

the new conditions of temperature and pressure, and became what is known as metamorphic rock — the third class. Marble is a common metamorphic rock.

Rocks of all three classes have been used by man, and much of the stone secured by quarrying. The ancients, of course, took what was nearby, so whether they quarried an igneous, sedimentary, or metamorphic rock depended upon what was within hauling distance. The Egyptians quarried limestone for the building of the Pyramids. The Romans and Greeks quarried great quantities of marble. The Mayans used enormous quantities of limestone, a sedimentary rock, in their extensive building.

The Geology of Iowa

Let us review the geology of Iowa before taking up the quarries. Most of Iowa, and of the upper midwest for that matter, is covered with a mantle of glacially deposited material — the glacial drift, which constitutes the bulk of the subsoil. Here and there above it lies a deposit of wind-blown silt — the loess. Along the valleys are stream-laid deposits. These three materials are only in the way of the quarryman wishing to get at the rock below. They form the "overburden" of the quarries; the less the better, from the standpoint of the quarry operator.

The drift, the loess, and the stream deposits average approximately 200 feet in thickness. Below

them lies the solid rock of the earth's crust, the bedrock; in places it is at the surface, particularly along valley-sides.

Sioux Falls Stone

In the extreme northwestern corner of the state, in Lyon County, the geologically oldest rock appears at the surface. This is a metamorphic rock called quartzite — a hard, brittle stone which is quarried at Sioux Falls, South Dakota. Geologists call it Sioux quartzite but it is commonly known as Sioux Falls stone. It has not been quarried in Iowa except on a very small scale.

Other Iowa Bedrock

Elsewhere in the state, the bedrock is entirely sedimentary. It is piled layer upon layer: limestone, shale, sandstone, conglomerate, coal, gypsum. In the eastern part of the state, these rocks have a gentle dip, or slope, ten or twelve feet to the mile, toward the southwest. Similarly, these same beds in the northern part of the state dip southward; and in the western part, southeastward. Thus, they have an arrangement like that of a pile of nested spoons with the tip toward the northern part of the state and extending up into Minnesota, and the bowl in the southwest corner and beyond. The land surface cuts right across the edges of these nested spoons.

The oldest of these sedimentary rocks outcrops around the outer part of the spoonlike structure, each succeeding horizon within, until finally the

youngest of the columns forms a large area in the southern and southwestern counties. In the northeastern corner, where only the older are present, these sedimentary rocks are a thousand feet in thickness; in the southwestern part, they are about 5,000 feet thick. Beneath them everywhere lie much older, presently inaccessible, so-called crystalline rocks, such as quartzite and granite.

In the northwestern counties, a rather thin deposit of younger bedrock lies almost horizontally upon the truncated beds of the spoon-like structure described above. It also extends toward the south in patches and broader areas. Most of it is sandstone, though conglomerate, clay, and chalk (a soft variety of limestone) are also present. It ranges up to about 400 feet in thickness.

Geologic Groups

Geologists have divided the long span of earth history into eras, and the eras into periods. The rocks corresponding to these are groups and systems respectively, and the systems are further subdivided into series and formations. The quartzite of the northwest belongs to the Proterozoic group; the rocks of the spoon structure to the next succeeding group, the Paleozoic; and the blanket of western counties to the still younger Mesozoic.

Geologic Systems

The systems of the Paleozoic are, from oldest to youngest: Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian, and Per-

mian. All are represented in the bedrock of Iowa. Of the three systems of the Mesozoic, only one (called the Cretaceous) is present in Iowa. It forms the blanket above the Paleozoic rocks in the northwest and western areas. The geologic map on the back cover shows the distribution of these systems in the state, accompanied by the sketch cross-section to show the structure.

Rocks of all these systems have been quarried to some extent in Iowa. Some systems are almost entirely one kind of rock, as is the case with the Silurian — largely a variety of limestone. Others are composed of shale and sandstone, as well as of limestone. The conglomerates (coal and gypsum) make up only a small part of this sequence of sedimentary rocks.

Most of these rocks then are interpreted as the hardened deposits of sediments which were laid down in seas spreading over the continent in ages past, shallow seas which were connected with the broad oceans of their time. Sand deposits became sandstone, clay became shale, and limey mud, sea shells, or ooze became limestone.

Layers, or Beds of Rock

All of these rocks are in layers, or beds. Some of the beds are many feet thick, others only a few inches. In one quarry, the rock may be all limestone in beds of variable thickness. Below the quarry floor, there may be a bed of sandstone, and below that, layers of other sedimentary rocks. In

another quarry, there may be beds of limestone and shale, or of sandstone in addition. The quarry operator may be interested only in the limestone, so the other rocks really constitute a hindrance to his operation. Limestone, of one variety or another, is the rock which has been most widely quarried in Iowa. It makes up a large part of our geological column.

Joints

The fact that these sedimentary rocks are in layers instead of in great solid masses is an aid in their extraction. So, also, is the presence of joints. These are straight cracks — vertical or nearly so — variably spaced, which extend through the rock. Joints exist in sets, and there are frequently two or more sets in a single quarry. Obviously, if it were not for the bedding planes separating the beds, and for the joints, getting the rock out would be a much more difficult job than it is.

Wherever the country has been dissected by stream action so that there are many valleys and ridges, these layers of sedimentary rock may outcrop. By this, we mean that the beds actually stick out at the surface. In the northeastern part of the state, the terrain has been cut up by post-glacial erosion, and rock outcrops are very abundant. Over much of the north-central and northwestern parts of the state, covered by more recent glaciers, the drift is thicker and relatively undissected, so bedrock outcrops are few. Some counties have