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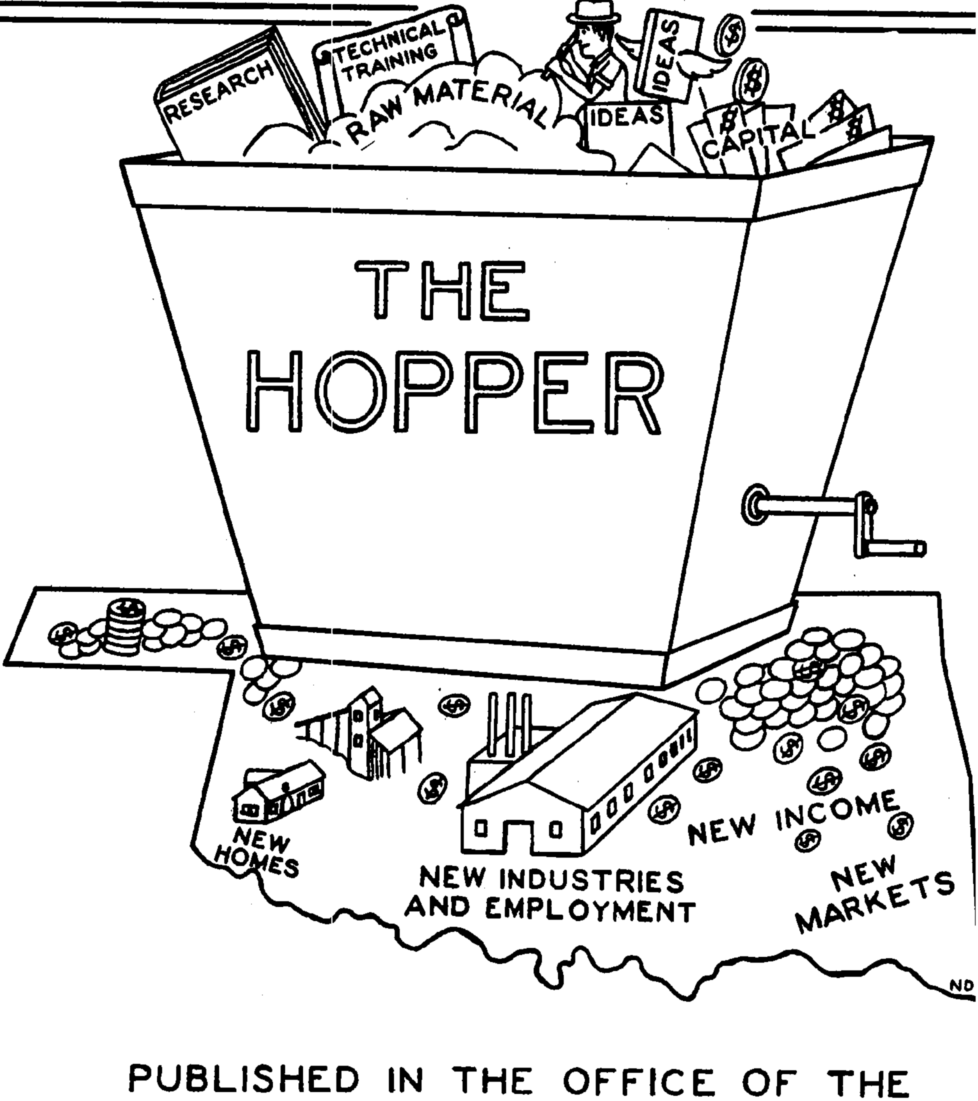

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GYPSUM

by
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Gypsum, known as the "miracle rock" to the ancients, dates in use as a building material to at least the time of the pyramids when it was used for the famous Egyptian memorials which were executed 4,000 years or more ago. For their finer work the Egyptians used a calcined gypsum plaster precisely similar to the plaster of paris of modern times. The methods of use as well as the tools used were also similar to the modern ones. The Greeks also used the calcined plaster in making casts, the earliest known use for this purpose. The word gypsum is derived from the Greek meaning "to cook" in reference to the burnt or calcined material.

Pure gypsum, $CaSO_4 \cdot 2H_2O$, a hydrous calcium sulphate, is colorless or white, containing 32.6 per cent lime (CaO), 46.5 per cent sulphur trioxide (SO_3), and 20.9 per cent water. Beds of gypsum practically always contain other minerals as impurities, the more common of which are iron and aluminum oxides, calcium and magnesium carbonates, clay, and sodium chloride or common salt. The common granular form is called gypsum; the marble-like gypsum is known as alabaster; the crystallized form is called selenite; and a fibrous variety occurring in veins which when freshly broken has a pearly opalescence or satiny sheen is called satin-spar. Gypsum may also be deposited as crusts on the borders of gypsiferous lakes. The dunes of the famous white sands of Alamogordo, New Mexico have been formed by the wind from such a deposit. Dirt rich in the sulphate is known as "gypsite". In arid regions gypsite may be blown by the wind, winnowed, and as a result form dunes of nearly pure gypsum sand.

Alabaster has for centuries been used for carving into various objects of art. The white variety has been used extensively for interior decoration and ornamentation of European cathedrals and other ecclesiastical buildings. Vases, urns, boxes, lamp bases, book ends, and statuettes are among the more common objects made from alabaster. Present in commercial quantities in Oklahoma are deposits which range in color from the pure white through shades of cream, pink, and reddish tones.

More than 95 per cent of all gypsum mined is used in construction. Calcined to plaster of paris, and mixed with something to retard setting, it is used as wall plaster, and in very arid countries has even been used as outside finish. Because the gypsum from the quarries of the Montmartre district of Paris has long furnished calcined gypsum, this material has become known throughout the world as plaster of paris. A special type of gypsum plaster is that commonly known in this country as Keenes cement. It is valued because it is much harder than ordinary gypsum plaster, takes a high polish, and as commonly made is slower in setting. In general the process of manufacture is to reburn calcined gypsum which has been mixed with chemicals that will unite to form a double salt.

In the United States the gypsum industry began in New York when the population was principally restricted to the Atlantic seaboard. As the population moved westward, the development of the gypsum resources followed. The development of the important Michigan deposits began in a small way about 1840 and that of the Iowa deposits near Fort Dodge in 1872. The first plaster mill in Kansas was built in 1889, and the first mill in Oklahoma a few years later.

By 1913, twelve plaster mills were in operation in the new state of Oklahoma. However, the industry in the state was not in a very satisfactory condition. There was present a virtually inexhaustable supply of gypsum with many excellent quarry sites, but at that time the gypsum area was not close to fuel supply and markets.

Since the great oil and gas development of Oklahoma the state has become criss-crossed with pipelines carrying low-cost fuel -- natural gas -- to all parts of the state, and railroad facilities have been expanded. Oklahoma is located geographically so that it can ship to any area of the country with equal facility, and the center of population of the nation is moving toward Oklahoma. (Oklahoma Business Bulletin, Vol. 19, No. 6, p. 3, 1951.) This materially changes the situation that faced the industrialist of thirty years ago who was looking for a new site for his industry.

In 1894, Oklahoma produced 1,300 tons of gypsum. As more people moved into the area and the need for building more and more homes, office buildings, etc. became apparent in the construction business, the tonnage of gypsum produced increased. By 1909, production had passed the 100,000 ton mark, and thereafter, to a very great extent, fluctuated in direct ratio to the general economy of the area. Over 350,000 tons of gypsum were produced from Oklahoma quarries in 1928 and 1929. During the depression this production dropped, not to pass the 100,000 ton per year mark until 1934. Production figures for the past decade: (Mining World, April, 1951, p. 57.)

Year	Tons	Year	Tons
1940	176,166	1946	138,314
1941	258,258	1947	239,468
1942	243,545	1948	292,605
1943	371,893	1949	355,590
1944	295,604	1950	339,746
1945	32,343		

In contrast to the production figures of gypsum mined in Oklahoma is the fact that there remains in the state, virtually untapped, one of the great reserves of gypsum of the nation. Occurring in ledges up to 60 feet in thickness in Washita County, the available gypsum (at a depth of less than 100 feet) is estimated to be 20 billion tons. Deposits available in Harper, Blaine, Woodward, Caddo, Harmon, Woods, and Custer Counties are estimated to total more than 75 billion tons.

Gypsum has been mined from both the Cloud Chief and the Blaine formations of the Oklahoma Permian. However, only the Blaine formation is being mined at present. The Forty-second Annual Report of Mines and Mining of Oklahoma, 1950, p. 17, reports three companies operating in the state -- United States Gypsum Company at Southard, the Universal Atlas Cement Company at Watonga, and Walton and Sons at Okeene.

In 1912, the United Gypsum Company bought the Independence Gypsum Company which had been operating at Southard since around 1905. During the 39 years the Southard Plant has been owned by the United States Gypsum Company a completely integrated organization has been built. Located at Southard in Blaine County, the plant employs approximately 300 persons with an annual payroll of nearly one million dollars. The population of Blaine County was reported in the 1950 census as 19,049. The value of the Southard Plant to the economy of the county as a whole is considerable but would be difficult to estimate in dollars.

The Southard Plant operates two quarries from which raw gypsum is mined, then processed and manufactured into a broad line of finished building and industrial products. On the average 25 carloads of material are shipped daily from the plant. The work is divided into ten departments:

<u>quarries</u>: Overburden is removed and the ledges of gypsum exposed by using tractors and scrap-

ers. The rock is then drilled and blasted to produce broken rock of a size suitable for loading into haulage trucks.

mill: Here the rock is crushed, screened, sized, ground and then cooked. The calcined (cooked) material is further processed by screening, air-separating, or re-grinding. It is then conveyed to bins where it is used by other departments.

packing department: The calcined material is removed from storage bins and is conveyed to mixers where certain chemicals are added to produce the desired characteristics in the finished product. After mixing, the various plasters are packaged in paper bags by means of Bates packers. The filled bags are then trucked to box cars and prepared for shipment.

Keenes mill: Lump rock from the Keenes quarry is loaded into beehive kilns where it is cooked at temperatures up to 1300 degrees Farenheit (approximately 700° C.). In this process all chemically combined water is removed from the rock. The cooked rock is removed from the kilns and dumped into a pot crusher. Fine grinding and air separating or screening follows crushing. The finely ground material is then mixed with chemicals and packaged as Keenes Cement or is packaged as industrial fillers without the use of additives.

Hydrocal* plant: This operation produces a super strength gypsum cement through cooking crushed gypsum in autoclaves. The calcined material is dryed, ground, and then screened or sized in an air separator. A wide variety of packaged products are then made by adding various ingredients to the ground material.

board plant: Kettle "stucco" is mixed with water, rosin soap, starch, and other ingredients and sandwiched between two continuous sheets of paper. The gypsum board thus produced is cut into the desired lengths after the core has become hard. After passing the knife the board is fed into a kiln for drying. It is then ready to package and ship to building material dealers.

quality control: In this department the products are checked continually in the laboratory by trained technicians and inspectors to see that they meet specifications.

plant engineering department: This department handles the repair, replacement and installation of plant equipment. The machine shop and service shops are used in conducting this work.

office: This department is responsible for payrolls, cost accounting, order handling, billing, and other clerical and administrative functions.

personnel department: All matters pertaining to personnel services are handled in this office. Responsibilities include accident prevention, first aid, group insurance, employment, counseling, dwellings, group activities, etc.

The safety record of this company is enviable--for the past three years which the HOPPER can check, no accidents of any type were reported as occurring at the Southard Plant.

The products manufactured by the Southard Plant range from dental plaster to sheetrock. They are classified in the following groups: (All names followed by * are trade names registered by the United States Gypsum Company.)

Gypsum rock: raw gypsum rock up to 1½ inch size is sold for use in retarding the setting time of Portland cement; finer size is sold for use as "land plaster" for agricultural purposes.

Wall plasters: Red Top Granite Cement Plaster* and Structo-Cal Cement Plaster*, designed for mixing with sand or other aggregate and water, are for residential and commercial interior plastering. Red Top Wood Fiber Plaster* is used for the same purpose, does not require an aggregate and yields a more flexible and stronger plaster.

Gauging plasters: Red Top Star Gauging, Structo-Cal Gauging*, etc. are white plasters for mixing with lime on the job and are used as the finish plaster usually seen in plastered kitchens.

Keenes cement: most common use is in corridors of public buildings and in bathrooms--gives a harder wall than the gauging plasters and is fairly water resistant.

Sheetrock: Fireproof, a gypsum wall board which will take decoration such as paint, wall paper, texture finish, etc.

Rocklath: Fireproof, gypsum plasterboard over which wall plaster is applied.

Sheathing: a water-repellent gypsum sheathing.

Dental plaster: Laboratory, Impression, Coe-Cal*, etc. used for making dental impressions by dentists and dental laboratories.

Pottery plaster: used in making molds to form the clay body to shape for china and art wares.

Plate glass plaster: used for bedding and holding the plate glass to permit grinding and polishing.

Metal Casing Plaster: such plasters as Match Plate, P-M-C, Kastical*, etc. are designed for making gypsum molds in which any non-ferrous metal can be cast.

Pattern and Die Plaster: A-11 and B-11 Hydrocal* are strong, low expanding plasters used in making up patterns and dies of dimensional accuracy. These are used extensively in the aircraft industry.

Moulding plasters: Red Top No. 1 Moulding Plaster, Hydrocal White, Hydrostone*, are plasters used for general casting purposes. Hydrostone* produces a quite hard and strong mold.

Fillers: Snow white Filler and Calopone* are industrial plasters used as fillers in food and drug stuffs, paper filler, pigment, water hardener, oil filtrations, tooth paste, etc.

Owing to the current shortage of sulphur, the eyes of American chemical industry have turned to the economics of breaking down the hydrous calcium sulphate, gypsum, or the anhydrous mineral anhydrite, to sulphur and to needed sulphur derivatives. The process has long been known and utilized in some of the European countries, but was never considered as being economically feasible in the United States while the Frasch process was successfully extracting the elemental form of sulphur from the domes of the Gulf Coast area. With the world change from the peace economy of the twenties and thirties all figures for the amounts of sulphur needed per year have had to be revised upward. The net result is that we are no longer able to supply from established sources all the demands from both our foreign and domestic markets.

The Minerals Yearbook, 1948, reports, p. 1191: "At Sindhri, Bihar, a plant is being constructed in which gypsum will be used as a raw material in the manufacture of ammonium sulphate. The waste sludge may be used in the manufacture of cement."

The result in increase in price of any element has always resulted in bringing into production hitherto strictly marginal properties. For a number of years the cost of producing sulfuric acid in France, Germany, and England from American sulphur has been sufficiently high to warrant the investigation and use of materials other than sulphur in the elemental form. The processes in use for the manufacture of ammonium sulphate are an example. Very little ammonium sulphate has been made in these countries by reacting sulphuric acid and synthetic ammonia, as is becoming common practice in the United States. Two German, one French, and one English plant produce ammonium sulphate by reacting gypsum or anhydrite with ammonia and carbon dioxide.

The latter process is particularly significant when considered in connection with the location of the principal producers of synthetic ammonia of the Mid-Continent area. Phillips Chemical Company at Etter in the Texas Panhandle, Spencer Chemical Company at Pittsburg in southeastern Kansas, and Lion Chemical Company at Eldorado in Arkansas form the apexes of a triangle. Within this area enclosed occur tremendous deposits of gypsum and anhydrite, containing billions of tons of combined sulphur, together with fuel to furnish power, heat and carbon dioxide to complete the list of necessary raw materials. Within this area is found a threefold choice of fuel, natural resources of the area, from which the manufacturer can choose -- coal, petroleum, or natural gas.

In 1941, U. S. Patent No. 2,232,099 was granted De John. Briefly, it is a controlled reaction of gypsum to quicklime -- sulphur dioxide -- carbon dioxide. $2CaSO_4 \cdot 2H_2O \longrightarrow 2CaO + 2SO_2 + 2H_2O$. "A process of decomposing calcium sulphate into calcium oxide and oxides of sulphur consists in heating calcium sulphate in a substantially neutral atmosphere using a percentage of carbon (coal) substantially within the range between 0.55 and 0.7 molecule of carbon for each molecule of $CaSO_4$."

When will sulphur and sulphur derivatives from the vast deposits of gypsum and anhydrite enter the picture? The economic driving force indicated by the estimated demand for sulphur in 1960 will gradually bring on the market increasing quantities of by-product sulphur values at increasing prices. The marginal sources will always require a premium price. With increasing costs for sulphur values, consumers will be looking for methods to reduce their intake of sulphur. Just where the supply-cost-demand level will reach equilibrium is anyone's guess. It will be a gradual struggle between the suppliers and the consumers in the market place.

Should the price of sulphur rise to the point any of these processes, or modification of them, for the production of sulphur and sulphur derivatives from gypsum and/or anhydrite becomes profitable in this country, Oklahoma can offer to the industrialist the rare combination of raw materials, fuel, labor, and transportation in a region toward which the center of population is migrating.

NORTHEAST OKLAHOMA PROJECT YIELDS LARGE FOSSIL COLLECTION

by

Prof. George G. Huffman

Since June 1, 1949, twenty-three graduate students from the University of Oklahoma have mapped approximately 1,600 square miles on the south and west flanks of the Ozark Uplift in northeastern Oklahoma. This work was sponsored by the Oklahoma Geological Survey in conjunction with the new State Geological Map of Oklahoma which is being compiled by Mr. Hugh D. Miser of the United States Geological Survey.

During the progress of the investigation, extensive faunal collections were made by the students and staff from the pre-Atoka strata of that area. To date, seven large museum cases have been filled with fossil specimens which have been cleaned, identified, labeled, and placed in the Paleontology Laboratories of the University of Oklahoma. Conservative estimates indicate that approximately 50,000 specimens are in this collection, making it one of the largest assemblages of Mississippian and Lower Pennsylvanian fossils to be made from one area.

The work has been delegated among the students in such a way as to provide a suitable Master's Thesis problem for each participant. Upon completion of the field work, scheduled for January 1, 1952, the information will be assembled in a report covering the entire area. The detailed mapping is being utilized in the compilation of the new State Map; the fossil collections will be figured and described in future publications. Many of the fossils are being used at the University of Oklahoma in the training of students in advanced invertebrate paleontology while others have been sent to various universities in exchange for material from other areas and horizons.