Jackson Gas Field was in 1954. Both fields were later reworked to be utilized as natural gas storage facilities. The gas is stored during periods of light demand for use when heavy usage would overtax distribution facilities. The Amory Storage facility is operated by Mississippi Valley Gas Company to facilitate their distribution system in Chickasaw, Lee and Monroe Counties. United Gas operates the Jackson Storage which serves as reserves for the metropolitan area around Jackson.

Data released by the American Gas Association shows that the total reservoir storage capacity for both fields on December 31, 1968, was 6.906 billion cubic feet of gas. Total amount of gas stored in both reservoirs during the entire year was 6.904 billion cubic feet and total withdrawal was listed as 6.71 billion cubic feet.

Several oil companies utilized storage facilities at the Petal Salt Dome in Forrest County for storage of LPG products. The Oil and Gas Journal reported liquids stored during 1968 as being 3,767,000 barrels of propane, 600,000 barrels of butane and 2,240,000 barrels of LP gases.

Engineering studies have been completed and preliminary work has begun for a storage facility in the Eminence Salt Dome in Covington County. Anticipated storage capacity has not been announced. Other salt domes are present in the south central part of the State which may be utilized as storage facilities.

LIGNITE

Unknown quantities of lignite have been mined spasmodically in the past for local uses at various localities in the State. At least one company was formed during the 1920's to produce lignite. Evidences of mining could be observed at one time in Choctaw and Winston Counties.

The possibility of establishment of a local fuel supply during the early 1900's encouraged the publication of a report on the lignite of Mississippi. In 1907 the Geological Survey released

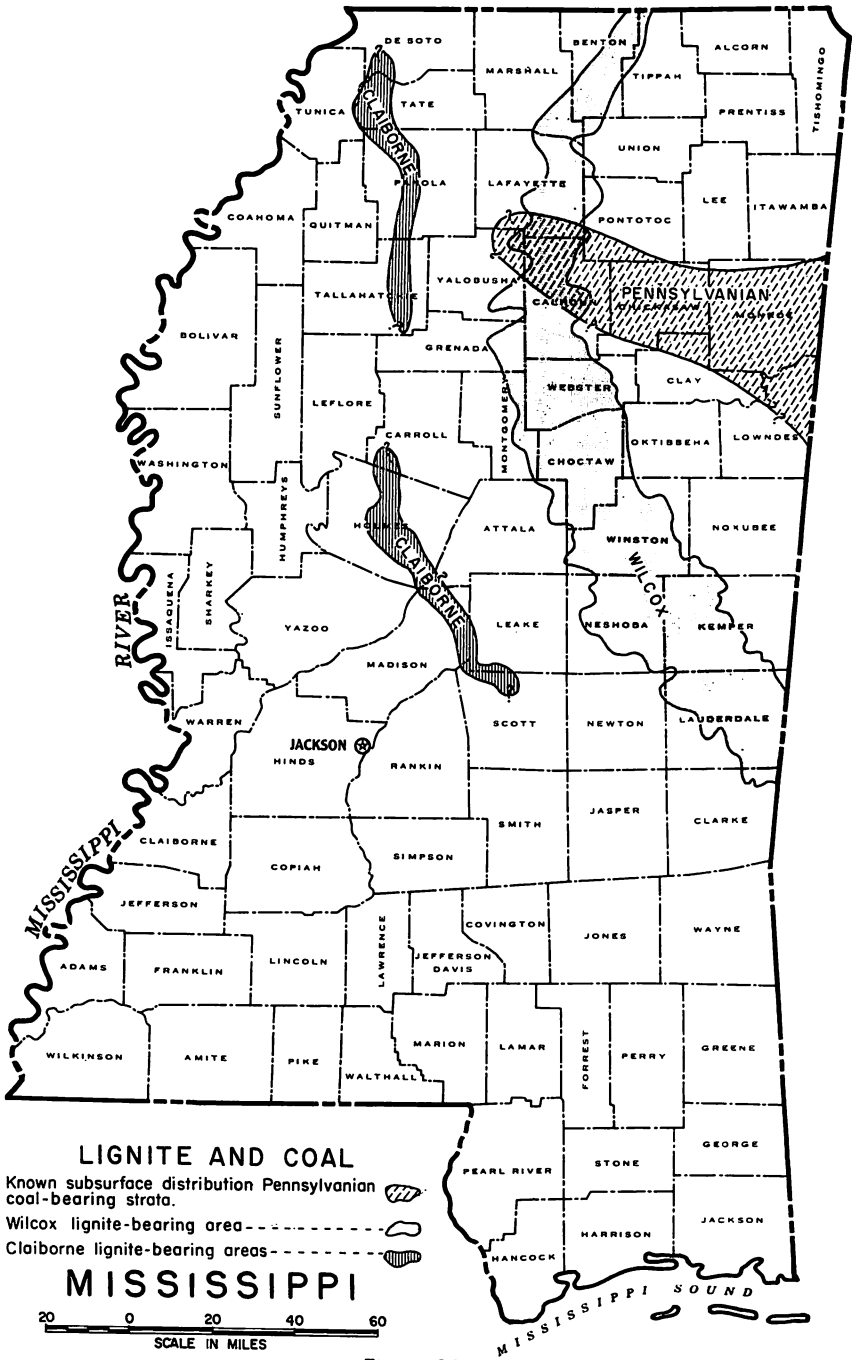

DE SOTO
BENTON
ALCORN
MARSHALL
TIPPAH
TISHOMINGO
TUNICA
TATE
CLAIBORNE
PRENTISS
UNION
PANOLA
LAFAYETTE
LEE
ITAWAMBA
COAHOMA
QUITMAN
PONTOTOC
YALOBUSHA
PENNSYLVANIAN
CALHOUN
CHICKASAW
OUTCROP
TALLAHATCHIE
BOLIVAR
SUNFLOWER
GRENADA
LEFLORE
WEBSTER
CLAY
MONTGOMERY
CARROLL
OKTIBBEHA
LOWNDES
WASHINGTON
CHOCTAW
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
CLAIBORNE
ISSAQUENA
SHARKEY
YAZOO
LEAKE
NESHOBA
KEMPER
WILCOX
RIVER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
JACKSON
HINDS
RANKIN
SMITH
JASPER
CLARKE
MISSISSIPPI
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
COVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
LINCOLN
LAWRENCE
JEFFERSON DAVIS
WILKINSON
AMITE
PIKE
WALTHALL
MARION
LAMAR
FORREST
PERRY
GREENE
GEORGE
PEARL RIVER
STONE
JACKSON
HARRISON
HANCOCK
MISSISSIPPI SOUND
LIGNITE AND COAL
Known subsurface distribution Pennsylvanian coal-bearing strata.
Wilcox lignite-bearing area
Claiborne lignite-bearing areas
MISSISSIPPI
20 0 20 40 60
SCALE IN MILES

Figure 29.

Bulletin 3, "Lignite of Mississippi" by Brown. This report is the only publication available that discusses lignite exclusively. Subsequent information is available in more recent county reports where lignite is present. Table 21 shows analyses of selected samples of lignite from 14 counties.

The thickest and most widespread beds of lignite are found in strata of the Wilcox group. The outcrop belt of the Wilcox group forms an arcuate band from the Mississippi-Tennessee state line in the north to the Alabama boundary on the east. Data from existing county reports located within the area of the Wilcox outcrop shows that the more consistent thicknesses of lignite are present in Choctaw County. Beds of lignite measuring 7 to 8 feet thick have been reported. Choctaw County was the locality of the attempted commercial mining venture during the 1920's.

Other reported thick deposits of lignite are found in the strata of the Claiborne group. The thickest beds of lignite from this group are located in Holmes County. Beds approaching 7 to 8 feet in thickness have been reported. However, these reports have not been verified. Minor amounts of lignite have been reported in strata of the Tuscaloosa, Eutaw, Midway and Forest Hill formations, and also in beds of Vicksburg and Miocene age.

Recent experiments in the field of lignite gasification and production of carbon disulfide has renewed some interest in lignite reserves. Lignite gasification is a process to produce low cost pipeline gas for the nation's existing gas systems. Carbon disulfide is used in the manufacture of rayon and cellophane. Without some new developments in the use of lignite, demands for domestic production in Mississippi are nonexistent.

Coal is present in the subsurface strata of Mississippi. Beds of coal have been reported in test wells drilled for oil and gas which have penetrated into Pennsylvanian sediments of the Paleozoic period. Coal beds as much as two feet thick have been reported at depths greater than 1000 feet below the surface. The area where these beds are found nearest the surface is located in Chickasaw, Clay and Monroe Counties.

TABLE 21
ANALYSES OF MISSISSIPPI LIGNITES

No.	Locality	Moisture	Volatile Matter	Fixed Carbon	Ash	Total	Sulphur	Calories	B.T.U.
2	Panola Co., 1 m. from Tocowa	13.93	44.65	35.17	6.25	100	.70	5,517	9,930
5	Itawamba Co., E. A. Palmer, II	12.51	36.55	38.44	12.50	100	3.27	4,928	8,870
6	Choctaw Co., W. A. Collins	11.44	36.57	38.56	13.43	100	2.05	5,115	9,207
7	Choctaw Co., Chester	11.39	39.79	38.72	10.10	100	2.83	5,236	9,425
8	Choctaw Co., Moses Bridges	14.29	38.90	37.71	9.10	100	.86	5,018	9,032
9	Choctaw Co., Patrick Ray	10.79	41.59	36.54	11.08	100	1.18	5,311	9,560
10	Choctaw Co., E. W. Oswalt	11.61	34.61	42.47	11.31	100	2.66	5,595	10,071
11	Choctaw Co., Snow's field	11.07	42.92	39.70	6.31	100	1.92	5,526	9,947
12	Winston Co., W. E. Huntley	9.91	37.08	36.42	16.59	100	2.95	4,987	8,977
13	Winston Co., Drip Spring	11.59	37.49	43.76	7.16	100	1.29	5,455	9,819
14	Winston Co., C. L. Taylor	14.20	35.24	41.80	8.76	100	.63	5,255	9,459
15	Kemper Co., DeKalb	11.40	32.61	37.00	18.99	100	1.80	5,112	9,201
16	Kemper Co., Pool's mill	13.61	37.14	42.10	7.15	100	2.64	5,439	9,790
17	Jasper Co., Garlandville	12.51	41.40	33.93	12.16	100	2.77	5,050	9,090
18	Scott Co., Pearl River	13.50	39.66	36.50	10.34	100	4.10	4,972	8,950
20	Holmes Co., G. F. Nixon	13.20	40.16	32.24	15.40	100	1.20	5,050	9,090
21	Holmes Co., Burning bed	13.87	36.32	34.46	15.36	100	1.39	4,681	8,426
22	Holmes Co., Tolarville	10.07	41.71	22.86	25.36	100	1.64	4,831	8,696
23	Holmes Co., Shenoah Hill	15.22	42.38	34.91	7.49	100	.91	5,112	9,201
25	Panola Co., Tocowa	11.84	38.96	29.36	19.84	100	.69	4,706	8,471
27	Tate Co., Sarah	12.01	38.51	25.88	23.60	100	1.40	4,457	8,022
30	Benton Co., J. C. Orman	14.29	47.38	30.73	7.60	100	1.26	4,769	8,584
35	Lafayette Co., near Caswell	9.60	30.54	28.86	31.00	100	.57	4,021	7,238
39	Webster Co., 3 m. from Alva	13.04	36.68	35.62	14.66	100	.48	4,582	8,247
40	Webster Co., Bellefontaine	14.90	39.21	35.57	10.32	100	.56	5,065	9,117
42	Calhoun Co., Pittsboro	13.96	39.97	38.58	7.49	100	.56	5,190	9,342
43	Calhoun Co., Camp Spring	12.20	46.27	30.86	10.67	100	.76	5,096	9,173
44	Calhoun Co., John McPhail	11.46	40.74	37.59	10.21	100	.78	5,486	9,875
45	Calhoun Co., near Slate Spring	12.26	37.43	41.94	6.37	100	.94	5,533	9,959
46	Yalobusha Co., J. J. Milton	12.62	40.85	39.94	6.59	100	2.05	5,392	9,706
47	Lafayette Co., W. J. Hogan	11.84	34.15	35.68	18.33	100	.48	4,598	8,276
48	Lafayette Co., near Delay	14.61	38.51	39.10	7.78	100	1.28	5,221	9,398
50	Lafayette Co., R. V. Edwards	14.60	38.59	35.21	11.60	100	1.83	4,878	8,780

RADIOACTIVE MATERIAL

Occurrences of radioactive materials within the State have been reported from several sources. The largest concentrations of radioactive material thus far reported are in the heavy mineral deposits found in the recent beach sands of the Mississippi Gulf Coast and asociated offshore islands. Other occurrences are found widely disseminated throughout the geologic strata of the State. Most of the reports show the occurrences to be the minerals monazite and thorium with associated uranium.

Areas of potential radioactive materials are as follows:

The Paleozoic rocks of northeast Mississippi where radioactive material may possibly be found in the carbonaceous shales and in asphaltic limestones and sandstones. Reports of such occurrences are known in Alabama. The bauxitic material which overlies the Paleozoic strata represents a potential horizon for the presence of radioactive material. Adams and Richardson reported on the occurrences of thorium, uranium and zirconium in bauxites in the Bulletin of Economic Geology, Vol. 55, pp. 1653-1675.

In the State of Tennessee the McNairy sand of Cretaceous age contains monazite. In as much as the McNairy sand extends into Mississippi it can be expected that monazite concentrations are probably within this sand body in Mississippi.

Grim in 1936 reported monazite as a constituent of the heavy mineral suite in a number of different formations of Eocene age. Overlying the Eocene strata are carbonaceous, phosphatic and calcareous rocks of Oligocene age which may contain radioactive material. The Miocene sands and clay are equivalent to the strata which yields uranium ore in Texas.

The heavy mineral content of the recent beach sands of the coastal area has been reported in several sources. Hahn in 1962 reported concentrations of monazite in the beach sands of the offshore islands.

TABLE 22

PIERCEMENT SALT DOME DISCOVERIES—MISSISSIPPI

Listed Chronologically

NR*—Salt not reached by well.
**—Depths are shallowest known on each dome, not always in discovery well.

No.	Name	County	Location	Discovery Date	Discovery Well	Depth to Cap Rock	Depth** to Salt
1	Midway	Lamar	28- 4N-15W	1-12-37	Sun Oil Co.-1-Scanlon-Semmes	1646	2555
2	Edwards	Hinds	35- 6N- 4W	12-15-37	Sou. Nat. Gas Co.-1-Angelo-Williams	2773	3124
3	Glass	Warren	6-14N- 3E	4- 1-40	W. O. Allen-1-Cully	3996	4025
4	Tatum	Lamar	14- 2N-16W	10-23-40	Tatum Lbr. Co.-1-Tatum	1456	1613
5	Dont	Covington	7- 8N-14W	10-24-40	Sun Oil Co.-D-1-Speed	2037	NR*
6	Oakvale	Jefferson Davis	32- 6N-19W	11- 6-40	Sun Oil Co.-1-Taylor	1870	2652
7	Newman	Warren	12-14N- 4E	11-23-40	Magnolia Petr. Co.-1-Paxton-Brown	4935	5114
8	Kings	Warren	39-17N- 4E	11-23-41	Magnolia Petro. Co.-1-Hall	3591	3845
9	Halifax	Hinds	1- 7N- 4W	12-28-41	Plains Prod. Co.-1-Gaddis	3890	3938
10	Ruth	Lincoln	15- 5N- 9E	7-28-42	Freeport Sul. Co.-2-Clarke	2176	NR*
11	D'Lo	Simpson	17- 2N- 4E	9- 5-42	Gulf Refg. Co.-1-Blalock-Nichols	2050	NR*
12	Sardis Church	Copiah	29-10N- 9E	5-14-43	Freeport Sul. Co.-1-Bell	1471	NR*
13	Lampton	Marion	20- 3N-17W	6-25-43	Gulf Refg. Co.-1-Bradshaw	1282	1344
14	Leedo	Jefferson	19- 8N- 4E	6-29-43	Gulf Refg. Co.-1-Cupit	1612	2065
15	Byrd	Greene	16- 3N- 7W	7-21-43	Gulf Refg. Co.-1-Greene Cty. Sch.	1440	2054
16	New Home	Smith	5-10N-13W	8- 4-43	Gulf Refg. Co.-1-Dykes	1823	2570
17	Prentiss	Jefferson Davis	25- 7N-19W	8- 8-43	Gulf Refg. Co.-1-Blackmon	2546	NR*
18	Carson	Jefferson Davis	19- 7N-17W	9- 3-43	Gulf Refg. Co.-1-Price	2690	3093
19	Monticello	Lawrence	35- 7N-10E	9-25-43	Gulf Refg. Co.-1-Cox	2260	2750
20	Moselle	Jones	31- 7N-13W	11- 6-43	Gulf Refg. Co.-1-A-1-Lowery	2120	NR*
21	Bruinsburg	Claiborne	1-11N- 1W	3-10-44	Freeport Sul. Co.-2-Hammett	1981	2020
22	Allen	Copiah	5- 9N- 6E	3-15-44	Freeport Sul. Co.-2-Case Lbr. Co.	2517	2844

No.	Name	County	Location	Discovery Date	Discovery Well	Depth to Cap Rock	Depth** to Salt
23	Richton	Perry	35- 5N-10W	10-15-44	Exploro Corp.-1-Carter	497	722
24	Richmond	Covington	17- 6N-15W	11-24-44	Freeport Sul. Co.-1-Beasley	1609	1945
25	Arm	Lawrence	8- 6N-20W	1- 7-45	Humble Oil & Refg. Co.-1-Nelson	1516	1931
26	Hervey	Claiborne	7-10N- 5E	6-22-45	Sun Oil Co.-1-Segrest	3326	3547
27	Galloway	Warren	43-13N- 3E	11- 7-45	C. H. Osmond-1-Anderson-Tully	3990	4196
28	Hazlehurst	Copiah	28- 1N- 1W	3-21-46	Stanolind-1-Huntington	1460	NR*
29	Utica	Copiah	8- 2N- 4W	5-29-46	Sun Oil Co.-1-Little	2830	3135
30	Dry Creek	Covington	21- 8N-17W	9-20-46	Sippiala Corp.-1-McRaney	1831	NR*
31	Petal	Forrest	25- 5N-13W	10-24-46	Sippiala Corp.-1-Wilson	1699	1739
32	McBride	Jefferson	10- 9N- 4E	12-25-46	Calif. Co.-2-Greer et al	2050	2250
33	Eagle Bend	Warren	9-18N- 2E	6-15-47	Amerada Petr. Co.-1-Dabney-Bonelli	4292	4445
34	Brownsville	Hinds	15- 7N- 2W	11-18-47	Gulf Refg. Co.-1-Trotter	4511	4695
35	Eminence	Covington	5- 7N-14W	12- 7-47	Humble Oil & Refg. Co.-1-Rogers	1960	2442
36	Kola	Covington	28- 8N-15W	3-20-48	Humble Oil & Refg. Co.-1-Daughtry	2228	3048
37	County Line	Greene	1- 5N- 6W	4-10-48	Sun Oil Co.-1-Gaines	1290	2169
38	McLaurin	Forrest	10- 2N-13W	6- 1-48	Danciger Oil & Refg. Co.-1-Love Petr. Co.	1700	1969
39	Vicksburg	Warren	15-16N- 3E	9-14-48	Calif. Co.-1-Johnson	4362	4386
40	Carmichael	Hinds	27- 3N- 3W	4-19-49	Southeastern Drlg. Co.-1-Lewis-Ervin	2700	2966
41	Centerville	Jones	18- 8N-13W	5-14-49	Walter Sistrunk-1-Powell	2030	NR*
42	Oakley	Hinds	27- 5N- 3W	5-28-49	Sun Oil Co.-1-Shuff	2613	NR*
43	Learned	Hinds	35- 5N- 4W	11-11-49	Texas Co.-1-Noble (Min. Fee)	4429	4437
44	Sunrise	Forrest	8- 4N-12W	6-27-51	Calif. Co.-1-Berry	5632	5942
45	Glazier	Perry	19- 4N- 9W	12- 7-51	Union Prod. Co.-A-1-Stevens	7476	7835
46	Caseyville	Lincoln	23- 8N- 5E	12- 9-52	Gulf Refg. Co.-1-U.S.A.	2509	3035
47	Oak Ridge	Warren	16-17N- 5E	3- 3-55	Calif. Co.-3-1-Bd. of Supervisors	5060	5078
48	Wesson	Copiah	35- 9N- 8E	2- 4-56	Sun Oil Co.-1-McIntosh	3394	NR*
49	Raleigh	Smith	17- 2N- 8E	4- 2-64	Central Oil Co. Unit 17-14	1490	2140

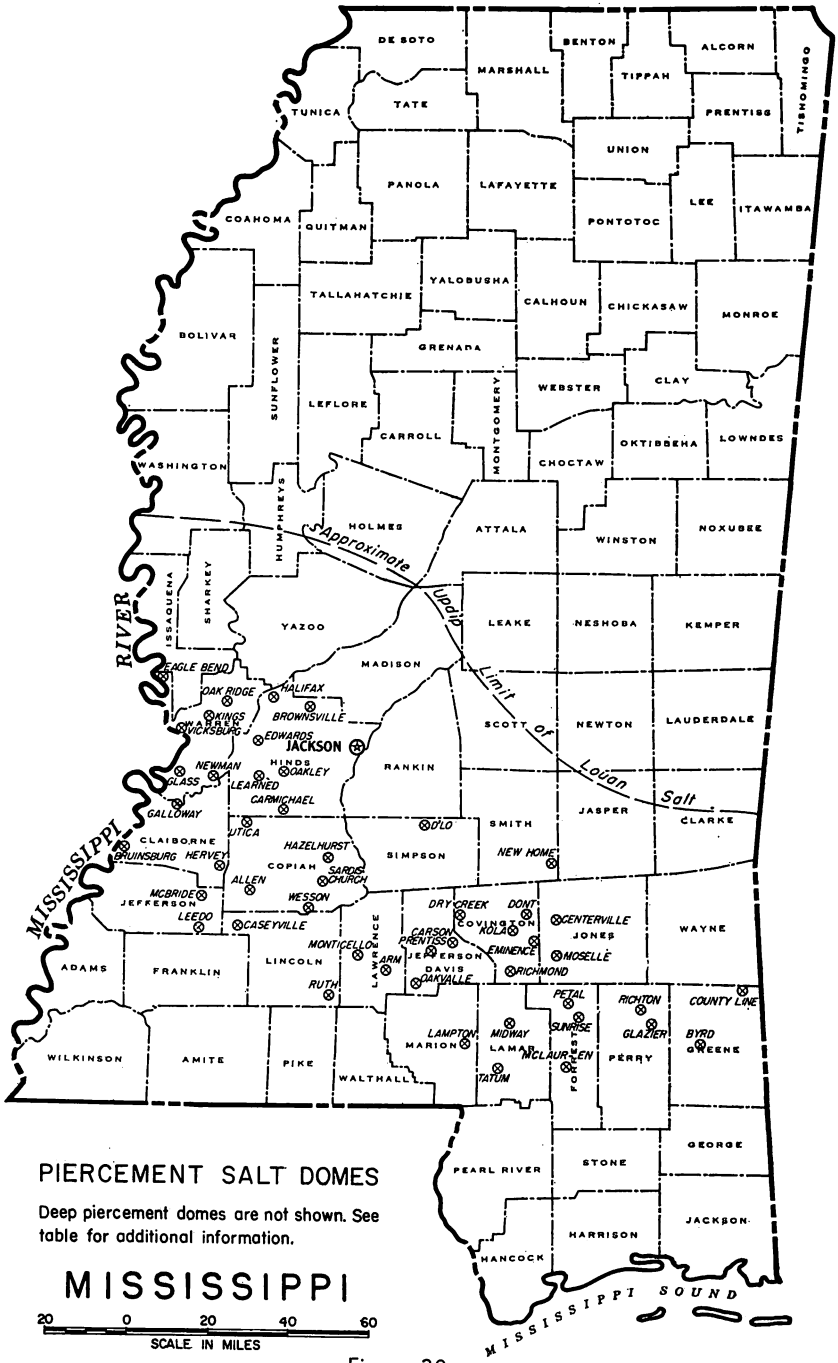
SALT

During 1968 approximately one hundred thousand tons of salt was reported to have been consumed by Mississippi industries. Although the supply of salt in the State is practically unlimited, none is produced locally. Rock salt is available in the form of halite in salt domes which are present in the subsurface strata of south central Mississippi. Present salt production in the Gulf Coast area is from 24 salt domes located in the states of Alabama, Louisiana and Texas.

There are 49 relatively shallow piercement type salt domes in the State which have been proven by drilling of test wells. Of these proven domes 25 reached the salt stock at a depth of 3000 feet or less. Present salt production in the Gulf Coast area is from depths less than 3000 feet in all but one operation.

The Richton salt dome in Perry County is probably the best located dome in terms of minable depths and proximity to existing rail transportation. The top of the salt stock of the Richton dome is 722 feet below the surface. The dome is the largest in areal extent of any salt dome yet identified in the State. The Bruinsburg dome in Claiborne County offers the advantage of potential water transportation as the dome is located less than three miles from the Mississippi River and less than one mile from Bayou Pierre. Depth to the top of the salt stock at the Bruinsburg dome is 2020 feet.

The approximate locations of the shallow salt domes are shown on the map in Figure 30. Data concerning the depths to the caprock and salt, names, locations and discovery dates of the domes are shown in Table 22. Besides offering economic potential as a source of salt the salt domes are being utilized as storage reservoirs for gases (see section titled Underground Storage). The Tatum dome in Lamar County was the site of tests conducted by the Atomic Energy Commission.


DE SOTO
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BENTON
TIPPAH
ALCORN
TISHOMINGO
TUNICA
TATE
PRENTISS
UNION
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LAFAYETTE
LEE
ITAWAMBA
COAHOMA
QUITMAN
PONTOTOC
YALOBUSHA
TALLAHATCHIE
CALHOUN
CHICKASAW
MONROE
BOLIVAR
SUNFLOWER
GRENADA
CLAY
WEBSTER
LEFLORE
CARROLL
MONTGOMERY
OKTIBBEHA
LOWNDES
WASHINGTON
CHOCTAW
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
Approximate
Updip
Limit
of
Louan
Salt
ISSAQUENA
SHARKEY
YAZOO
LEAKE
NESHOBA
KEMPER
EAGLE BEND
MADISON
OAK RIDGE
HALIFAX
KINGS
BROWNSVILLE
SCOTT
NEWTON
LAUDERDALE
VICKSBURG
EDWARDS
JACKSON
NEWMAN
HINDS
OAKLEY
RANKIN
GLASS
LEARNED
CARMICHAEL
GALLOWAY
JASPER
CLARKE
UTICA
OLD
SMITH
CLAIBORNE
BRUINSBURG
HERVEY
HAZELHURST
COPIAH
SIMPSON
NEW HOME
SARDIS
CHURCH
ALLEN
MCBRIDE
WESSON
JEFFERSON
LEEDO
CASEYVILLE
DRY CREEK
DOVINGTON
DONT
KOLA
CENTERVILLE
JONES
WAYNE
CARSON
PRENTISS
JEFFERSON
EMINENCE
MOSELLE
MONTICELLO
LAWRENCE
ARM
ADAMS
FRANKLIN
LINCOLN
DAVIS
OAKVALLE
RICHMOND
RUTH
PETAL
RICHTON
COUNTY LINE
SUNRISE
GLAZIER
BYRD
GREENE
LAMPTON
MARION
MIDWAY
LAMAR
MCLAURIN
PERRY
WILKINSON
AMITE
PIKE
WALTHALL
TATUM
FORREST
GEORGE
PEARL RIVER
STONE
HARRISON
JACKSON
HANCOCK
MISSISSIPPI SOUND
MISSISSIPPI RIVER
PIERCEMENT SALT DOMES
Deep piercement domes are not shown. See table for additional information.
MISSISSIPPI
20 0 20 40 60
SCALE IN MILES

Figure 30.

BRINES

Soluble salts are present in the subsurface waters of Mississippi. Millions of gallons of subsurface waters are produced annually in conjunction with the production of oil and gas. While sodium chloride is the most common constitutent found in these underground waters, other minerals are present in smaller concentrations. The most notable of the other minerals are magnesium and bromine. In other states these minerals are now being produced from brines and sea water. The concentrations of sodium chloride, magnesium and bromine in the subsurface waters vary as to location and depth. However, the concentrations of these salts in some of the underground waters are somewhat greater than the concentrations of the same salts in ordinary sea water.

Table 23 shows the concentrations of these minerals from selected oil field brines. The data was selected to show the higher percentages of magnesium and bromine and do not represent average concentrations for the formation from which the water samples were obtained.

TABLE 23

MAGNESIUM AND BROMIDE CONTENT OF SELECTED BRINES

(Values in Parts per Million)

Sample No.	Formation	Depth	Mg	Br
1	Glen Rose	10,554-10,568	2,070	
2	Rodessa	6,136- 6,148	2,000	
3	U. Cretaceous	8,014- 8,030	3,500	
4	Paluxy	11,280-11,286	3.000	
5	Hosston	9,931- 9,936	5,400	
6	Cotton Valley	14,487-14,635		1,890
7	Smackover	12,559-12,585		1,600
8	Norphlet	17,152-17,160		2,650
9	Ordovician	2,800- 2,860	737	
10	Knox	7,210- 7,340	2,635	

Sample No.	Reference
1	No. 201, Bureau of Mines, RI 6167, Analyses of Brines
2	No. 208, do.
3	No. 224, do.
4	No. 227, do.
5	No. 257, do.
6	Sample 2, Bureau of Mines, Jurassic Brine Analyses
7	Sample 5, do.
8	Sample 12, do.
9	Sample 5, Mississippi Geological Survey, Bulletin 86, p. 73
10	Sample 10, do.

SHELL

Dead oyster shells dredged from the continental shelf area are the basis of a 30 million dollar industry. In the gulf coast area shells form the basic raw material for cement plants located in Texas and Louisiana. The shells are also used for road aggregate, for production of cattle feed, agricultural lime, whiting, soil conditioners and for seeding oyster beds.

The dead reef deposits usually are oyster shells mixed with mud or silt and have a mud overburden. Occasionally, clean tighly packed reefs are found. The dead reefs are generally found in water depths of 8 to 10 feet, but may be found in depths as great as 40 feet. Thickness and areal extent of the reefs vary. These factors are dependent upon environmental conditions of the coastal waters before burial.

Commercial production of shell from dead reefs in Mississippi began in 1951. From 1951 to 1969 a reported 1,633,000 cubic yards of shell were dredged from Mississippi coastal waters. The main dredging areas for dead shell in Mississippi are reported to be the Pearl River estuary bordering Hancock County and in the Mississippi Sound off Harrison County.

STONE

The stone industry consists of two main divisions, dimension stone and crushed stone. Dimension stone is the term applied to stone that is sold in blocks or slabs which have been cut to specific sizes and shapes. Crushed stone is irregular broken rock which is used as an aggregate for concrete, highway construction and other uses.

Dimension stone has been quarried in Tishomingo County for a number of years. Several quarries have produced limited quantities of Highland Church sandstones for use as rubble, ashler and special cuts such as flagstone and mantel. The Highland Church sandstone is found in the Chester group of the upper Mississippian strata. The stone is a fine to medium-grained quartzose sandstone without well defined bedding planes. Color is generally light-tan to brown, but gray, yellow and pink variations are sometimes encountered. Thickness varies from 15 to 30 feet throughout most of the outcrop area. Durability of the Highland Church sandstone is excellent and it provides a lasting and attractive structural stone.

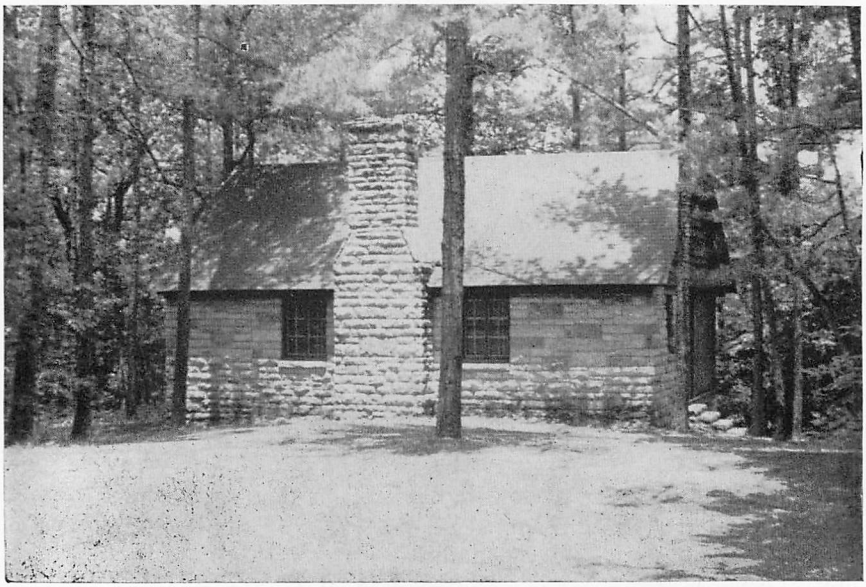


Figure 31.—Cabin constructed of Highland Church sandstone in Tishomingo State Park, Tishomingo County. (M.G.S. Bull. 86, Fig. 27).

Ferruginous sandstone can be found in many geologic horizons in Mississippi. The beds of sandstones are irregular and

Figure 32.—Gang mill quarry of Mississippi Stone Company located in NW ¼, NE ¼, Sec. 7, T. 6 S., R. 11 E., Tishomingo County. Company produces standard grades of dimension stone. (M.G.S. Bull. 86, Fig. 28).

thin, ranging from less than one inch to several feet in thickness. Lack of uniformity of bed thickness and cementation detracts from the possibility of using this material for structural purposes. However, ferruginous sandstone has been widely used for flagstone and stone veneer construction.

Paleozoic limestones which crop out in Tishomingo County offer the greatest potential for the development of a crushed stone industry. These limestones are hard, but because of their nonabrasive characteristics they are more economical to produce than more resistant rock. The Glendon member of the Vicksburg group, which crops out in a narrow belt trending east-west across the centarl part of the State, contains limestone suitable for crushed stone. In some localities the harder layers of limestones are missing and the softer limestone would not be applicable for aggregate uses. The establishment of a crushed stone industry has been hindered by an abundance of natural gravel. However, continuous depletion of these gravel deposits enhances the outlook for crushed stone.

The Mineral Yearbook of the Bureau of Mines reports production of stone in Mississippi. In recent years this reported production has been restricted to limestone and marl quarried for production of cement.

SULFUR

The high hydrogen sulfide content in some crude oils and some natural gases produced in Mississippi was recognized early by the petroleum industry. After commercial oil production was established, approximately 21 years elasped before sulfur was produced. Even then sulfur production was a byproduct in the refining process of crude oil.

The first production of sulfur in the State was reported in 1960 at the Black Creek refinery near Purvis in Lamar County. The refinery is operated by Gulf Oil Corporation. Sulfur is extracted from sour refinery gases using a modified Claus process. Petroleum feed stock is supplied by oil and gas wells from fields in the area of the refinery. The feed stocks are from wells producing from Cretaceous horizons. Rated capacity of the Black Creek extraction plant is reported to be 25 long tons of sulfur per day.

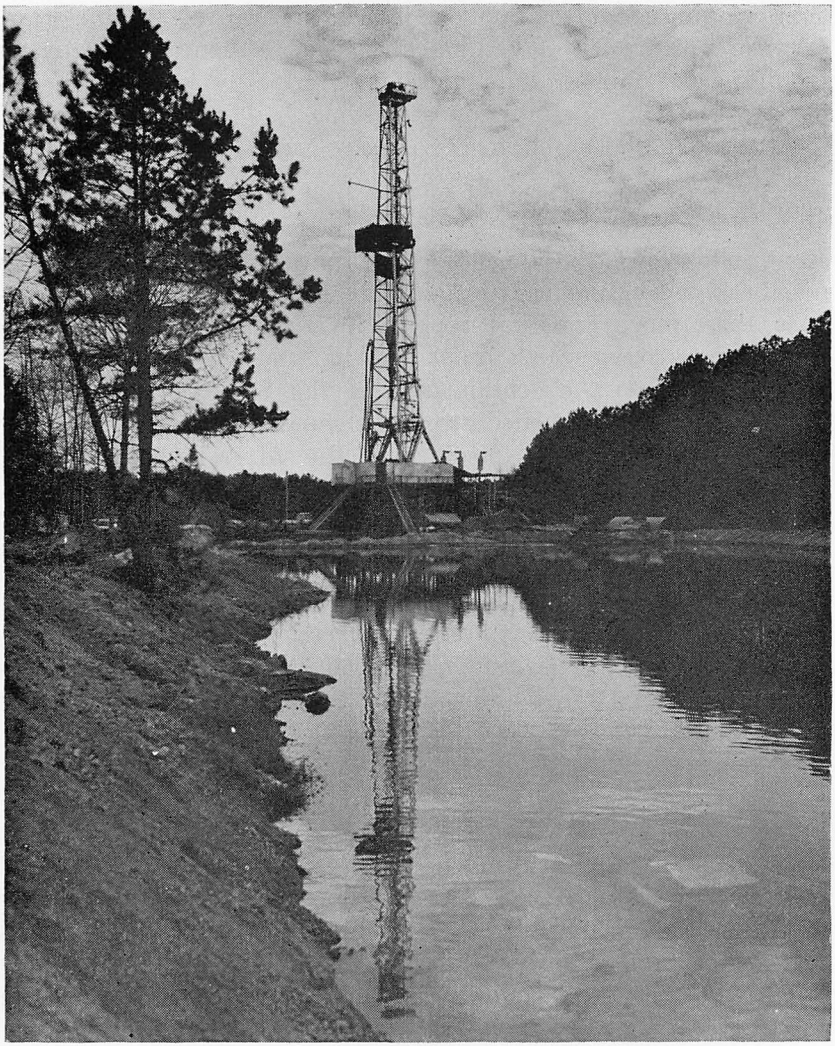
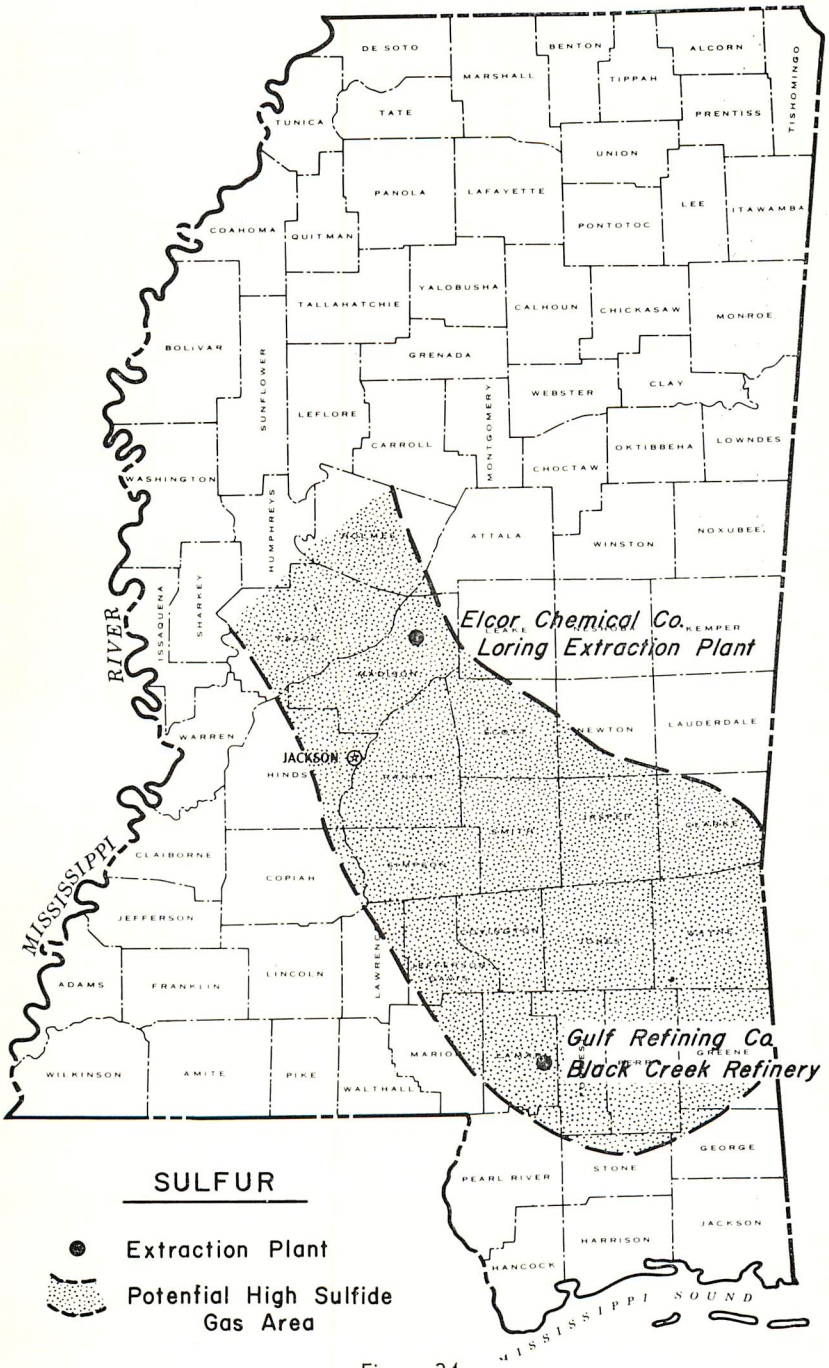


Figure 33.—Shell Oil Company No. 1 Garrett, Sec. 28, T. 4 N., R. 3 E., Rankin County. Potential high sulfide gas discovery from Smackover formation at a depth of approximately 20,000 feet. Photo by Shell Oil Company, 1969.

Sulfur extraction from natural gas of Jurassic origin began in 1965 when a plant near Loring in Madison County went on stream. The Loring plant was installed by National Sulfur Company and is now operated by Elcor Chemical Company. A modified Claus process is utilized to extract sulfur from the feed


DE SOTO
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TIPPAH
ALCORN
TISHOMINGO
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TATE
PRENTISS
UNION
PANOLA
LAFAYETTE
LEE
ITAWAMBA
COAHOMA
QUITMAN
PONTOTOC
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
TALLAHATCHIE
BOLIVAR
GRENADA
WEBSTER
CLAY
SUNFLOWER
LEFLORE
CARROLL
MONTGOMERY
OKTIBBEHA
LOWNDES
CHOCTAW
WASHINGTON
HUMPHREYS
ATTALA
WINSTON
NOXUBEE
ISSAQUENA
SHARKEY
YAZOO
MADISON
LEAKE
KEMPER
Elcor Chemical Co.
Loring Extraction Plant
NEWTON
LAUDERDALE
WARREN
JACKSON
HINDS
RANKIN
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
JEFFERSON
LAWRENCE
JEFFERSON DAVIS
COVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
LINCOLN
MARION
GREENE
Gulf Refining Co.
Black Creek Refinery
WILKINSON
AMITE
PIKE
WALTHALL
GEORGE
STONE
PEARL RIVER
JACKSON
HARRISON
HANCOCK
MISSISSIPPI SOUND
MISSISSIPPI RIVER
SULFUR
Extraction Plant
Potential High Sulfide Gas Area

Figure 34.

gas. Feed gas is supplied from wells in the Loring Field. Original rated capacity of the unit was reported to be 12 long tons of sulfur per day.

Recent exploratory test wells which have tested or are now in the process of testing strata of the Jurassic age report high percentages of hydrogen sulfide in gases in some localities. Reported shows indicate potential extraction plant sites in Greene, Perry, Rankin, and Stone Counties. Confirmation wells are being drilled at sites of reported shows in Rankin and Stone Counties, indicating interest by oil companies and sulfur companies in the possibilities of establishment of extraction plants in these areas. No analyses of the gases have been made available for publication. However, reports indicate high percentages of hydrogen sulfide in the gases.

Another area of interest is the old producing area at the Tinsley Field in Yazoo County. Gas containing hydrogen sulfide was found in Jurassic strata penetrated by a test well drilled in 1951. During the period of short supply of sulfur, which existed pre-1969, reports were circulated of the possible construction of a sulfur extraction plant at the Tinsley Field. However, at this time construction has not started.

The 1969 Bulletin of the Mississippi Oil and Gas Board shows 3,317 producing oil and gas wells producing within the State. There is no record of the number of these wells which may be venting gases which contain hydrogen sulfide. In view of standards being set by the Air and Water Pollution Control Commission something will have to be done to clean the vented gases to abate air pollution. Collection of these gases and the removal and marketing of their sulfur content could reduce the cost of the pollution control. There is even a possibility of a profit for a product which in the past has been wasted.

UNUSUAL GASES

Existence of natural gases that contain high concentrations of hydrogen sulfide and carbon dioxide in strata of the Jurassic system was documented during the early year of the oil industry. In recent years expanded exploration of the Jurassic has proven additional reserves of these gases. During 1965, twelve years after the discovery of the Loring Field in Madison County, a sul-

fur extraction plant was put on stream to extract sulfur from the Jurassic gas produced at the field. Although the Loring plant is the only installation utilizing the hydrogen sulfide gas at the present, continuing exploration in areas known to contain gas with high hydrogen sulfide content indicates interest in further development of these gases.

A number of wells drilled in central Mississippi have encountered gas which is almost pure carbon dioxide. Some of the gases tested were reported to have carbon dioxide concentration in excess of 99%. While the uses for carbon dioxide is largely in the field of refrigeration smaller amounts go into carbonated beverages, chemical and other uses. Of increasing importance is the use of carbon dioxide in secondary recovery operations in the petroleum industry. The use of carbon dioxide is very attractive for these operations in viscous oil reservoirs because it greatly reduces viscosity which enhances ultimate recovery. Prospects for development of carbon dioxide gas production in Mississippi are excellent.

TABLE 24

ANALYSES OF JURASSIC GAS

WELL	CO_2	H	N_2	O_2	H_2S	C_xH_y	He	A	Undet.
1	95.2			0.4					4.4
2	95.63	0.05	0.53	0.08		3.16	0.24	0.01	0.3
3	99.28		0.33		Tr	.59			
4	70.60		2.82		7.10	19.48			
5	20.23		0.28		77.94	1.55			

1. Lion Oil Co. No. 2 Denkman, Rankin County, Mississippi (22-7N-4E).
2. Continental Oil Co. No. 1 Cameron, Madison County, Mississippi (36-10N-1E).
3. Chevron Oil Co. No. 1 Cox, Rankin County, Mississippi (8-7N-4E).
4. Carter Oil Co. No. 1 Brown, Madison County, Mississippi (31-11N-4E), Loring Field.
5. Phillips Petroleum Co. No. 1 "A" Josephine, Perry County, Mississippi (35-1S-10W).

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OIL AND GAS MAP OF MISSISSIPPI

PREPARED BY

STATE OIL & GAS BOARD

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W. Scott Thompson, Greenville — VICE–CHAIRMAN

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Martin McLendon — ASST. ATTORNEY GENERAL

LEGEND

- OIL FIELD
- GAS FIELD
- GAS–CONDENSATE FIELD
- OIL & GAS FIELD
- OIL & GAS–CONDENSATE FIELD
- SALT DOME (Name)
- COUNTY SEAT (Name)
- TOWNS
- REFINERY
- OIL LINE
- GAS LINE
- GAS COMPRESSOR STATION
- OIL PUMPING STATION

LIST OF NUMBERED FIELDS

1 ANNA
2 N. CHURCH HILL
3 N. SUNNYSIDE
4 OAKWOOD
5 FORREST HOME
6 MOSS GROVE
7 VERNON
8 COWPEN POINT
9 GARDENS
10 HOMEWOOD
11 NATCHEZ
12 JEANETTE
13 POPLAR GROVE
14 WOODLANDS
15 NEW ERA
16 COOPER HILL
17 LOCUST HILL
18 W. LOCUST HILL
19 WAYSIDE
20 MOORLAND
21 S. WHITEAPPLE
22 PELLUCID BAYOU
23 LEVEES CREEK
24 FLAT ROCK
25 KNOXVILLE TOWER
26 KNOXVILLE
27 N. KNOXVILLE
28 N. FREEWOODS
29 FREEWOODS
30 WELLS CREEK
31 IRELAND
32 GARDEN CITY
33 COURTLAND
34 COMMENCEMENT
35 KINGSTON
36 N. KINGSTON
37 OVERTON
38 N. OVERTON
39 MANDAMUS
40 POSSUM CORNER
41 S. POSSUM CORNER
42 SIBLEY
43 GLEN AUBIN
44 ARMSTRONG
45 SHIELDSBORO
46 LAKE LUCILLE
47 E. FAIRVIEW
48 MILLS BAYOU
49 DARRINGTON
50 WILKINSON
51 MUD CREEK
52 SOAPSTONE
53 SAUKUM
54 N. LESSLEY
55 LAKE MARY
56 S. KINGSTON
57 SE. ELLISLIE
58 DEERFIELD
59 BEAVER BRANCH
60 GLENDALE
61 BUTLER LAKE
62 LAUREL HILL
63 ELLIS CLIFFS
64 MOSS HILL
65 SPRING POND
66 KELLY HILL
67 FORT ADAMS
68 DOLOROSO
69 ROSE HILL
70 TAR CREEK
71 DIXIE
72 RICHARDSON CREEK
73 REEVES
74 N. ESPERANCE POINT
75 N. FLAT ROCK
76 ANCHORAGE
77 DRY BAYOU
78 GALLILEE
79 NE. FREEWOODS
80 GLASSCOCK
81 SE. FAIRVIEW
82 SW. CRANFIELD
83 GILLIARD LAKE
84 N. LAKE LUCILLE
85 SE. MOSS HILL
86 N. PELLUCID BAYOU
87 CANNONSBURG
88 GILLIAM CHUTE
89 PRETTY CREEK
90 PINE MOUNT
91 N. FORT ADAMS
92 ARNOT
93 S. DEERFIELD
94 HUTCHINS LANDING
95 ELLIS LAKE
96 E. KELLY HILL
97 BUNCKLEY
98 W. CARTHAGE POINT
99 DRY CREEK
100 FRANKLIN
101 GLASSCOCK ISLAND
102 GLASSCOCK TOWHEAD
103 OAKLAND
104 QUITMAN BAYOU
105 CYPRESS BRANCH
106 PINE CREEK
107 ZEIGLER CREEK
108 COUNTY LAKE
109 PINCKNEYVILLE
110 BEVERLY
111 STAMPS
112 BELMONT LAKE
113 ALLOWAY
114 CROOKED CREEK
115 LOWRY LAKE
116 MAGNOLIA
117 N. LAKE MARY
118 PLEASANT VALLEY
119 SOUTHWOOD
120 TURKEY CREEK
121 CLEAR SPRINGS
122 PANTHER CREEK
123 NATCHEZ FERRY
124 HAZLIT CREEK
125 ROSETTA
126 DAY CREEK
127 ROXIE
128 E. ROXIE
129 MORGAN CREEK
130 S. MORGAN CREEK
131 PROVIDENCE
132 S. PROVIDENCE
133 BOURBON
134 CLIFFORD
135 MERCER
136 PAINTERS
137 KIRBY
138 LEESDALE TOWER
139 ROBINS BAYOU
140 SANDY CREEK
141 FAIRCHILDS CREEK
142 GREENS BAYOU
143 SPRING HILL
144 SPRINGFIELD
145 GRAFTON
146 ESPERANCE POINT
147 N. MUD CREEK
148 N. COWPEN POINT
149 STAMPLEY
150 CLOVERDALE
151 COTTON VALLEY
152 OLD RIVER
153 PLEASANT HILL
154 E. FRANKLIN
155 MISTLETOE
156 ELLISTON
157 HILO
158 MORGAN FORK
159 S. IRELAND
160 W. POSSUM CORNER
161 W. PINE RIDGE
162 TOM BRANCH
163 MORGANTOWN
164 ALLIGATOR BAYOU
165 N. ELLIS LAKE
166 S. DAY CREEK
167 CROSBY
168 S. JEANETTE
169 W. TAR CREEK
170 S. GLEN AUBIN
171 OTTER LAKE
172 W. IRELAND
173 WESLEY CHAPEL
174 BYRD
175 E. COUNTY LAKE
176 CORBIN BRANCH
177 COLES CREEK
178 KINGS BRANCH
179 ARTONISH
180 TALLY'S CREEK
181 W. FAIRCHILDS CREEK
182 WILLIS BRANCH
183 MANTUA
184 OLDENBURG
185 N. LAGRANGE
186 S. LAGRANGE
187 PINE RIDGE
188 CHURCH HILL
189 SUNNYSIDE
190 IDLEWILDE
191 N. FAYETTE
192 BROWNLAND
193 CADILLAC
194 BONUS
195 RODNEY ISLAND
196 N. CARTHAGE POINT

SCALE IN MILES 0 6 12 18 24 30

NOTE: LINE ORIGINATES AT BURAS, LA.

REVISED BY: R. S. MYERS, JR. 10-10-68