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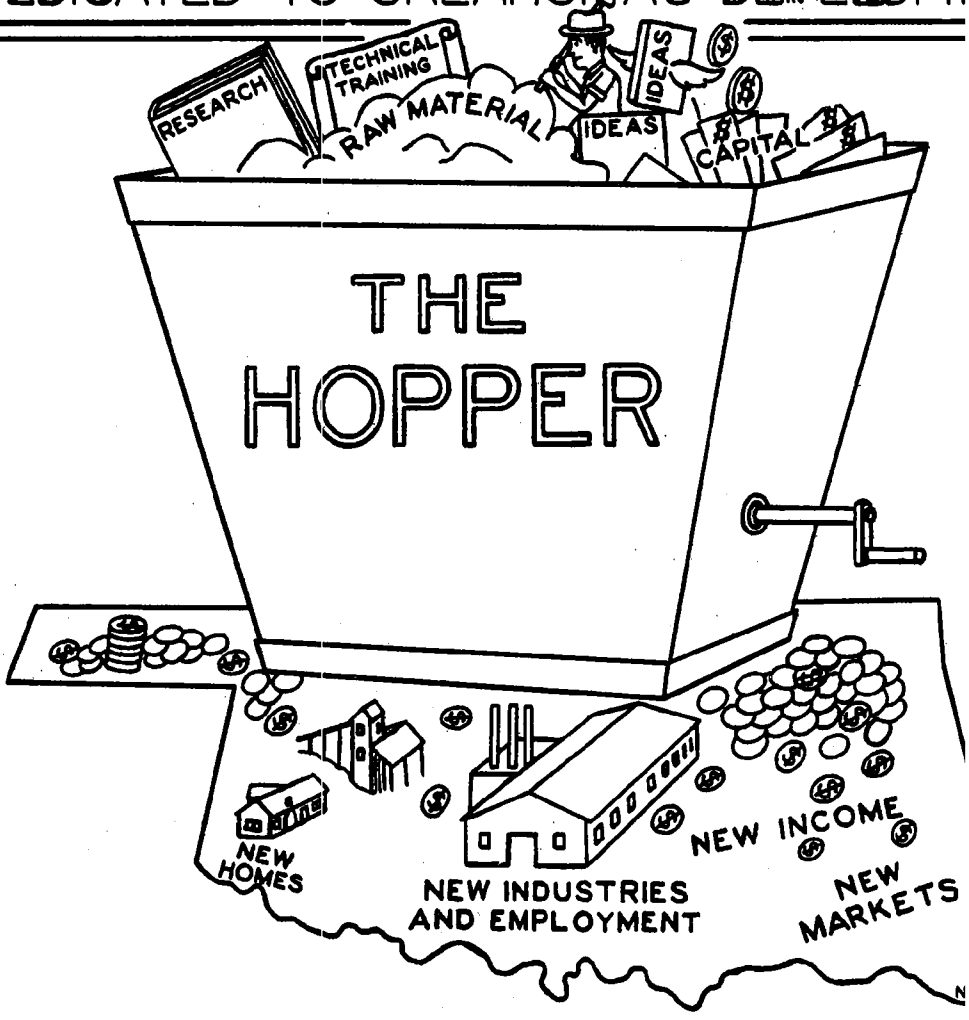


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# INDUSTRIAL MINERALS OF THE ARBUCKLE MOUNTAINS, OKLAHOMA

by
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delivered at
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The Arbuckle Mountains of south-central Oklahoma comprises a region of about 600 square miles, where lower and middle Paleozoic stratified rocks about 12,000 feet thick were strongly deformed by orogenic pulses in the Pennsylvanian period. By the close of Pennsylvanian time the mountain range was made; then it was covered by younger sediments which have since been eroded off, and now the Arbuckle Mountains stand as a huge inlier of ancient rocks surrounded by Pennsylvanian, Permian, and Cretaceous strata. These younger rocks consist mostly of common sandstone and shale, and have wide distribution in the Mid-Continent area.

It is necessary to give a geologic background because the isolation of the diverse rock types in the Arbuckle Mountains is an important factor in their economic development, especially because this isolation has resulted in a concentration of industry.

The Arbuckle Mountain region produces 10 different basic raw materials from 12 principal quarries, in addition to which there are many smaller active quarries and some quarries that are now abandoned. The total value of raw materials, plus the value added by processing within the region, is roughly estimated at $6,500,000 per year. For the state of Oklahoma, the Arbuckle Mountain region produces all the silica sand, all the dolomite, all the native asphaltic rock, much of the building

stone, and half the cement. Along with these resources there is production of crushed stone, filter stone, sand and gravel, and brick shale.

The quarries and plants are concentrated in a region of about 450 square miles. As the population density of the region is low, most of the materials are shipped to consumers elsewhere, so that this activity results from the exceptional kinds of materials present and their accessibility, rather than proximity to large urban and manufacturing centers.

The principal factors in such active development are (1) availibility of large volumes of limestone and dolomite in a region having sufficient relief for the establishment of inexpensive quarry sites, (2) adequate railroad and highway facilities, and (3) availibility of cheap natural gas for processing, obtained from fields bordering the Arbuckle Mountains. An additional factor of considerable importance is that some of the rocks occur as segregations of nearly pure minerals, which has provided substantial reserves of high-purity dolomite, high-calcium limestone, and high-purity silica sand.

Silica sand. High-purity silica sand, used chiefly as melting sand in the manufacture of glass, has been produced in the Arbuckle Mountains since 1913. The first sand plant, established at Roff, is still in operation and can be credited with the important role of making possible in Oklahoma a glass manufacturing industry that has grown from 1 plant in 1905 to 13 plants in 1950. Without local supplies of sand it is doubtful that glass-making would ever have flourished to its present state.

Currently two plants are in operation, the Mid-Continent Glass Sand Co. at Roff and the Pennsylvania Glass Sand Corp. at Mill Creek. Sand is produced from the Oil Creek and McLish formations

of the Simpson group, of middle Ordovician age. Quarry faces are about 50 feet high and are developed as pits after first removing a sandy soil overburden that generally is 10 feet thick. Sand shot from the face is disaggregated by hydraulic monitors, then pumped to the processing plant where it is washed, screened, and dried. Processed sand normally contains about 99.8 percent $SiO_2$ and 0.025 to 0.04 percent $Fe_2O_3$.

The plant at Roff also uses a flotation process to remove certain impurities, notably pyrite, and is the pioneer company in the United States to make this application of flotation.

In addition to its use in glass manufacturing, the Arbuckle Mountain sand is sold for foundry sand and for the manufacture of sodium silicate, and is ground by the Pennsylvania Glass Sand Corp, to silica flour.

High-purity dolomite. Although vast resources of dolomite have long been known in the Arbuckle Mountains, production was not started until 1948, after high-purity deposits had been investigated and mapped by the Oklahoma Geological Survey. The new plant is that of the Rock Products Manufacturing Corp., which quarries dolomite from the Royer formation of upper Cambrian age at a locality near Troy, in the south-central part of the region. They are currently shipping about 4,250 tons per week for fluxing stone in iron-ore smelting, for glass manufacture, and agstone.

The stone is exceptionally pure, containing 98.98 percent theoretical dolomite and 0.11 percent excess $CaCO_3$. Silica is 0.32 percent and iron oxide is 0.09 percent.

Native asphaltic rock. With the discovery of petroleum in so many parts of Oklahoma, it is no surprise that petroleum is or has been present in

parts of the Arbuckle Mountains, particularly in view of the fact that beds in the Simpson group, Hunton group, and Viola limestone are some of the most prolific oil-bearing strata in the state. In the Arbuckle Mountains, however, these beds are exposed at the surface and petroleum that may have been present has either dissipated or has been decomposed to asphalt. Such asphaltic rocks have been produced since 1890.

The area worked most actively is in the central part of the northern edge of the Arbuckle Mountains, where the Pontotoc conglomerate of late Pennsylvanian age lies unconformably upon the folded sedimentary beds. It appears that the conglomerate has been an effective seal preventing complete escape of the petroleum.

Asphaltic sandstone and asphaltic limestone are worked in two quarries by the Southern Rock Asphalt Co., which blends the two materials and markets the asphaltic composition for road surfacing. The asphaltic sand is chiefly in the Oil Creek formation near Sulphur and is worked in open cuts 50 to 70 feet high. The sand contains 6 to 12 percent bitumen. Asphalt impregnates the Viola limestone in a locality near Dougherty and is worked in a face 130 feet high that contains 3 percent bitumen. Production of the plant is about 1,750 tons per day.

High-calcium limestone. Limestone containing 95 percent or more $CaCO_3$ occurs in workable deposits in several parts of the Arbuckle Mountains. Stone from the Bromide formation of middle Ordovician age has been burned to lime at Fittstown; and a lime kiln was built near Bromide on outcrops of the Wapanucka limestone, lower Pennsylvanian, but neither is worked at present. Probably the biggest reserve of high-calcium limestone is in the Fernvale formation, upper Ordovician, which contains 98.17 percent $CaCO_3$ and is extensively worked at

Lawrence for making portland cement. The Ideal Cement Co. operates a quarry 50 to 70 feet high and produces about 1,300 tons per day. This is shipped, together with shale from a nearby quarry, to the cement plant at Ada. The Ada plant is one of the few in the United States that recovers carbon dioxide from flue gases, converting it to liquid or to dry ice.

Shale. Shale is produced from two quarries, one at Lawrence in the Sylvan formation of upper Ordovician age, used in the manufacture of cement; another at Ada in the Francis formation of middle Pennsylvanian age, used for making vitrified brick and tile. Current production at Lawrence is 700 tons per day. Shale at the Ada Brick Co. is red-burning and the company has a capacity of 20,000 bricks per day.

Crushed stone. In terms of volume, more crushed stone is produced in the Arbuckle Mountains than any other material. Inexhaustible supplies of compact limestone suitable for general construction, railroad ballast, and agstone are present in the numerous hills of Arbuckle and Viola strata; and excellent filter stone is available in the Sycamore limestone of Mississippian age.

Three quarries are active, two being in the Viola limestone and one in the West Spring Creek formation of the Arbuckle group.

The largest producer is the Dolese Bros. Co., which operates a quarry at Bromide in the Viola limestone and another quarry at Big Canyon in the West Spring Creek formation. The Big Canyon quarry with a face 150 feet high is the largest in the region and was opened in 1907.

A third quarry area is that of the Rayford Stone Co., near Davis. They work one quarry in the Viola formation for general construction stone and

agstone, and other quarries in the sandy Sycamore limestone for filter stone. These quarries range in height from 60 to 125 feet and the plant has a capacity of 200 tons per hour.

Building stone. Production of building stone has advanced with the great increase in home construction during the past 5 years. One stone that has found wide favor is the pale greenish-gray "birdseye" limestone of the McLish formation, which is extensively quarried in an area near Fittstown. The stone is fine grained and compact and contains scattered patches of coarsely-crystalline clear calcite. It is well bedded, the limestone strata being separated by shale seams that facilitate quarrying into layers of uniform thickness. Other rocks quarried are the Sycamore limestone, which has a pale yellowish color, and the pink crinoidal limestone of the Chimneyhill formation.

Sand and gravel. Finally we turn to the last resource that is produced in quantity--sand and gravel. Local supplies are obtained from many streams draining sandy formations or granite outcrops, so that plentiful supplies of sand are available. Production of gravel, however, comes chiefly from Rock Creek near Dougherty, where the Makins Sand and Gravel Co. operates a processing plant and ships about 2,000 tons per day. The gravel deposits are worked by dragline, the material being trucked to the plant and there classified into desired specifications.

In this paper I have attempted to review the mineral resources in a region of diverse character. Other materials which may be developed later, include barite, brown iron ore and ochres, granite, stone for rock wool, and deposits of zinc and manganese. None of the metallic ores show promise of large scale production, and the Arbuckle Mountains probably will continue to be known as a center of non-metallic industrial minerals.

# Resumé of A.I.M.E. Regional Meeting
## Industrial Minerals Division
## Norman, Oklahoma
## October 17-20, 1950

by
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Geologist

Approximately 65 members and guests attended the regional meeting of the Industrial Minerals Division, A.I.M.E., on October 17-20, 1950, held on the North Campus of the University of Oklahoma at Norman. Facilities of the Extension Study Center were available for presentation of papers at the technical sessions, as well as for two luncheons and one banquet. The Oklahoma Geological Survey was host for the meeting.

The program included the technical sessions of 14 papers, a field trip to the industrial mineral plants and quarries of the Arbuckle Mountains, and a field trip to the pre-Cambrian rocks of the Wichita Mountains. The technical sessions were held on October 17 and 18, and were characterized by papers on mineral development in the southwestern states of Kansas, Oklahoma, New Mexico, Texas, Louisiana, Arkansas, and Missouri. One session was devoted to a symposium on occurrence and origin of titaniferous magnetites. The meeting was especially characterized by audience participation in vigorous and revealing discussion of the technical papers. Geologists, mining engineers, chemists, plant managers, and railroad men from 9 states and Canada all contributed to these discussions.

At the opening session the keynote paper was read by Harold B. Foxhall, Director, Arkansas Geological Survey, under the title "Trends in the Industrial Mineral Industries of the Southwest". Mr. Foxhall emphasized that in the southwest region

there has been a 300 percent increase in dollar value of mineral resources produced during the 1939-1948 period, and further that this region embraces a powerful concentration of mineral wealth, contributing in 1948 about 30 percent of the mineral wealth of the United States. In the same year the value of all industrial minerals produced in the region was 388 million dollars. In a breakdown by commodities, it was shown that the dollar increase in 1948 over 1939 for barite was 621 percent; cement, 267 percent; lime, 318; salt, 218; heavy clay products, 230; gypsum, 800; sand and gravel, 272; sulphur, 251; and stone, 191 percent. Using charts and colored slides, Foxhall reviewed the production by states, pointing out that the expansion in Oklahoma has been in all construction materials, as well as in chemical grade limestone, dolomite, and silica sand. In Kansas cement manufacture is up 200 percent, and the same trend is noticeable in brick and tile, gypsum, and sand and gravel. Salt production in Kansas has remained comparatively stable, whereas volcanic ash is down, its use being supplanted by feldspar and the new detergents. New Mexico reports a marked increase in perlite and pumice, and continues to be the leading producer of potash. Missouri is a leading producer of barite, cement, refractory clays, lime, and stone. In Louisiana the principal industrial minerals are salt and sulphur. Texas is the leading producer of sulphur and also ranks high in production of cement and gypsum, together with other industrial minerals as discussed in a later paper by Dr. Lonsdale. Arkansas leads all states in production of barite and bauxite.

The second technical paper "Geology and Industrial Minerals of Oklahoma" by Robert H. Dott, Director, Oklahoma Geological Survey, appeared in the October, 1950, issue of The Hopper, and the third paper - "Industrial Minerals of the Arbuckle Mountains, Oklahoma", by William E. Ham, appears in the current issue.

The following two papers contributed to a symposium on titaniferous magnetites, which are now being used as a source of titanium for white pigments: "Titaniferous Magnetite in Basic Rocks of Wichita Mountains, Oklahoma", by Gerald W. Chase, Oklahoma Geological Survey, and "Geology and Utilization of the Titaniferous Magnetites at MacIntyre Development, Tahawus, New York", by George W. Wunder and Paul W. Allen, National Lead Company. They discussed the origin, occurrence, and composition of the ores in these districts, and then general problems of titaniferous magnetites were brought out in further discussions by R. C. Stephenson, J. L. Gillson, and B. T. Denis, together with a reading of prepared statements by A. M. Bateman and H. Ramberg.

After a banquet the same evening, Hugh D. Miser, U. S. Geological Survey, spoke on "Making a Geologic Map of Oklahoma", a project in which Mr. Miser is currently engaged.

The first paper on the morning session, October 18, was "Mineral Industry in Texas", by John T. Lonsdale, Director, Texas Bureau of Economic Geology. Dr. Lonsdale outlined the major geologic provinces in Texas and showed the mineral resources contained in each. He said that the mineral industry in Texas is based on the abundant common materials cement, clay, sand and gravel, stone, lime, salt, and gypsum; but in addition there is production of specialized mineral commodities such as sulfur, sodium sulphate and helium, graphite and soapstone, bromine, magnesium and magnesium compounds from sea water, and asphalt rock. The minor materials are silica sand, feldspar, mica, celestite, sulfur earth, volcanic ash, barite, manganese ore, magnesite, and grinding pebbles. Total annual production of Texas mineral resources, including fuels, reaches nearly three billion dollars, according to Lonsdale.

Final papers of the morning session included: "Gulf Coast Sulphur--An Industrial Mineral", by Albert G. Wolf, Texas Gulf Sulphur Co., in which the mining of sulphur from salt domes was described; "Production of Anhydrous Sodium Sulphate from Natural Brines", by William I. Weisman and R. C. Anderson, Ozark Mahoning Co., which described the flow sheet of the plant at Monahans, Texas; and "Clay Resources of the Wilcox Group in Arkansas", by Norman F. Williams, Arkansas Geological Survey, in which attention was called to the possibilities of undeveloped ball clays.

At the afternoon session a movie entitled "Drama of Making Portland Cement" was shown and narrated by Cecil Perkins, Portland Cement Association, and this was followed by "Review of the Kansas Salt Industry" by Earl K. Nixon, Kansas Geological Survey. Mr. Nixon told about the underground mining of salt in a typical central Kansas mine. The next paper, "Specifications for Specific Uses of Limestone and Dolomites", by Edward L. Clark and Mable E. Phillips, Missouri Geological Survey, emphasized that strict specifications are required for certain commodities but, in general, proximity to consumer is considerably more important than detailed physical and chemical requirements.

Dr. Garrett A. Muilenburg, Missouri Geological Survey, next spoke on "Barite Mining in Missouri". He outlined the geology, occurrence, mining, milling, recovery, production, and future of the barite deposits, which since 1850 have produced more than 5,000,000 tons valued at more than 32 million dollars. The center of most active mining is in Washington County, about 50 miles southwest of St. Louis. From the estimated reserve of about 15 million tons, production is assured at the present rate for about 50 years.

The technical sessions were concluded by a paper on "Chats in the Tri-State District, by

Ernest Blessing, U. S. Geological Survey. As used in the zinc-lead district of northeastern Oklahoma, southwestern Missouri, and southeastern Kansas, chats consist mainly of chert and limestone coarse tailings resulting from the milling of the ore. An estimated 200,000,000 tons of chats have been sold or otherwise removed from the district since they were first used about 1900, of which about 75 percent is used for railroad ballast and 25 percent is used for highway construction, foundations, sidewalks, concrete building blocks, blasting sands, and shingle coating. A freight rate increase of about 30 percent in May, 1950, has restricted competitive sales to distant shipping points. Chat reserves in the Tri-State district are estimated at 160,000,000 to 200,000,000 tons, enough for 50 years supply at the present rate of consumption.

For those interested in titaniferous magnetites and pre-Cambrian igenous rocks, a trip was conducted to the Wichita Mountains on October 19 by Gerald W. Chase, who has recently completed for the Oklahoma Geological Survey an investigation of anorthosites and related gabbros in the area around Roosevelt.

A two-day trip to the Arbuckle Mountains, was conducted on October 19 and 20 by William E. Ham. A guidebook prepared for the trip described the quarries and plants that were visited the first day as well as the stops of geological interest visited on the second day. Seventeen members and guests participated in the trip.

Particular interest was shown by the party at the Lawrence quarry of the Ideal Cement Co., where a new $110,000 Marion electric shovel is being used in quarrying the high-calcium Fernvale limestone for manufacture of cement at Ada. Production of limestone and shale at the quarries will be expanded about January, 1951, when a new kiln will be installed to increase cement capacity about 40 per-

cent. Quarrying and flotation beneficiation of glass sand at the Mid-Continent Glass Sand Co., Roff, likewise attracted considerable attention. The party was impressed by the simple hydraulic mining of loosely consolidated sand in the face of the pit quarry, which is so soft that no blasting is required. Numerous comments also were made about the blue-green illite clay which is intermingled with high-purity sand in the lower part of the pit. Perhaps the surprise of the day was occasioned by the hot and cold liquid refreshments that unexpectedly were served at the plant by Ralph Hamer, General Manager of the company.

The visit at the Pennsylvania Glass Sand Corp., Mill Creek, was well received, as was the stop at the dolomite quarry and crushing plant of the Rock Products Manufacturing Corp. near Troy. This is the first large scale production of high-purity dolomite in Oklahoma, and we were happy to show how undeveloped deposits in Oklahoma can be worked and expanded into a growing business. Rock Products now ships about 4,200 tons per week for flux in iron ore smelting, glass manufacture, agstone, and base in prepared fertilizers.

Afternoon stops included a quarry in asphaltic sand and in asphaltic limestone of the Southern Rock Asphalt Co., which crushes and blends these materials for road surfacing at their plant near Dougherty. The trip was concluded with stops at Makins Sand and Gravel plant near Dolese Bros. Co. at Big Canyon. All plants are running at near-capacity to fill increased construction demands. The Rayford plant is the newest limestone producer in the district, specializing in crushed stone for construction, filterstone, and agstone which they quarry from the Viola and Sycamore formations. Dolese Bros. have nearly completed the quarrying of their original large hill and will now cut a bench about 30 feet below the present quarry floor.

The trip on October 20 was intended principally to illustrate points of geological interest in the central Arbuckle Mountains. We traveled southwest from Mill Creek across the Rock Prairie to Oklahoma Highway 18, seeing a complete section of Arbuckle and older beds. Then we drove to U. S. Hwy. 77 and studied the major structural features of the Arbuckle anticline, concluding the conference with the magnificent view that can be seen from the Seven Sisters highway near Prices Falls.

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## INCOME PAYMENTS IN THE TENTH DISTRICT

Excerpts taken from the Monthly Review, Tenth Federal Reserve District, October 31, 1950.

The latest available statistics of income payments to individuals, published by the Department of Commerce, reveal that in some of the states in the Tenth Federal Reserve District the income gains made during the war and early postwar years have been maintained and improved, while in others there has been a decline both in terms of dollars and in relation to the national average.

Comparisons over a longer span of years indicate that the level of per capita income payments has risen faster in this District over the past ten years than in the nation as a whole. In 1939, per capita income payments ranged from 37 per cent below the national average in New Mexico and Oklahoma to 5 per cent above the average in Wyoming. In 1949, the states of the District ranged from 22 per cent below the national average in New Mexico to 11 per cent above the average in Wyoming. This trend of states having low per capita income payments to increase their incomes faster than the national average has occurred in the nation as a whole as well as in the Tenth District over the past decade. And in both the region and the nation, the gain in

the per capita payments of low income states has been attributable in part to higher total income payments and in part to the failure of the population of the states to rise as fast as the population of the United States has risen.

To the extent that higher per capita incomes reflect only the outward migration of people, they do not carry any connotation of larger markets for products in the region. Thus, they do not mean what they seem to mean for merchants and other suppliers. It is likely to be the case, however, that the ability of the relatively low income states to retain the population which their comparatively high net excess of births over deaths provides will depend in the first instance upon improvement in per capita incomes.

Equally as interesting as the gains in per capita income are the changes taking place in the sources of income in the states of the Tenth District. Manufacturing reached the peak of its importance both in the District and in the United States in 1944, owing to the great importance of manufacturing in wartime, when it accounted for 28.2 per cent of all income payments in the country. In New Mexico and Wyoming, however, manufacturing produced a larger share of total income in 1949 than in 1944, and in Colorado and Missouri income payments from manufacturing were closer to the national average than they were in 1944. These changes may be clearer from another viewpoint. While manufacturing payrolls increased in the Continental United States by 20 per cent from 1946 to 1949, the increases were as follows in the states of the Tenth District: Colorado, 30 per cent; Kansas, 41 per cent; Missouri, 30 per cent; Nebraska, 31 per cent; New Mexico, 14 per cent; Oklahoma, 34 per cent; and Wyoming, 45 per cent. While these gains are substantial, manufacturing payrolls still account for less than 10 per cent of total income in all states except Missouri and Kansas.