DESCRIPTION OF THE MAYNARDVILLE QUADRANGLE.

By Arthur Keith.

GEOGRAPHY.

General relations.—The Maynardville quadrangle lies entirely in Tennessee. It is included between the parallels 36° 30' and 36° 50' and the meridians 85° 30' and 84° 30', and contains 363 square miles, divided between Knox, Sevier, Anderson, Campbell, Union, Claiborne, Valley and Jefferson Counties.

In its geographic and geologic relations this quadrangle forms a part of the Appalachian province, which extends from the Atlantic coastal plain on the east to the Mississippi lowlands on the west, and from central Alabama to northern Kentucky. All parts of this region have a common history, which is recorded in its rocks, its geologic structure, and in topography. These divisions extend longitudinally the entire length of the province, from northeast to southwest.

The central part of the province is known as the Allegheny Mountain region. It is the best defined and most uniform of the three subdivisions. In its southern part it is underlain by the rocks of the Allegheny Mountain region. Its rocks are almost wholly sedimentary and in large measure calcareous.

Drainage of the Appalachian province.

The Appalachian province may be subdivided into three well-marked physiographic divisions, each of which contains different rocks and features different in the area south of New River, except the eastern part of the eastern, or Appalachian Mountain, division, being a succession of ridges alternating with narrow valleys. This division varies in width from 40 to 125 miles. It is sharply outlined on the southwest by the Appalachian province. The eastern division of the province embraces the Allegheny Mountain region. It is the best defined and most uniform of the three subdivisions. In its southern part it is underlain by the rocks of the Allegheny Mountain region.

Drainage of the Appalachian province.

The Appalachian province may be subdivided into three well-marked physiographic divisions, each of which contains different rocks and features different in the area south of New River, except the eastern part of the eastern, or Appalachian Mountain, division, being a succession of ridges alternating with narrow valleys. This division varies in width from 40 to 125 miles. It is sharply outlined on the southwest by the Appalachian province.

The Appalachian province may be subdivided into three well-marked physiographic divisions, each of which contains different rocks and features different in the area south of New River, except the eastern part of the eastern, or Appalachian Mountain, division, being a succession of ridges alternating with narrow valleys. This division varies in width from 40 to 125 miles. It is sharply outlined on the southwest by the Appalachian province.

The Appalachian province may be subdivided into three well-marked physiographic divisions, each of which contains different rocks and features different in the area south of New River, except the eastern part of the eastern, or Appalachian Mountain, division, being a succession of ridges alternating with narrow valleys. This division varies in width from 40 to 125 miles. It is sharply outlined on the southwest by the Appalachian province.
argillaceous; the mountain rocks silicious, argil-
caceous, and calcareous. In the valley the rocks lie in long, narrow beds and are often repeated by the numerous folds. In the moun-
tains the folds are very slight, so that the beds of rock are more irregular in shape, largely depending upon the location of the stream cuts. The rocks will be described in order of age.

Conasauga rocks. Rocky formation.—Six beds of this formation are found in the quadrangle, two being divided into smaller areas. All of them are in the valley of East Tennessee, principally south and east of Clinch River. The formation includes the thick, middle CLINCH COUNTY. Clinch forms an outlier of the Conasauga formation. The base is cut off by a fault. The formation appears as the Conasauga formation. The shales equivalent to all four of these formations; it is named because of its fine development in the valley of Rutledge, Grainger County. As a whole, this shale is thin or nearly absent, being mainly carbonate of lime and magnesia. It can be separated from the Conasauga shale by its much weathered condition and the uppermost 20 feet of the formation is split open and washed away. The dolomite becomes white or yellow or brown, and forms some of the best farming lands in the State.

The amount of earthy matter in the dolomite is very small (from 50 to 10 per cent), the remainder of the rock being mainly magnesium carbonate. It was deposited very slowly, and dolomite must have continued for a very long time in order to weather and accumulate such a heavy weight of rock. The dolomite represents a longer epoch than any other Appalachian sedimentary formation. Dolomite is deposited in the form of white or light-colored beds, and is generally of siliceous or argillaceous limestone, variegated marble, and quartzite. A few of the beds are argillaceous and others are thin or nearly absent, being mainly carbonate of lime and magnesia. It can be separated from the Conasauga shale by its much weathered condition and the uppermost 20 feet of the formation is split open and washed away. The dolomite becomes white or yellow or brown, and forms some of the best farming lands in the State.

The amount of earthy matter in the dolomite is very small (from 50 to 10 per cent), the remainder of the rock being mainly magnesium carbonate. It was deposited very slowly, and dolomite must have continued for a very long time in order to weather and accumulate such a heavy weight of rock. The dolomite represents a longer epoch than any other Appalachian sedimentary formation. Dolomite is deposited in the form of white or light-colored beds, and is generally of siliceous or argillaceous limestone, variegated marble, and quartzite. A few of the beds are argillaceous and others are thin or nearly absent, being mainly carbonate of lime and magnesia. It can be separated from the Conasauga shale by its much weathered condition and the uppermost 20 feet of the formation is split open and washed away. The dolomite becomes white or yellow or brown, and forms some of the best farming lands in the State.

The amount of earthy matter in the dolomite is very small (from 50 to 10 per cent), the remainder of the rock being mainly magnesium carbonate. It was deposited very slowly, and dolomite must have continued for a very long time in order to weather and accumulate such a heavy weight of rock. The dolomite represents a longer epoch than any other Appalachian sedimentary formation. Dolomite is deposited in the form of white or light-colored beds, and is generally of siliceous or argillaceous limestone, variegated marble, and quartzite. A few of the beds are argillaceous and others are thin or nearly absent, being mainly carbonate of lime and magnesia. It can be separated from the Conasauga shale by its much weathered condition and the uppermost 20 feet of the formation is split open and washed away. The dolomite becomes white or yellow or brown, and forms some of the best farming lands in the State.
red slaty limestone. These beds are, as a rule, very fossiliferous, and in the marbles especially, the fragments and gasteropods are so abundant as to make much of the rock in places as marly as shale.

The variation in the Chickamauga, in both thicknesses and appearance, is greater than in any other formation. Along the line of the Chickamauga and the Clinch Mountain, the formation consists of 2,000 feet of blue and gray limestones, pink and white marbles, and gray sandstone; while in the Clinch Mountain the formation becomes thinner, and is more fossiliferous, and the marbles are more slaty. The lower part of the formation is for the most part accessible only by descents of which the surface is entirely covered.

The thickness of the formation ranges from 1,200 feet in the Clinch Mountains to 500 feet in the Bays Mountain. Considering its thickness, this formation is one of the most persistent in the region, and is especially prominent in Clinch Mountain, from which it is named. The formation is composed of various beds of sandstone and shale, none of which is extensively developed. In this region there are a few layers of sandstone and a few beds of shale, which are too thin to show on the map, and the remainder of the interval between the beds of sandstone and the shales of the Clinch Mountain limestone is occupied by the Chickamauga limestone.

The Chickamauga limestone in the Clinch Mountain is a portion of a formation of considerable extent which is separated from the main formation by a thin, yellow clay, which is readily washed off in some cases, and in others, it appears in small knobs. The limestone is very abundant in this formation, and its mass is considerable. It is the most persistent formation in Clinch Mountain, and is composed of various beds of sandstone and shale, which are too thin to show on the map.

The formation is named for its occurrence along the Clinch Creek in Scott County, Virginia. It is a white, fine-grained, well-sorted sandstone, which is very abundant in this formation, and is the most persistent formation in Clinch Mountain, and is composed of various beds of sandstone and shale, which are too thin to show on the map.

The formation is named for its occurrence along the Clinch Creek in Scott County, Virginia. It is a white, fine-grained, well-sorted sandstone, which is very abundant in this formation, and is the most persistent formation in Clinch Mountain, and is composed of various beds of sandstone and shale, which are too thin to show on the map.

The formation is named for its occurrence along the Clinch Creek in Scott County, Virginia. It is a white, fine-grained, well-sorted sandstone, which is very abundant in this formation, and is the most persistent formation in Clinch Mountain, and is composed of various beds of sandstone and shale, which are too thin to show on the map.

The formation is named for its occurrence along the Clinch Creek in Scott County, Virginia. It is a white, fine-grained, well-sorted sandstone, which is very abundant in this formation, and is the most persistent formation in Clinch Mountain, and is composed of various beds of sandstone and shale, which are too thin to show on the map.

The formation is named for its occurrence along the Clinch Creek in Scott County, Virginia. It is a white, fine-grained, well-sorted sandstone, which is very abundant in this formation, and is the most persistent formation in Clinch Mountain, and is composed of various beds of sandstone and shale, which are too thin to show on the map.
is strikingly like the Rome formation. Beds of fossiliferous iron ore occur in it, chiefly in the western portion, in layers from a few inches up to 3 feet in thickness. The lower beds are generally yellow. Layers and nodules of black chert are interbedded with the sandstones. There are few outcrops to be found except of the heavier sandstones and limestone beds. The formation is interbedded with the Chattanagua limestone from 100 to 200 feet in thickness. It is a single bed that portion of an anticline which throughout includes the highest portion of a stratum of the arch, and is thus approximately the same in appearance throughout this region. The two small areas at the foot of Cumberland and Clinch mountains are small fragments and do not accumulate in such great masses as the shale, and the upper layers of black sandstone are interbedded with the sandstones. The formation is practically the same in appearance throughout this region, and in the Clinch mountains, beds of fine red clay and sandstone are interbedded with the lower portion of the black sandstone. In the Clinch syncline the red shales include thin layers of sand, black shale, and the upper layers of black sandstone are interbedded with the sandstones. The formation consists of massive sandstone. Some of the layers are calcareous and calcareous strata, while the sandy layers are but little affected. They gradually change, however, under rain and frost. The formation stands out in ridges rising 400 to 500 feet above the valleys on either side. These ridges are very regular in height and are frequently cut through by streams from the valleys in the Chattachoochee syncline. The Chattachoochee sand is sand and full of life, and is at high altitude, so that it is sterile and practically valuable for farming.

**Chattanooga Shale**

As was stated in the description of the Devoe rocks, the upper part of the Chattanooga is probably of Carboniferous age. Because it is impenetrable to divide this formation the whole of this quadrangle is practically the same in appearance throughout this region. The two small areas at the foot of Cumberland and Clinch mountains are small fragments and do not accumulate in such great masses as the shale, and the upper layers of black sandstone are interbedded with the sandstones. The formation consists of massive sandstone. Some of the layers are calcareous and calcareous strata, while the sandy layers are but little affected. They gradually change, however, under rain and frost. The formation stands out in ridges rising 400 to 500 feet above the valleys on either side. These ridges are very regular in height and are frequently cut through by streams from the valleys in the Chattachoochee syncline. The Chattachoochee sand is sand and full of life, and is at high altitude, so that it is sterile and practically valuable for farming.

**Chattanooga Shale**

As was stated in the description of the Devoe rocks, the upper part of the Chattanooga is probably of Carboniferous age. Because it is impenetrable to divide this formation the whole of this quadrangle is practically the same in appearance throughout this region. The two small areas at the foot of Cumberland and Clinch mountains are small fragments and do not accumulate in such great masses as the shale, and the upper layers of black sandstone are interbedded with the sandstones. The formation consists of massive sandstone. Some of the layers are calcareous and calcareous strata, while the sandy layers are but little affected. They gradually change, however, under rain and frost. The formation stands out in ridges rising 400 to 500 feet above the valleys on either side. These ridges are very regular in height and are frequently cut through by streams from the valleys in the Chattachoochee syncline. The Chattachoochee sand is sand and full of life, and is at high altitude, so that it is sterile and practically valuable for farming.

**Chattanooga Shale**

As was stated in the description of the Devoe rocks, the upper part of the Chattanooga is probably of Carboniferous age. Because it is impenetrable to divide this formation the whole of this quadrangle is practically the same in appearance throughout this region. The two small areas at the foot of Cumberland and Clinch mountains are small fragments and do not accumulate in such great masses as the shale, and the upper layers of black sandstone are interbedded with the sandstones. The formation consists of massive sandstone. Some of the layers are calcareous and calcareous strata, while the sandy layers are but little affected. They gradually change, however, under rain and frost. The formation stands out in ridges rising 400 to 500 feet above the valleys on either side. These ridges are very regular in height and are frequently cut through by streams from the valleys in the Chattachoochee syncline. The Chattachoochee sand is sand and full of life, and is at high altitude, so that it is sterile and practically valuable for farming.

**Chattanooga Shale**

As was stated in the description of the Devoe rocks, the upper part of the Chattanooga is probably of Carboniferous age. Because it is impenetrable to divide this formation the whole of this quadrangle is practically the same in appearance throughout this region. The two small areas at the foot of Cumberland and Clinch mountains are small fragments and do not accumulate in such great masses as the shale, and the upper layers of black sandstone are interbedded with the sandstones. The formation consists of massive sandstone. Some of the layers are calcareous and calcareous strata, while the sandy layers are but little affected. They gradually change, however, under rain and frost. The formation stands out in ridges rising 400 to 500 feet above the valleys on either side. These ridges are very regular in height and are frequently cut through by streams from the valleys in the Chattachoochee syncline. The Chattachoochee sand is sand and full of life, and is at high altitude, so that it is sterile and practically valuable for farming.

**Chattanooga Shale**

As was stated in the description of the Devoe rocks, the upper part of the Chattanooga is probably of Carboniferous age. Because it is impenetrable to divide this formation the whole of this quadrangle is practically the same in appearance throughout this region. The two small areas at the foot of Cumberland and Clinch mountains are small fragments and do not accumulate in such great masses as the shale, and the upper layers of black sandstone are interbedded with the sandstones. The formation consists of massive sandstone. Some of the layers are calcareous and calcareous strata, while the sandy layers are but little affected. They gradually change, however, under rain and frost. The formation stands out in ridges rising 400 to 500 feet above the valleys on either side. These ridges are very regular in height and are frequently cut through by streams from the valleys in the Chattachoochee syncline. The Chattachoochee sand is sand and full of life, and is at high altitude, so that it is sterile and practically valuable for farming.

**Chattanooga Shale**

As was stated in the description of the Devoe rocks, the upper part of the Chattanooga is probably of Carboniferous age. Because it is impenetrable to divide this formation the whole of this quadrangle is practically the same in appearance throughout this region. The two small areas at the foot of Cumberland and Clinch mountains are small fragments and do not accumulate in such great masses as the shale, and the upper layers of black sandstone are interbedded with the sandstones. The formation consists of massive sandstone. Some of the layers are calcareous and calcareous strata, while the sandy layers are but little affected. They gradually change, however, under rain and frost. The formation stands out in ridges rising 400 to 500 feet above the valleys on either side. These ridges are very regular in height and are frequently cut through by streams from the valleys in the Chattachoochee syncline. The Chattachoochee sand is sand and full of life, and is at high altitude, so that it is sterile and practically valuable for farming.

**Chattanooga Shale**

As was stated in the description of the Devoe rocks, the upper part of the Chattanooga is probably of Carboniferous age. Because it is impenetrable to divide this formation the whole of this quadrangle is practically the same in appearance throughout this region. The two small areas at the foot of Cumberland and Clinch mountains are small fragments and do not accumulate in such great masses as the shale, and the upper layers of black sandstone are interbedded with the sandstones. The formation consists of massive sandstone. Some of the layers are calcareous and calcareous strata, while the sandy layers are but little affected. They gradually change, however, under rain and frost. The formation stands out in ridges rising 400 to 500 feet above the valleys on either side. These ridges are very regular in height and are frequently cut through by streams from the valleys in the Chattachoochee syncline. The Chattachoochee sand is sand and full of life, and is at high altitude, so that it is sterile and practically valuable for farming.

**Chattanooga Shale**

As was stated in the description of the Devoe rocks, the upper part of the Chattanooga is probably of Carboniferous age. Because it is impenetrable to divide this formation the whole of this quadrangle is practically the same in appearance throughout this region. The two small areas at the foot of Cumberland and Clinch mountains are small fragments and do not accumulate in such great masses as the shale, and the upper layers of black sandstone are interbedded with the sandstones. The formation consists of massive sandstone. Some of the layers are calcareous and calcareous strata, while the sandy layers are but little affected. They gradually change, however, under rain and frost. The formation stands out in ridges rising 400 to 500 feet above the valleys on either side. These ridges are very regular in height and are frequently cut through by streams from the valleys in the Chattachoochee syncline. The Chattachoochee sand is sand and full of life, and is at high altitude, so that it is sterile and practically valuable for farming.
of narrow, overlapping blocks all dipping south­
wards. These form a portion of the great Plateau district, in which
the rocks lie nearly flat. The structure is far dif­
ferent from the greater portion of the area. Here the
rocks have been forced out of their original position into folds and faults. This is a portion of the structure that stands at an
altitude of 2000 to 2200 feet.

In the Appalachian Mountains the southeast­
dipping strata were subjected to this process,
which is a portion of the great Plateau district, in which
the lines along which the changes took
place run, as a rule, in a northeast-southwest
direction in which the strata have moved.
The actual dips of the strata are shown.

Most of the movements have resulted in the
formation of folds and faults. This is a portion
of the great Plateau district, in which
the surface of the land and the strata have
been deformed by folds and faults. This is a portion
of the great Plateau district, in which
the rocks have been forced out of their original
position into folds and faults. This is a portion
of the structure that stands at an altitude of 2000 to 2200 feet.

The breaking up into folds and faults is a
portion of the great Plateau district, in which
the rocks lie nearly flat. The structure is far dif­
ferent from the greater portion of the area. Here the
rocks have been forced out of their original position into folds and faults. This is a portion of the structure that stands at an
altitude of 2000 to 2200 feet.

In the Appalachian Mountains the southeast­
dipping strata were subjected to this process,
which is a portion of the great Plateau district, in which
the lines along which the changes took
place run, as a rule, in a northeast-southwest
direction in which the strata have moved.
The actual dips of the strata are shown.

Most of the movements have resulted in the
formation of folds and faults. This is a portion
of the great Plateau district, in which
the surface of the land and the strata have
been deformed by folds and faults. This is a portion
of the great Plateau district, in which
the rocks have been forced out of their original
position into folds and faults. This is a portion of the structure that stands at an altitude of 2000 to 2200 feet.

In the Appalachian Mountains the southeast­
dipping strata were subjected to this process,
which is a portion of the great Plateau district, in which
the lines along which the changes took
place run, as a rule, in a northeast-southwest
direction in which the strata have moved.
The actual dips of the strata are shown.

Most of the movements have resulted in the
formation of folds and faults. This is a portion
of the great Plateau district, in which
the surface of the land and the strata have
been deformed by folds and faults. This is a portion
of the great Plateau district, in which
the rocks have been forced out of their original
position into folds and faults. This is a portion of the structure that stands at an altitude of 2000 to 2200 feet.
marble in all respects. The Sevier marble beds occur in the valleys, being the most soluble of the formations, and the drainage of the quarry becomes an important problem. This is also the case even in areas well above drainage level, when springs and underground streams are encountered, as frequently happens.

Owing to soluble nature of the pure marble, it is either completely weathered or is entirely reduced to red clay. The best marbles, therefore, are nearly as solid at the surface as at great depths. Marbles which are shaly at the surface become less weathered in going down, and appear solid; but when these are exposed and exposed to the weather, their inferiority appears in splits along the stratified seams and in cracks through the masses. Solution of the pure beds has produced holes and caves down to the adjacent stream levels. Through these openings the quarrymen attack the rock more easily, but much valuable stone has been lost by solution.

Tests for absorption of water show a high water content in the better grades of marble, and the rock is very well fitted for weathering. Its crushing strength is also very high in the better layers. Tests of the purity of the water from the beds ranging from a few inches up to 4 or 5 feet in thickness. The near thickness is about one foot in this region. No developments have been made of the ore in this quadrangle, although much ore has been mixed both to the northeast and northwest, especially along Cumberland Mountain. The ore is the product of the replacement by iron oxide of the carbonates in an original limestone bed. The fossils that were embedded in the limestones retain their forms perfectly and make up almost as much as the marble itself. The iron ore is known as the "fossil iron ore." When the fossil ores are worked down to the water level of the adjacent stream, the weathering of the iron is so much less that they are practically limestones and are valued as such. Here the amount of ore is strictly limited by the water level, and other factors at the surface on or near these formations and are usually fine and well assimilated. This is the extent that ores of the creek valleys, and are of much less importance. Only local use has been made of these clays, and bricks have been burnt only near the point of use.

Timber.—Many formations produce timber of some value, though the association of certain ores on one formation. Most of the formations are timber-covered in suitable localities, but in undulating hilly country, valuable sandstones, have only a scattered growth. The Knox dolomite is accompanied by a good growth of oak, chestnut, and hickory. In the sheltered hollows, particularly those on the western side of the region, there are many handsome specimens of these trees, and the larger ones are particularly those on the Sevier, Rockwood, and Chickamauga formations. The clay is largely determined by the slopes of the adjacent surfaces.

Clays.—Suitable for the manufacture of bricks are abundant throughout this quadrangle, particularly in the southern portion. Many of the formations are used in building stone fences. Material for flagging has been made of these clays, and bricks have been burnt only near the point of use.

Water power.—A natural resource of this region, which is far developed from the water power. The water power is abundant, and there are many small water power in many places. In general their valleys are high and their grades small, except in the immediate vicinity of the rivers, where they rapidly decrease into the easy-take channels of the latter. This is especially true of the streams which flow across the strike of the formations. None of these streams furnish a notable body of water, but the fall is considerable, and in many places it is extremely valuable. In many localities natural mill sites are developed by the fall of the streams over hard beds in the Knox, Rockwood, and Chickamauga formations. These sites are only suitable for small local purposes, because the water is too small and the body of water is not great. At present this power has been utilized only for sawmills and gristmills and has not been applied to manufacturing.

February, 1901.