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NEBRASKA ROCKS WHICH EXCITE COMMON INQUIRY

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NEBRASKA GEOLOGICAL SURVEY

ERWIN HINCKLEY BARBOUR, State Geologist

VOLUME 4

PART 21

NEBRASKA ROCKS WHICH EXCITE COMMON
INQUIRY

BY

ERWIN H. BARBOUR



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NEBRASKA ROCKS WHICH EXCITE COMMON INQUIRY

BY ERWIN HINCKLEY BARBOUR

This leaflet is intended to serve as an answer to correspondents who make inquiry about the rocks of Nebraska¹. Unfortunately for those interested in such matters, the rocks of the State are few in number, and are deeply buried from view by sand and soil, so there are thousands of square miles in which even a pebble is a rarity. That our rocks are level and undisturbed is practically true. Still there are some surprisingly interesting folds and faults.

The native rocks of Nebraska are three in number, namely: sands, limes, and clays.

LIMESTONE

In the preceding number, the mineral calcite was described tersely as crystallized lime. Limestone is so completely composed of calcite that it is correctly called massive calcite. Calcite is carbonate of lime, so is limestone. It may be pure, or mixed with varying amounts of sand, iron, clay, and magnesia. The universal test for all limestones is

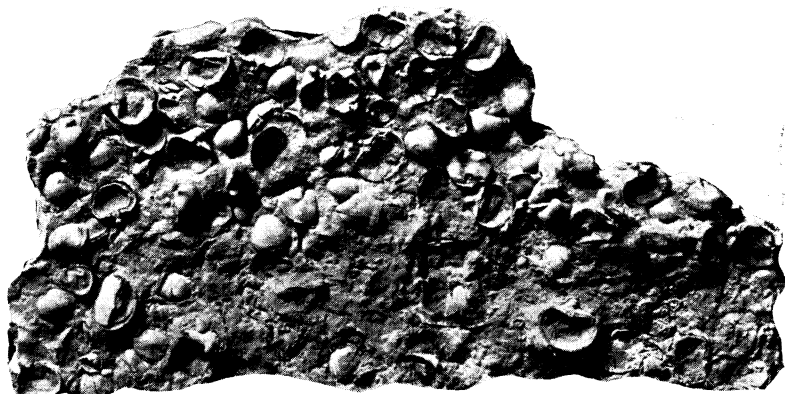


Fig. 1.—Brachiopodal limestone, Nebraska, composed of brachiopod shells, *Ambocoelia planocconvexa*.

1. The Minerals, Rocks, and Fossils of Nebraska which Excite Common Inquiry, are treated briefly in leaflets numbered 37, 37a, and 37b respectively. These leaflets are intended to serve as circular letters to correspondents.

to apply acid. If it foams or effervesces vigorously, it may be pronounced lime. This is a very reliable and satisfactory test. Furthermore, one can judge approximately the relative purity or impurity of the sample in which he is interested. It is common practice to use hydrochloric acid and water in about equal parts. Put some of this acid in a small bottle, a slim dram bottle being preferable, and drop into it a piece of rock the size of a pea. If it is pure, the effervescence will continue actively until it is dissolved, and the solution will be clear and with practically no sediment. If impure, sand and clay will appear as a sediment at the bottom. If the supposed limestone does not effervesce, or does so tardily and feebly, note the test for dolomitic limestone.

If it contains a large amount of grit or sand, it is called arenaceous limestone; if clay, argillaceous limestone. There is every degree of natural adulteration. For instance it may contain so much impurity in the way of sand that it is a matter of judgment whether to call it a sandy limestone or a limy sandstone. Or it may be so mixed with clay as to pass equally for clayey limestone or limy shale. That is, there is every gradation from the one to the other, and naming it

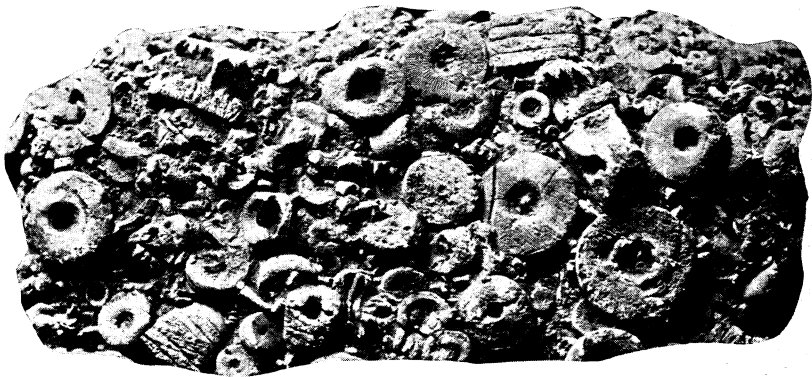


Fig. 2.—Crinoidal limestone. Made up of disjointed crinoid stems. Common in Nebraska.

exactly is a matter of personal judgment, and is unimportant. Our limestones are gray or buff as a rule. Those of yellow color are so because tinted by that form of iron rust known as limonite. Nebraska limestones are comparatively free from pyrite, but some have damaging amounts. In general it may be said that rocks containing even small amounts of iron pyrite are ruined for architectural purposes. On ex-

posure, pyrite decomposes readily and the walls are streaked by bands of dark iron rust.

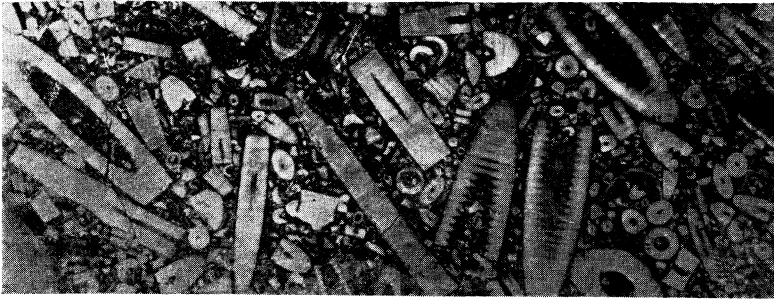


Fig. 3.—Crinoidal limestone, polished; showing sections of crinoid stems.

Our limestones range geologically from the Upper Carboniferous to the Tertiary, although, as already stated, they are generally so blanketed from sight by our deep loess, soil, and sand, that they are seldom seen. It is only along the deeper watercourses that they are exposed. The most important rocks of the State are the Carboniferous limestones extending from Lancaster County eastward. These are almost wholly marine as shown by the shells, sponges, crinoids, and sharks' teeth



Fig. 4.—“Rice stone,” common in the Carboniferous of southeastern Nebraska. Composed of foraminiferal shells, *Fusulina secalica*.

found in them. These rocks are highly fossiliferous. This is particularly true of our “rice-stone,” which often literally looks like a block of petrified rice. “Nemaha coquina” is composed of such a mass of whole and fragmentary shells as to resemble the shell-limestone or coquina of Florida.

Considerable capital has been invested in the quarries of this region, and their output is large and important. Dimension stone, crushed stone, sugar stone, smelter stone, ballast, riprap, and the like are produced. Great beds of shale alternating with the limestone afford ample material for extensive brick plants.

LIMESTONE, VARIETY CHALK

Chalk, which is limestone consisting of foraminiferal shells, is also marine in origin. Our Niobrara limestones are chalk. Conspicuous chalk bluffs are to be seen in the eastern Republican Valley, in southern and northeastern Nebraska, and at certain isolated intermediate points. Chalk is soft when "green," that is when fresh from the quarry, and is often sawed into uniform blocks. These harden on drying and make surprisingly serviceable building material. The Niobrara chalk is underlaid by dark Carlile shale and, when the two are mixed and ground, an excellent hydraulic cement may be produced. The Nebraska Portland Cement Company has built a large mill at Superior².

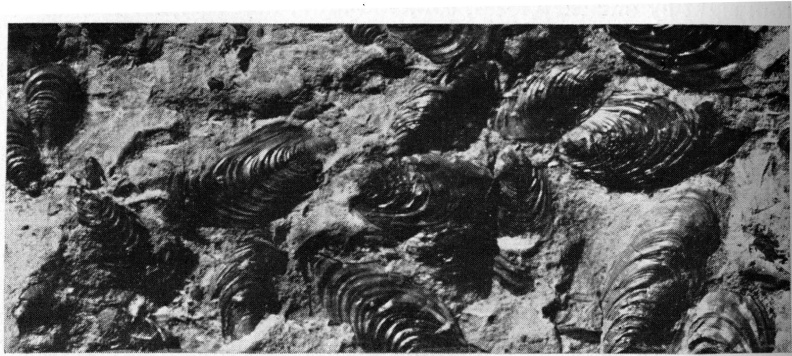


Fig. 5.—Shell limestone, with *Inoceramus* shells. From the Greenhorn limestone at Milford.

Tertiary limestone of fresh-water origin is occasionally found in local patches in the region of the bad lands in western and northwestern Nebraska. The quality of some of this is so fine that it is strictly lithographic limestone. However, with one or two exceptions, the Tertiary limestones offer little inducement at present for the development of quarries.

2. Described in Nebr. Geol. Survey, vol. 4, pt. 7, No. 29, Cement Manufacture in Nebraska.

LIMESTONE, VARIETY DOLOMITE

Dolomitic limestone, or magnesian, as it is sometimes called, is like the ordinary save that a little magnesia has been added. To the eye they are the same, but the difference may be demonstrated by very simple tests. Limestone is vigorously effervescent in hydrochloric acid, but the foaming is retarded, or stopped outright, according to the amount of magnesia present in the rock. If any sample of supposed limestone refuses to react by effervescing in cold acid, then heat the acid, or else heat or powder a bit of the rock and drop into the acid. If effervescence then takes place, it is undoubtedly dolomitic limestone. This is a very reliable test.

Ordinarily it matters little whether a limestone is dolomitic or not. If anything, dolomitic limestones are better and more lasting. However, it does make a difference if one is burning lime for mortar. Much of our limestone contains magnesia, which is said to make Nebraska lime quick-setting and undesirable for mortar. This accounts, in part at least, for the fact that there are no limekilns in operation, although there are ruins of many.

In the Nebraska City well, pure crystalline dolomite occurs at a depth of 1,700 feet.

SANDSTONE

Sandstone is even more universally known than limestone. It is ordinarily recognized at sight. Its name, like that of limestone, suggests its constituents. Sandstone is very reliably tested by sight and touch. The sand grains are generally quite apparent to the eye and to the finger tips. Sandstone is rough to the touch as compared with limestone. Sandstone scratches glass readily, while limestone never



Fig. 6.—Dakota sandstone, famous for its leaf impressions. Dark rusty color.

does. Accordingly, no matter how nearly they may resemble one another, they are readily distinguishable by very simple tests. Sandstones never effervesce with acid, while limestones always do. But if you are testing a sandstone which is cemented by lime, it will momentarily effervesce with vigor, but as soon as the cement is dissolved the action ceases. The bulk of the rock is not affected.

Sandstone consists of sand grains more or less intimately cemented together by lime, iron, or silica. When cemented with silica, the rock is very enduring. The origin of sand and sandstone is readily understood. When crystalline rocks are exposed to the destructive action of the weather, the more perishable minerals are decomposed. This liberates large amounts of quartz grains, which are so resistant that they defy the elements. They constitute our sand and gravel. The quartz grains are washed into streams and eventually built into great sand banks and bars. The finer sands and silts may reach the ocean and build up great deltas, or may be swept out to sea. Such banks and bars of silt, sand, and gravel, may in the process of time become compacted, and cemented into rock suited to building purposes.

The oldest sandstone in the State belongs to the Coal Measures exposed in the extreme southeastern corner. It is poorly lithified, often friable, and crumbly. It is characterized in many exposures by innumerable glistening mica scales. Our best known sandstone belongs to the Dakota formation of the Cretaceous age. This is generally coarse in texture, and has a characteristic rusty brown color, because cemented by iron.

Coarse sandstones always deliver water more rapidly than fine-grained, and since the Dakota sandstone is coarse, and extensive in area, it is recognized as the important water-bearing bed of the Great Plains. There is a strip of Dakota running nearly north and south, some two hundred miles across the State, yet it is so completely buried by drift and loess that it is seen only in widely separated exposures where streams lay it bare. The Dakota formation, so called because of the typical exposures found at Dakota City, Nebraska, is ordinarily spoken of as "Dakota sandstone," for the reason that everyone is familiar with its sandy character. In reality, there is as much clay as sand in this formation, and some of our best clay comes from the extensive and important clay deposits in the Dakota. This sandstone is characterized in many places by the impressions of countless leaves. Over five thousand specimens are displayed in the State Museum as the result of one summer's collecting.

The Dakota sands are mostly crumbly, or friable; sometimes light in color, but generally dark, and strikingly rusty. In fact it is so heavy with iron in places as to be mistaken for iron ore, and many samples are sent to the State Survey for determination. This is not "cast iron," though resembling it. Nor is it "melted sand and iron," nor is it "lava." Iron concretions are very common in this sandstone. They are round, solid, or hollow, and heavily stained with iron, but they are not "meteoric." This sandstone is so loose and incoherent in places that it is used for mortar. Elsewhere it may be loosely cemented. Or it may be firm and solid enough for use as building stone. In favored local spots it is dense and like quartzite. Its economic importance is limited to a few sandstone quarries and sand pits, and to the excellent water which it yields. Associated with it are valuable beds of clay. There are certain Tertiary sandstones and conglomerates which are too young to be well solidified, and therefore of little commercial value. Near Bloomington, some Tertiary sandstones are densely hard. This will be discussed under Quartzites.

Sandstone containing clay is called argillaceous sandstone; containing marl, marly sandstone; containing lime, calcareous sandstone; containing iron, ferruginous; asphaltum, asphaltic sandstone; and so on.

SAND AND GRAVEL

Commercial sand and gravel vary from fine to coarse, and are well known. Ordinary sand and gravel are generally well water-worn and rounded. Sharp sand is more angular than ordinary, and is a variety often specified by architects and engineers for mortars and cements. Large amounts of sand are produced in Nebraska, and its market is not confined to the State alone, for important amounts are shipped to Iowa, Kansas, and South Dakota. The sand-hill region, covering much of the northwestern half of the State, consists of a wind-blown deposit of well-rounded sand. The sand and gravel of our valleys were transported by water; those of the drift by glaciers. In many places, very fine sand occurs in beds of considerable thickness and extent. The grains are so fine that the eye is not quite capable of distinguishing them. A jeweler's hand lens, or a school microscope, will resolve them at once. Certain fine, uniform sands of the State are being used in foundries for moulding and casting iron, as well as in sweeping compounds and scouring soaps and powders.

Many inquiries have been made of the Nebraska Geological Survey respecting glass sand. Glass sand is a pure white variety, almost free

from iron. So far as known, glass sand has not been found in this State.

SILT

Silt might be described, in general terms, as exceedingly fine sand and clay. It is the fine mud along the shores of rivers, lakes, and oceans. It is the material which silts down the mouths of certain great rivers, making deltas. The rich soil known as the alluvium of our valleys is silt.

CONGLOMERATE

Conglomerate may be described as very coarse sandstone. The constituent pebbles are generally large and well rounded. It is often called Pudding stone, because the well-rounded pebbles resemble the plums in a pudding. Some of our Tertiary conglomerates are very coarse, particularly in Cheyenne County, where the pebbles in some cases are as large as one's head.



Fig. 7.—Peanut conglomerate, Louisville, Nebraska.

The most interesting as well as the best known conglomerate in Nebraska, is that at Louisville, which in 1891 was named Peanut Conglomerate by the writer. The white, rounded, quartz pebbles imbedded in the ferruginous cement resemble peanuts in candy.

QUARTZITE

Quartzite, in brief, is densely hard sandstone. Sand, it will be remembered, is essentially quartz grains (silica). If the quartz grains are intimately bound together by a cement of silica, it is plain that a

rock of nearly pure quartz is the result. Hence it is very hard and lasting. People in the State associate the name quartzite with the pink, purplish, and red boulders, common in the glacial drift. These were carried by glaciers from the quartzite ledges at Sioux Falls, South Dakota, and dropped over the eastern fifth of the State.

As tests for quartzite the following may be used: It is not scratched by a file, cuts glass readily, and emits a light when two pieces are struck together. In a dark corner this phenomenon is produced by vigorously rubbing two pieces together. None of these boulders are native to the State for they have all been transported. But we have some native quartzite which seems to the Geological Survey to be the



Fig. 8.—Bloomington quartzite. An important rock awaiting development.

best rock in Nebraska. Running from Bloomington through Fullerton to Verdigris, there are certain scattered exposures of a fine, green, densely hard quartzite. Near Bloomington, there are several million dollars' worth of this quartzite lying idle and untouched.

It seems incredible that such an important resource has lain idle so long. It is worthy of wide publicity, for the time must soon come when this will be developed. When crushed, this quartzite is quite as good and serviceable as granite chips. As railroad ballast, it could not be better. As crushed stone for use in concrete mixtures, it is highly endorsed by engineers. Unfortunately, this bed lies south of the Republican River, and it would be necessary to bridge the stream. Were it otherwise, capital would have been employed on this deposit long ago. It is only a question of a few years, or perhaps a few months, when this bed of quartzite will be the foundation for one or more flourishing industries.

CLAY ROCKS

Any earthy materials which are more or less plastic, and which harden on burning, are called clay. The clay rocks comprise marl, common clay, potter's clay, fuller's earth, hardened clay, shale, and slate. The commercial importance of clay may be judged from the fact that the wealth derived from industries based on clay exceeds that derived from gold and silver. It is scarcely necessary to mention any test for clay, for it is so readily determined by the eye, and is so universally known. When moistened, or breathed upon, it gives a characteristic argillaceous odor. In the case of pure clay, this is strong and unmistakable. Another simple test is to reduce a little to powder by pounding, then moisten and knead. If it is clay, it will become more or less plastic and easily moulded.

Loam, loess, and marl are well-known earthy deposits which, though containing impurities in varying amounts, are essentially clay. There is considerable lime in marl, and in some cases there is an abundance of shells, in which event it is called shell marl. The test for marl is its vigorous foaming when touched by acid or strong vinegar. Loess is the extensive and well-known buff deposit which covers the southeastern half of Nebraska. This deposit, like adobe further to the southwest, is technically clay. The truth is that it contains about 85 per cent of fine sand and only about 15 per cent of clay, but it can be moulded and burned into brick. In fact the greater number of brick plants in the State are making loess brick, for loess clay is quite universal while the richer clays in Nebraska are confined to the southeastern corner.

Pure clay is white, and remains white when burned. Impure clays almost invariably turn red on burning. A clay rich in sand and resistant to heat is called a fire clay. In general, it is less smooth and soapy to the touch than ordinary clay. Clay is sometimes hard and imitative of limestone. However, a bit of limestone can be dissolved in acid, while clay cannot, although it may show momentary effervescence, indicating the presence of lime.

A rich gritless clay is so soapy that the name soapstone has arisen. Soapstone, properly speaking, does not occur in Nebraska, but according to popular usage the term invariably means gritless clay or shale. When clay is reasonably free from sand and silt, it is soft and soapy to the touch, and the name "soapstone," though misapplied, is an expressive term. In mineralogy, soapstone is massive talc or steatite.

Shale is clay arranged in fine, more or less hardened, layers, often darkened by carbonaceous matter. Exposed to atmospheric agencies, it readily breaks down into brick clay. A highly interesting kind of hardened clay is occasionally found in the glacial drift. It is of a rich blood-red color, and is known as pipestone, Catlinite. This is the famous red pipestone of the early Indians. These beds were so admired by the Indians that they are said to have been agreed upon as neutral ground. When fresh from the quarry it is easily dressed, but when dry it is hard and susceptible of a high polish.

Slate is clay so hardened, compressed, and metamorphosed that slaty cleavage is developed. Slate is not native in this State, though fragments of slate are common in our glacial drift.

TRANSPORTED ROCKS

In a preceding paragraph it was explained that Nebraska has but three kinds of native rock, namely: sand rock, lime rock, and clay rock. But in addition, there occurs a wide range of "stones" not native, but transported. That is, they were carried to this State by glaciers. They



Fig. 9.—Glacial boulders near Fairbury, Nebraska. Mostly Sioux quartzite and granite.

bear no more relation to the State than does a stone carried by man and dropped here, or than a boulder carried from the mountains of Alaska by the present Muir glacier. They never occur in beds, but always as isolated boulders in the glacial drift. They comprise a wide range of crystalline, metamorphic, and basaltic rocks. Chief among these are quartzitic boulders, already described and boulders of granite and gneiss.

GRANITE

Granite consists essentially of quartz and feldspar with mica, or hornblende, or both. The quartz is recognized by its hardness and glassiness; the feldspar by its whiteness or flesh color, and its cleavage surfaces. Mica, though as black as hornblende, cleaves readily into fine scales, while hornblende will not.



Fig. 10.—Polished granite, showing distinct grains of feldspar, quartz, and hornblende (black).

It is to be assumed that everyone is familiar with granite, for it is one of the choicest of all rocks for architectural purposes, being uniform in color, even in texture, and standing as the type of permanence. Still the most enduring of rocks must eventually yield to the chemical effects incident to continued weathering, and thus it is that many of the granite boulders in our glacial drift are half decomposed and ready to crumble. At this stage, the mica in some cases is so silvery, or so golden, that it is mistaken for silver and gold respectively. A sure and easy test follows: mica will cleave into thinner and thinner scales indefinitely, while gold and silver will not. Then, too, gold or silver, if placed on a smooth iron and pounded with a carpenter's ham-

mer will flatten into unmistakable metallic scales, while mica so treated would soon become powder.

GNEISS

For present purposes, gneiss may be called banded granite. It is fairly common in the drift. The bands are often crumpled and distorted.

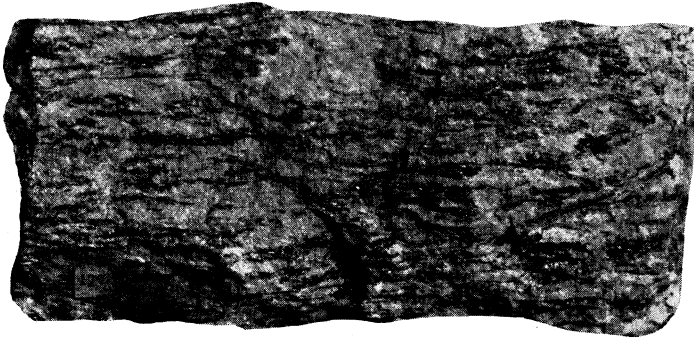


Fig. 11.--Gneiss. Found in glacial drift. Like granite, but banded.

MICA SCHIST

The name almost describes this rock. Mica scales arranged loosely in foliated order predominate so plainly that it is recognized at once. In good examples, it tends to split rather readily, and on fresh surfaces exposes a glistening array of innumerable clean mica scales.

BASALT

Basalt is a sort of densely hard, compact lava which in many instances presents a greenish, or rusty surface. On fresh fracture, it is very dark green, or black. These rocks are common in the drift, and are instantly recognized by their dark color.

DIABASE

Diabase is closely related to basalt but shows structure. Grains of black and white are visible, which makes the name "salt and pepper rock" appropriate.

NATIVE PUMICE, PUMICITE

Associated with our rocks, surface deposits, and soils, are often found extensive deposits of silvery white powder, so unlike the material

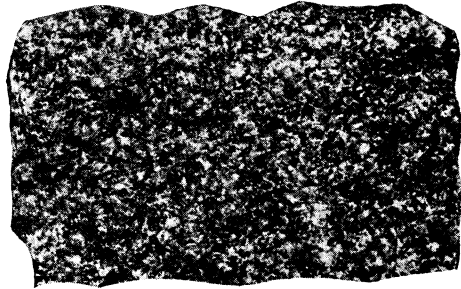


Fig. 12.—Diabase, "salt and pepper" rock. Found in glacial drift in Nebraska.

in which it occurs as to excite immediate attention. The constant inquiry is "What is the shiny white substance which we find on our farms and ranches?" There is no easy test for native pumice unless you have a microscope. In that case, mount a little in water on a glass slip in the usual way, and examine under a low power. You will then discover small, flat, very angular, glassy particles, some of which are full of hair-like tubes. Compare with Diatomite. In case you have no microscope, take a sample to the superintendent of your nearest high school, or to some physician, and he can quickly recognize it. Or samples may be mailed to the office of the State Geologist for determination.

Volcanic dust or pumicite probably occurs in every county in the State, and in the nearby states, South Dakota, Montana, Wyoming, Colorado, Kansas, and Oklahoma.

The production of pumicite in Nebraska is now large and the industries based upon it are important. Before the State Geological Survey had published its reports, this natural resource was counted a worthless thing, and at that time commanded in the market about one dollar a ton. It immediately rose to two dollars and a half a ton, and the price now varies between three and ten dollars a ton. Out of a long list of several hundred pieces of pumicite land on file in this office, not one piece now remains unsold, and some of this land netted the owners as much as four hundred dollars an acre. The present demand for this pumice is such that the office of the State Survey is in constant communication with firms in various cities respecting it, and the office is making a new list of pumice lands. Our native pumice has been variously termed "volcanic dust," "volcanic ash" and "gey-

serite." Where mined extensively it has come to be called "Silica," and the mines are called "Silica Mines."

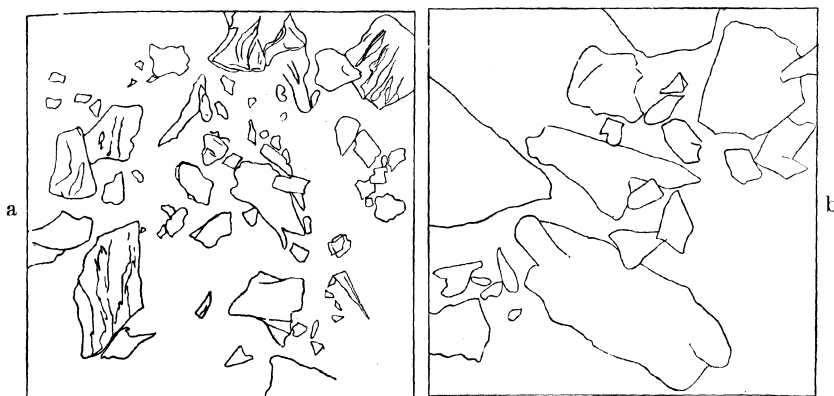


Fig. 13.--Volcanic dust or pumicite of Nebraska. Greatly magnified. a, shows the fine, vesicular variety demanded by the present market; b, a coarser variety consisting of glassy grains devoid of vesicles. There is little market for this grade.

This material, although a silicate, is not silica, and should not be so called. It is natural pumice and for a long time we have called it pumicite, which seems to be a far better name than silica.

A large force of men find steady employment in the various "Pumicite Mines," especially those in Harlan County. A still larger force is employed in its manufacture in South Omaha, and one Omaha firm has established branch factories in Chicago and Montreal. Industries worth several million dollars a year are now based on this natural resource. According to such records as are obtainable by this office, the amount of native pumice produced and sold in 1896 was 5,000,000 pounds; 15,000,000 in 1907; 22,000,000 in 1908, with an increasing demand for succeeding years. The production of native pumice in Nebraska exceeds that of the other states of the Union, and seems destined ultimately to displace from the market much of the pumice now imported from Sicily. The consumption of pumice in the United States amounts to 20,000 tons a year, most of which comes from the island of Sicily. Already Nebraska produces 10,000 tons of native pumice yearly. This has become an industry of consequence to this commonwealth, and when one considers the army of men employed, the usefulness of the product, and the increased

value of pumice land, he must grant that the development of this one resource alone amply justifies the costs of the Nebraska Geological Survey for years to come.

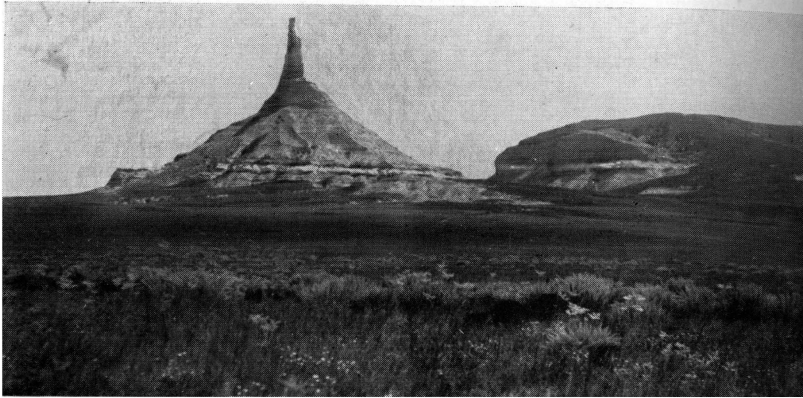


Fig. 14.—Chimney Rock, near Gering, Scotts Bluff County, Nebraska, showing a five-foot bed of pumicite near its base.



Fig. 15.—A pumicite mine near Orleans, Nebraska. One of the largest in the State.

PUMICEOUS ROCK AND SOIL

Nebraska is remote from regions of vulcanism, and volcanic rocks are not to be expected. However, our beds of pumicite are volcanic. An interesting volcanic rock sometimes results from the solidification of pumicite. The powdery beds become permeated by lime waters, and calcite is deposited uniting the pumice grains into a solid mass. In places there are scattered lumps of it; in other places continuous layers a foot or two in thickness. It is a sort of volcanic tuff. For local use we have named this pumilith. It is an interesting pumiceous-calcereous rock. Likewise volcanic soil is occasionally found. There are certain tracts where extensive pumicite beds are exposed to the action of the elements, and are altered into rusty volcanic soil, which we have named pumicite soil.

DIATOMITE

Diatomite, or diatomaceous earth, is an exceedingly fine white powdery substance, often confounded with chalk, fine white silt, and pumicite. Under the glass, however, the test is easy: diatomite is composed of symmetric and ornate siliceous shells of minute aquatic plants; pumicite is glassy, and angular, and has no definite

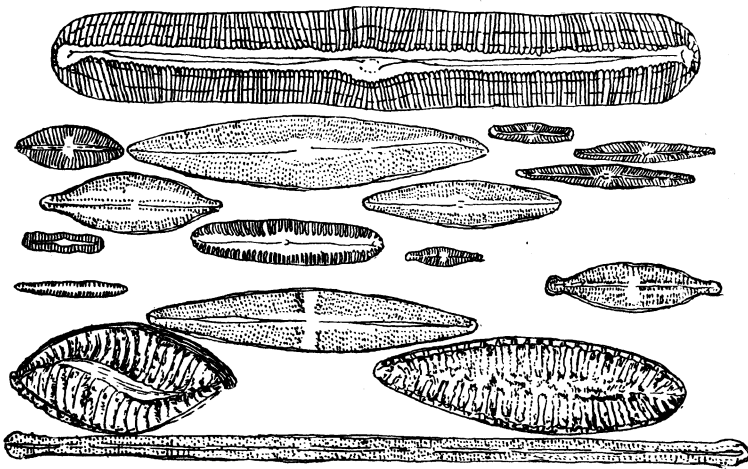


Fig. 16.—Diatomite of Nebraska. Highly magnified.

shape; silt looks like coarse sand. Try this simple test: if diatomite is free from impurities, lumps of it dropped in water will float, until they become water-logged. The other substances named will not float. The

acid test will serve to instantly distinguish chalk from diatomite. (See Limestone.) Diatomite will not effervesce in hydrochloric acid, while chalk will. Diatomite, in this State, is generally of a grayish-white color, occasionally nearly white, and in some cases nearly black, because of the admixture of clay and peaty matter. In some states, pure white diatomite occurs in beds of great thickness. It has been used for a great variety of purposes, and at the present time there seems to be an increasing demand for it. The thickest beds known in Nebraska are those in the region of the Loup River, where nearly pure diatomite, six feet in thickness, may be found. It is a finer abrasive than pumicite, and may be used for polishing silver. As far as can be learned, the deposits of diatomite in this State have been put to no commercial use. The work of exploring, studying, and reporting upon our diatomaceous deposits has been assigned to Mr. C. J. Elmore, Professor of Science in Grand Island College. His report is to be published in the spring of 1915.

CONCRETIONS

Concretions are common everywhere, and always attract attention, especially those which simulate familiar objects, such as nuts, fruits, and creatures. They vary so widely in their structure and origin that

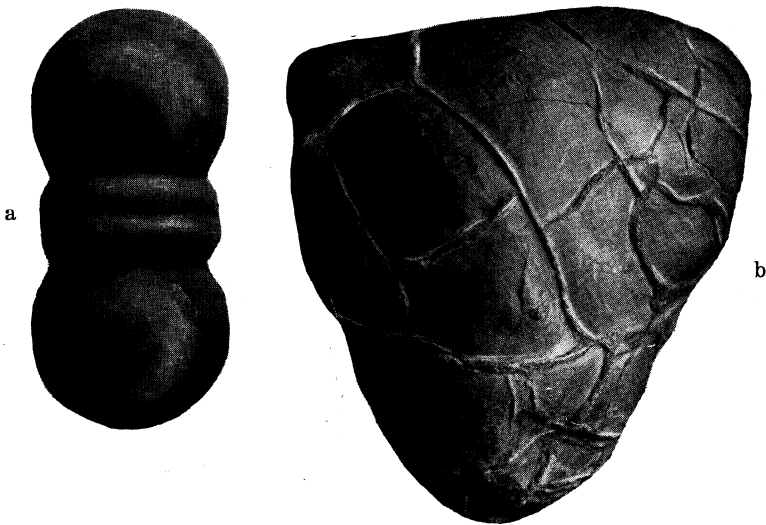


Fig. 17.—Concretions. a, marcasite dumb-bell, Plattsmouth, Nebraska. Natural size; b, clay concretion (Septarium) simulating a beef's heart, Brownville, Nebraska. $\times \frac{1}{2}$.

it is difficult to offer any definition which will cover all cases. However, those in Nebraska do not differ widely, and it may be said briefly that they consist of native sand, clay, lime, or other materials, mineralized or hardened about some nucleus, which, in some cases, is a decaying object.

On drying, clay concretions may shrink and crack and the spaces may afterwards be filled with some of the various mineralizing substances, especially lime. (Note the heart concretion shown in figure



Fig. 18.—Sand concretion simulating a pup seal. Natural size. Found at Indianola, Redwillow County, Nebraska.

17b.) These concretions are very abundant, especially in the Pierre shale, and are commonly called "pineapple concretions," "partition stones," or better still, Septaria.



Fig. 19.—Sand concretion simulating a dog's head. $\times 1\frac{1}{2}$. From a sand pit near Malcolm, Lancaster County, Nebraska.

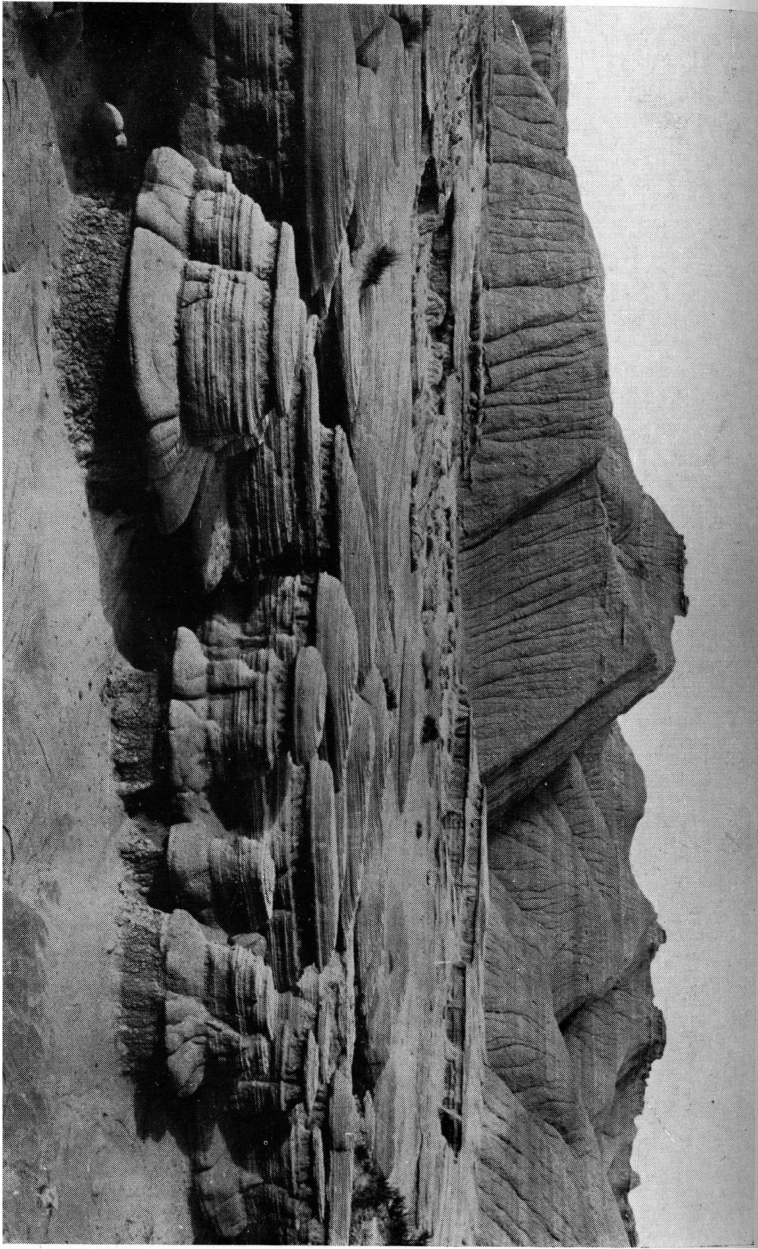


Fig. 30.—Sand concretions, Toadstool Park, Sioux County Bad Lands, near Adelia.

In some localities, large concretions of our Pierre shale are veritable storehouses for fine shells. In the sands of the Dakota formation, the concretions are often round and rusty, and simulate small cannon balls. More frequently they are irregular forms, commonly hollow, and resembling cast iron on fresh fractures. In certain Tertiary sandstones of western Nebraska, concretions shaped much like great eggs occur in thousands, and in places are united into strings and pipes.

Concretions are commonest in our well-known loess formation, where they occur in legions, and assume a wide range of forms, many simulating all kinds of familiar objects. Some are irregular, while others are roundish, white lumps of lime, which can easily be tested with acid, as directed under Calcite. These lime balls on weathering are often reduced to loose lime. Upon examination, this proves to be composed of minute crystals of calcite.

FLINT NODULES

Flint may be classed with nodules and concretions, and an explanation of its origin may cast a little light upon our commercial flint beds. Many animals, and some plants, secrete skeletons of a flinty nature, the bulk of them microscopic. When marine limestones are deposited, siliceous spicules and shells are sometimes scattered throughout the mass. Under favoring conditions, such as the presence of alkaline

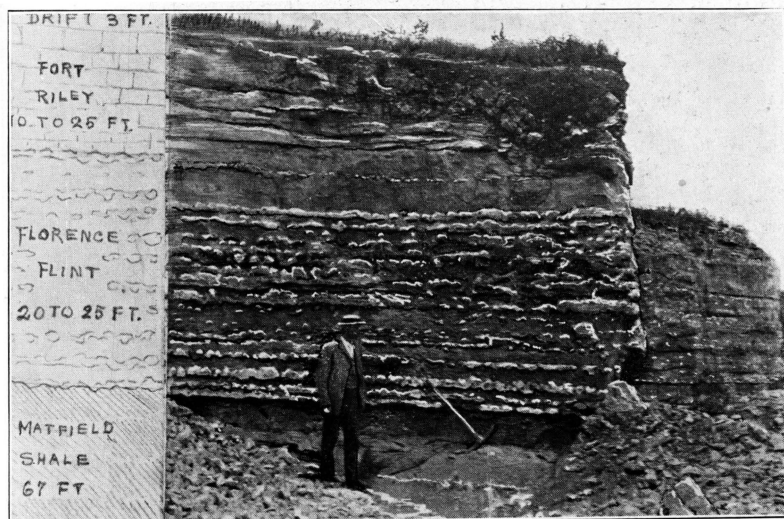


Fig. 21.—Flint beds at Wymore and Blue Springs, Nebraska.

water, these minute spicules and skeletons are dissolved, and by an intricate chemical process the lime is displaced and flinty material substituted forming lumps or nodules. For many square miles flint nodules are interspersed throughout some of our best stone layers, thus damaging or ruining them altogether for dimension stone.

At Wymore and Blue Springs, these flinty nodules are in such numbers that they may be considered a continuous bed of flint approximately 20 feet in thickness. As a rule, nodules and concretions have little value outside of certain desirable specimens which find their way to public museums. An important industry, however, is based upon the layer of flint nodules at Wymore and Blue Springs³ where three large quarries are in operation producing riprap, ballast for railroads, and crushed stone for concrete mixtures. It is said that for some three hundred miles one of our railroads is ballasted with this crushed flint, and that many carloads of flint riprap have been shipped to the Missouri River to prevent wash along its shores. Considerable amounts of Missouri flint chips, produced incidentally to the mining of lead and zinc, have been displaced through the development of our own flint beds.

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3. Barbour, E. H., The Flint Ballast Industry of Gage County, Nebraska, Nebr. Geol. Survey, vol. 3, pt. 5, pp. 231-242; and An Important Undeveloped Clay Bed, Nebr. Geol. Survey, vol. 4, pt. 6, pp. 68-87.