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State Geological Survey

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BULLETIN No. 18

A QUESTIONNAIRE
On the Mineral Resources of Mississippi
AND
The Work of the State Geological
Survey

By E. N. LOWE, State Geologist

March, 1923

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PREFACE

To meet a growing interest in the mineral resources of Mississippi, and to convey more definite information on the activities of the State Geological Survey, this little bulletin has been prepared. By setting before the reader the salient facts in the form of questions and answers we have attempted to meet the needs of busy men and women of today, who would not have time to read more extended discussions.

We believe, too, that by thus presenting the whole subject in a nutshell, this little brochure will be found suitable for the use of pupils in schools acquiring a knowledge of the natural resources of our state.

(Signed) E. N. Lowe.

March, 1923.

MINERAL RESOURCES OF MISSISSIPPI

What Is Geology?

Geology is the science that tells of the earth, the materials of which it is composed, and how these are arranged to make up its structure, the features of its surface, its ancient life, and the history of its changes as far back as the rocks furnish testimony, and especially of valuable minerals that are found in the rocks of the earth.

Does Geology Study only the Solid Body of the Earth?

No, the earth consists of matter in three states—solid, liquid, and gaseous. (1) By far the greater part of the earth's mass is solid rock, which forms the basal foundation beneath all the rest. (2) Lying upon this rock foundation is a layer of water, which, accumulated in the great depressions, forms seas and lakes, running over its surface forms rivers, and sinking into the earth through pores and crevices to a depth of a few thousand feet forms ground water, which issues again sooner or later as springs. (3) Everywhere, resting upon the seas and the lands, is the gaseous, invisible mantle of air which we call atmosphere. This air is densest next to the surface of the earth, but extends above it to an unknown distance. At an elevation of a few miles it becomes so tenuous as to inhibit life. The earth as a whole is made up of these three parts, and as Geology treats of the whole earth, each of these parts is included in the scope of geological study.

Is Geology an Important Study?

How can it be otherwise, since it tells us of the solid earth upon which we dwell and build our houses and cities; of the rock and other materials from which are made the cement, stone, and brick, with which we build; of the soils which grow our crops; of the manner in which these soils are formed from the solid rock, and how they may be conserved and their fertility maintained; of the water which we drink and use in all of our living processes, and which in the form of rain supplies our fields and gardens; in streams furnishes water-power to turn the wheels of industry, and in lakes, rivers and seas transports our commerce; of the mineral wealth of the world upon which the great industries for human progress are so largely built; of the very air which we breathe in order to live. Can you think of a more important study than this?

Is Geology Simply an Interesting Theoretical Study?

No, it is an intensely practical and useful science, touching our lives at every angle. Besides what has been already said, irrigation and drainage investigations come legitimately within the field of the geologist, as does discovery and development of oil and gas; of metallic ores, such as iron, copper, lead, silver, gold, tin, zinc, quicksilver, aluminum, and radium; of valuable

non-metallic minerals, such as coal, clay, graphite, phosphate, asbestos; and of precious stones, as rubies, diamonds, garnets, topaz, etc.

What other Evidence Have We that Geological Science Is of Practical Benefit to Man?

Every civilized country on the globe maintains an official Geological Survey, even China, Mexico, and the far Islands of the Seas, as Australia, New Zealand, Tasmania, which have well-equipped Geological surveys. Further, all great mining and mineral developing companies find it necessary to maintain strong geological departments for scientific investigation and exploitation of their holdings.

What Is a Geological Survey?

A technical organization maintained for the purpose of investigating the geology and mineral resources of a definite region.

Does the United States Maintain a Geological Survey?

Yes. This country early realized the importance of a systematic and scientific examination of our very large public domain, most of which lay in the West, where, even at an early date, much of that which lay in the mountainous parts was known to be rich in valuable minerals.

The first Federal Geological Survey authorized was one of the western territories, mainly of the Rocky Mountain Region, conducted by Dr. F. V. Hayden, between 1867 and 1878. Several special surveys of the western regions were undertaken about the same time, including among others the Powell survey of the Rocky Mountain Region, in which the Grand Canyon of the Colorado was traversed for the first time. Realizing the importance of a permanently organized department for this kind of work, the Government established the present United States Geological Survey in March, 1879. This useful department of the Federal work has grown until its activities today are indispensable, and reach out in many directions, embracing the geological history, the mineral resources, the geography, the topography, the surface and underground waters, and the classification of lands of the country.

What Is a State Geological Survey?

An organization maintained at State expense to investigate and report upon the geology, topography, water supply, and mineral resources of a particular state.

What States Have Geological Surveys?

Practically all the states of the Union maintain them, and many have had such surveys continuously for half a century or more.

Has Mississippi a Geological Survey?

Yes. The first Survey was organized in 1850, and was supported by legislative appropriation until the outbreak of the Civil

War. Inactive during the war, it was continued for a few years after the war, when it was suspended for lack of financial support. The present Geological Survey was organized in 1906, and has been in continuous existence since that date.

How Was this Survey Established?

Through an Act of the Legislature.

What Is its Governing Body?

A Geological Commission, consisting of ex-officio members. These are: The Governor of the state, State Superintendent of Education, Chancellor of the State University, President of A. & M. College, and Director of the Department of Archives and History.

Who Is Responsible for the Technical Work of the Survey?

Trained specialists constituting the Geological Survey staff, consisting of the State Geologist, Associate Geologists, Archeologist, Topographers, Soil Surveyors, and office Secretary and Librarian.

What Were the Specific Purposes for which the Mississippi Geological Survey Was Organized?

As stated in the Legislative Act creating the Survey, its duties are: (1) "An examination of the economic natural resources of the State"; (2) To prepare and publish topographic surveys and maps of the State; (3) Examination and classification of the soils and the study of their adaptability to particular crops; (4) Investigation of water supplies, artesian wells, and water powers of the State; gaging streams with reference to their application for irrigation, protection from overflow, and other purposes; (5) Examination and report upon road-making and building materials; (6) Examination of the physical features of the State; (7) Preparation of special geological and economic maps and reports on the resources of the State; (8) Preparation of special reports "which shall embrace both general and detailed description of the geology and natural resources of the State"; (9) "The consideration of such other kindred scientific and economic subjects as may be deemed of value to the people of the State."

Has the Geological Survey Been Fulfilling the Purposes Above Enumerated?

Yes, as will appear from answers to questions given in the pages of this pamphlet.

Name Some of the Activities of the State Geological Survey.

This Survey has investigated and reported upon the following: (1) The geological history of the state, embracing the study of the physical characteristics of the formations, and of the fossil remains contained in them; (2) The underground water resources; (3) Surface waters in their relation to soil erosion, and their flow in streams as presenting possible water powers; (3) De-

tailed investigation and mapping of the soils of the state; (4) Mineral resources of the state, embracing (a) Cement Materials, (b) Lignite, (c) Brick and Tile Clays, (d) Pottery and Ball Clays, (e) Iron Ores, (f) Building Stones, (g) Road-Making Materials, (h) Peat, (i) Tripolite, (j) Oil and Gas, (k) Bauxite, (l) Marls and Limestones, (m) Mineral Pigments, and others of less importance; (5) Forestry and Forest conservation; (6) Drainage; (7) Archeology; (8) Flora of the state; (9) Topographic Survey.

Has Mississippi any Mineral Resources of Economic Value?

Yes, though many people do not seem to think so. To begin with: there is a misconception as to what constitutes mineral resources. Mississippi has no gold, silver, copper, zinc, etc., but she is rich in high grade clays, cement materials, gravel, and lignite, and has commercial deposits of iron, building stone, agricultural limestone, bauxite, ochres, etc. While the precious metals are desirable, they are by no means as indispensable as are some of the non-metallic minerals, such as clay, for instance.

What Are Some of Mississippi's Most Important Non-Metallic Minerals?

Clays, Cement materials, Lignite, Road-Making and Concrete Gravels, Sands, Building Stone, Limestone, Tripolite, Marls, Fuller's Earth, Mineral Pigments, Mineral Waters, Amber, Acid Iron Earth.

What are the Important Ores of Metallic Minerals Found in this State?

Brown Oxide Iron Ore, Carbonate Iron Ore, and Bauxite, which is the ore of Aluminum.

Is Clay a Resource of Value?

Yes; Clay products have steadily increased in value from year to year, the greatest increase being in the value of pottery clay products. According to Government reports, in 1916 (under normal pre-war conditions) clay products in the United States had a valuation of \$207,260,091. Of all the mineral production of the country CLAY stands third in valuation, being exceeded only by COAL and IRON, in the order named. In 1912, and all recent years, the clay products of the United States each year exceeded in valuation all the gold, silver, and lead combined which was produced by the United States, including that from Alaska, during the same period.

Coal and Iron are recognized the world over as the "great civilizers"—indispensable to modern progress—and in the light of the above figures, Clay may be considered as a third "civilizer".

Name Some of the Uses of Clay that Give it a Place of Commanding Importance Among Minerals.

Two general classes of clay may be recognized: (1) Common, or Brick and Tile Clay; (2) High Grade Pottery or Ball Clay. The common clays usually burn red, and, as the name would in-

dicate, are chiefly used for the making of brick and tile, both drain and roofing tile. Certain of these clays are also used in the manufacture of Terra Cotta, which is often beautifully ornamental. Paving or vitrified brick are made from a brick clay or shale that in burning becomes partially melted or vitrified, so that they become very hard on cooling and resist wear.

The high grade white clays are used for a great variety of purposes; for stoneware of all kinds, as jugs, churns, crocks, jars; for tableware, Rockingham ware, lavatories, tubs, sinks, basins, electric insulators, crucibles, mortars and pestles, paint filling, paper sizing, fire-brick and ornamental tile making, etc.

Has Mississippi Good Brick and Tile Clay?

Yes; practically every county in the state has abundance of clay suitable for making brick of excellent quality. The State Geological Survey has investigated and reported upon these clays. Bulletins 2 and 4, "Brick and Tile Clays", give the results of these investigations. About 100 plants in Mississippi are making brick, which are being extensively used. Drain tile are being made by a few plants in the state, located for the most part in the Delta. During 1913 (before the World War disturbed economic conditions) the value of Mississippi's output of brick and tile was \$623,820.00, and was steadily increasing.

Has Mississippi any Pottery Clays of Value?

In the course of the work of the Geological Survey it has been discovered that this state has enormous deposits of high grade white clays; few states in the country are as rich in these clays as Mississippi. Several counties, as for instance, Tishomingo, Benton, Lafayette, Marshall, Webster, Panola, and Tallahatchie, have extensive deposits of white clays, all of which have been investigated and reported upon by the State Geological Survey. One of the most remarkable deposits of this clay in the whole country occurs in Tallahatchie County. At the Bramlett pitt, near Enid, the clay is known to be at least 18 feet thick, possibly much thicker, as the bottom has not yet been reached, and it outcrops along the hillslope for half a mile. At the French clay pit, a few miles farther south, pure white clay to a depth of 15 feet is exposed, and a drilling made in the bottom of the pit revealed a thickness of 40 feet, below which was a few feet of white sand, underlain by another deposit of white clay to a depth of 70 feet. This remarkable deposit is known to underlie an area of 10 to 20 acres.

In all the counties mentioned above deposits of these clays in commercial quantities are found, but in many instances, as in the Bramlett and French clay pits just mentioned, they are too far from railroads for convenient development. With good railroad facilities these clays will some day prove one of the state's most valuable resources.

The State Geological Survey has had all of these clays tested by approved Government methods to establish their quality. This

survey is also constantly in touch with consumers of high grade clays with a view to interest them in Mississippi clays.

The valuation of Pottery Clay products in Mississippi during 1913 was \$17,451.00. If the same clays had been located in Ohio, Illinois, or New York, with their abundant fuel and railroad facilities, the output would have gone into the millions of dollars. Our Bulletin No. 6, "Pottery Clays of Mississippi", gives full information about these clays.

Has Mississippi any Cement Materials?

Yes. All cement is made from limestone, but not all limestone is suitable for cement manufacture. In the extreme northeast corner of Mississippi is an extensive deposit of limestone that when fused at suitable temperature and then ground to fine powder, will set to firm cement on addition of water alone. This is what is called a natural cement.

Very few places in this country yield natural cement, but in many places Portland Cement is manufactured, and this is the cement so extensively used today in structural work. Portland Cement requires a particular grade of limestone to which must be added a certain proportion of clay, to give the mixture the proper composition. The whole is then ground and thoroughly mixed, placed in great revolving steel furnaces and gradually heated until the mass fuses to a clinker. It is then cooled and ground to fine powder; and this is the Portland Cement of commerce. As is well known, this cement has the property of "setting" into firm rock on the addition of water.

Has the Geological Survey Investigated Our Resources in Cement Materials?

One of the first mineral investigations undertaken by the Geological Survey was the study of Portland Cement materials occurring within the state. It was found that inexhaustible deposits of limestone and marls in Mississippi were suitable for the manufacture of Portland Cement. These deposits occupy large areas of the prairies of the northeastern counties, the cement rock lying at the surface and covered by only a few feet of residual soil, in itself would be valuable combined with the lime rock to give it the required proportions of ingredients. Much of this rock lies along railroad lines, making it readily accessible. Other deposits are found abundantly along the outcrop of the Vicksburg Limestone, from Vicksburg to Waynesboro. This rock is equal to that of northeast Mississippi, and presents numerous accessible outcrops. A detailed discussion of these deposits, together with a general description of the methods of cement manufacture, will be found in Mississippi Geological Survey Bulletin No. 1.

It should not be concluded, however, that at all points where the prairie rock (technically called Selma Chalk) outcrops in great quantity, the material can be used for cement manufacture. The rock must analyze a high percentage of calcium carbonate, and be low in magnesium and certain other ingredients. A suit-

able clay or shale must be at hand to mix with the ground rock. A cement plant is a costly enterprise, and should not be attempted until after thorough and technical examination of the local conditions.

Have Mississippi Cement Resources Been Developed?

Not yet, owing to unfavorable economic conditions throughout the country for several years past. According to Government reports this country consumes more than 100 million barrels of cement per year, and the demand is rapidly increasing. A cement plant costs from two to three million dollars, and Mississippi capital is not familiar with the cement business, which is very technical. Outside capital has not become interested because states with cement resources which are nearer the great centers of population and industry have heretofore commanded attention. But Mississippi will soon be in line for development.

What Mineral Fuels Occur in Mississippi?

Lignite, Peat, and probably Oil and Gas.

Does Coal Exist in Mississippi?

True bituminous coal has never been found in Mississippi. The coal measures of the Appalachian field extend into northern Alabama, but do not reach the borders of this state. The later formations, notably the Tuscaloosa of the Cretaceous and the Wilcox of the Eocene Tertiary, contain considerable deposits of Lignite, which is a stage in the formation of coal intermediate between bituminous coal and peat.

What Is Lignite?

Lignite is immature coal.

How Is Lignite Formed?

The first step in the formation of Lignite is the growth of plants in and around shallow lakes, ponds, and swamps. The seasonal fall of leaf and the dying of many forms of vegetation year by year cause a gradual accumulation of organic matter in these waters. Covered by water this vegetable matter does not undergo complete decay, as it would upon land, but gradually loses some of its elements by escape of gases; the remaining vegetable tissue becomes macerated into a pulpy mass like black mud. This is called Peat, which accumulates on the bottom, and eventually may fill the lake.

The gradual depression of these accumulations beneath the sea level causes deposition of sands, clays, and marine muds upon them. Under great weight of accumulated sediments and after long ages of pressure and lateral compression, the peat gradually loses its spongy, fibrous condition and becomes solidified into Lignite—first brown Lignite, then black Lignite, and finally, if time and compacting has been sufficient, becomes bituminous coal. With further change, associated with mountain folding, bituminous coal becomes anthracite.

Lignite is less firm than true coal, contains a high percentage of water, and generally has a fuel value in thermal units of

between 7,000 and 10,000. It is found distributed over a large area of the state in beds interstratified with clays, shales, and sandstones.

How Is the Fuel Value of Lignite Tested?

The fuel value of coal or lignite is measured in Thermal Units, the British Thermal Unit being the standard, abbreviated in reports to "B. T. U." A British Thermal Unit is that amount of heat sufficient to raise one pound of water through one degree of temperature Fahrenheit. Taking bituminous coal from Carbon Hill, Alabama, it gives a fuel value of 12,449 B. T. U., as compared with lignite from Choctaw County, Mississippi, with a fuel value of 10,071 B. T. U.

Has Mississippi Lignite Been Developed?

Not for general commercial purposes, but for local use a few pits have been opened. One at Reform, in Choctaw County, another at Ackerman, Choctaw County; both have made limited shipments, but its consumption has been mainly local. It has been mined in a small way near Tehula, Holmes County. Near Russell, in Lauderdale County, a lignite bed was worked a number of years ago, the product of the mine being used as an ingredient in the manufacture of fertilizer.

Is Lignite a Satisfactory Fuel?

Not as it comes from the mine; it contains too much water to burn before drying, and on drying it "slakes," or crumbles to pieces so as to be unsatisfactory to handle. This difficulty can be avoided by grinding it, mixing with it a small portion of bitumen to act as a binder to hold the particles together, then, under heavy pressure, compacting it into briquettes. Used in this way it burns readily, and is a very satisfactory fuel.

What Has the Geological Survey Published on Lignite?

In Bulletin No. 3, of the State Geological Survey, "Lignite of Mississippi," by Calvin S. Brown, will be found a detailed account of the lignite deposits of Mississippi, with tests of the fuel values of lignites from different counties of the state.

What Is Peat?

(For formation of Peat see discussion under Lignite).

Where Does Peat Occur in Mississippi?

In most counties of the state peat is forming now, in swamps, marshes, sloughs, and lakes. These deposits are all comparatively small, and are of no present value. In the southern counties conditions especially favor peat formation. An undrained, sour condition of the soil is always associated with the formation of peat. Clear, amber-tinted water in the streams of the piny woods counties tells the story of the making of peat at the source of their waters. The tidal marshes along the low coastal flats and upon the islands off the coast are the present regions of peat formation.

What Is Meant by the Expression "Oil and Gas", so Frequently Used?

"Oil", as so used, refers to crude petroleum, a natural liquid hydrocarbon obtained from the earth, and "Gas" is a gaseous, inflammable hydrocarbon usually associated with petroleum.

Have Oil and Gas Been Discovered in Mississippi?

In certain wells they have been discovered as a "show," but not in commercial quantity.

Is there Reason for Believing That Oil Exists in Mississippi?

Under proper structural conditions there seems to be no sufficient reason why oil and gas may not exist here.

What Is Meant by "Proper Structural Conditions"?

Oil is almost surely derived from organic matter, perhaps both animal and vegetable, which has become entombed in rocks formed by deposits along sea shores. After long ages, under pressure this organic matter undergoes change into petroleum and natural gas. At first, as the organic matter is widely scattered in the off-shore deposits, oil and gas also will be widely disseminated. If these conditions persisted no commercial production of oil would be possible. Sooner or later however, these rock strata with their contained oil and gas become compressed from side to side until they gradually yield and bend, becoming bowed up into ridges. These ridges are called "anticlines", and oil in the strata by slow concentration becomes collected in porous beds, called "sands", beneath these anticlines.

Certain sands, well known in Arkansas and Louisiana as oil-bearing sands, are known to underlie large areas of Mississippi at depths within reach of the drill. These sands are presumably oil-bearing in this state under proper conditions. Therefore, wherever these formations show well-defined anticlinal structure, a reasonable presumption of oil exists, and the structure should be drilled.

Is Drilling for Oil a Reasonably Certain Business?

In proven territory, or territory already producing oil, the chances are 50% to 75% for success on a good structure; in unproven, or "wildcat" territory, like Mississippi, the chances for success do not exceed 1% or 2%, when the drilling is made on a good structure. If the drilling is not made on structure, chances for success will probably not exceed 1 or 2 in 1000.—*Hence it is imperative to drill on structure.*

Has Mississippi Been Adequately Tested for Oil and Gas?

Not yet. About 43 wells have been drilled for oil in different parts of the state, but perhaps less than a dozen of these were drilled on structure—the rest were foredoomed to failure. Of those drilled on structure less than half went deep enough to tap any known oil horizon. None of the 43 wells has produced oil in commercial quantity, but in view of the above statements, it can be said with certainty that Mississippi has not received adequate test.

What Has Been the Deepest Drilling Made in the State?

The Preston Oil Co's McLean Well No. 1, near Winona; depth 4260 feet.

What Has the Geological Survey Done to Encourage Development of Our Oil Possibilities?

The Geological Survey has located and reported a number of favorable structures, some of which have been drilled, while some have not; furnished all available information to representatives of oil development companies and to all oil geologists who have visited the Survey office or have written for information, kept, so far as the cooperation of developing companies would permit, accurate logs and notes on all wells drilled while drilling was still in progress; assisted drilling companies in determining local conditions in their wells, so far as these were determinable; examined and reported upon all cuttings furnished by developing companies, and regularly visited drilling wells to obtain such information as would be important for the state to have, and to render assistance and counsel to well owners; kept on file complete records of all wells drilled in the state, and, so far as possible, has preserved complete sets of cuttings from important wells.

This Department has not hesitated, however, to discourage ill-advised efforts to develop, where investment of the people's money was foredoomed to loss.

What Is Here Included under the Head of Structural Materials?

Those materials, as gravel, chert, sand, quartzite, building stones, etc., used in the construction of buildings, bridges, roads, conduits, tunnels, and similar structures. Cement preeminently belongs here, but is of such importance that special discussion has already been given to it; so also with clay, in so far as it is used for brick or building tile.

What Is the Chief Structural Material Occurring in this State?

Chert Gravel, of which numerous and very valuable deposits are found in many counties. These gravel deposits consist of water-rounded fragments of chert (an impure form of flint), buff to brown colored, embedded in a matrix of sandy clay, or other material which sets when once compacted, and forms a solid mass like concrete. The pebbles which form these gravel deposits are of fairly uniform size, varying from the size of a marble to that of a hen's egg. They are very hard, and resist wear on roads and streets remarkably well.

Where Do these Gravel Deposits Occur?

In north Mississippi deposits of gravel of commercial size are limited to three or four counties in the extreme northeast corner of the state, and to a tier of counties bordering the Delta. In south Mississippi such deposits are found in most of the counties north of the coastal flats.

What Is the Principal Use of these Gravels?

Road construction and street paving. Two principal varieties of gravel exist: those in which the matrix is pure sand, used in the making of concrete, and those in which clay and sand, or clay alone forms the matrix; the latter gravels are applied directly to roads and form a compact surfacing.

Has the State Geological Survey Reported on these Gravels?

Yes. Send to the Director for copies of Bulletin 9, or Bulletin 16, for full information about them, and tests made on them.

What Is Bedded Chert?

Chert which is found in stratified solid beds, not in gravel form.

Has Mississippi Deposits of Bedded Chert?

Yes. In the bluffs bordering the Tennessee River in Tishomingo County, very extensive deposits are known, 40 to 50 feet thick. This material crushed to proper size would be one of the most valuable road materials. The deposits lie within a mile of Tennessee River, and could be quarried, crushed, and loaded on boats by gravity.

What Is Quartzite?

A very dense, hard and tough siliceous rock, like sandstone, but much harder. When crushed it forms a good road metal.

Has this State any Quartzite?

Yes. Beds of gray or whitish quartzite are found in Tallahatchie, Grenada, Carroll, Holmes, Attala, and Leake counties in deposits of from two to four feet thick. These have not been used except locally, the rock being too variable in toughness, and for the most part too far from transportation to be handled to advantage.

Has Mississippi any Building Stones?

Mississippi has both Limestone and Sandstone suitable for building purposes. The limestones have been used locally in south Mississippi, but not put on the market. They take a fine polish, but are difficult to quarry owing to alternate hard and soft beds. A very superior crystalline gray limestone that offers real promise is found in Tishomingo County. The Selma limestone of the northeast prairies is not suitable for building purposes.

A light-gray sandstone of very fine quality outcrops in thick beds along Bear Creek, in Tishomingo County. This forms ledges 25 to 40 feet high. A quarry has been opened within three miles of the Birmingham branch of the Illinois Central Railroad station of Tishomingo. This rock dresses a handsome block, and will doubtless make excellent building stone. For fuller information and for tests made on this stone, see Mississippi Geological Survey Bulletin No. 16.

What other Structural Material of Importance Is Found in Mississippi?

Sand, of which there is unlimited quantity. In several parts of the state moulding sands occur in large quantity. Vast deposits of pure white sand suitable for glass manufacture occur along the Gulf Coast and on Cat and Horn Islands, as well as elsewhere in the state. Good building sand is abundantly found in most of the counties, especially in the northern hill counties.

What Metallic Minerals Are Found in Mississippi?

Ores of metals are less common in Mississippi than in the mountain states of the country. Gold, silver, copper, lead and zinc have not been found in the state, and probably never will be. From numerous counties specimens of galenite, or lead sulphide (Lead 87%, Sulphur 13%) have been received at the Geological Survey office, but in every case it was found under conditions that precluded the probability of commercial deposits. Small concretionary masses have been received from the limestone of northeast Mississippi, but specimens from other parts of the state were almost surely carried there by human agency.

Iron ores of two kinds are found in the state in considerable quantity. The most extensive deposits of Iron Ore are in the form of Iron Carbonate, or Spathic Ore. These occur either in thin beds a few inches to a foot or two feet in thickness, or in lens-shaped concretions, interstratified with gray or lignitic clays. Spathic iron ore (also called Siderite) is a very dense and heavy, light gray rock, with so fine a grain that a broken surface looks like that of flint, and by well-drillers in the regions where it is found, is often called "flint rock."

Widely scattered through the state, usually exposed at the surface, are smaller, but more important deposits of Brown Ore, or Iron Oxide. This ore is most abundant in the regions where the spathic ore occurs, and is usually derived from it as a weathered product. This ore, by its distinct metallic appearance has attracted attention, while, except to the geologist, the more extensive spathic ores have escaped notice because of their rock-like aspect.

The oxide ores generally have from 40% to 50% of metallic iron, the carbonate ores, about 40%, but on roasting the ore it is converted into the oxide, which may have an iron content of as high as 60%. These ores are largely found in the north-central upland counties, and are extensive enough to have attracted limited development. A small charcoal furnace was established at Winborn, Benton County, in 1912, but is not now in operation.

The chief usefulness of these ores will probably be as a source of paint.

What other Forms of Iron Occur in this State?

In many parts of the state a sulphide of iron known as Marcasite is found in notable quantity. This is not ordinarily considered an ore of iron, but has distinct lines of usefulness. Its composition is: Sulphur 53.4%, Metallic Iron 46.6%.

Marcasite usually occurs in small nodular masses, having a shining metallic lustre and a light brass-yellow color. It is sometimes mistaken for gold, but is brittle, whereas gold is soft and malleable. It is found abundantly in certain zones of the prairie limestone in the northeast counties, but is much more commonly found in Lignite or Lignitic clays.

In some of the southern counties, particularly Newton, Jasper, Smith, and Jefferson, marcasite is found in extensive deposits impregnating the soil, giving it a blackish-green color and acid taste and odor. This is commonly called Acid Iron Earth, and by leaching, a strong styptic, and astringent amber colored fluid is obtained which has a local reputation as a remedy, efficacious in numerous ailments.

Iron Sulphide in large deposits has a market value as a source of sulphuric acid, and is largely used in fertilizers.

For more detailed information on the Iron Ores of Mississippi, see Geological Survey Bulletin No. 10.

What other Metallic Ore Is Found in Mississippi?

Within the past year Bauxite, the ore of the white metal, Aluminum, has been found in the state in extensive deposits. These deposits are found capping the hills that lie immediately west of the Flatwoods region in several counties. Geologically they lie at the contact of the Wilcox and Midway formations of the Tertiary. Large deposits of the ore are found in Tippah, Pontotoc, Calhoun, and practically all the counties that border the Flatwoods southward to the Alabama line.

The ore is always associated with white or gray clays, and has the appearance of being made up of massed pea-like concretions, whence it is said to have "pisolitic" (or rock-pea) structure. It varies in color chiefly on account of iron present, a high proportion of iron oxide giving the ore a dark, iron-like appearance, and causing it to be heavy, and very hard and rock-like.

This character of ore resembles very closely a ferruginous pebble conglomerate, and has been called locally "peanut rock". Absence of iron in the ore leaves it a buff color and soft.

Is Bauxite a Common Ore?

No, it is rare; so far found in but three or four states in this country. Arkansas produces 90% of the commercial bauxite used in the United States.

Is Mississippi's Bauxite Discovery Important?

It is so important as to have attracted a strong developing company which has expended many thousands of dollars prospecting and securing acreage of these bauxite lands. The quality and quantity of the bauxite deposits have been attractive enough to engage the attention of all the large dealers in bauxite, and we may confidently expect the exploitation of these resources.

What Has the Geological Survey Done to Bring these to the Notice of the Public?

In May, 1922, the State Geologist made a reconnaissance survey of the bauxite area, and issued a press report for general information. Mr. P. F. Morse is now preparing for the State Geological Survey a careful and detailed report, after very extensive investigations. This report will be published during the year.

What Is an Ocher?

A pulverulent iron oxide used as a pigment.

Has Mississippi any Ochers?

Perhaps no pure ochers, but large deposits of clays highly colored with iron oxides are found in the state. These are called ocherous clays, and make very excellent paints. These ocherous clays are of two principal colors, yellow and red. In northern Tishomingo County are quite extensive deposits of deep Indian red ocherous clays, free from grit, which mix well with oil and spread uniformly producing a good paint. These deposits have had some local development from time to time. From southeast Mississippi samples of a good quality of red ocherous clay have been received by the Geological Survey, the deposits reported to be extensive. A deep red, or purple sand a few miles east of Meridian, on washing, gave a rich red ocher 25% of the volume of the sand.

Ocherous clays of light yellow tint and free from grit, have been dug and shipped in carload lots from a deposit seven miles southeast of Iuka. This order was shipped to Kansas City, and was reported to be satisfactory. Other deposits of yellow ocherous clays have been examined in different parts of the state, but none have been exploited.

Ground lignite offers possibilities as a pigment; when mixed with white it gives beautiful grays of different tints. The iron ores of the state also have possibilities as mineral pigments. (See Bulletin 14 for account of Mineral Pigments).

What Is Tripolite?

Tripolite is a finely pulverulent silica, made up largely of the microscopic shells of minute organisms. Near old Eastport landing on the Tennessee River, deposits of snow white tripolite 15 to 20 feet thick are known to underlie the uplands over several square miles of territory. These deposits have been mined, the old tunnels running several hundred feet in different directions under the hills, looking like tunnels in a great snow bank.

Tripolite has its chief use as an abrasive or polishing powder, its fineness of grain fitting it especially for polishing silver without scratching the surface. It is also used for filters, and the Mississippi tripolite has been manufactured into glassware reported to have been exhibited at the Chicago Exposition and pronounced as good as Bohemian glass. It should be useful also for making dynamite, scouring soaps, and fireproofing for safes, steam pipes, and boilers.

Chemical analysis of Mississippi tripolite shows 99% pure silica. These tripolite deposits are interbedded with the chert of the basal Mississippian formations of Tishomingo County.

Is there any Limestone in Mississippi?

Yes, Mississippi has abundance of limestone. In the extreme northeast corner of the state Carboniferous limestones of great purity outcrop near the Tennessee River. Some of this rock is crystalline, and of 95% pure lime carbonate. That found in large deposits near old Eastport is well adapted to making natural cement.

In the prairie counties of northeast Mississippi, beneath a few feet of surface soil, lies a soft, bluish limestone of great thickness. Geologically this is of Cretaceous age, and contains abundance of marine fossils. Further south is a belt of limestone extending across the state from Vicksburg to Waynesboro. This limestone formation consists of alternating beds of limestone and soft friable marls, all very rich in lime and highly fossiliferous.

For what Are these Limestones Useful?

As already explained, the high grade limestones of all these limestone areas are suitable for cement manufacture, and will eventually be developed for that purpose. Besides this, all the deposits are of immense value to the state for crushed limestone for agricultural uses. The Carboniferous limestone also has a future as an excellent building stone, some of this rock being superior for that purpose to the well-known Bedford Limestone, of Indiana. The Mississippi rock takes a high polish, and is, in fact, a very beautiful gray marble.

The southern, or Vicksburg limestone has possibilities as a building stone, taking a handsome polish, but the bedding is too thin for successful exploitation for building purposes.

The Cretaceous limestone, geologically known as Selma Chalk, being in massive unstratified form, can be quarried in blocks of any size, but the absence of regular jointing makes it difficult to quarry. This rock has no value for structural purposes, having the property on exposure to the weather of cracking, and falling to pieces. This adapts it well for application to agricultural lands.

What Is the Proportion of Lime Carbonate in these Different Limestones?

The Carboniferous Limestone (pure type) has analysed 95%; the Selma Chalk averages about 80%; the Vicksburg Limestone, about 85%.

Is this Limestone Being Used?

Yes, the state has two lime crushing plants under the management of the Penitentiary Department. One is located on the Selma Chalk about three miles west of Okolona, and one at the mouth of Limestone Creek three miles north of Waynesboro, on

the Vicksburg Limestone belt. These plants crush the limestone, using convict labor, and furnish the output to farmers of the state at cost of production.

Is Crushed Limestone Needed on Our Soils?

Practically all of our soils would be greatly benefited by the application of lime, especially all long-used upland soils which have become acid by continuous cultivation.

How May a Citizen Know More about these Limestones and their Use on Farms?

Send for State Geological Survey Bulletin No. 13, which gives full information on the subject; it will cost nothing.

What Is Marl?

A marl is a soft, incoherent, impure limestone, containing usually considerable proportions of clay, sand, iron, and other impurities. The lime content of marl is generally less than that of limestone and is in the form of fine shell fragments.

What Is Marl Used for?

For similar purposes as limestone, except for building.

Has Mississippi any Marl Deposits?

Quite extensive marl deposits are associated with the limestones, especially those of the Vicksburg belt.

Are Mississippi Marls Rich in Potash or Phosphate?

No; our marls contain small proportions of both, but not enough to make them of value as sources of potash or phosphate. (For further discussion of Mississippi Marls see Bulletin 13, of the State Geol. Surv.)

Has Phosphate Rock Been Found in Mississippi?

Yes; on the Tennessee River limited deposits of phosphate rock have been found, some of the rock, at least, being of commercial grade, but the deposits lie under heavy overburden, and the known phosphatic bed is not more than two feet thick, so that prospects for immediate development do not seem bright.

What Is Fuller's Earth?

A fine earthy material resembling clay, but lacking plasticity, and usually containing magnesia. Its chief use is in clarifying oils by retaining the coloring matter.

What Is the Market Price of Fuller's Earth?

According to latest statistics at hand, good Fuller's Earth produced in this country was marketed in 1920 at \$19.51 per short ton.

Has Mississippi any Fuller's Earth?

Wailes, in his Report on the Agriculture and Geology of Mississippi (1854), mentioned the presence of Fuller's Earth in Yalobusha County, but later investigation has failed to re-discover the deposit. In 1911 very good Fuller's Earth was found on the property of Gov. A. H. Longino, in Smith County. During the past year (1922) promising Fuller's Earth was found

in Adams County. In Clarke, Lauderdale, and Newton counties occur extensive deposits of buff-colored, light material called claystone. This has been found to possess the property of clarifying oils, and holds out prospects of becoming a valuable Fuller's Earth. In some places the material outcrops in high bluffs along railroad lines, making transportation easy.

So far, none of these deposits have been developed.

What Is Amber?

Amber is a hard, brittle, fossilized resin from trees related to the pine. It is of a clear yellowish-brown, or "amber" color, and is used for pipestems, cigar holders, and for ornamental purposes.

Is Amber Found in Mississippi?

Yes; in several places. It is usually associated with lignitic clay deposits, the lignite being derived in part from the wood of the trees furnishing the resin. High grade amber in small quantities has been found in the Cretaceous clays of Tishomingo County, and in the Tertiary clays of Tallahatchie County. None of it has been marketed.

What Is Mississippi's Most Valuable Resource?

Unquestionably the Soils of Mississippi, as of the world in general, constitute the state's most valuable resource. Mines furnish the world many metals and minerals at present indispensable to modern civilization; forests of timber supply the markets of the world with lumber for structural purposes. The exhaustion of both these resources, with satisfactory substitution of other materials to fill their place, is conceivable; but when the earth's soils are gone the human race will disappear. They constitute the pabulum which supplies the life-blood of the world.

What Attention Has the State Geological Survey Given to the Study of this Primary Resource of the State?

During 1910, realizing that a detailed soil study of the state could not be completed for several years, and to supply an immediate need for a preliminary report on our soils, the State Geologist had analyses made of about 150 samples of soils and sub-soils, collected by him in the southern counties in 1908. A new feature of the tests at that time was a determination of the humus (organic mold) content of each soil. These results were embodied in a "Preliminary Study of the Soils of Mississippi", published in February, 1911. This Report was in large demand, the edition being now exhausted.

What Further Attention Have the Soils of the State Received from the State Geological Survey?

A cooperative survey of the soils of the state was organized in 1909, upon an arrangement by which the United States Bureau of Soils and the State Geological Survey would put an equal number of men in the field, and otherwise share equally the expenses of the work, except the printing of the report and map,

which was to be done in Washington at Government expense. These soil maps are in demand for many purposes.

The Soil Survey is a detailed study by counties, the soils of each type being examined and samples tested. Each county is accurately mapped, the maps being on a scale of one inch to a mile. The physical characteristics of the soil, the drainage conditions, the treatment needed by each soil, adaptability of the different types of soil for different crops, their relative productivity, and the character of subsoil, are elements considered in the survey. A soil survey is a reliable basis upon which the farm demonstrator can found his experiments and recommendations.

The cooperative soil survey work has been steadily in operation since its inception; usually two men constitute a field party, who work together in one county. Altogether 44 counties of the state have been completed, besides a few other counties, which were done by special arrangement at an early date. While it would be desirable to expedite the work by adding more field parties, our funds allotted to that work will not permit it.

Has Surface Erosion with Rapid Soil Wash Received Attention?

Rapid soil wash is one of the great evils of many of the hill counties of this state. Its destructive effects, conditions which favor it, and methods of arresting it, are important questions that have engaged the attention of the State Geological Survey, and several papers have been issued calling attention of the public to this problem. Some of these papers are "Our Waste Lands", and "Soil Erosion and Its Influence upon Flood Control in the Yazoo Drainage Basin."

What Has the Geological Survey Done on Forestry and Conservation in Mississippi?

From the beginning of its existence the Geological Survey has given attention to the forest problems of Mississippi; has made investigations of the rapid rate of depletion of the state's forests; has suggested legislation looking to a conservation of our timber resources, and has studied the problems of soil waste and rapid surface erosion incident to deforestation of our uplands.

Two bulletins, 5 and 7, with subsequent reprint of the two in one volume, as Bulletin 11, have been issued, dealing with these subjects. "Our Waste Lands", a brief paper issued in 1910, discusses the problem of soil waste. In the soil survey of all the upland counties, notice is taken of soil washing, and areas that have suffered serious injury from this cause are indicated on the maps.

The State Geologist has been delegated by the Geological Commission from time to time to attend and report at various conservation and forestry congresses on the situation in this state, and to receive any useful information that will apply to our conditions. The Survey has always been in active cooperation with all agencies in the state looking to an intelligent policy of forestry and conservation of our resources.

Is Forestry an Important Problem in Mississippi?

In many of the northern counties it is particularly so on account of the intimate relation of soil wash to removal of the forests from the hillslopes in large areas. Many thousand acres of agricultural lands have become cut up into deep gullies, due to this cause. In many southern counties reforestation of cut-over lands is an important problem.

What Is Meant by Water Resources of the State?

The water running upon the surface in streams, and that which flows beneath the surface in porous beds of sand or rock, and which finally comes up again to the surface in springs or is tapped in wells.

What Is Meant by Underground Water Resources?

The water that flows at greater or less depth beneath the surface of the ground and finds its way to the surface in springs or wells. This is also called ground water.

What Is the Source of Ground Water?

Rain sinking beneath the surface.

Has Mississippi an Adequate Supply of Ground Water?

Perhaps no state has a fuller supply, or water of better quality than Mississippi. Practically anywhere in the state water in abundance and of good quality can be had from springs, or from shallow or deep wells.

Which Is Better for Drinking Water, Springs, Shallow or Deep Wells?

Water from deep wells is always safer, because springs and shallow wells may easily become contaminated with disease germs, though they are not necessarily so.

Is there any Natural Law Controlling the Finding of Underground Water in Mississippi?

Yes. Ground Water follows porous beds, as sand; all bedded formations in north Mississippi dip or slant toward the west (regardless of how the surface of the land slopes); therefore a sand producing good water (a water horizon, it is called) may be expected to get deeper and deeper the farther west in the state one goes; and hence the wells in that direction will be deeper and deeper. In South Mississippi the formations dip more toward the south, and hence any certain water horizon will become deeper in that direction. A deep well may tap more than one water horizon.

Do All Deep Wells in Mississippi Flow Out at the Surface?

No. Usually deep wells in the Delta flow, as do also those on the low coastal flats bordering the Gulf.

Deep wells on the alluvial plains of all our larger streams flow, but those on the uplands throughout the state do not flow at the surface. Shallow wells, as a rule, do not flow, though there are a few wells from 25 to 50 feet deep that flow continuously.

What Work Has the State Geological Survey Done on the Underground Waters of the State?

Owing to the yearly multiplication of wells throughout the state, and the demand for more definite information on available water horizons, it early became evident that a thorough and detailed investigation of our underground water resources was necessary. With this object in view, very complete records of all available wells have been obtained; analyses of several hundred representative waters have been made, and the character, depth, and distribution of the various water-bearing strata have been ascertained.

The Report on this work is now ready to go to press, and will be much the fullest and most complete study of the state's underground waters that has ever been undertaken. This work has been done in cooperation with the United States Geological Survey.

What Is a Mineral Water?

A natural water coming from a spring or well which contains an appreciable quantity of some mineral ingredient in solution. It is usually characterized by a distinct taste, and often possesses curative properties.

Has this State any Important Mineral Waters?

Yes, Mississippi has a great many mineral springs and wells that are patronized by health-seekers and by tourists seeking recreation from all parts of the country. Most of these are resorts fitted up with hotel accommodations, and some of them ship waters to patrons at a distance. In 1920 the value of mineral waters shipped by Mississippi producers amounted to \$31,312; this, of course, does not include the much larger quantities of mineral waters consumed at the resorts.

What Attention Has the Geological Survey Given to these Mineral Waters?

Several years ago the Survey collected data on the location, hotel facilities, and medicinal qualities of these springs and wells, and had analyses made of the water of each. This information will be embodied in an illustrated report in the near future.

Has Mississippi any Drainage Problems?

With more than 6,000,000 acres of alluvial lands in the Yazoo-Mississippi Delta, large areas of which are still undrained, besides numerous stream valleys throughout the state, with other thousands of acres of rich lands that would be improved by drainage, this becomes necessarily one of the State's great problems.

Where Are the State's Great Drainage Problems?

In the Delta, necessarily, where millions of acres of the most fertile soil in the country lie nearly at the level of the streams, and with so little relief as to shed rainfall very slowly. Much of this area is subject to overflow; large districts are permanently covered with shallow swamps, sloughs, and lakes

What Minor Drainage Problems Has the State?

Besides the Delta lowlands, nearly every county of the state contains stream bottoms that require drainage. Hence, drainage is emphatically one of the important problems of the state.

Is Anything Being Done in Drainage Development in the State?

Yes, under the state laws drainage districts have been organized in about half the counties, and many of these projects are now completed and in successful operation.

What Has the State Geological Survey Done in the Furtherance of Drainage Projects?

In 1908 the State Geological Survey in cooperation with the U. S. Geological Survey, and under the auspices of the Tallahatchie Drainage District, made a topographic survey of nine quadrangles in the northern Delta, to be used as a base for drainage development.

In 1910 the State Geological Survey began investigations on drainage, but at that time, while many districts were being organized for drainage, little of the actual results of this work had been attained. The Survey, therefore, deferred further investigation until a later date.

During the year 1921 this work was again taken up, both by correspondence and by actual visitation of the various counties where drainage districts are organized. A large mass of data has been accumulated; maps and details of plans, acreage covered, cost per acre, estimate of increased valuation of lands due to drainage, are among the many points brought out in these investigations. More than one and one-half million acres are now covered by drainage projects. This information will be published in a Report as soon as funds are available.

Should a Survey of the Surface Waters of the State Be Made?

It is desirable that a careful study of the surface waters should be made. This is particularly needed in connection with drainage investigations, the study of the extent and rapidity of soil erosion in order to take measures for its arrest, and for the location of available water power sites. Many thousand acres of the state's most valuable soils need drainage, and many other thousands of acres of upland soils are suffering the ravages of soil wash at an alarming rate, and unless immediate action is taken for the arrest of soil erosion much of the uplands of North Mississippi will become impoverished sand wastes, which will not only withdraw much support in taxable property from the state, but will be a standing reproach to the enterprise and intelligence of our citizenship.

Soil erosion in certain parts of our state, where the formations are particularly susceptible to surface wash, has reached such proportions that its arrest ought to become a question of state policy.

The first step toward a systematic remedy of the condition should be an accurate study of the streams and surface run-off,

together with a measure of the damage done, the rate at which it is progressing, and the causes operating to favor soil wash.

Has Mississippi Water Power Possibilities?

Mississippi cannot, of course, compete with those southern states that have mountainous districts, as Tennessee, Alabama, Georgia, North Carolina and Arkansas, in large water powers; but our state has numerous smaller water power sites that aggregate many thousands of horsepower, none of which is being utilized. In the early history of the state, before steam power became general, nearly every stream of considerable size had one or more water mills. These were crude affairs, but served the needs of frontier conditions existing then. The future development of these water powers will be by entirely different methods. The stream gradients will be determined; the annual flow of water and the average flow per month and per day will be measured; reservoir sites where the waters can be impounded behind great concrete dams will be located. The horsepower at each site will be determined, and machinery will be installed to convert the energy of the water into electricity, which will be distributed to points where needed for lighting, heating, manufacturing, etc.

Will Water Power Development Be Important in the Future?

Undoubtedly the problems of motive power will in the near future be very largely transferred from coal, oil, and wood consuming machinery to electrically driven plants. The change is inevitable, and is already rapidly taking place in many parts of the country. The costliness of all fuels is driving enterprises more and more to the use of the motive power of water for generating electricity, and it will be both wise and timely for Mississippi to begin to take stock of her resources in this direction with a view to conserving them to the use of the people. All power sites should be under State or Government control, otherwise profiteering corporations will surely absorb them, and make the people pay high prices for what should be their own.

What Is the State Geological Survey Doing towards Development of the State's Power Sites?

A stream survey of the state is now in progress which will furnish a basis for the location of water powers by delineating on accurate and detailed maps the configuration of stream valleys and the gradients or profiles of the stream courses. In conjunction with this the accurate gauging of streams is necessary to determine the volume of water and the variations of flow throughout the year. This work is done in cooperation with the U. S. Geological Survey.

What Is a Topographic Survey?

It is a detailed survey and mapping of an area which shows accurately on the map the section, township, and range lines, the location of streams, lakes, swamps, railroads, and highways; the position of towns, villages, schools, churches, and even individual

houses throughout the area. In addition to these, certain brown lines on the map, called contour lines, show the elevation above sea level of every part of the area, or the topography of the area.

Is a Topographic Survey Useful?

Immensely so, as shown by the fact that all civilized countries have either already completely mapped their areas topographically, or are doing so as rapidly as possible, and most of the states of this country have either completed their topographic mapping or are doing so very rapidly.

Name Specifically Some of the Benefits of Topographic Maps.

They form the basis for all detailed work that has to do with the surface of the land; for Soil Surveys, Health and Sanitary Surveys; drainage development; highway construction; location of Water Power sites; mineral and oil development; for any detailed geological surveys; for military, and general educational uses, serving teachers and pupils in accurate geographic study. Topographic maps are in all states and in all countries regarded as essential.

Why Is a Topographic Survey an Activity of the Geological Survey?

The name under which the Geological Survey was organized recognized a topographic survey as part of its activities. In the Law creating the Geological Survey it is designated under the name "Geological, Economic, and Topographic Survey of the State of Mississippi", and one of its duties mentioned in the Law reads, "The said Board (Geological Survey Board) shall have prepared and published a topographical survey and maps of Mississippi".

Has the Geological Survey Made a Topographic Survey of this State?

Except for a small fund set aside in 1907 for work in a part of Coahoma County for drainage purposes, the support fund of the Survey has been too small to attempt a beginning in topographic work, until the season of 1920. The Legislature of 1920 made a liberal appropriation for topographic work, to be met by an equal sum from the United States Geological Survey. An agreement was then entered into by the Federal and State Surveys on a basis of equal expenditures.

The work was begun in May, 1920, and continued throughout the year. Sixteen field parties consisting of thirty-two men were actively in the field in different parts of the state. The work was so planned that a group of quadrangles in the northern counties, a group in an east-west zone of counties in the middle of the state, and a group of the southern counties were included in the operations.

During 1921 this work was vigorously prosecuted, and good progress was made. The area covered by this work during the period from May 1, 1920 to November 1, 1921, is as follows:

Completed Sheets,	7
Partially completed Sheets,	8

The territory embraced in the topographic work for the biennial period covers an area of approximately 4,000 square miles, about one half of which has been completed. For the balance, the primary traverses have been made so that the areas are prepared for soil survey, which will soon be made at greatly reduced expense, and in much less time than when the soil surveyor had to prepare his preliminary map.

Furthermore, in the areas covered by the topographic survey, the maps made by the topographers can be used as a basis for all highway construction, drainage enterprises, and numerous other activities, at enormously reduced expense.

What Purely Scientific Investigations Has the State Survey Carried on?

The lines of work outlined in the preceding pages are primarily economic in their bearings, but since its inception the State Survey has made other investigations more purely scientific, but which have also important economic bearings.

The most important of these has been the careful re-survey of the geological history of the state. In previous surveys this has been studied in outline, but for many reasons it was desirable to know more in detail the geology of the state. Hence a much more careful and detailed study of the geological formations was begun some years ago; this work has been carried on incidental to other work, until now it is practically completed.

Have the Reports of this Investigation Been Published?

Not yet. The Report has been prepared in manuscript and the map is about ready for publication, after clearing up a few doubtful points. This Report will constitute a large volume of from 800 to 1000 pages of print. The map will be detailed and printed in several colors, and the volume will be illustrated with numerous photographs and diagrams. The publication of this report will cost considerable, and at present the Survey has not sufficient funds to print it.

What Is Meant by Paleontology?

The study of the ancient forms of life, both animal and vegetable, that have lived upon the earth in past ages. Mississippi formations reveal abundant evidences of these ancient creatures. The Geological Survey has collected large quantities of them, mostly fossil shells, some of which are displayed in the Survey cabinets in the Old Capitol, in Jackson. These fossils have been carefully studied by experts, and the results will be embodied in the large volume just referred to on the geology of the state.

Do other State Geological Surveys Publish Reports on Fossils, Etc.?

All Surveys give some attention to this phase of geological study, and some have published series of costly and handsomely illustrated volumes on the subject.

Has the Knowledge of Fossils any Economic Importance?

Often directly so; as for instance, in New York alone prospectors for coal have spent enormous sums of money looking for coal where any geologist, on examining the fossils, could have told of the futility of looking for coal there. Also in oil drillings examination of the fossils brought up by the drill will often tell whether the oil sand sought has been reached, or at how much greater depth the sand may be expected.

Has the Geological Survey Stressed Educational Work?

Necessarily an important part of the work of a State Geological Survey is educational, and it is very desirable that it should be so. This feature of our work has been kept constantly in mind, and several lines of activity have been stressed, mainly for their educational value.

Name Some Features of the Educational Work of the Geological Survey.

1. A study of the Geography of the State.
2. A study of the Archeology of the State.
3. A study of the native wild flowers of the State.
4. Formation of a Geological Museum in the Old Capitol.

What Work Has the Geological Survey Done on the Geography of the State?

Almost from the inauguration of the State Geological Survey numerous and insistent requests began to come to the office of the Survey for literature that could be used in the schools of the state on its geography and mineral resources. Our Bulletin No. 8, on Soils, which also gives general information on the geography of the state, was for several years sent out to meet this demand. But feeling that something more definite on these subjects was needed, the State Geologist, in 1915, issued Bulletin No. 12, on "Mississippi: Its Geology, Geography, Soils, and Mineral Resources." This was written in a popular vein, free from technicalities, and at once became largely used in the high schools and colleges of the state. The edition was soon exhausted, and in 1919 Bulletin No. 14, a revision of No. 12, with some modifications and additions, was issued. The demand for this was as active as for the previous edition, in some cases as many as two or three dozen copies being ordered for one high school or college. As long as there was a demand for it we felt that the book was serving a useful purpose among the youth of the state. This second edition is now exhausted, and possibly another revision will be needed.

In the belief that the importance of the subject demanded a special report, the State Geologist, in 1920, engaged Professor Frederick A. Burt, of the Department of Geology at the Agricul-

tural College, to prepare a bulletin on the Geography of Mississippi. The work was carried on during the summers of 1920 and 1921, and at such times during the school years intervening as Professor Burt could spare time from his class work. The Director is now in possession of the manuscript report, which will be issued as soon as funds for printing can be obtained.

Does the Geography of the Coastal Islands Present Anything of Interest?

By way of geographic study, the State Geologist, in company with Mr. T. L. Bailey of South Carolina, the botanist of the Survey, early in September, 1915, spent a week among the coastal islands off the Mississippi Sound, studying their geologic structure, soils, economic resources and native growth. This reconnaissance extended from Petit Bois Island on the east to Brush Island on the west. Important observations were made, which will be embodied in a special report. Briefly stated, the soils of the islands are sandy and peaty, and of little agricultural value, but they support in abundance coarse grasses and rushes, and furnish fair grazing for cattle and goats. On Horn and Cat Islands considerable quantities of undersized but fairly good timber exist, mostly of Cuban and loblolly pine. Excellent flowing artesian wells are obtained on the islands at a depth of from 600 to 700 feet. Pure white sand, fit for glass-making, is found in great quantity on the north side of Horn Island. Immense deposits of comminuted shells suitable for making shell roads, or for lime-crushing plants, are found on the Keifer Keys, Door Point, and on other islands lying to the west and south of Cat Island, but unfortunately these valuable shell banks are by a recent court decision all in Louisiana.

Some very interesting dune studies can be made on Cat Island; also some evidences of rapid cutting by waves and currents, with concomitant transfer and redeposition of sand in long spits and hooks. Classes in Physical Geography in the state colleges would find a trip to Cat Island not merely a pleasant diversion, but a source of most profitable study in physiographic processes along shore lines.

What Is Meant by the Archeology of the State?

A study of the relics left by the aborigines, especially by the prehistoric peoples who once inhabited the state.

Are Many Such Evidences and Relics to be Found in Mississippi?

Our state was once rich in the relics of the aborigines, both of the tribes which were in possession of our territory when the white man appeared, and of the Mound Builders who antedated them. These interesting and instructive relics are now much less abundant than formerly. Many have been sent out of the state to museums and private collections in other parts of the country; many are in private collections within the state, and not a few that were once in private collections have been destroyed by fire.

Have the Collections of Relics from Mississippi Been Studied?

A large collection of valuable archeological material, much of it from Mississippi, is now fortunately placed in the cabinets of the Geological Survey and of the Department of Archives and History. One very beautiful collection of Indian pottery, weapons, and ornaments which was made by the late Dr. E. R. Ballard, of Montgomery County, Mississippi, has been loaned to the Geological Survey Museum by his family. But much that is not in state collections is still in danger of being lost to science. Knowing this to be true, and with a view to collect as much as possible of this scattered material and to study and photograph all that could be reached, in private as well as public collections, both in the state and out of it, the State Geologist entered into an arrangement with Dr. Calvin S. Brown, of the State University, to prepare a report on the Archeology of Mississippi.

Dr. Brown has for years been making investigations along this line—for the past three years under the auspices of the State Geological Survey. He has studied and photographed all available material. Through the courtesy of Dr. Dunbar Rowland, the Director of the Department of Archives and History, he was given free access to the material belonging to that valuable collection.

Has a Report on Archeology of Mississippi Been Published?

The manuscript of Dr. Brown's report is now about ready to go to the printer and several hundred handsome plates, lithographed in Philadelphia, have been completed to accompany the report. This will be one of the most valuable publications of the Geological Survey.

Why Has the Geological Survey Felt Justified in Making a Study of the Native Plants of the State?

Several reasons seemed to justify it, a few of which are as follows: 1. The Survey is called, in the Law by which it was created, "a geological, economic, and topographic survey," and after enumerating lines of work strictly geological the Law says its further duty shall be "the consideration of such other kindred scientific and economic questions as in the judgment of the Board shall be deemed of value to the people of the state." The study of the native plants has been considered of sufficient economic and educational value to the people to justify entering upon it. 2. No systematic study of the flora of the state had ever been undertaken. 3. Such an intimate relationship exists between the geological formations and the soil derived from them, and between the soils and the plants growing naturally upon them, that an intelligent study of any one required a study of all three.

How Has the Study of the Native Flora Been Prosecuted?

Very largely this work has been carried on incidental to other activities. Since 1909 the State Geologist has personally given much attention to this branch of study, besides having employed Mr. T. L. Bailey, an excellent field botanist, for three summers to make collections of plants from the state. In addi-

tion to our own collections, a gift of the Allison Collection was made to the Survey by Mr. Andrew Allison, formerly known in the school work of the state, now a missionary in China.

Has a Report on these Studies Been Issued?

With these materials in hand the State Geologist spent the nights of the winter of 1920 working on the collections and preparing a report, which, in 1921, was published as Bulletin No. 17 of this Survey. It seemed very desirable that our citizens, especially the school and college students of the state, should know more about the native plants of their own section. With this idea in view the report was prepared, and it is the only work of the kind on Mississippi plant life. In order to make it more generally useful a key is being prepared to be used with it in the field in identifying the native species of our state. Many of our native plants have medicinal properties, and are well-known remedies.

Have Other States Issued Such Reports?

Nearly every state in the country has full reports on its native plants, many of them beautifully illustrated. Alabama has a splendid volume of more than 900 pages, on the Plants of Alabama, published by the Alabama Geological Survey at heavy expense. The New York Geological Survey has recently issued two large volumes beautifully illustrated with natural sized, colored photographs.

The educational as well as the economic value of such reports cannot be estimated.

In What Other Way Has the Geological Survey Tried to Promote Education in the State?

Beginning in 1909 the gradual building up of a museum of the geology and mineral resources of Mississippi has been one of our activities. This includes, so far as we have been able to collect them, the rocks, marls, soils, sands, clays, lignites, ores, and other resources found in our state. These specimens have descriptive labels attached giving necessary information about each; besides the collections include characteristic fossils of the different formations, many of which are rare and interesting. A collection of the state's native plants, made in the course of other work, is an important feature of the museum. In fact, the museum is intended to show whatever of interest or of educational value, or of economic importance there is in the Geology or Natural History of our state.

These collections are, of course, far from complete, but additions are constantly being made; and already our display space is overcrowded, and overflow cases will have to be placed in the adjoining corridor.

From time to time, in order to bring to the attention of the country at large Mississippi's potential wealth, the Geological Survey has in the past sent exhibits to various Expositions. These never failed to attract attention, and our own people, as well

as those from other states, were surprised at the variety and extent of Mississippi's mineral resources. These exhibits served a good purpose, but in several cases some of our most valuable exhibits were lost to the state at the close of the Exhibitions.

Exhibits placed at the State Fair in Jackson have attracted wide interest, and have proved their educational value. These exhibits the Survey hopes to keep up each year.

Would Educational Exhibits Given to Schools throughout the State Be Worth While?

We believe that small but representative collections of the minerals, soils, fossils and other materials of geological interest placed in the various high schools, especially the agricultural high schools, will be a valuable educational asset to each school. These collections would be described in such detail as to give them high educational value. The children of the schools would be deeply interested in studying them, and so receive first-hand information about the resources of their state.

The Survey anticipates furnishing such collections to the schools.

How Many Reports Has the Geological Survey Issued?

Seventeen separate reports on the different resources of the state, and other important reports are now in manuscript awaiting publication.

How Can Copies of these Reports and Maps Be Obtained?

By applying to Dr. E. N. Lowe, State Geological Survey, Jackson, Mississippi. They are all free, except for postage, and a small charge on maps.

What Was the Money Valuation of the Mineral Output of Mississippi Marketed in 1920?

According to report on the Mineral Resources of the United States issued by the U. S. Geological Survey, the total valuation of the mineral output of Mississippi for 1920 was \$2,198,013.

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