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The Clays of Minnesota

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each foot in depth, this bog alone contains approximately 896,000,000 tons of air-dry machine peat fuel.

USE

It seems probable that the most profitable commercial use which can be made of the peat in Minnesota at the present time is the manufacture of power in peat producer-gas plants. This has been highly successful in a number of large plants in Europe, and there seems to be no reason why their success can not be duplicated here. As the rapidly diminishing timber supply of northern Minnesota becomes exhausted, peat will be used more and more for fuel. Already the coal resources of the United States have shown great depletion, and in the near future we may expect to see the beginning of this new industry—the manufacture of machine peat for domestic fuel.

MINNESOTA

THE CLAYS OF MINNESOTA*

By F. F. Grout

University of Minnesota

WHILE the clays of Minnesota play a subordinate part in her mineral resources, due to the importance of iron ore, there is in the state a noteworthy industry based on a considerable variety of clays. Furthermore, a careful study of the materials and a search for deposits now concealed, may lead to notable developments in the future. Even now the clay industry in Minnesota involves from one and a half to two million dollars annual production, a large part of which is pottery and sewer pipe from the deposits near Red Wing. Common and fancy brick are produced in all parts of the state, and no better building material can be found than is made within the state.

Near Red Wing the clays are light gray, and banded, and were accumulated in Cretaceous time. Later geologic events have disturbed them somewhat, and to some extent, isolated the relatively small parts of a large formation. Smaller fragments of the same formation are known in other places in the neighborhood. Much of the clay needs washing, before it is in condition for use in making stoneware, as it contains some coarse and dark-colored minerals. Sewer pipe are made from the poorer grades of clay in the same deposits, and for these, no washing is needed. The thickness of the clay deposit is variable, rising to a maximum of over 40 feet, though many layers of sand are interbedded. The clays used at Red Wing are shipped in a few miles from Clay Bank and Belle Chester.

The Decorah Shale.—There is a large shale formation—a hardened clay—of very different character, extending from the vicinity of St. Paul, south and southeast. This is known as the Decorah shale, from outcrops at Decorah, Iowa. It is a green shale, and likely to be contaminated with lenses

*Acknowledgements are hereby made to Bulletin 11, Minnesota Geological Survey, "The Clays and Shales of Minnesota," by Messrs. Grout and Soper.

and layers of limestone. Most of it is very fusible, and the burned product is colored by the iron it contains. However, the process of fusion is gradual and if it is carefully controlled, brick and tile can be burned to a very dense vitrified product. At West St. Paul, many fancy-front brick and "klinker" brick are produced with a large assortment of handsome colors.

Other Deposits.—The other bed rock formations of the state which have ceramic interest are: more fusible Cretaceous shales known at Springfield and New Ulm; the residual kaolins of the Archean and Huronian; and the somewhat metamorphic slates. It is thus evident that while Minnesota has not extensive refractory shales, that compare with those of Illinois and Ohio, there are large formations capable of making excellent ware.

These are the clays of the state, which, having been formed by some mineral alteration in early geologic ages, and having accumulated in beds of considerable thickness, were incorporated in a series of rock formations, often associated with sandstone and limestone. If they were covered by a great weight of overlying beds they were hardened into shale, but this does not prevent their use as a clay. Unfortunately for the development of these clays in Minnesota, more recent geologic events have spread a mantle of debris over most of the bed rock clays and they are rarely seen except in the gorges of the rivers.

The Glacial Drift.—The concealing mantle, however, has in itself some interest as a clay. It is the glacial drift brought into its present neighborhood by the action of a great continental glacier. This ice sheet entered the region from two or three directions, and on its way gathered in portions of the clay beds it crossed. These clays, mixed with sand and rock, now form the drift mantle. Scarcely a county in the state lacks drift clays that can be manufactured into common brick.

A large part of the state received a cover of *gray drift*, material which came from the northwest and which contains a high proportion of lime. The texture and physical state of this lime has been the decisive point in the success or failure of the attempts to use the clays of the drift. If the lime is in the form of pebbles, there is difficulty in making good brick without an expensive treatment to counteract their effects. However, along the rivers and in some of the lakes, Nature has done the preliminary washing and clays of the gray drift have been freed from pebbles. These make excellent cream colored brick and fireproofing. Where the demand for brick and drain tile warrants it, an artificial process can be conducted so as to yield good results; as, for example, at Hutchinson. Some other methods of utilizing the gray drift have at least partially succeeded; and attempts have been numerous, because of the large amounts of the clay in easily accessible places.

In the northwest quarter of the state this drift was once flooded by a glacial lake—Lake Agassiz,—and its deposits, as well as those of the Red River, now draining the area, are of a slightly different type. The clays, however, have the same defect, the small fragments of limestone.

In the eastern and northeastern quarter of the state there is a superficial

deposit of *red drift* which is radically different from the gray. A much smaller proportion of the drift is clay, and when clay occurs, it contains pebbles, not of limestone but commonly of granite and related rocks. These do not have so serious an effect as the limestone, which may slake and swell after burning, but the clay is, of course, improved by their removal. A large plant at Coon Creek, near Minneapolis, is using the red drift clay, after passing it through conical rolls to remove pebbles. The product is an excellent grade of hard red brick, for the clay can be safely vitrified. In the few places where Nature has washed the pebbles from this red drift clay, the resulting clay is extremely plastic and shows such a high shrinkage as to make it difficult to manufacture. It yields good vitrified products, however, as shown by its use at several plants in Wisconsin. Such clay is abundant around Lake Superior and along the St. Croix River.

In a few places, notably at Wrenshall, and along the rivers farther south, washed clays have been mixed by natural processes, being derived partly from the gray and partly from the red drift.

In the southeastern corner of the state there is an area in which are many deposits of *loess*, a material derived by some process of working over and assorting surface material. The loess is used at Preston and elsewhere for excellent red brick.

MINNESOTA

ROCK QUARRYING INDUSTRY IN MINNESOTA

By T. M. Broderick
University of Minnesota

THE stones quarried for building purposes in Minnesota are chiefly granite, sandstone, and limestone. The limestone area is mainly in the southeastern part of the state, along the Mississippi river, and westward to the middle and southern parts of the state. The sandstone occurs along the western boundary of the limestone area, in the southwest corner of the state, and near Lake Superior. The important granite producing areas are along the upper Minnesota valley at Ortonville and Redwood Falls, and in the section centering about St. Cloud. As most of the state is covered with drift the quarries usually occur along the sides of the valleys where the streams have exposed the bed rock.

The region in Stearns, Benton, Sherburne, and Kanabec counties, but centering mainly about St. Cloud, is the largest granite producing area in the state. Here pink, red, and gray granites are quarried. The coarse grained pinkish-gray granite in the basement of the new capitol at St. Paul is from the St. Cloud quarries. The red stone is used for polished monumental works, pillars, and columns. The gray stone is used for monuments, building stone, curbing, and paving blocks. In the vicinity of Ortonville a dark red granite is quarried which is being used extensively in the Twin Cities.

In the southwestern corner of the state a quartzite, locally called granite