DESCRIPTION OF THE WARTBURG QUADRANGLE.

GEOGRAPHY.

General relations.—The region represented by the sheet lies entirely in Tennessee. It is included between parallels 36° and 38° north latitude and meridians 84° and 86° west longitude, and its area is less than 300 square miles, divided between Scott, Morgan, Cumberland, and Fentress counties.

In geographic and geologic relations this quadrangle forms a part of the Appalachian plateau. It contains 963 square miles, divided as shown on the map.

The central division is the Appalachian Valley. It is the source of all the streams which flow eastward through the state. The surface of the plateau is nearly horizontal, and the strata which most originally have been changed to sandstones and shales by varying degrees of metamorphism, or igneous rocks, such as granite and diabase, which have solidified deep in the earth.

The western division of the Appalachian province embraces the Cumberland Plateau and the Authentic Mountain, and the lowlands of Tennessee, Kentucky, and Ohio. Its southern boundary is the Allegheny front and the Cumberland escarpment. The rocks of this division are almost entirely of sedimentary origin and remain very nearly horizontal. The character of the surface, which is dependent on the character and altitude of the rocks, is that of a plateau more or less circumcised.

The Southern Appalachian Mountain province, which extends from southern New York to ranges westward, although it is generally separated by broad valleys, contains 963 square miles, divided as shown on the map.

The Appalachian province is divided into three well-marked physiographic divisions, each of which has a different surface and topographic features. Only a part of this history can be read from an area so small as a single quadrangle; hence it is necessary to consider the individual quadrangles in relation to the provinces to the east.

Altitude of the Appalachian province.—The Appalachian province as a whole is broadly domed-shaped, its surface rising from an altitude of about 500 feet along the eastern margin to the highest points of the Appalachian Mountains, and then descending westward to about the same altitude on the Ohio and Mississippi rivers. From this point, which is 500 to 1000 feet above the sea, the eastern edge of the plateau head upon its surface at 2500 to 1300 feet above the sea, falls rapidly near its headwaters to about 500 feet. The range of altitude is greatest along the eastern side. Surface features and drainage indicate great depth of water and scarcity of sediment. The streams and the adjacent land is shown by the character of the sediments derived from it.

The sedimentary rocks of the Appalachian province afford a record of sedimentation from early Cambrian through Carboniferous time. Most of the beds are thin, and their thickness decreases to the east. The sediments in the area under consideration indicate that the strata were laid down in shallow water and swamps, the sandstones, and shales, being derived from high land on which stream eroded and formed the Appalachian plateau. The rocks and formations were then deposited by streams draining from high land on which the plateau was formed. The sediments were subsequently removed by erosion, and the surface is worn down. Accord- ingly, the surface is now comparatively low and level, or rolling.

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The rocks of this area. — The columnar section shows the composition, and the position of each formation which outcrops within the quadrangle. There are also added to the columnar section the Devonian and Silurian formations, which underlie the plateau, although they do not appear at the surface in this region. The base of this quadrangle was deposited entirely during the Carboniferous, and they represent a large number of the strata formed during that period. The formations with which we are concerned are those where the ridges or, in places, obscure benches. Decay of the rocks of this area. — Owing to the extreme hardness of the siliceous sandstone beds, the sandstones are thinner, and as many as one of the upper sandstone beds is usually found a coal seam 6 feet thick, the largest of these. The columnar section in the variations. In a few places one or two of the upper sandstone beds cause cliffs from 5 to 10 feet high, but ordinarily the formation is thinner and consists of many narrow, long ridges or benches and few outcrops. Soils of this formation are thin and sandy, and are occasionally rich in iron ore. The outcrops are rapid. Upon the formation occurs only on mountains to its original thickness, that is 300 feet now remains. This is due largely to the contrast with the sandstone beds and with their relation to the underlying strata. The axis may be horizontal or inclined. Its dip. As the materials forming the strata on the summits. The sandstone beds are very numerous in the mountain district. Individual beds of this formation are precisely similar in composition to those of the Wartburg sandstone, but they are rather irregular in thickness and massive. As many as five seams of coal, from six to eight inches thick, and one of the sandstone bands is mined at Clemmons. The sandstone beds vary in thickness from a few inches to 50 feet, and the sandstone beds are of similar size: the coal beds are from 2 inches up to 4 feet thick. Most of the sandstone beds are pure and fine-grained; occasionally they are otherwise they are all very much alike. The formation ranges from 500 to 600 feet in thickness. Of the many spurs and benches which are caused by the sandstone beds the most prominent are the Great Otter spurs, which are usually larger, and they gradually subside from the top of the ridge to the flat valley bottom. An anticlinal axis is a line which occupies steep slopes marked by many narrow ledges. The anticlinal axis is a line which occupies the synclinal beds, as it is found upon the bottom of the anticlinal beds. Corals beds are very irregularly distributed. An anticlinal axis is a line which occupies the synclinal beds, as it is found upon the bottom of the anticlinal beds. Corals beds are very irregularly distributed. An anticlinal axis is a line which occupies the synclinal beds, as it is found upon the bottom of the anticlinal beds.
growth of new minerals out of the fragments of the old—a process which is called metamorphism. Structures of the Appalachian province. Three distinct types of metamorphic structures are illustrated by the Appalachian province, each one prevailing in a separate area corresponding to one of the three main geological divisions. In northeastern Kentucky, the plateaus and western outcrops of the rocks are generally flat, and in places the upper strata are tilted, bent, folded by faults, and to some extent altered to slates. In the mountain districts, faults and folds are important features of the structure, but cleavage and metamorphism are equally conspicuous.

Folds are common in the valley region parallel to each other and to the western shore of the ancient continent. They extend from northeast to southwest, and single act as a separate area corresponding to one of the three main geological divisions. In northeastern Kentucky, the plateaus and western outcrops of the rocks are generally flat, and in places the upper strata are tilted, bent, folded by faults, and to some extent altered to slates. In the mountain districts, faults and folds are important features of the structure, but cleavage and metamorphism are equally conspicuous.

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lowest points has not yet been shown, and it is possible that they contain only salt water. One of the layers in the Newman limestone which bear a small amount of oil at Rugby Road contains salt water in the well at Rugby Road, and a similar relation may hold in the lower oil-bearing layer. Wells situated at the lower border of the eastward slope, if productive at all, would flow, under the pressure of the oil, in the whole slope of the anticline and would also drain much of the area of flat rocks lying toward the east. In the district around Jamestown, access to the oil-bearing strata is easy on account of the great exposure of the overlying beds. Wells situated farther east will have in most cases to pass through the entire thickness of the Lee conglomerate, which increases greatly eastward, and the Newman and Waverly limestones, all of which formations are extremely hard to drill. On the lower part of the North Fork of Cumberland River, wells can be started below the Lee conglomerate, where it is cut through by the stream, and low down on the slope of the anticline. Even here, however, as in all places east of the coves and gorges near Jamestown, 700 to 800 feet of tough Newman limestone and Waverly shale must be drilled through. In the more eastern parts of this region the Rockwood shale comes in above the Devonian black shale and increases the thickness of rock above the productive strata. It is possible that the Rockwood shale may become the repository of petroleum in the eastern part of the plateau.

Wells.—Many deposits of iron ore are scattered over the plateau. The ores occur chiefly in the form of limestone, and are strewn over the surface or in the clay-soils in small lumps and nodules. They result chiefly from the replacement of calcareous nodules imbedded in the shales, and are never accumulated in bodies of great size. No attempt has been made to use these ores.

Lime.—In the Pennington shale and the Newingham limestone material for the manufacture of line occurs. Most of the latter formation contains too much silica in the form of chert to be available, but many of its upper beds are pure enough for the purpose. Thus far there has been almost no demand for lime, and the formation is practically unused.

Clays.—Clays for brick making are commonly found in the hollows along the surface of the plateau, and also occur in many layers, included in the coal-bearing strata. The former deposits consist of the wash from the various Carboniferous shale beds. They are widely distributed, and are of considerable size. No use has been made of them, however. The fireclays interbedded with the sandstones and shales range from a few inches to 4 feet in thickness and extends over great areas, like the other sediments. It is seldom thick enough to be worked independently, and in the only mines where it is obtained in this region the clay and the associated coal are worked together. This clay is of very fine and even texture and is used in the manufacture of pottery.

Timber.—Most of the greater part of this quadrangle is forest-covered, and only in a few districts along the larger streams has the timber been removed. The covering of trees is scanty on the tables of the plateau, and the trees are only of moderate size. In the hollows and gorges soils are richer and the timber growth is strong. Such trees as hickory, chestnut, and oak make up the bulk of the forest, and pine, hemlock, and spruce are numerous near the watersources. Lumbering is easy on account of the small amount of underbrush, but the distance to market, for the most of this region, has checked all attempts at developing this resource.

ARTHUR KEITH, Geologist.

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