1946

EXPLANATION SANDSTONE (ss) AND QUARTZITE (qt) GYPSUM-BEARING STRATA SODIUM SULFATE AND CARBONATE (Dashed line shows outcrops of bentonite beds; solid area known deposits) MINERAL PIGMENT (hematite) NATURAL SLAG OR CLINKER (Leucite-bearing igneous rock) VOLCANIC ASH AND PUMICE MINERAL OR ROCK DEPOSIT MINE OR QUARRY Numbers are for convenience in reference)

CONSTRUCTION MATERIALS AND NONMETALLIC MINERAL RESOURCES

phosphate and the sodium salts are also abundant, but others, including but in many places it has disintegrated to as great a depth as 50 feet, recorded production of sandstone is less than 100,000 tons per year. the pegmatite minerals, asbestos, talc, fluorspar, and graphite, occur only forming an angular pebble gravel that is used for road metal, railroad Quartzite occurs in the pre-Cambrian and basal Cambrian rocks of in small and scattered deposits. During the five year period, 1935-1939, ballast, and concrete aggregate. the average recorded value of construction materials and nonmetallic minSmall bodies of granite-like rock crop out in Crook County in northgenerally not available. One area of pre-Cambrian quartzite is shown in erals (exclusive of fuels) produced in Wyoming was \$2,685,000* per year, eastern Wyoming. Some contain considerable dark minerals or nepherine. the Medicine Bow Mountains. and by 1942 the annual value had risen to almost \$5,000,000. Wyoming Other small bodies of granite and similar rocks occur in western Park leads all other States in the production of bentonite; it is estimated that County near Yellowstone National Park, and granite is present in the prethe value of total production of bentonite in Wyoming prior to 1944 was Cambrian rocks of Teton County, and eastern Fremont and southwestern Deposits of sodium sulfate and carbonate have been known in Wyoming about \$9,700,000. No other construction material or nonmetallic mineral Natrona Counties. It should be noted that many of the areas of prein the State has been equally well exploited, and many, such as phosphate Cambrian crystalline rocks shown on the map include granite bodies, but Hydrated sodium sulfate has been produced from the Gill Lake deposit and volcanic ash, are almost totally undeveloped. This is due to the remotethere has been no detailed mapping to separate granite and metamorphic
near Casper, Natrona County, and from a small lake 4 miles east of the ness of Wyoming's natural resources from large manufacturing and rocks. Most of the granite quarries in the State are small operations town. The salt has also been produced near Sodium, Natrona County, consuming centers and to the relatively small population of the State. undertaken to meet limited local demand, but production of granite can and near Rawlins, Carbon County. Sodium carbonate has been recovered Low-cost power and increased manufacturing and agriculture, with the be expanded to meet increased needs for construction materials. accompanying increase in population, will inevitably bring a greater demand for industrial raw materials.

Deposits of construction materials and nonmetallic minerals are shown

No occurrences of flake graphite are known in the State. Fine-grained deposits northeast of Medicine Bow; and the Bothwell deposits 30 miles on this map and discussed briefly in the paragraphs below. This informagraphs below. tion has been compiled from all readily available sources, including Haystack Hills, Goshen County; near Rattlesnake Creek in the Casper Independence deposits, west of Pathfinder Reservoir. The Morgan depublications of the Wyoming Geological Survey and other State organiza- Mountains, Carbon County; and in Halleck and Plumbago Canyons 27 posits, east of Split Rock, and Lake de Smet also contain sulfate. tions, trade journals and technical publications, and especially published to 30 miles northeast of Laramie. Deposits of graphitic schist in the Production of sodium salts in 1942 was 9,214 tons with a total value of and unpublished reports of the U. S. Geological Survey. Sources of sand Haystack Hills along the eastern edge of the Hartville uplift contain as \$94,308. Many of the Wyoming deposits are still undeveloped. and gravel are shown on a separate map. Some deposits are shown as much as 16 percent of very fine-grained graphite. These deposits were large areas or bands, similar to formations on a geologic map, whereas prospected as early as 1881, and the Halleck Canyon deposits were prosothers are shown as spots with a letter symbol indicating the rock or pected before 1909. No production has been reported. mineral present. The more important deposits are numbered for convenient reference. The map is neither complete nor wholly accurate, for some of the available source data are inadequate. A geologic map of Gypsum occurs in two types of deposits - rock gypsum and gypsite. Wyoming, scale 1:500,000, was published in 1925 by the U. S. Geological Rock or massive gypsum is the more common type, and although usually and travertine. It was deposited by hot springs similar to those now Survey. This State geologic map was the chief source of information white, it is frequently stained pink or red on the surface by the red shales active in both areas. In two groups of deposits in the Absaroka Range used in the compilation of data on distribution of limestones, sandstones, which enclose it. Gypsum, which is soluble, has been removed from many sulphur occurs as a cementing material in superficial rock debris, and and several other rock types shown on the resources map.

County. The anorthosite is closely associated with norite, gabbro, and formations, and in places can be traced for many miles, although the titaniferous iron ores, all of which are of pre-Cambrian age. The typical individual beds thicken and pinch out in much shorter distances. anorthosite consists of labradorite with minor amounts of magnetite and

Gypsite, a secondary surficial deposit, is found in depressions near large

The chief vermiculite-producing areas of the State are the Encampment hypersthene, and contains 25 percent or more of Al₈O₈. Known deposits of asbestos are located south and southeast of Casper, Gypsum was first mined in Wyoming in 1890 at Red Buttes, Albany map, occurrences of vermiculite have been reported in the Laramie Peak

Yellowstone Park. Development of deposits in each of these areas has near Greybull, and at Dayton. Most of these were small operations that and about 29 miles southwest of Sheridan. been attempted but the operations were short-lived. Mills were built at supplied only local demand for plaster or wall blocks. In 1945 only one The total amount of vermiculite produced in Wyoming prior to 1944, some deposits south of Lander and near Casper, but there has been no significant company, with a plant at Laramie, was operating. In 1943 Colorado, 5,000 to 5,500 tons, is equal to about 10 percent of the total United States production. Some of the asbestos is good quality cross-fiber chrysotile, Montana, South Dakota, Utah, and Wyoming together produced 166,547 production for the years 1942-43. Additional production of vermiculite is and a small amount is of spinning length. The deposits might be exploited tons of gypsum valued at \$235,628. Reserves of gypsum are enormous, anticipated, especially if cleaning plants are installed at several mines and if there were a strong local demand. ASPHALTIC SANDSTONE AND BITUMENS Asphaltic sandstone and native bitumens are often used as a local source

of road surfacing or for other construction purposes. Many of the larger deposits are a potential source of petroleum and petroleum products. The most important occurrences of asphaltic sandstone are in the Black Hills region of the northeastern part of the State. The largest deposit is minerals in the State is about 23 miles by road west of Wheatland. It was in the Rocky Ford district near Sundance, and the reserves of asphaltic rock to a depth of 200 feet in this district are estimated to be large. This deposit, and the small deposit 12 to 15 miles from Moorcroft, are accessible by road, and two smaller deposits occur adjacent to railroad lines near Thornton and Newcastle. Oil-saturated sandstones from 20 to 30 feet volcanic rocks in eastern Albany County may also contain volcanic rocks of the Yellowstone region are not shown separately on the thick are reported on Muddy Creek southeast of Wamsutter, and asphaltic kyanite occurs in schist along the margins of pegmatite dikes map. Fine-grained, leucite-bearing rocks in central Sweetwater County sandstone, said to be 6 feet thick, occurs on the west slope of the Bighorn Mountains northeast of Basin. A number of other oil seepages and occurof these are shown on the map, although their importance is questionable.

Many limestone quarries have been opened to obtain material for Volcanic rocks have been quarried for local use as building stone in the rences of bitumens and asphaltic material have been reported, and most

Bentonite produced in the United States is of two main types: (1) that

eastern corner of Wyoming, the largest deposits are the massive gray

rocks in the State are generally not well situated for use in construction. which swells to as much as 12 to 15 times its original volume when put in water, and (2) that which swells no more than ordinary clay. The first this formation is pure limestone, but the upper and lower parts are in type is used as a bonding agent in foundry moulding sands, as a thickener wany places cherty or sandy. In the same region, the Minnekahta limein oil well drilling muds, and for engineering purposes. Large tonnages of the second type are used as bleaching clay. The high-swelling type of bentonite occurs chiefly on the flanks of the common impurities. Black Hills in eastern Wyoming and western South Dakota; Wyoming is the chief producing State. In the Black Hills region of Wyoming the limestone occur in the Hartville formation, which is about 700 feet thick thickest bentonite beds are at the top and base of the Mowry shale and and consists mainly of fine-grained gray limestone. Some beds contain dug in a deposit of volcanic ash 12 miles south of Laramie; deposits of the base of the Belle Fourche shale. The Mowry is the more resistant dolomite, sand, or clay. Caverns are common, and some of them have unknown extent occur in the Canyon Creek area of the Bighorn Mountains, rock and forms low cuestas. The lower seam crops out at the base of the yielded onyx marble. Limestone of the Hartville formation has been Great quantities of volcanic ash and volcanic debris are associated with cliffs and is frequently covered by talus; the upper crops out with a width

quarried near Guernsey for lime-burning, sugar refining, and for building

the lavas of northwestern Wyoming. 3 feet thick, and is continuous around the Black Hills. On the east flank of the Bighorn Mountains the bentonite horizon shown on the Map is at the top of the Mowry shale. East of this horizon are parallel seams 100 to 200 feet above the base of the Frontier formation, and west of it a similar seam occurs in the upper part of the Thermopolis The bentonite horizons on the northeast flank of the Wind River Mountains and along the southern and eastern margins of the Bighorn Basin are also

and central Hot Springs Counties is similar lithologically to that in the

Red iron oxide was produced from mines near Rawlins, Carbon County, at the top of the Mowry shale. Thin beds of bentonite occur in the over
Bighorn Mountains. The same formation, 400 feet thick, extends from from 1870 to 1890, and intermittently since that time. Production before lying Frontier formation and the underlying Thermopolis shale, but the thickness and number of bentonite layers in these two formations are unknown. West and southwest of Casper, the bentonite is also that at the top of the Mowry shale, and other beds are present in the Thermopolis and Frontier formations. In the Rattlesnake Hills area, the only bentonite horizon mentioned in published reports is at the top of the Mowry shale. Bentonite occurs near the middle of the Steele shale in the Salt Creek area. Near Medicine Bow, bentonite is found at the top of the Mowry shale and the base of the Mesaverde formation. In 1943 Wyoming produced 159,252 short tons of bentonite valued at \$1,389,644, a tonnage equal to one-third of the total national production.

| Since its in pre-cambrian inequality in the Niobrara formation, is about 15 feet thick, and extends discovery in 1936, several thousand pounds have been recovered by collection. The reserves of bentonite in northeastern Wyoming are very large, and tion about deposits in other areas is generally inadequate, but undoubtedly

are also of suitable composition for use as cement rock. In the north
*Minerals Yearbooks for 1935-1939: U. S. Bur. of Mines. (Minerals material suited for local engineering uses occurs in the bentonite beds of

Clay is widespread in the State but little information has been published on the location of specific deposits, their size, or the types of material. Nearly all of the clay produced has been used for making brick, drain and sewer pipe, and tile. Alluvial deposits of clay have been reported from the wider parts of the valleys of the Laramie and Little Laramie Rivers. The quality and size of these deposits are unknown. Many of the shales of Triassic and Cretaceous age are sufficiently soft to be classed and used as clays. These are found mainly in the following stratigraphic units: the lower part of the Montana group, the Benton shale, Fuson shale, Morrison formation, Sundance formation, and the Chugwater formation. Refractory and fire clays are reported to be abundant, but locations of the deposits are not given in the literature. Pottery clay occurs near Casper, and a deposit of kaolin has been found near the soda lakes in Many companies manufacture brick from clay, shale, and loess containing clay. Tile and drain pipe are produced by one or more companies. Clays of several types are evidently widespread and the reserves may be large, but are chiefly undeveloped at the present time. DOLOMITE

purposes, dolomite is the largest potential source of magnesium within the yards of this material are available in the northeastern Wyoming coal United States. Although the deposits in Wyoming have not been exploited, fields. Clinker probably occurs in many other coal fields in the State, reserves are almost inexhaustible. Dolomite occurs extensively in the but only a few deposits have been mapped or described. Absaroka, Wind River, Owl Creek, and Bighorn Mountains and at scattered localities in southeastern Wyoming. Pre-Cambrian dolomites occur in the Whalen group about 2 miles north- Most of the Wyoming pegmatites are small; the production of such east of Guernsey, in the Laramie Range west and southwest of Wheatland, minerals as feldspar, mica, beryl, and columbite-tantalite has never reachin the Medicine Bow Range, and at a few other localities. Most of these ed major proportions, even under stress of wartime needs and prices. dolomites are coarsely crystalline, and although some are very pure, Feldspar production increased from 1,168 tons valued at \$4,343 in 1938, to others contain large amounts of silica and silicate minerals. The Bighorn dolomite, of Ordovician age, is the most extensive dolomite the State probably are not large. formation in the State. The average thickness is between 150 and 300 feet, and throughout its extent the formation is chiefly a massive, lightcolored dolomite with subordinate amounts of limestone. Large, accessible The phosphate deposits of the western United States occur in sedimendeposits of dolomite in the Bighorn dolomite and lower part of the Madison tary rocks which extend from west-central Montana through eastern Idaho limestone (Carboniferous) are located close to sources of electric power and western Wyoming almost to central Utah. These beds were folded, in the Wind River and Shoshone Canyons. Dolomitic limestone of Devonian age occurs in the Darby formation in in linear bands which may extend for miles across country. In western the Wind River and Absaroka Ranges, and dolomite of lower Carboniferous Wyoming, these beds crop out along the flanks of many of the mountain age occurs in the lower part of the Madison limestone. The Amsden and ranges. Although the phosphate deposits of Idaho and Montana have Casper formations of Carboniferous age locally contain dolomite, and been developed in several localities, there has been little mining in Wyothere are also beds of dolomite in some of the Permian rocks. ming, and none at all since 1931. However, the Wyoming reserves are

The principal known deposits of fluorspar are in the Bearlodge Mountains and thickness over different parts of the State, but in general the deposits of Crook County. No record of production from this area is available, appear to be thicker and richer toward the west. Development in the near but the deposits probably contain moderate reserves. Deposits in western future will depend less on the quality of the beds than on the proximity Laramie County and the Encampment district of Carbon County are small. of deposits to power, railroad facilities, and markets.

Silica sand of sufficient chemical purity for use in the manufacture of The mineral leucite, an insoluble potassium aluminum silicate, is abunglass is said to be abundant in the State, and deposits of both sodium dant in igneous rock of the Leucite Hills, north-central Sweetwater sulphate and limestone are widespread. However, Wyoming is remote County. The total potash content is estimated to be 197,350,000 tons. from large centers of manufacture and consumption, and only two attempts have been made to manufacture glass. The Salem Co-operative the discovery of large quantities of soluble potassium salts in New Mexico. Glass Co. of Lovell produced several thousand boxes of window glass in 1926 and a factory at Laramie produced a small amount of glass using soft sandstone from the Casper formation which crops out east of the city. These localities are shown on the map, but both plants have been inactive of Star Valley, in the western part of the State, and one north of Newfor more than a decade. No adequate study of potential glass sands of castle, in the Black Hills region. Salt from the western deposits and from the State has been published. GRANITE AND OTHER COARSE-GRAINED ACID IGNEOUS

Granite and granite-like rocks are commonly used for riprap, for building Sandstone is plentiful and widespread, but it has been quarried only on stone, and as crushed stone for road metal, concrete aggregate, and railroad ballast. Granite is abundant in most of the higher mountain country Hills region and Bighorn Mountains, hard sandstone and quartzite occur in of Wyoming. About 1,200 square miles of the Bighorn Mountains in the Dakota, Lakota, and Cloverly formations. The Minnelusa sandstone Bighorn and Washakie Counties is underlain by pre-Cambrian granite. in the Black Hills also contains soft to hard sandstone. In south-central The rock is moderately coarse-grained, light gray to light pink in color, Wyoming hard sandstone occurs in the Tensleep and Casper formations, and widely to closely jointed, in part faintly foliated. Similar rock crops and farther west in the Wells and Flathead formations. Many other forout in the mountains of Hot Springs and western Washakie Counties, and it is abundant in the Wind River Mountains of western Fremont County.

mations contain sandstone interbedded with shale or limestone; these formations have been omitted from the map although they may be a sat-

Large deposits of construction materials, especially stone, gypsum, and bentonite, are widespread in Wyoming. Nonmetallic minerals such as

Coarse-grained granite is widespread in the Laramie and Medicine Bow isfactory local source of construction material. The softer and more Mountains of southeastern Wyoming. The rock is strong where fresh, GRAPHITE

wide, occurs in the Laramie Mountains northeast of Laramie, Albany Permian and Triassic age. The thickest beds are in the upper parts of the present conditions. more than a few acres in extent or thicker than 15 feet.

KYANITE, SILLIMANITE, ANDALUSITE estimated by C. M. Boos to contain several thousand tons of kyanite. in the Encampment district. LIMESTONE, CEMENT ROCK, AND MARBLE

limestones in the 500-foot thick Pahasapa limestone. The middle part of 200 feet of quartzite, is the Guernsey formation, which contains about 120 feet of fine-grained gray limestone. Montana State line to about 250 feet in southern Washakie County. It is on the map. chert nodules in some places. The Madison limestone in western Washakie although it is abundant in pre-Cambrian rocks of the State. feet of massive dolomitic limestone. The Casper formation contains beds of limestone that have been quarried Talc is widespread, but no deposits have been exploited, and very few near Laramie, north of Rawlins, and elsewhere in south-central Wyoming. have been reported. Two described localities are shown on the map, one Many formations, including the Phosphoria and Sundance in western in Teton County and a second in Washakie County. A commercial deposit Wyoming and the Chugwater, Morrison, and other formations of Mesozoic of fibrous tale has been reported in the Laramie Hills, near Wheatland. age in central and eastern Wyoming, also contain some limestone. Argillaceous limestone is quarried by the Monolith Portland Midwest

Apple-green jade has been found in boulders of Tertiary beds, and darker Company, for cement manufacture, 10 miles southwest of Laramie. This jade occurs in pre-Cambrian metamorphic and igneous rocks. Since its northwestward into Carbon County. The Forelle limestone near Laramie tors, chiefly from surface gravels. The jade is cut locally for gems. eastern part of Wyoming two narrow belts of argillaceous limestone, in Yearbooks are the source of most production figures quoted.) the Niobrara formation and Greenhorn limestone, are probably usable for cement rock. Argillaceous limestone beds in the Sundance formation in the western part of the State might be usable as cement rock. Marble is reported to occur in the crystalline rocks in Washakie and Hot Springs Counties. It also occurs in the pre-Cambrian crystalline rocks of the Laramie Range and has been mapped in the central part of the Medicine Bow Mountains. Any of the harder limestones or dolomites may locally be called marble. Wyoming has no large, centralized limestone industry, and the recorded annual production has never exceeded 500,000 tons. However, limestone

production can be increased to meet any industrial and construction needs. NATURAL SLAG OR CLINKER Clinker, also called natural slag or scoria, has resulted from the burning of coal beds at or near the surface. The altered or fused rock is used in road construction and for railroad ballast. The deposits in northern Campbell County are reported by section, township, and range, hence the peculiar geometric pattern of areas shown. Clinker is abundant in the Sheridan coal field southeast of Sheridan, but it has not been mapped and therefore has not been shown on the map. Farther southeast from Sheridan is the Buffalo coal field; its extensive clinker deposits are represented in a generalized fashion by a large solid area on the map. Clinker In addition to its usefulness as a building stone and for other construction has been mined east of Gillette in Campbell County, and billions of cubic

is plentiful and has found much local use throughout the State. Future

PEGMATITE MINERALS 13,953 tons valued at \$50,730 in 1942. Reserves of pegmatite minerals in

broken, and finally eroded, so that the phosphate rock comes to the surface estimated to be more than 115,000,000 tons, and there is strong probability of development in the future. The phosphate varies greatly in grade

Two salt-producing regions have been reported in Wyoming: one south a spring in northeastern Wyoming has been used locally, but it cannot be

SANDSTONE AND QUARTZITE

several mountain ranges, but detailed information of its occurrence is

SODIUM SULFATE AND CARBONATE

from deep wells at Green River, and trona was found in cuttings from

wells west of Green River. Other large deposite of sulfate include Union

Pacific Lakes and Downey Lakes, southwest of Laramie; Rock Creek

In the past small quantities of sulfur were produced from mines near Cody and Thermopolis, but low-cost production of sulfur in other States has now made these operations unprofitable. The sulfur near Cody and Thermopolis occurs at shallow depths where it is associated with limestone places where it formerly occurred on the tops of hills. Chemical analyses there are numerous sulfur deposits in Yellowstone Park associated with indicate that most of the gypsum is rather pure and contains very little hot springs and gas vents. Deposits in the Park are not shown on the calcium carbonate or silica. The workable deposits are confined to red accompanying State map. The Wyoming sulfur deposits are relatively A large deposit of anorthosite, about 36 miles long and 10 to 18 miles beds—the Chugwater, Embar, and Spearfish formations which are of small, and there is little chance that they can be exploited profitably under

deposits of rock gypsum. It occurs at a number of localities, a noteworthy district in Carbon County, the Glenrock district in Converse County, the example being near Laramie, Albany County. The deposits are rarely Wheatland district in Platte and Albany Counties, and the Sweetwater deposits in Natrona County. In addition to the localities shown on the in southern Fremont County, and in the Teton Mountains just south of County. Pits have also been opened near Laramie, at Stucco, at Alcova, district, the Saratoga region, in the Antelope Hills southeast of Lander, and production can be expanded rapidly to meet any local construction if the future price and demand are high. The deposits are generally small and irregular; no estimates of reserves are available. VOLCANIC AND OTHER FINE-GRAINED IGNEOUS ROCKS Minerals of the kyanite group are used in the manufacture of high-grade

Fine-grained igneous rocks, especially basalt, are used extensively as refractories, but the Wyoming deposits have not yet been exploited or crushed rock for road metal, concrete aggregate, and railroad ballast. A fully investigated. The largest reported deposit of kyanite and related small amount is used for building stone. Acid volcanic and fine-grained igneous rocks include the nepheline-bearing rocks of Devils Tower and Missouri Buttes in Crook County; the dense, hornblende-bearing porphy-The mineral, associated with andalusite, occurs in small crystals which ries in the Laramie Mountains, Laramie County; and a large area partly

make up about half of a biotite-kyanite schist. Kyanite associated with in Yellowstone National Park underlain by massive rhyolite, andesite, and feldspar and mica occurs in a deposit southwest of Wheatland, and other fragmental volcanic material. Volcanic ash and debris associated with are discussed as a source of potash. Basic volcanic rocks are also abundant in the Yellowstone Park region. These consist of dark andesite, basalt, and layers of basic volcanic ash and agglomerate. aggregate, road metal, sugar refining, and to less extent, for dimension western part of the State and in adjoining parts of Idaho, but the producstone, lime-burning, and Portland cement manufacture. In the north-VOLCANIC ASH AND PUMICE

stone forms an outcrop belt about 8 miles wide. This formation, about scouring powders and soaps, and small quantities are used in other types 50 feet thick, is chiefly massive gray limestone, but clay and dolomite are of abrasives. Pumice and pumicite are becoming more important in the preparation of acoustic stucco and light-weight aggregate. Deposits of In the Hartville uplift, northeastern Platte County, large reserves of ash and pumice in the State have not been developed or adequately inves-MISCELLANEOUS MINOR NONMETALLIC MINERALS In the Bighorn Mountains of central Wyoming, much limestone occurs has received little attention, and no description of the deposits has been in the Madison limestone which thins southward from 1,000 feet near the published. Three localities at which corundum has been found are shown light gray to buff, massive, and contains a few dolomite beds and abundant

Garnet, used as an abrasive in some industries, has not been produced, central to northwestern Fremont County. In Fremont County the Gallatin 1899 was about 100,000 tons, which was used as a metallurgical flux and limestone, which lies 400 feet below the Madison limestone, contains 200 as paint pigment. The red iron ore occurs as secondary hematite in solution caverns in the Madison limestone.

Nephrite jade has been found over a sizable area in Fremont County.

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