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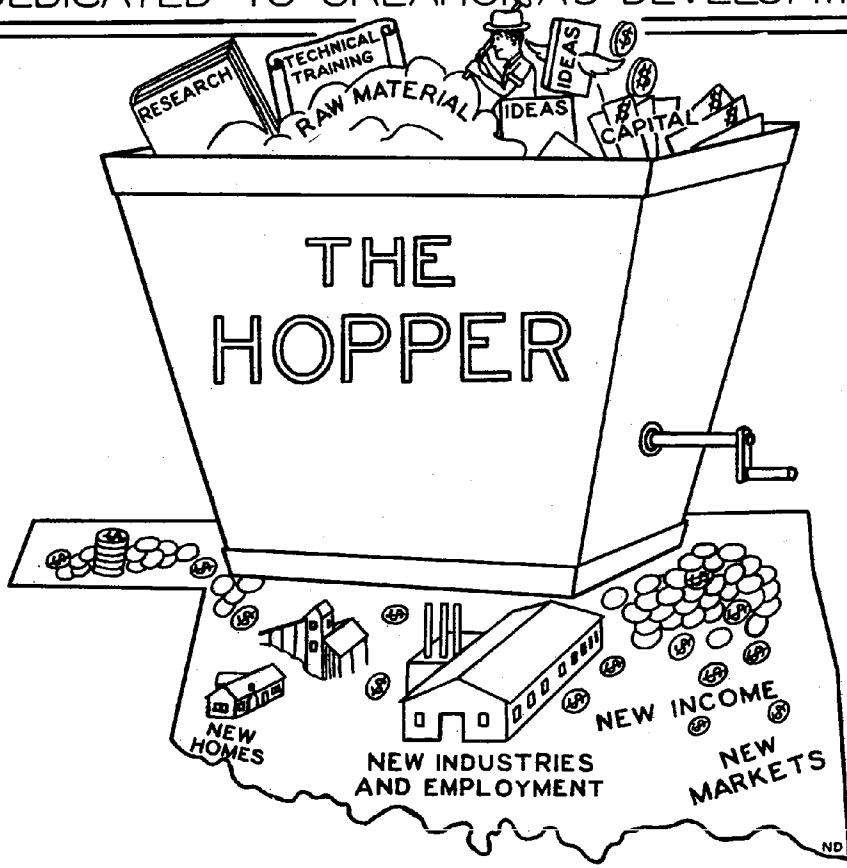


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THE HOPPER
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Carl C. Branson, Director.

Beginning with this issue The Hopper will print a series of articles devoted to acquainting you with the geologic features of the area about your community and their relation to the economic development of your community. This issue might be called the Lawton issue since it deals with an area of about 10,000 square miles centered by this city. The bounds of this area are roughly the Enid-Vernon division of the Frisco Railroad on the west, the El Reno-Waurika division of the Rock Island Railroad on the east, the Washita River on the north and the Red River on the south.

Albert L. Burwell, Industrial Chemist, has written the introduction and that portion dealing with Mineral utilization.

Gerald W. Chase, Associate Geologist, has written on the geology and mineral occurrences in the area. Mr. Chase has devoted much of his time since coming with the Survey to the Wichita Mountain region and surrounding territory.

## THIS IS YOUR CITY

Your city in common with all other cities of any consequences in the State of Oklahoma has come to recognize the need for more industry to bolster and sustain economic stability and an environment in which living, working, and playing is pleasant and satisfying. Industry employs both people and capital. Gainfully employed people and gainfully employed capital jointly enable a community to prosper,-- a good place to live and a place to be proud of.

What is meant by Industry? Qualifying words take it out of the realm of generalities. Transportation industry obviously pertains to railroads, bus and truck service, and air travel. Public utility industry includes the supplying of electric power, water, gaseous fuel, and telephone service. Agricultural industry is made up of such things as cotton and wheat farming, cattle raising, and growing and harvesting of timber. Minerals industry has to do with quarrying, mining, concentration of mineral materials both metallic and non-metallic and their beneficiation. Manufacturing industry involves changing the form of matter in order to increase its utility. Conversion is the essence of all manufacturing,-- changing something of limited utility into something of greater utility. Stated in another way, manufacturing consists in changing an article for which there is little or no use into an article for which there is use, preferably one for which there is or will be a need and a demand, and for which people willingly pay the price.

The Oklahoma Geological Survey is primarily interested in the minerals industry. Its duties include exploring, mapping, and evaluating the state's mineral resources. It follows naturally that it is interested in utilization of these mineral resources through mineral production and development of manufacturing industry based upon these minerals.

## SOME MINERALS OF THE LAWTON AREA

Sand and Gravel occurring in the area around Lawton was deposited during three Geologic periods. The sand and gravel found in streams are of Recent age, while those found in numerous terraces were deposited during the Ice Age. The boulder and arkose conglomerates are of Permian Age and associate themselves with the red shale beds near the mountains.

Sand composed of feldspar and quartz are found in abundance along Post Oak Creek seventeen miles west of Lawton and along West Cache Creek south of Cache. A large amount of this sand also occurs on Sandy Creek northwest of Indiahoma.

East of Lawton, the flood plain of Cache Creek is composed of a thick deposit of fine quartz sand with a terrace joining the flood plain on the west composed of coarse gravel.

West of Apache, numerous terraces of both Recent and Pliocene Age occur composed of limestone gravels and sands. A few miles north of Meers deposits of limestone gravels occur as the result of weathering of the conglomerate.

Along the north side of Lake Lawtonka huge deposits of sand composed of quartz and feldspar lie buried under a thin layer of clay.

Barite and Caliche occur in the red shales of the area with barite confined primarily to the shales exposed west of Lawton and south of Cache. Caliche occurs in numerous places from Lawton westward. It is composed of fine crystals of nearly pure calcium carbonate.

The barite is associated with purplish-red shale beds as concretions ranging in size from

1/2 inch to 4 inches in diameter. The area where these concrecretions are most abundant is along the west side of West Cache Creek in Sec. 7 and 18, T. 1 N., R. 13 W. These barite concretions also occur in many places as thin beds or lenses in the shales and except for the location given above, the concretions are usually about 1/2 inch in diameter.

The Caliche occurs in irregular zones in the Permian shale and is usually covered by a thin layer of soil or clay. Two locations where the Caliche has been examined are in Sec. 2, T. 3 N., R. 16 W., and in Sec. 12, T. 4 N., R. 17 W. These deposits resemble fine precipitated chalk and the material is snow white.

Limestone and Dolomite occur in the area west and northwest of Lawton. Huge deposits of bedded limestone occur approximately 11 miles north of Lawton and continue in a northwest direction for a distance of 20 miles as a series of thick limestone beds that are highly folded and faulted. This limestone contains beds of dolomite of which little is known at present. Future investigations may show commercial quantities of the dolomite.

Two hills of dolomite have been reported south of the Wichita Mountains and west of Lawton in Sec. 24, T, 2 N., R. 13 W. The two hills at this location rise to a height of 10 to 20 feet above the surrounding beds and are located close to Frisco RR.

Igneous Rocks composed of both granite and gabbro occur in the area northwest of Lawton. A large portion of these rocks crop out in the army and U. S. Wildlife Reservation, but tremendous exposures of igneous rocks are still accessible west of the land owned by the Federal government.

Large outcrops of anorthosite occur in T. 4 N., R. 17 W. forming hills 300 feet in height. It has been estimated that approximately 500,000,000 tons of this rock is exposed at the surface and readily accessible to mining. Fine grained diorite rocks occur within this area whose thickness is such that relatively large blocks may be removed for use in sea walls or as monuments.

At the present time a number of companies are quarrying granite and finishing it into monuments. The large stones they reject in their quarries may be suitable for use in sea walls along the Gulf Coast.

Clay and Shale occur throughout the area surrounding Lawton. A large portion of the shale and clay exposed is suitable only for soil, but in a few areas they are suitable for other purposes.

In an area both east and west of Meers, the granite boulder conglomerate has been subjected to intense groundwater action, altering the feldspar in the granite to clay. One deposit of this type is located $1\frac{1}{2}$ miles east of Meers, occurring as a long northwest-trending ridge covered with granite boulders. A second deposit is a mile north of Meers and 1/2 mile east where a north-south ridge has a covering of granite boulders. An east-west section road cuts the south end of the ridge, revealing the altered rock in place.

Montmorillonite clay occurs in the western part of the area in the southern half of T. 4 N., Rs. 16 and 17 W. and ranges in thickness from 20 to 60 feet. This clay is white to gray and contains 15 to 20 percent $Al_2O_3$, and is usually covered by a thin layer of soil.

Kaolin type clay occurs in a number of places

within the mountains. This clay is associated with anorthosite and is the result of groundwater action on the plagioclase feldspar. This clay is usually associated with weathered anorthosite in the floor of valleys and tests of this altered material show as much as 16% kaolin content. One extensive altered zone occurs in Sec. 36, T. 4 N., R. 14 W. A second is in Sec. 23, T. 4 N., R. 17 W.

Iron and Titanium minerals in the area include hematite, ilmenite and titaniferous magnetite. A 30 foot bed of siliceous hematite occurs in the Reagan sandstone in Sec. 6, T. 4 N., R. 12 W. The $Fe_2O_3$ content is approximately 30%.

Ilmenite is associated with the alluvial sands of Medicine Creek in T. 4 N., Rs. 13 and 14 W. and occurs in considerable quantity in the soil present as a talus slope around the north and east sides of Mr. Sheridan. Along the north side of Lake Lawtonka and on the lake bottom are relatively large quantities of ilmenite in the alluvial sands. These sands contain 3 to 4% ilmenite. The titanium dioxide content of the ilmenite is about 44%.

Titaniferous magnetite occurs in the basic rocks in Sec. 7, T. 4 N., R. 16 W and Sec. 14, T. 4 N., R. 17 W. In section 7 the magnetite is present as irregular dikes. In section 14 it occurs as a 27 foot layer, exposed for approximately 100 feet. This is what can be seen. An aerial magnetic survey indicates that large bodies of ore may possibly be present subsurface where only drilling will determine its presence and extent. Magnetite of the area contain about 52% iron and 17% $TiO_2$.

Brines are known to occur in the northern part of the area in the districts producing petroleum, as at Cement, Apache, and Gotebo. Also, in the Grandfield district on the southern edge brine has been encoun-

tered. Brines will be found undoubtedly in non-petroleum producing regions but for considerable distance from the mountains the conditions are not favorable and occurrence of brines is extremely doubtful.

Utilization.

Minerals in the ground may have potential value but acquire actual value only when separated from the earth and when there is a use and a demand for them. One may possibly make use of potential value by borrowing against it, then trusting to Heaven that development will take place before the note falls due. As a matter of fact, minerals "in place" have little practical value. Conservation by delaying development may benefit a later generation but the late President William Howard Taft said "True conservation lies in intelligent utilization" and most persons agree.

Sand and Gravel may be classified by origin, by chemical or mineralogical composition, by geological and geographical distribution, by grain size, by uses, or by a combination of these methods. The principal uses for gravel are in road building and paving, concrete construction, and as ballast. Sand is used in a multitude of ways. Following are some of them: A clean siliceous sand of medium grain and sharpness is blended with asphalt. Most any sand may be used as bedding in cattle cars. Either round or angular sized sand is used in blasting metal and stone. Sand for mortar and concrete must meet certain specifications. Manufacture of sand-lime brick is based on silica sand. Coarse sand is used in making molds for metal casting, but a finer sand for facing the mold. Even the sand to prevent locomotive-wheel slippage has specifications. Sand for abrasive use, for filler in mixed fertilizers, and for water fileters do, too. Sand for glass makin

must meet rigid standards, varying with the kind of glass produced, not only on composition but on grain size. A recent strictly "specification" use for sand is in "hydrofracing" of subsurface petroleum reservoirs.

Most sands are washed and sized. Many are also processed to increase their utility in one way or another, which accounts for values running from less than $1 to $40 a ton or more. Using modern technic, sands containing several minerals may be economically separated. The sand and gravel business in the U.S. in 1950 amounted to about $300,000,000. Did Lawton area get all they could or should have?

Barite & Caliche occurrences in the Lawton area have not been developed and perhaps can not be. The market for barite for use in drilling mud is active. Also, barite is used in the preparation of other barium compounds for use in pigments, rubber compounding, and for "scum" control in brick and tile manufacture. Barite is widely distributed in the Lawton area. It is hoped that it will be found in sufficient concentration to warrant development.

Caliche is considered usually as "no account, worthless dirt" but that is not necessarily so. For example, the deposit in Section 2, T. 3 N., R, 16 W., was sampled. This particular sample on sieve analysis showed 69% passing 10 mesh, and a "calcium carbonate equivalent" of 92%. Such material should find uses. Further tests gave 45.6% passing 200 mesh, and composition of 97.35% calcium carbonate and only 0.40% magnesium carbonate. This fraction would pass for a good grade precipitated chalk such as finds wide use in the paint and paper trade. It should meet the specifications for other uses including calcium carbide, and lime and hydrated lime manufacture. What are the reserves in this deposit? Is the composition uniform? What about the other deposits? Is it worth

the time, money, and effort to find out.

Limestone & Dolomite occur in quantity in this area. Use of this limestone will follow the pattern developed at Richard's Spur unless a "chemical-grade stone" should be found, a possibility somewhat enhanced by the opening of a quarry near Cooperton. The production of aggregate for concrete and asphalt can be expanded, of course, to meet any demand no matter how great.

Dolomite in the Strang formation outcrops just northwest of Lawton. Analyses made in years past indicate it is in the "chemical-grade" catagory. A dolomite of comparable quality in Johnson County is the basis on which Rock Products Company have built a business. A quarry and mill are supplying the glass plants in Oklahoma and adjoining states. Shipments are made to fertilizer blenders and for soil conditioning. Fluxing stone for blast furnaces in Texas have been supplied from this source. Dolomite of this grade may be calcined to yield a "mortar lime" sometimes preferred by plasterers and the raw material used in processes for the manufacture of so-called 85% magnesia.

In 1950, 7,500,000 tons of quicklime and hydrated lime were sold in the U. S., valued at $83,000,000. 4,137,000 tons were sold to chemical and industrial concerns. 1,760,000 tons were dead-burned dolomite for refractory use. 1,125,000 tons were sold to the building trade.

Igneous Rocks cover an immense territory in this area. Also the meaning of the name covers a lot of territory. It includes granite, diorite, and anorthosite all three of which are quarried and finished for monumental and building purposes. Possibility of expanding this industry in Oklahoma is "outside my ken." A further possibility lies in

processing such materials to obtain merchantable silica, mica, feldspar and "heavy minerals." It may not be feasible at this time but should be investigated.

Anorthosite is recognized as a potential source of alumina. A process has been developed and is in pilot-plant operation near Laramie, Wyoming, taking alumina from this mineral. The economic feasibility of the process rests upon concurrent production of Portland cement along with the alumina.

Clays and Shales are relatively abundant in the area but those that occur in Lawton's immediate neighborhood cannot be recommended. All shales examined on the south slopes of the mountains carry too much limestone even for common brick. Brick, tile, and pottery plants are consumers of shales, clays, and certain other materials containing clay. Tests indicate that altered granite and altered anorthosite in the Meers district and in the Roosevelt district can be processed to brick. Shales in district east of Manitou should serve for brick, tile and pottery. It is probable that quarry sites in similar material will be found to the south and southwest of Lawton.

Montmorillonite-type clays are known in the western part of the area. No specific uses for this clay other than drilling mud has been found in our tests.

Kaolin-type clays have been found in the western part of the area and also near Meers. These clays are "in place" where they were formed by alteration of anorthosite rock. Therefore, unaltered material is also present. This situation exists wherever this type of occurrence is found. Separation of the clay from the debris is by elutriation with water, followed by filtration and drying. Tests indicate the percentage recovery of merchantable

clay from deposits in this area will be as great as obtained from commercial deposits elsewhere.

U. S. production of kaolin in 1950 amounted to about 1,750,000 tons valued at $24,000,000 with 93% coming from southeastern states. Pottery and stoneware, paper, and refractories were the principal consumers. Shales and miscellaneous clays were produced in an amount of about 23,700,000 tons with value of slightly less than $20,000,000. The consumers were portland cement (27%) and brick, tile, drain and sewer pipe, etc. (71%).

Iron & Titanium Minerals in this area include a siliceous hematite recommended as red pigment for use in corrosion-control paints. Also ilmenite which currently is the principal raw material for production of "titanium white" pigments, and titaniferous magnetite which may be smelted to produce iron and a slag rich in titanium. The slag may be processed to recover titanium as dioxide or as metal.

Ilmenite concentrates produced in the U. S. in 1950 were about 468,000 tons. In addition about 216,000 tons were imported, and valued around $14 ton Atlantic ports. Titanium dioxide made from ilmenite brought from 19 to 24¢ per pound with pigment and ceramic industry as the main consumers.

Present production of titanium metal is about 20,000 tons priced at $5.00 per pound. Expansion of production to 33,000 tons is the present goal.

Brines are source material for sodium chloride (common salt), calcium chloride, magnesium chloride, bromine, and iodine. Salt is the main component followed by calcium and magnesium chlorides. Subsurface brines examined from the northeastern part of this area (T. 5 N., R. 9 W.) contain about 52 lbs. sodium chloride, 9 lbs. calcium chloride, and

2 lbs. magnesium chloride per barrel.

16,600,000 tons of salt were produced in 1950, of which 9,400,000 tons came from brines from 17 operations in 7 states. Over 10 million tons of salt were consumed by chemical industry,- making soda ash, caustic soda, chlorine, hydrogen, bleaches, etc. The 16.6 million tons of salt brought in 60 million dollars. A rough estimate of recoverable brine from subsurface formations in one section of Oklahoma was 1½ million barrels per square mile.

Calcium chloride is used in refrigeration, in weighting tractor tires, to stabilize road soils, prevent freezing of concrete, and in manufacture of low-alkali cement. Magnesium chloride is raw material for metallic magnesium, refractories, insulation, and medicinals. Production in 1950 of calcium and magnesium chloride from natural brines totaled 300,000 tons valued at $3,800,000.

Summary. The knowledge that certain raw materials are available and that these materials are used for certain purposes is only a small part of the information needed in any effort to persuade an industry to locate in your area. However, it is an essential part. Your State Geological Survey welcomes the opportunity to work with you in every possible way.

A Note to our Readers:

THE HOPPER has fallen behind its mailing dates and the last number was labelled Vol. 13, Nos. 9, 10, 11, and 12. We promise to get THE HOPPER out on time in the future. This and subsequent numbers will in most cases be devoted to discussion of some phase of geology around Oklahoma cities and towns.

Advance copies of the present issue are to be distributed to those who attend the Lawton Chamber of Commerce meeting in Lawton on March 26th. Mr. Burwell and Mr. Chase will address the meeting and they have written an article on mineral resources of the Lawton area designed to supplement their talks. We hope that you will find this and the later numbers of interest and value to you, and that you will let us know if you like them or if you do not.

We wish to announce to the readers of THE HOPPER that Dr. Carl C. Branson took office as Director of the Oklahoma Geological Survey on February 22nd, 1954. He asks you to address your bouquets to the authors; your brickbats to him.