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An Important Undeveloped Clay Bed

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NEBRASKA GEOLOGICAL SURVEY

ERWIN HINCKLEY BARBOUR, State Geologist

VOLUME 4

PART 6

AN IMPORTANT UNDEVELOPED CLAY BED

BY

ERWIN H. BARBOUR



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AN IMPORTANT UNDEVELOPED CLAY BED

BY ERWIN HINCKLEY BARBOUR

The purpose of this paper is to set forth briefly the possibilities of developing an important clay industry at Blue Springs and Wymore in Gage County, Nebraska, where a remarkable and wholly undeveloped clay bed has been exposed. Out of desire to further the interests of his commonwealth by exploring and publishing its natural resources, every State Geologist is unconsciously predisposed to sanguine views respecting manufacturing possibilities.

The clay beds at Blue Springs and Wymore seem so unusual as to justify a special report in an effort to interest manufacturers in establishing one or more brick plants here. These clay beds should tempt clay workers inasmuch as they are extensive, well situated for the manufacture of brick, have ample shipping facilities, and there is



Fig. 1—Jointed face of the Union Pacific Quarry showing Florence flint resting upon Matfield shale.

The accompanying illustrations are from Hon. Charles H. Morrill's collection of geological photographs.

always a ready market. It is doubtful if an opportunity of greater promise presents itself anywhere in the State.

It is interesting to note the extent to which luxuries have become necessities. The pioneer sod houses gave way to frame structures, which are now being replaced by those of brick, stone and stucco. The demand for paving brick, building brick, fancy brick, terra cotta, sewer pipes, roofing and drain tile has never been met by the Nebraska producers, and cannot be for many years to come. Extensive importations of all kinds of brick from neighboring states are made annually.

Because the Blue River has exposed ledges of rock for several miles along its north bank near the twin towns, Blue Springs and Wymore, a stone industry of some magnitude has developed there. Three quarries with crushers and screens are located here—the Atwood, the Davis, and the Union Pacific.

An average section shows thin soil, a few feet of glacial drift, 25 feet of Fort Riley limestone, 25 feet of Florence flint, 67 feet of Matfield shale, and an undetermined amount of Wreford limestone. This Matfield shale, exposed for two or three miles, with broad patches entirely stripped of overlying material, is the feature under consideration in this paper.

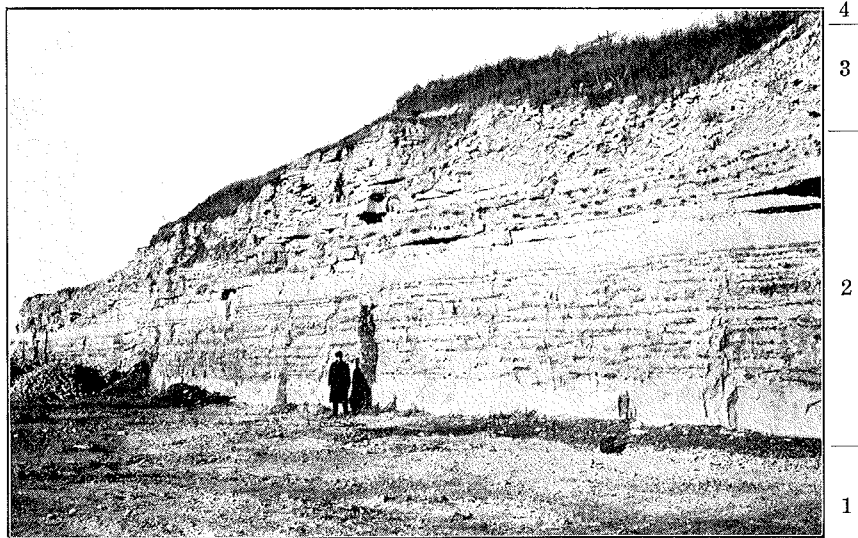
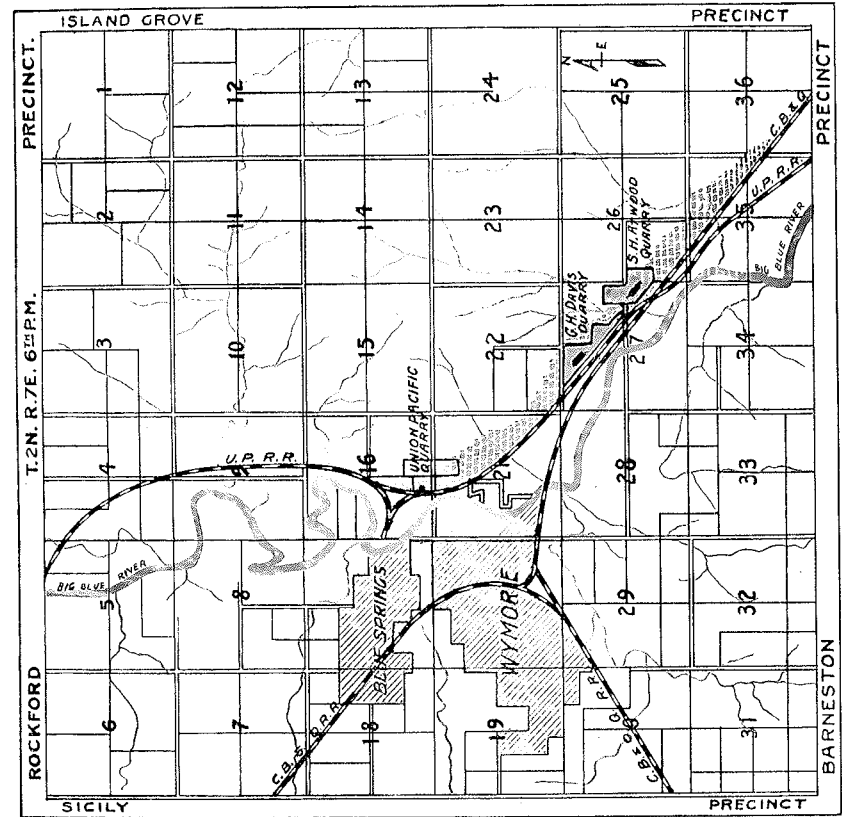


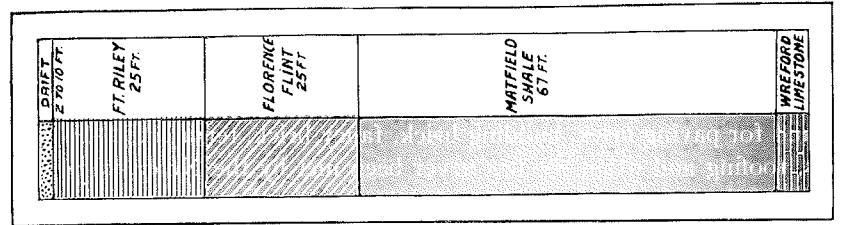
Fig. 2.—Main face in the Atwood Quarry. 1. Matfield shale. 2. Florence flint, with nodules in two distinct bands. 3. Fort Riley. 4. Drift.

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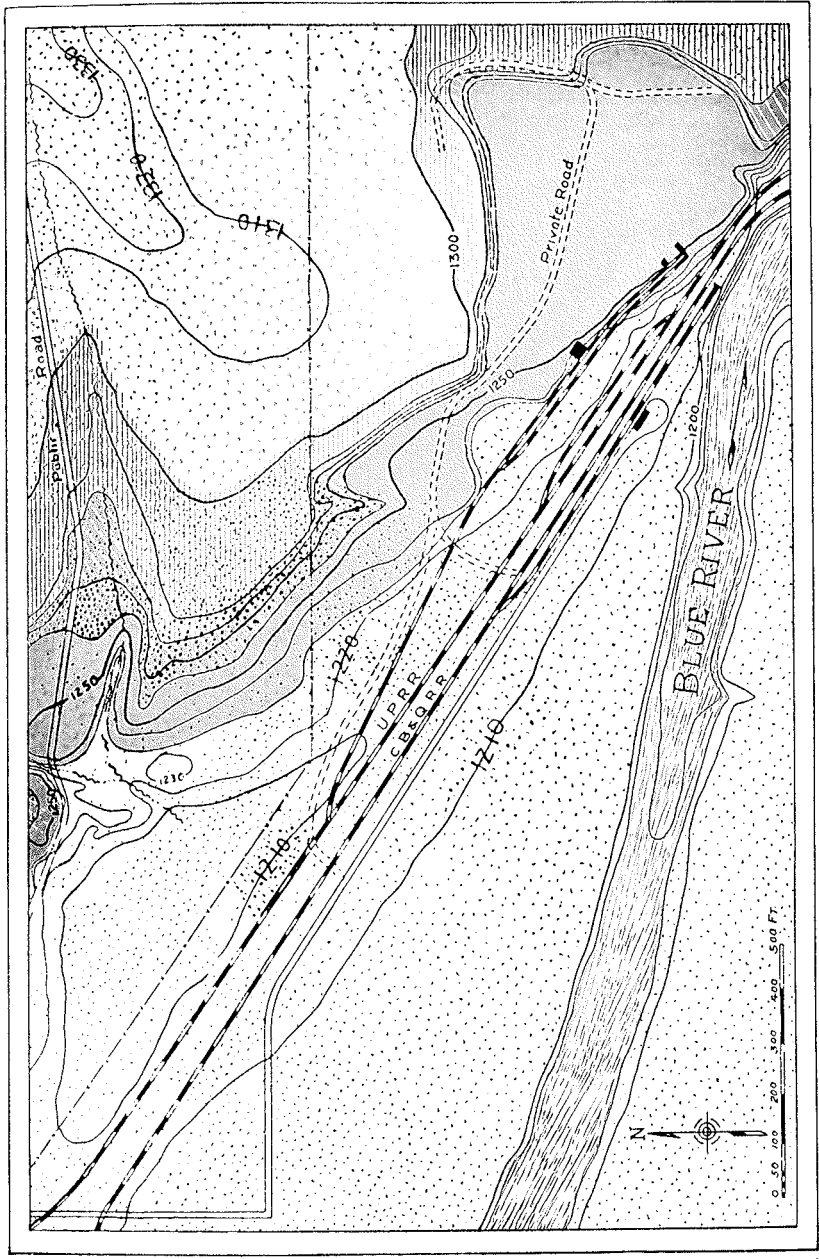
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MAP OF THE QUARRIES AT BLUE SPRINGS AND WYMORE
Blue checks indicate limestone and shale outcrops.



GENERAL SECTION
WYMORE AND
BLUE SPRINGS



MATFIELD SHALE EXPOSED IN THE DAVIS QUARRY

Topography by J. B. Burnett and R. A. Graham. December, 1912. Contour interval 10 ft.

The Davis Quarry is particularly attractive, because the entire shale layer lies high above the Blue River; and two lines of railroad—namely, the Burlington and Union Pacific—lie parallel to and immediately at its base. The shale stands high above the tracks; and natural drainage is assured.

Upon the Matfield shale lies a bed of flinty limestone known as the Florence flint, some twenty-five feet in thickness, containing 15 to 20 feet of nearly solid flint. This layer is crushed into excellent flint ballast, used extensively by Nebraska railroads. It is also furnished in large blocks for rip rap. While working the flint layers excellent dimension stones are quarried from certain layers. The Florence flint is probably the most distinctive layer in our Permo-Carboniferous and can instantly be recognized without geologic training. It is a most satisfactory and unmistakable stratigraphic landmark.

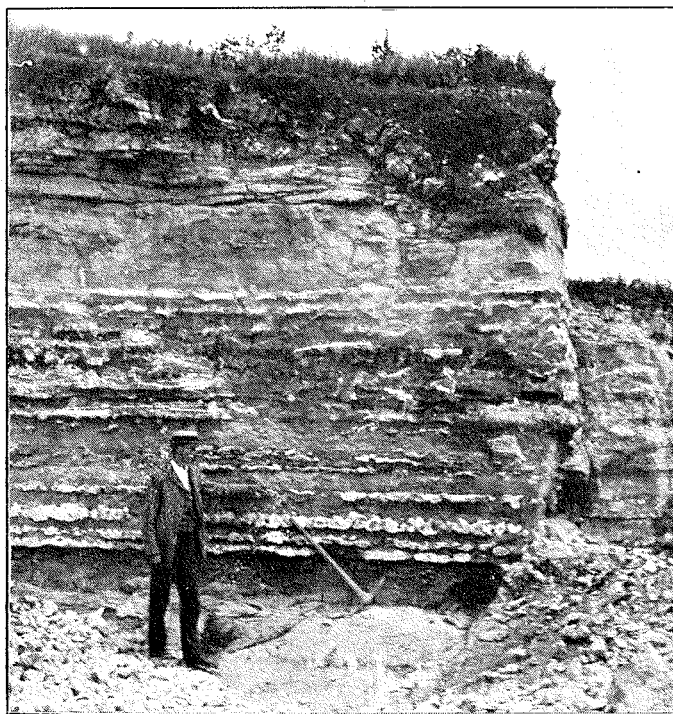


Fig. 3—Close view of a joint plane, Atwood's Quarry, showing flint nodules. The quarry floor is Matfield shale.

Directly upon the Florence flint lies a bed of argillaceous limestone, the Fort Riley layer, which is worked along with the flint layer. Accordingly everything is stripped to the clay layer, leaving acres of clean, level quarry floor.

The Atwood Quarry was opened about two miles southeast of Wymore, in March of 1902; since then about a hundred and twenty-five men have been kept in employment. About 100,000 tons of rock are produced annually, of which sixty per cent is screened flint ballast. Three-quarters of a mile of quarry face has been developed, and a large acreage has been stripped, exposing Matfield shale. When completely stripped this quarry will expose forty acres of workable shale.

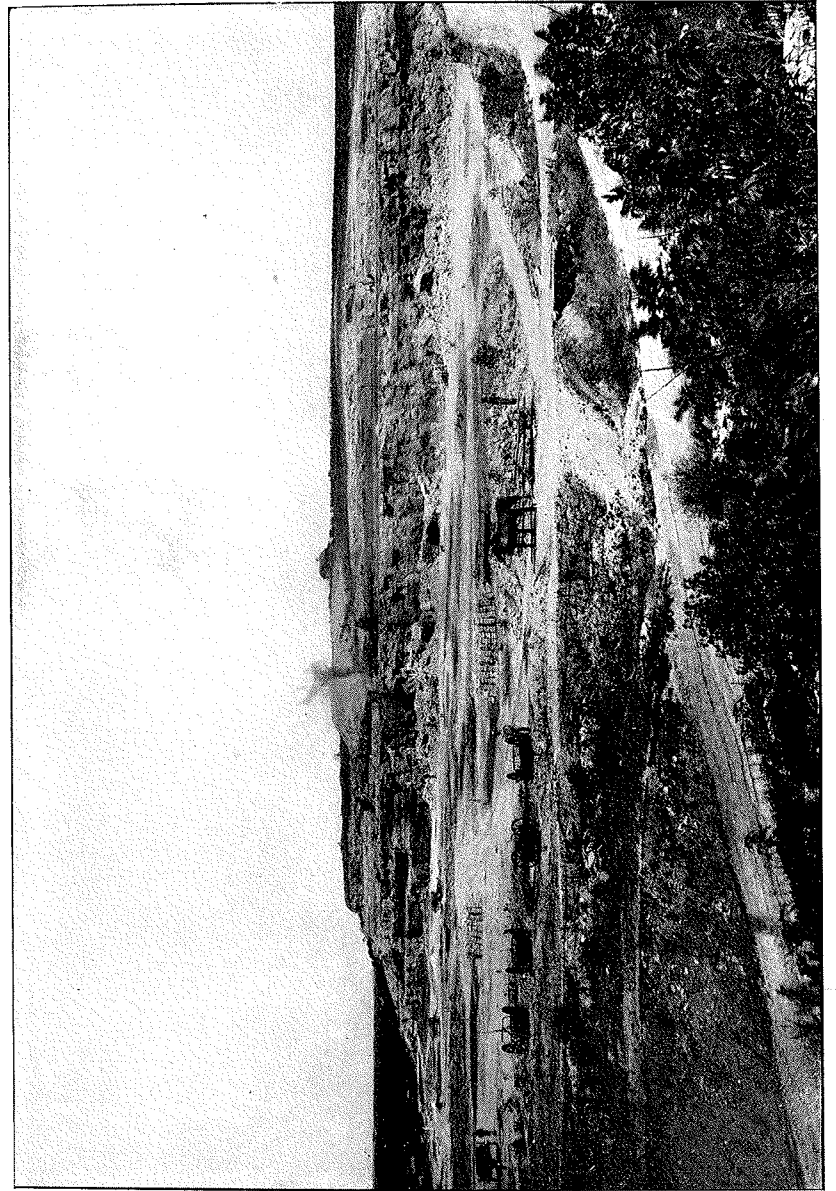
A few years ago, in April, 1906, the Union Pacific Quarry was opened about a mile to the east and a trifle south of Blue Springs. Some forty men are employed. Four thousand to five thousand tons, chiefly flint ballast and rip rap, are annually produced. A large quarry face has been developed and several acres of Matfield shale exposed. This exposure of shale will amount to fourteen acres, when the quarry is completely worked.

Between these two lies the Davis Quarry, opened in 1895, which employs fifty to seventy-five men, and produces annually about 50,000 tons of flint ballast, rip rap, and dimension stone. A large quarry face has been developed and four to five acres of shale completely stripped of rock, and exposed ready for clay workers. When completely stripped this quarry will expose forty-five and a half acres of shale sixty-seven feet in thickness. In addition, several broad exposures occur just to the northwest on the Wonder estate in ravines.

Professor Borrowman of the Department of Chemistry is making complete chemical and physical analyses of the commercial clays of the State for the Nebraska Geological Survey. Since the physical tests are much more important than the chemical, in the study of clays, Professor Borrowman has hastened to complete the physical tests, quoted below:

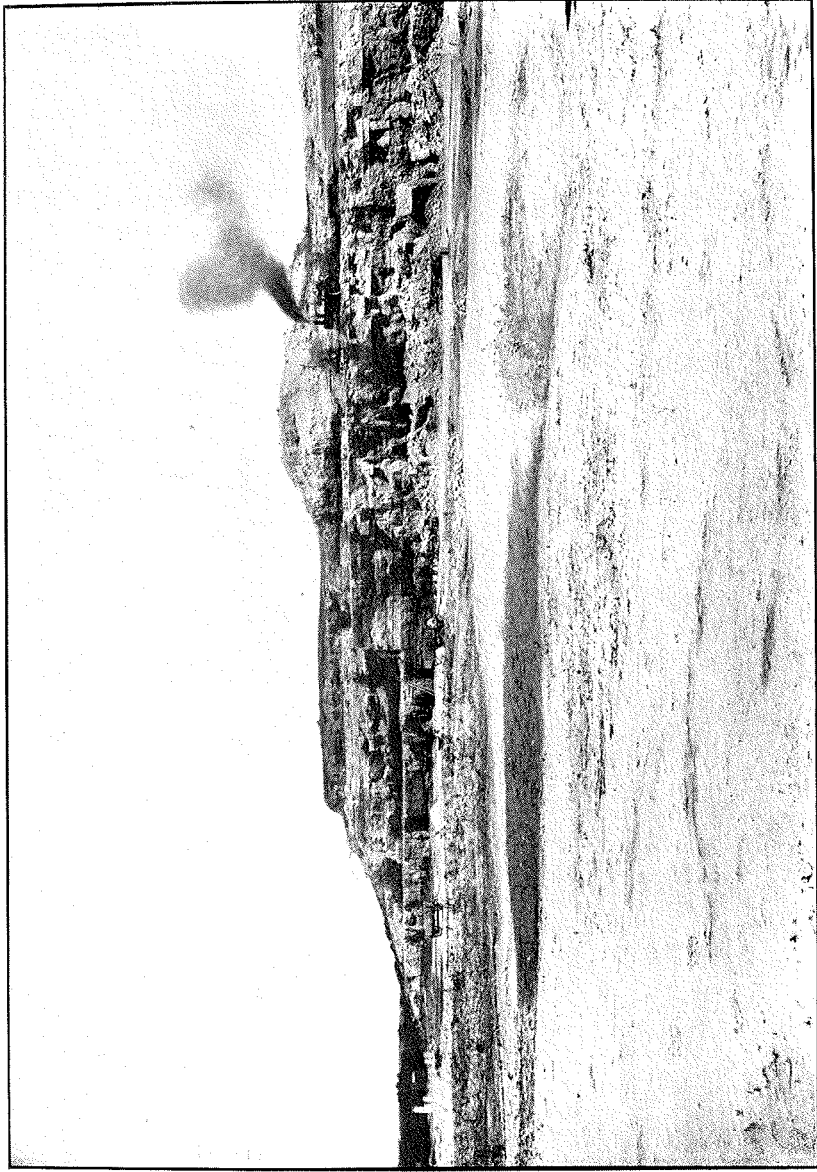
"The Matfield shale of the Davis Quarry consists of three well-defined layers differing decidedly in color, but very similar in some other physical characteristics. One hundred pound samples were taken in each instance. Sample number 1 was taken 53 feet from the base; sample number 2, 30 feet from the base; and sample number 3 from the top of the bed.

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GENERAL VIEW DAVIS QUARRY SHOWING BROAD EXPOSURE OF MATFIELD SHALE.



4

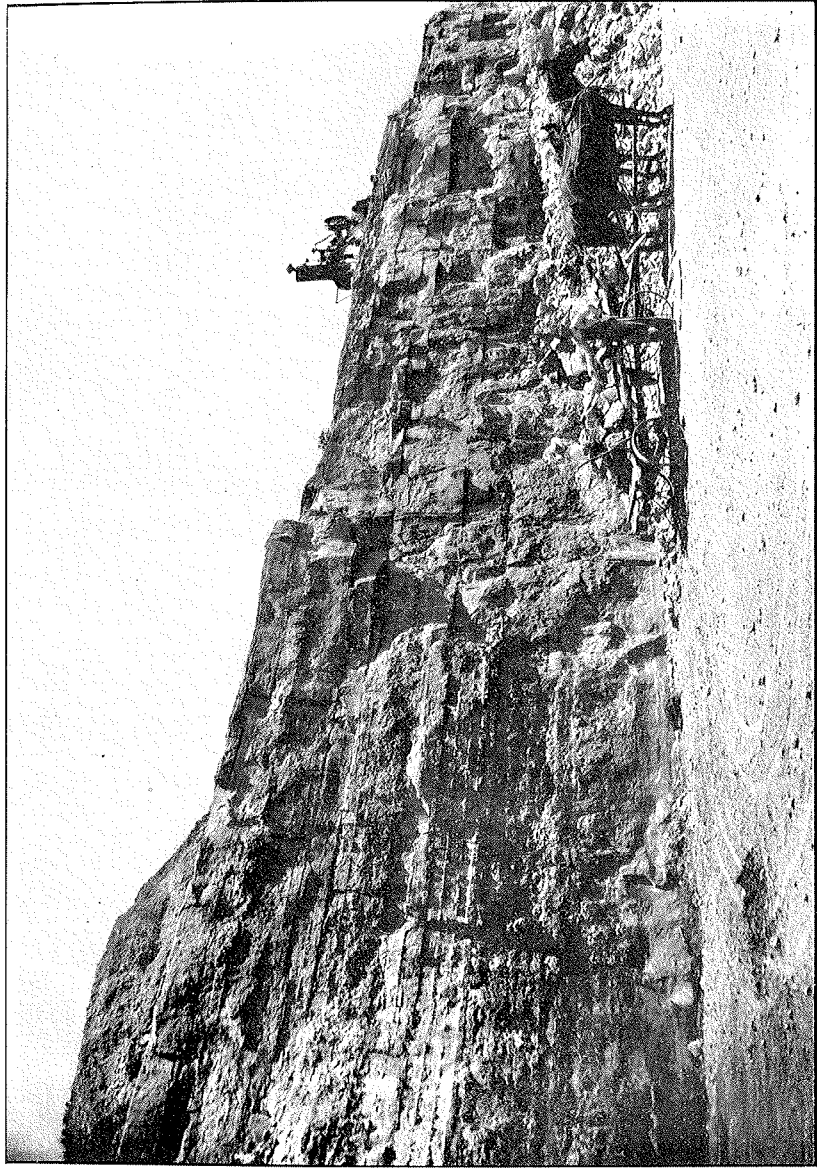
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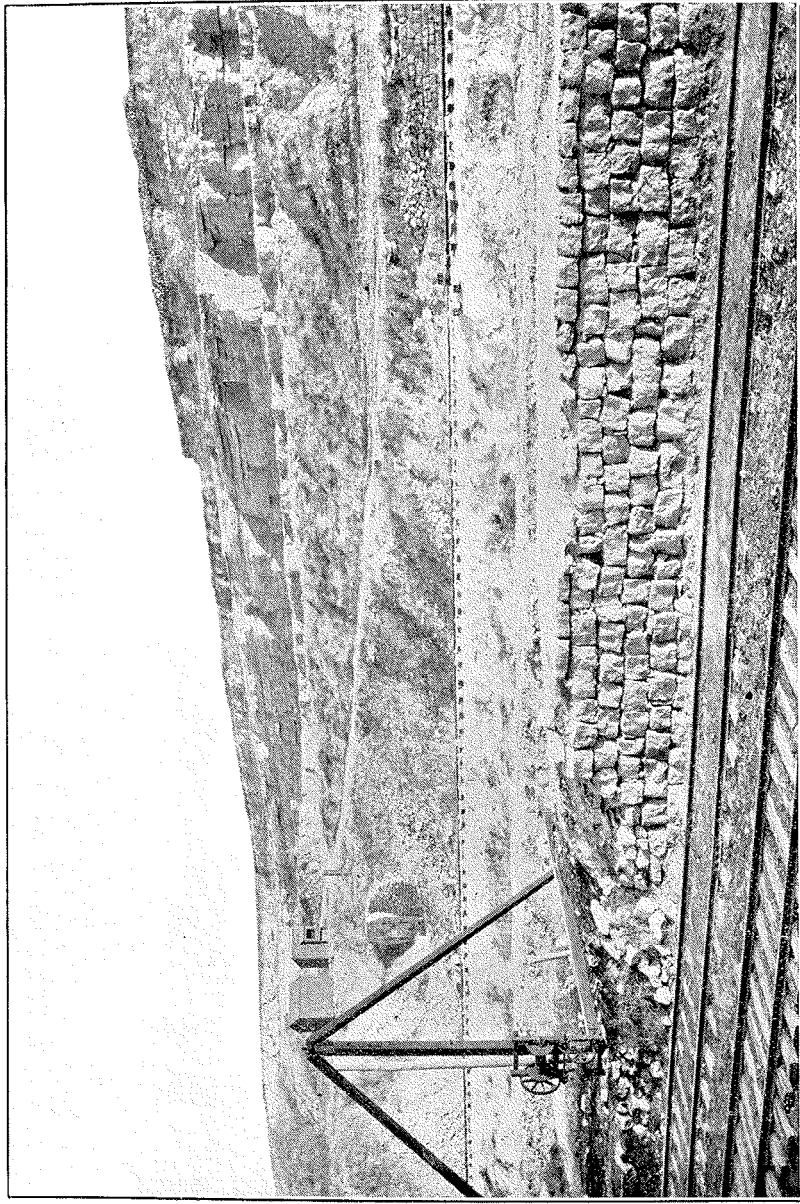
MAIN QUARRY FLOOR TOP OF MATFIELD SHALE.

1. Matfield shale.
2. Florence flint.
3. Fort Riley limestone.
4. Glacial drift.



CLOSE VIEW DAVIS QUARRY.

Quarry floor, Matfield shale; Florence flint above, capped to the left by Fort Riley and drift.



GENERAL VIEW DAVIS QUARRY.

1. Wreford limestone exposed at railroad bridge. 2. Matfield shale, 67 feet. 3. Florence flint, 25 feet. 4. Fort Riley, 25 feet. 5. Drift, 2 to 10 feet.

5

4

3

2

1

These samples were mixed and a portion of about two pounds taken for testing. Each two pound sample was crushed through a disk pulverizer set at about one-twentieth of an inch. The crushed samples were then tempered by mixing with sufficient water to give them their maximum plasticity, and thoroughly kneaded. The following observations and tests were then made: color, water required for tempering, plasticity, air-shrinkage, behavior on firing (shrinkage, color change, etc.), fusibility, and tensile strength. For determining the per cent of water, and the shrinkage and behavior on firing, small bricks about $2 \times 3 \times \frac{3}{4}$ inches were molded. Several of each were made to obtain average results. While freshly made, they were weighed, and a measured straight line drawn on each. They were then thoroughly air-dried by standing exposed for a week or more to the laboratory temperature. The dried bricks were weighed again, the difference in weight being the weight of water used in tempering. The lines were measured to get the air-shrinkage.

These same bricks were now placed in the muffle kiln, and heated gradually to cone 010 (950° Centigrade or 1742° Fahrenheit) and changes noted. The fusing point was determined by molding cone-shaped test pieces of the size and shape of standard temperature cones. These were carefully dried and placed in the muffle furnace along with standard temperature cones covering the probable range of temperature of the clays being tested. The heat was gradually applied and the simultaneous melting of the latter and the standards being noted. The tensile strength was measured in the usual way by making briquettes in cement molds and testing them in the Fairbank's tensile strength machine. Before testing the briquettes were thoroughly dried first in the air, and then in the drying oven. Pressure of the hand only, applied as uniformly as possible, was used in the molding.

A number of samples of each were tested and the average taken. The different pieces showed considerable variation, though the averages are probably approximately correct.

All three possess good plasticity. As the table indicates the air shrinkage is about the average seen in clay products, number 1 perhaps being a little above. The tensile strength is good. The low fusing temperature shows they are decidedly non-refractory. These clays will probably be found satisfactory for common brick, hollow tile, and red earthenware."

The results obtained are tabulated below :

	No. 1	No. 2	No. 3
Color	Chocolate	Pale yellow	Gray
Water %	21.3	24.	21.7
BEHAVIOR ON AIR-DRYING.			
Shrinkage %	7.81	6.76	5.46
Cracking	None	None	None
Warping	None	None	None
BEHAVIOR ON FIRING.			
Loss of weight based on air-dried brick %	14.3	11.6	8.66
Color	Reddish	Yellow-red	Pink
Shrinkage	None	None	None
Cracking	None	None	None
Warping	None	None	None
Hardness (Moh's scale)	3	3	3
Tensile strength pounds per sq. in.....	198	192	194
Fusing point	Cone 4 (1210° C or 2210° F)	Cone 5 (1230° C or 2246° F)	Cone 5

Extensive plants in Omaha, Lincoln, Nebraska City, Hastings, Table Rock, Humboldt, and other cities are in successful operation. The combined efforts of all these plants fail to meet the constantly increasing demand for brick. Fine beds of clay lie neglected and undeveloped while the demand for brick far exceeds the supply.

Under the present conditions, success is assured to clay industries developed in a state having such remarkable agricultural stability as Nebraska.

During the past few years there have been many inquiries by Eastern correspondents respecting special and general clay openings in Nebraska; and a report has been prepared by the Nebraska Geological Survey, covering the status of the clay industry throughout the State. This report is in press and will soon be ready for distribution.

Topographers are now at work making maps of undeveloped clay pits and exposures, and samples are being taken for chemical and physical tests, and when these are completed, the Nebraska Geological Survey will publish the results, with a view to furthering the clay industry in the State.

Nebraska is already shipping some of its brick to other states, and if properly fostered the industry can yet meet home demands, and have a large surplus for export.

The University of Nebraska,
December, 1912.

Distributed January, 1913.