INTRODUCTION

The Hollidaysburg and Huntingdon quadrangles are adjoining areas in the western-central part of Pennsylvania, in Blair, Bedford, and Huntingdon Counties. (See fig. 1.) Taken as a unit they are bounded by parallels 40°15' and 40°30' and meridians 78° and 79°W. Each quadrangle includes one-sixth of a "square degree" of the earth's surface, and its area is approximately 228 square miles. These quadrangles form a part of the Appalachian Highlands, which extend from the Atlantic Coastal Plain on the east to the Interior Plains on the west. The Hollidaysburg and Huntingdon quadrangles are adjacent to the Allegheny Front, which bounds the Valley and Ridge province on the east and the Appalachian Plateaus on the west, and the Blue Ridge province to the southeast. The Hollidaysburg and Huntingdon quadrangles are divided into several parts called provinces. These are, from a north-south direction about S. 40° W. and bounded by the Blue Ridge on the southeast and the Appalachian Plateaus on the northwest.

APPALACHIAN HIGHLANDS

The Hollidaysburg and Huntingdon quadrangles lie in a belt of country 20 to 80 miles wide extending from New York to Alabama in a general direction north-northeast and bounded by the Blue Ridge on the southeast and the Appalachian Plateaus on the northwest.

BLUE RIDGE PROVINCE

The Blue Ridge province, narrow at its north end in Virginia and Pennsylvania, is over 60 miles wide in North Carolina. It is a rugged region of hills and ridges and deep, narrow valleys. The altitude of the highest summits in Virginia is 5,000 to 5,700 feet, and in western North Carolina Mount Mitchell, 6,684 feet high, is the highest point east of the Mississippi River. Throughout its extent this province stands up conspicuously above the bordering provinces, from which it is separated by a steep, broken, rugged front about from 1,000 to 1,500 feet above the main valley levels, but only its highest knobs rise much above the mountains. The Allegheny Front, known as the Blue Ridge province, in the northern part of Bedford County, stands 3,150 feet above sea level and 1,500 feet above the surface of the Susquehanna Valley. The Allegheny Front, on the southeast side of the Valley and Ridge province, in Franklin, Adair, and Cumberland Counties rises 1,000 feet above the valley level. Near Big Stone Gap, Va., the crest of Black Mountain is 3,000 feet above sea level, and the highest point is the southern extremity of Brush Mountain, near the northwest front of the Blue Ridge province, rises nearly 5,000 feet above the sea level on the southeast side. These features are exhibited in the profile section of Figure 2. The rocks in these quadrangles, in the central Valley and Ridge province, are limestones, dolomites, conglomerates, sandstones, and shales, which have been greatly disturbed by folding and faulting.

APPALACHIAN PLATEAU

The Appalachian Plateaus, which are practically continuous with the Appalachian coal fields, are relatively high, ranging from 800 feet above sea level in parts of Allegheny to more than 4,500 feet in Pocahontas County, W. Va., where they descend through Pennsylvania to about 2,000 feet in western New York. Sandstone, conglomerate, shale, and coal beds make up most of the rocks of the Appalachian Plateaus. In contrast with those of the Valley and Ridge provinces the streams have been greatly modified by folding and faulting.

PRINCIPAL TOPOGRAPHIC FEATURES

The Allegheny Front, generally known as Allegheny Mountain, is the great north-south escarpment of the Appalachian Plateaus, and is the most prominent feature of this quadrangle. It is the most prominent ridge in the quadrangle and rises to a height of 3,150 feet above sea level in Blue Knob, in the southeast corner of the adjoining Ebensburg quadrangle (pi. 1). The highest outcrops of this escarpment descend to a valley continuous with Bald Eagle Valley on the northeast, and with the valley of Franklin Brunch on the southwest. From a point opposite Hollidaysburg through Altoona the valley is known as Logans Valley. Nearly inclosed by Brush, Lock, Lawn, and Short Mountains is a deep, topographic depression known as South Valley. Point View knob in the northwest corner of the Hollidaysburg quadrangle is another striking topographic feature (pi. 2). The slope broadens from Lock and Dunning Mountains on the west and Tussey Mountain on the east, known as Moravia Cove (pi. 3), is really a somewhat offset continuation of Nitiny Valley, Centre County. Raven's Gap is the broad, undulating, relatively low land between Tussey and Terrace Mountains, marked by northeast-southwest narrow ridges and drained by Raven's Gap Creek. Southeast of Raven's Gap Creek the Blue Mountain and Rolling Hill with the north and south of Tantallon Mountain, which together inclose the Great Trough Creek Valley (pi. 4), are the principal topographic features.

All the great ridges are caused by hard sandstones with, with the exception of the summit of the Allegheny Front, steeply inclined. The scarps are marked by steep slopes facing the valley and pointing at the escarpment, the Allegheny Front, Dunning Mountain, and some minor ridges being on the west limb and Tussey and Terrace Mountains on the east limb of the great Nitiny arch. (See structure sections.) Rolling Hill is a hogback on the Jerusalem Mountain anticline, whose crest is just east of the southeast corner of the Huntingdon quadrangle. (See pi. 6.) Dunning and Tussey Mountains and Rolling Hill are symmetrical, having equal slopes on the two sides, owing to the great attitude of the rocks; the Allegheny Front and Terrace Mountain are unsymmetrical, having steep slopes facing the Nitiny arch and low slopes facing the opposite direction, owing to the low dip of the strata in those directions.

Several deep gaps or notches through the high ridges are notable features of the topography. The largest of these are McKee Gap, 800 feet deep, and Point View Gap, 900 feet deep, through the Dunning-Lock Mountain ridge. Trough Creek Gap, 600 feet deep, and Tantallon Gap, 700 feet deep, through Terrace Mountain ridge; and Boggs and Sugar Run Gaps, each about 1,000 feet deep, through the Allegheny Front. The origin of these gaps is explained under "Geologic history."
The topographic maps show that the highest ridges and the crest of the Allegheny Front approach a common altitude of 3,000 to 3,200 feet, and the foot-ouls of the Allegheny Front between Lock and Darling Mountains and the west side of Tinty Mountain approach 3,000 feet, and the general altitudes of Morrisons Cove and Raystown Valley is 2,100 to 2,400 feet. The summits of the high ridges, the spurs and intervening valleys to 1,750 feet, and the tract at the near the lower level (Morrisons Cove, etc.) are believed possibly to be remnants of former more or less extensive paleotopics, the highest of which was in the foothills of the Allegheny mountains, named for the Allegheny mountains, in New Jersey; the intercalation one of the Schooley panshsh, named from Schooley Mountain, in New Jersey; and the lowest one the Horoben paleotopic, named from the Huron region, Pennsylvania. The origin of these features is explained under "Geology of the Allegheny Front.

The average rate of fall shown in the last column fails to express a significant feature of the stream-beds—the diminishing rate of fall downwound. For example, Frankfort Branch falls 100 ft in the first 5 miles of its course, which is 23 ft to the mile, 100 ft in the next 9 miles, which is 11 ft to the miles, 90 ft in the next 14 miles, which is 6 ft to the mile.

**WARRIOR FORMATION**

**SYSTEM**

**CAMBRIAN SYSTEM**

The rocks of Cambrian age include, in ascending order, the Waynesboro formation, the Pleistocene Hill limestone, the Warrior limestone, and the Gastrocnemius formation.

**Name and definition.**—The Waynesboro formation was named for its exposures at Waynesboro, in Franklin County. It is the oldest exposed formation in this quadrangle, where it crops out on the north side of the town of Waynesboro in the northwestern part of the Everett quadrangle, and in a small area northwest of Williamsburg, in a small area northwest of Bellefonte, in the northwestern part of the Everett quadrangle, and along the Pennsylvania Railroad east of Williamsburg.

**Age and correlation.**—According to Sloss, the upper part of the Waynesboro limestone contains part of the LowerCambrian Limestone, part of the UpperCambrian Limestone, and part of the MiddleCambrian Limestone. The formation crops out only on the north side of the town of Waynesboro in the northwestern part of the Everett quadrangle, and in a small area northwest of Williamsburg, in a small area northwest of Bellefonte, in the northwestern part of the Everett quadrangle, and along the Pennsylvania Railroad east of Williamsburg.

**Character.**—The Waynesboro formation is predominantly fine-grained sandstone, some 1,000 to 1,200 feet thick, and in a small area northwest of Williamsburg, in a small area northwest of Bellefonte, along the Pennsylvania Railroad east of Williamsburg. The formation crops out only on the north side of the town of Waynesboro in the northwestern part of the Everett quadrangle, and in a small area northwest of Williamsburg, in a small area northwest of Bellefonte, along the Pennsylvania Railroad east of Williamsburg.

**Distribution.**—The Waynesboro formation crops out only in a small area northwest of Williamsburg, in a small area northwest of Bellefonte, along the Pennsylvania Railroad east of Williamsburg.

**Thickness.**—The thickness of the Waynesboro formation is 1,200 feet.
Formation and is known from Larks to a point 1.5 miles north of the town of Clover, 7 miles east of Rooksdale, and along both flanks of the Woodbury antiline about to the latitude of Lark, and at a number of points on the east limb of the Rooksdale Spill Point from Rooksdale southeast to the limits of the Hollidaysburg quadrangle.

It is best developed just north of the road half a mile north-west of Drey Hill, at a quarry on the summary, the Ordovician limestones, and the Larks dolomite. At a quarry just east of Axemann, in Centre County, about 1 mile south of Williamsburg, the dolomite is present in and confined to the lower 1,000 feet or less of the dolomite of the Axemann formation. This same characteristic fauna is known through Quebec to Newfoundland and even in the Durnes limestone of northwestern Scotland and marks a continuous faunal break across North America. Another gastropod, 

**HOLLIDAYSBURG-HUNTINGDON QUADRANGLES**

In these quadrangles the rocks of Ordovician age consist predominantly of dolomite and limestone but end above with a thick shale formation. They include the following formations, named in order from oldest to youngest: Larks dolomite, Larks limestone, Stougal limestone (?), Nittany dolomite, Axemann limestone, Bellefonte dolomite, Curlews, Lowville, Rodman, and Trenton limestones, Baccalieu shales, Oswego sandstones, and Juniata formation—i.e., to about 5,000 feet thick.

**HERKELANDB GROUP**

The Beckwourth group of the Chiquipue Valley is represented in the Hollidaysburg and Huntingdon quadrangles by the Mines dolomite, the Lakem dolomite, the Nittany dolomite, and the Axemann dolomite.

**HERKELANDB GROUP**

The Mines dolomite was named for the town of Mines, 5 miles southeast of Williamsburg. Its outcrop on the northeast flank of the Woodbury syncline 1 mile southwest of Curryville and at Shelleytown, where the section given below is exposed. The best exposures of the Axemann are in the broad outcrop where it swings around the southern flank of the Valley syncline 1 mile southeast of Williamsburg and at Hollidaysburg, where it is treated by H. S. McQueen as a separate unit, under the name Van Buren formation, in a report issued by the

Missouri Bureau of Mines and Geology in March, 1930. This horizon extends southwest of Springville, where the rocks are vertical and the limits can be determined closely.

**Age and correlation.**—Fossils are scarce in the Nittany, being limited to the dolomite of the Nittany formation. None are found in the Nittany dolomite; the Nittany limestone below and the light-gray and fossiliferous Nittany dolomite above.

**Distribution.**—The dolomite is 15 feet thick at the town of Mines, 5 miles southwest of Williamsburg, and on the south bank of Rooksdale, just east of Williamsburg. At the base of the Nittany dolomite is overlain by a beds of dolomite, the bottom 50 to 100 feet, as exposed north of Williamsburg, is thin bedded, argillaceous, and slightly ferruginous, weathering to a smooth bright surface easily distinguishable from the gray-washing, stylo-dolomite dolomite above and below. For its exposures in the vicinity of Nittany Furnace, near Bellefonte, in Centre County.

**Axemann formation**

**Name and definition.**—The Axemann limestone was named for its exposures in the vicinity of Nittany Furnace, near Bellefonte, in Centre County. In this area it extends from the bottom of the Axemann limestone, the intervening Stonehenge limestone, and the top of the Larke dolomite to the bottom of the Axemann formation. The section given below is exposed. For its outcrops about 1 mile east of Axemann, in Centre County, about 1 mile south of Rooksdale. Another stratigraphic unit which underlies the Nittany dolomite but is not certainly known, known from Wisconsin to Quebec and even in the Durnes limestone of northwestern Scotland and marks a continuous faunal break across North America.

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The most significant of the fossils, 

The Carlim limestone was named for its exposures at Carlim, the lowest fossiliferous limestone of the Lock-Dunning Mountain ridge nearly across the quadrangle, passing through Martinsburg and Roaring Spring. The Carlim limestone is indicated in the following section, which is typical for the region. The Carlim limestone is a 5-foot bed crowded with fucoids (fossil seaweeds). In one section, through 200 feet of beds that are apparently in the upper half of the Bellefonte, the dolomite is blue and gray with thin layers of dark, apparently carbonaceous shale. Although prevalently dark internally, the rock weathered with a more dullish film, especially near the top of the formation, which gives the Bellefonte a rather distinct aspect by which it can generally be easily distinguished from the overlying Carlim limestone. Throughout the upper 800 feet or more exposed above the Carlim of Williamsburg there is a very thin clayey base layer, and there is the shaly, much of the shaly, being black, and brown. In the layer of black, brown, and yellowish gray, the most frequent is clay that lies thin plates or irregular stringers. The surfaces underlain by the Bellefonte dolomite are in places covered with chalk in areas a

The Lowville limestone has the same distribution as the Carlim limestone. It is exposed in all the quadrangles of the Williamsburg district and can easily be identified by its position between the impure, worthless beds of the Lower limestone of the Carlim limestone and the Lowville limestone, as shown in Plate 12. The Lowville limestone has the same distribution as the Carlim limestone. It is exposed in all the quadrangles of the Williamsburg district and can easily be identified by its position between the impure, worthless beds of the Lower limestone of the Carlim limestone and the Lowville limestone, as shown in Plate 12.

The Black River group in this area is divided into two formations—the Lowville limestone below and the Rodman limestone above.

LOWVILLE LIMESTONE

Limestone of the Lock-Dunning Mountain group was first described by D. W. Macfadden in 1905, and the name was proposed by J. E. Nickerson in 1907. The Lowville limestone is a 5-foot bed crowded with fucoids (fossil seaweeds). In one section, through 200 feet of beds that are apparently in the upper half of the Bellefonte, the dolomite is blue and gray with thin layers of dark, apparently carbonaceous shale. Although prevalently dark internally, the rock weathered with a more dullish film, especially near the top of the formation, which gives the Bellefonte a rather distinct aspect by which it can generally be easily distinguished from the overlying Carlim limestone. Throughout the upper 800 feet or more exposed above the Carlim of Williamsburg there is a very thin clayey base layer, and there is the shaly, much of the shaly, being black, and brown. In the layer of black, brown, and yellowish gray, the most frequent is clay that lies thin plates or irregular stringers. The surfaces underlain by the Bellefonte dolomite are in places covered with chalk in areas a

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The roughness is due to the coarse grain and the presence of crinoid plates and fragments of other fossils. The highly fossiliferous limestone bands 1 foot or less thick. The omission of the intermediate beds of the Chambersburg region, neither it nor any bed below it being exposed.

Character.—The Rodman limestone is dark, thin bedded, nearly crystalline, and highly fossiliferous or fossiliferous. It occurs together with a dirty gray- or green-colored cherty sandstone in the vicinity of Binghamton, N. Y., and indicates that the Lowville is represented in the Chicheleman.
UHNSOWA Anckerty

None and definition.—The Uhnsowa quadrangle was named for Uhnsowa Mountain, Pa., an old mine boundary.

Distribution.—The Uhnsowa quadrangle covers an area 10 miles north and 12 miles west of Huntingdon County, particularly the northeastern part of the Juniata quadrangle.

Character.—The Uhnsowa group includes carbonaceous shale, argillaceous limestone, and the Juniata formation.

Section of the basal beds of the Clinton formation at a cut on the Pennsylvania railroad near the town of Huntingdon, Huntingdon County, Pa.

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Ohio Railroad west of Cumberland, Md. It includes the limestone and the shale containing limestone layers that lie between the top of the Clinch and the bottom of the Busk formation. The Busk limestone is composed of fine-grained red sandstone, siltstone, and fine-grained limestone. The Wills Creek shale was so named because it is overlain by the Wills Creek shale, which is abundantly fossiliferous limestone.

The Bloomsburg red beds east of Tussey Mountain was named for its exposures in the lower slopes of Tonoloway Ridge, in Washington County, Md. It includes more than the lower half of the Limestone formation of the park area. It underlies the Keyser limestone member of the Helderberg limestone and overlies the Wills Creek shale.

Deposition. The outcrop of the Tonoloway limestone, together with the overlying Helderberg, makes a ridge parallel to the base of Brunk Mountain, northwest of Hollidaysburg. The Tonoloway also crops out along the east base of Lock and Dunning Mountains, near the base. East of Tussey Mountain it is overlain by the south side of Wartensleben Ridge east of Tussey Mountain and overlies a fossiliferous land. The formation is composed of basaltic sandstone and siltstone, with some conglomerate and sandstone. The top is capped by a limy soil and by fragments of shale and limestone. Redstone Ridge is an example.

The best exposures are along the highway southwest of Gaysport, and on the road leading to farmhouses east of the highway. The quarry rock of the Hollidaysburg district was used for its exposures in the lower slopes of Tonoloway Ridge, in Pennsylvania. It includes both the Helderberg and the Keyser limestone members of the Helderberg limestone. The Keyser limestone member of the Helderberg limestone is composed of fine-grained red sandstone, siltstone, and fine-grained limestone. The Wills Creek shale was so named because it is overlain by the Wills Creek shale, which is abundantly fossiliferous limestone.

The Bloomsburg red beds east of Tussey Mountain was named for its exposures in the lower slopes of Tonoloway Ridge, in Washington County, Md. It includes more than the lower half of the Limestone formation of the park area. It underlies the Keyser limestone member of the Helderberg limestone and overlies the Wills Creek shale. The section is very persistent overlying Bloomsburg redbeds. In the Hollidaysburg region, the Tonoloway also crops out along the east base of Lock and Dunning Mountains, near the base. East of Tussey Mountain it is overlain by the south side of Wartensleben Ridge east of Tussey Mountain and overlies a fossiliferous land. The formation is composed of basaltic sandstone and siltstone, with some conglomerate and sandstone. The top is capped by a limy soil and by fragments of shale and limestone. Redstone Ridge is an example.

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tain the Tonoloway has about the same character as at Hollis-
dayberg. North of McCauleytown, crystals of galena have
been found in calcite veins along the west side of Worthington
Ridge, and considerable money has been expended in pros-
pecting for lead ore without success.

Thickness.—The thickness of the Tonoloway exposed in the
Bald Hill section east of Hollidaysburg is 420 feet, and the
formation probably is thicker, as no beds are exposed in the
Bald Hill section like those at the bottom where it is
exposed 1 mile south of Hollidaysburg. East of Tussey
Mountain the thickness appears to be 600 feet.

Age and correlation.—There seems to be no doubt of the
identity of the Tonoloway of this region with that of Mary-
land. In Maryland 28 species of fossils have been obtained
from it, but in this region only a few species of Leperditia
were obtained, mainly in the upper 50 feet, where they are
plentiful in some layers.

Ulrich says, in comparing the Maryland and New York
sections, the fossils of Tones with those of the New York
section leaves little doubt concerning the late Orsaya age of the
formation. Most of the diagnostic species above noted near the
Schuylkill Valley section in New York between the base of the
Coal Hill and the top of the “Fenestella” or typical Manlius
limestones. A consid­erable part of these species, it is true, appears in the
Maryland sections into the Helderberg limestones. * * * The
Manlius and Coal Hill therefore seem to be in general correla­tion
with the Tonoloway, although the fauna indicates that Tonoloway
succeeds Manlius on the eastern side of the Schuylkill into New
York.

There are, however, some features of the fauna of the Coalhill
and Manlius that throw some doubt on the validity of this
correlation.

** Devonian System **

The Devonian system in these quadrangles includes the fol­lowing formations, beginning with the lowest and oldest:
Helderberg limestone, 150 to 200 feet; Otsenka group, com­posed of the Shriver limestone below, 200 to 300 feet, and the
Edgeway sandstone above, 50 to 100 feet; Otsenka forma­tion,
50 feet; Marcellus shale, 200 to 300 feet; Hamilton for­mation, 800 to 1,300 feet; Portage group, comprising the

In these quadrangles the boundary between the Helderberg
and the underlying Tonoloway limestone is not well defined;
the underlying Tonoloway limestone is of some doubt placed at
the bottom of a bed of limestone known to the quarrymen of
the region as the “calico rock,” or in some sections a few feet lower.
The Helderberg is bounded above by the black band shale of
the Sherburne limestones (No. 20 of the section at Bald Hill).

The Helderberg in this region and in Maryland is divided
into the Keyser limestome member at the base, the Cayuga limestone
member in the middle, and the New Scotland limestone
member at the top.

** Distribution.**—The Helderberg crops out near the crest of
the ridge parallel to Brush Mountain from Altoona by way of
Newry and Franktown to the northeast corner of the
Helderberg quadrangle, thence southwestward the outcrop fol­lows
the west flank of Lock and Dunning Mountains to the
south edge of the quadrangle. The Tower Rocks, just south­east
of Hollidaysburg, are in the Helderberg as are also the
limestone quarries from Altoona to Canoe Creek. East of
Tussey Mountain the Helderberg crops out along the west slope
of Worthington Ridge, where a number of quarries mark its basal
part. Its full thickness is exposed at the Bald Hill cut, 1 mile
east of Hollidaysburg, and in a quarry near Allegheny Fos­surn,
half a mile south of Altoona.

** Characteristics.**—The Helderberg limestone is variable in char­acter.
In general features are exhibited in the following sections and in the section at Bald Hill given on page 7.

These sections with others are shown in graphic form in
Figure 3.

Harrell shale below and the Brilliier shale above, 1,600 to
2,000 feet; Glummg formation, 2,000 to 4,000 feet; and
Harrah hill formation, 2,000 to 2,500 feet. In the Holliday quadrangle the total thickness of the Devonian is 5,745 feet,
and in the southeast part of the Huntingdon quadrangle, where the rocks are nearly vertical, the total thickness deter­mined from the width of outcrop is about 6,000 feet.

** Helderberg Limestone **

Name and definition.—The Helderberg limestone was named
for its exposure in the Helderberg Mountains, in New York.

** Upper Devonian **

Of Altoona Quarry

** Upper Devonian **

Holliday and Rhoda
ington quarries from Altoona to Canoe Creek. East of
Tussey Mountain the Helderberg crops out along the west slope
of Worthington Ridge, where a number of quarries mark its basal
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Character—The Helderberg limestone is variable in char­acter.
In general features are exhibited in the following sections and in the section at Bald Hill given on page 7.

These sections with others are shown in graphic form in
Figure 3.

1. Section of quarry at Allegheny Furnace, half a mile south of Altoona.

2. Section of quarry at Altoona, 3 miles northeast of Altoona.

3. Section half a mile southeast of Tyrone.

4. Section a half mile northeast of Oneonta.

5. Section of quarry in vicinity of Holliday and Rhoda.

6. Section of quarry half a mile northeast of Oneonta.

7. Section of quarry half a mile southwest of Graflon.

8. Section of quarry half a mile northeast of Oneonta.

9. Section of quarry half a mile northeast of Oneonta.

10. Section of quarry half a mile northeast of Oneonta.

11. Section of quarry half a mile northeast of Oneonta.

12. Section of quarry half a mile northeast of Oneonta.

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17. Section of quarry half a mile northeast of Oneonta.

18. Section of quarry half a mile northeast of Oneonta.

19. Section of quarry half a mile northeast of Oneonta.

20. Section of quarry half a mile northeast of Oneonta.

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22. Section of quarry half a mile northeast of Oneonta.

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24. Section of quarry half a mile northeast of Oneonta.

25. Section of quarry half a mile northeast of Oneonta.

26. Section of quarry half a mile northeast of Oneonta.

27. Section of quarry half a mile northeast of Oneonta.

28. Section of quarry half a mile northeast of Oneonta.

29. Section of quarry half a mile northeast of Oneonta.

30. Section of quarry half a mile northeast of Oneonta.

31. Section of quarry half a mile northeast of Oneonta.

32. Section of quarry half a mile northeast of Oneonta.
The thickness of the Heliker limestone in the vicinity of Hollidaysburg is about 150 feet and east of Tussey Mountain about 300 feet.

The Keyser limestone occurs in the Bald Hill section and the quarry near Allegheny Furnace the part of the Keyser above the nodular limestone is fully exposed, and the calcareous part is a finely crystalline, thin bedded gray to dark limestone of 12 to 20 feet thick at the bottom and 75 to 90 feet of thick bedded but more or less laminated limestone at the top. (See pl. 21.) In the top of this part of the Bald Hill section is a thin layer containing a notable large species of Leptodictyum, L. haugenii and L. giganteum. The Keyser is 100 feet thick in the Hollidaysburg region and somewhat thicker east of Tussey Mountain.

The Shriver limestone is persistent through the quadrangle of New Scotland, Pennsylvania, and the New Scotland limestone members. These members are separated here and identified lithologically with the Keyser limestone. Though the Ridgeley is thin it is persistent east of Tussey Mountain.

The Ridgeley sandstone crops out along the east slope of Dunning Mountain to Boiling Spring Run, west base of Dunning Mountain to Warriors Ridge. At the bottom of the section 1 mile east of Hollidaysburg (p. 17) is a bed of black shaly limestone, and other layers of shell conglomerate. On weathering the thin layers of the main body of the Shriver are leached of their calcareous matter and break down into small sandy pieces. This process of leaching is more common in the lower Shriver and in the Shriver of the Hollidaysburg-Huntingdon region by the ca. defined name Shriver.

The Shriver limestone is persistent throughout the quadrangle, its surface distribution being in a narrow belt parallel to that of the Hollidaysburg limestone. The only complete exposures of the formation in the east side of the Bald Hill cut, 1 mile east of Hollidaysburg. The Ridgeley is in part a pure quartz sandstone, some layers of which easily crumble to sand in the hand. It has been quarried for sand at a few points.

The Onondaga is persistent in the region. It shows near the highway just east of the outcrops at Bald Hill, 1 mile east of Hollidaysburg; in the road west about 1 mile west of Onondaga (p. 17); on the highway near head of Robinson Run, Hollidaysburg; also in part a pure quartz sandstone, some layers of which easily crumble to sand in the hand. It has been quarried for sand at a few points.

The Onondaga formation was named for its exposures in Onondaga County, N. Y. In New York the name Onondaga was once applied to the town of Onondaga, Oneida County, N. Y. According to the classification of the Onondaga is thought to be of Mississippian age and has been designated by the name Shriver limestone. Though the Ridgeley is thin it is persistent east of Tussey Mountain.

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dark green or bluish, and some bands are calcareous. Both shale and limonite are sparsely fossiliferous.

**Thicknesse:** The thicknesse of the Onondagas is 30 to 50 feet.

**Age and correlation:** The position of the beds here described, between the Oswego and the characteristic fossil beds of the Marcellus above, which is the same as the position of the Onondaga limonite in the type locality in New York State, points almost conclusively to the equivalence of the beds with the Oswego.

Forty-five species of fossils have been collected from the Onondagas in three quadrangles, but as most of them, exclusive of the trilobites, occur in the Oswego or Hamilton also, their evidence as to the age of the formation is not satisfactory. Nine species of trilobites from this region or from the same formation elsewhere in this or adjoining States are, according to Kindsell, not known in the Oswego and assume the Onondaga age of the formation here described. The trilobites are Arcaspis callinich, Conulus callinich, Otarion et. O. stygophorus, O. crassicornis, Olchascus crassicornis, O. stygophorus, O. crassicornis, and P. crassicornis var. pygma.

**NAME AND DEFINITION.**

The Marcellus shale was named for exposures at Marcellus, N. Y. It overlies the Onondaga formation and underlies the Hamilton.

**DISTRIBUTION.** The Marcellus is widespread in New York and Pennsylvania and preserves relatively well the characteristic fossiliferous black shale of the Marcellus. In these two states, the Marcellus and overlying Hamilton shale are soft and easily erodible, valleys have been formed along their outcrops. Such valleys are frequent in the vicinity of Scotch Valley and the Pennsylvania Railroad in the western outskirts of Altoona, in the shale pits along Frankstown Branch from Huntingdon to the southwest corner of the Huntingdon quadrangle. They are best exhibited on the South side of Altoona and along the Hamilton & Broad Top Mountain Railway, especially for 2 or 3 miles south of the town. The Marcellus and overlying Hamilton shale are soft and easily erodible, valleys have been formed along their outcrops. Such valleys are frequent in the vicinity of Scotch Valley and the Pennsylvania Railroad in the western outskirts of Altoona, in the shale pits along Frankstown Branch from Huntingdon to the southwest corner of the Huntingdon quadrangle. They are best exhibited on the South side of Altoona and along the Hamilton & Broad Top Mountain Railway, especially for 2 or 3 miles south of the town.

**Type-locality.** The type-locality is at Altoona. The best exposure is at the Pennsylvania Railroad at the south end of the town, just east of Standing Stone Creek at Huntingdon. The gray shale facies is best exhibited on the Pennsylvania Railroad in the western outskirts of Altoona. The best exposure is at the Pennsylvania Railroad at the south end of the town, just east of Standing Stone Creek at Huntingdon.

**NAME AND DEFINITION.**

The Marcellus shale was named for exposures at Marcellus, N. Y. It overlies the Onondaga formation and underlies the Hamilton.

**AITH, WHERE THE SECTION GIVEN BELOW WAS OBTAINED. A SMALL BLACK BAND OF LIMESTONE, MENTIONED ABOVE, APPEARS BETWEEN THE BLACK SHALE AND THE LIMESTONE.**

**SECTION:** The thicknesse of the Marcellus at Altoona is 250 to 300 feet, being perhaps a little greater east of Tussey Mountain. The gray shale facies is best exhibited on the Pennsylvania Railroad in the western outskirts of Altoona. The best exposure is at the Pennsylvania Railroad at the south end of the town, just east of Standing Stone Creek at Huntingdon.

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correlation are Clavatula lepida, Brachiola retrorsa, Ontario atornia, Productus gibbus, Cardioceras procera, and Productus rotulatus. In a railroad cut 5 miles northeast of Altoona a thin lens of C. lepida, which includes the equivalent of the Gander and probably to be correlated with all of the Portage above the Brallier is obtained from this shale. Although a number of these fossils, as Clavatula lepida, Cardioceras procera, occur in the Gander, the shale and older beds, the resemblance as a whole is characteristic of the lower Portage beds in the vicinity of Naples, Ontario County, N. Y., and in connection with the absence of any distinctly generic fossils justifies the assignment of the Harrelle shale to the Portage group. It probably represents to the main the Cas inefficient and Middle member of the Portage formation of New York and the fossiliferous beds at Naples. The soft gray shale is almost identical lithologically with the Cas. The Basket member is probably equivalent to the entire Casaceous shale of the Maryland Geologic Survey report on the Devonian of Maryland, 1912.

**Brallier shale**

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The Brallier is predominantly a pale greenish-gray massive, sandy, and shaly shale, generally clayey almost to a thin limy, but there are thin layers of coarser texture and less perfect cleavage. In railroad cuts half a mile east of Huntingdon very nearly bedded layers 1 to 2 ft thick appear, in their uppermost condition, in form compact sandstone (pl. 20), but on weathering these beds reveal their thin laminated character and ultimately break down to small, thin plates. The rock is really a stiff sandy shale. A striking feature of some of these shales is a strong displacement of the bedding planes. In the upper 200 ft layers of fine-grained greenish sandstone, becoming light gray or white when weathering, fragments of which in pieces cover the surface. There are a few layers of even bedded sandstone and some thin, irregular layers of hard brown fine-grained sandstone, generally from 1 to 6 inches and nearly 1 foot thick, which are more common from 200 to 400 feet above the base of the formation. Probably the formation does not contain more than 5 per cent of thin layers of sandstone in cohesion to yield fragments 6 inches thick on weathering. In one of the railroad cuts about a mile southeast of Altoona there are a few thin layers of pebbly shale, probably formed above the middle of the formation. A layer of red rock above a foot thick is exposed in the cut on the old line just west of Portage.

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View of the Brallier shale at Altoona. (Fig. 250.)

255

The lower part of the Brallier shale is of more clayey composition, or more of the nature of mudrock, the character is illustrated by the following detailed sections:

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shale and sandstone, chocolate-colored, with thin layers of sandstone, nearly all red.</td>
</tr>
<tr>
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</tr>
</tbody>
</table>

256

There are three belts of outcrop one on the northwest of the Allegheny Front, extending from Altoona to the southwest corner of the Hollidaysburg quadrangle and another on the northern part of Piney Ridge. Veins of the Portage formation of New York and the fossiliferous beds at Naples. The soft gray shale is almost identical lithologically with the Cas. The Basket member is probably equivalent to the entire Casaceous shale of the Maryland Geologic Survey report on the Devonian of Maryland, 1912.

257

The fossils of the thin sandstone near Upper Reese mentioned above probably include a brief formation of the Ehrlich fauna of the Portage which barely reached this area. Possibly the red beds mentioned above represent an extensive of the Onesota, sandstone, also of the Portage, in this region.

258

**Chemung formation**

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259

The Chemung was named for its exposures along the Chemung River, N. Y. In these quadrangles it is underlain by the Chemung shale and overlain by the Hampshire formation. The Chemung and Brallier are not separable by an easily recognizable lithologic boundary, but the section is marked at the lowest horizon where fossils of the Chemung appear in the bed. Such fossils are Convolvulites rafinesque, Productus speciosa, and Ctenosiga sappho, "Spirifer" comites, S. mucronatus. In a railroad cut 3 miles northeast of Altoona the Chemung is exposed in a thick bed, about 10 feet thick, which reaches a thickness of about 3,000 feet in Bland County.

260

The small fossils of the Napa Formation are present in the Woodmore shale member of the Jennings formation in Maryland and in the Kimbuling shale member of the Woodmore, which reaches a thickness of about 3,000 feet in Bland County.

261

Thickness. The thickness of the Brallier is about 1,800 feet.

262

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265

Thickness. The thickness of the Brallier is about 1,800 feet.
In this section the lower 810 ft is Braintree shale, and the fossiliferous St. Mark member. Here, as at other points in the area, the beds occur in rather soft greenish-gray, clay shale 130 ft below the Piney Ridge sandstone member. Some features of the preceding sections require comment. One of these is the frequency of sandstone in the upper half. This color has been described as red without recognition of the fact that, almost without exception, the “red” color below the top of the Chemung is brown or chocolate-colored and is noticeably different from the brown hues prevailing in the Chemung formation. It does not yield a red soil.

The green sandstone is mostly of clay composition, grains, to bluish gray or slate-colored, with fresh weathering, yellowish-green. A little of this shale shows in the Pennsylvania Railroad section on Beargrass Run of rather bright greenish-brown color (variable colors). The sandstone, which except in a few places is present on thin layers in the shale, comprising a small proportion of the whole, is almost all hard, fine-grained, and a greenish-yellow or grayish in the upper part. Formerly, the Hollidaysburg sandstone (for Allegheny) below the Piney Ridge sandstone member.

The formation is moderately fossiliferous throughout and differs greatly in that respect from the Chemung of western New York. Such features as ripple marks, sun cracks, and rain drop prints are not common. Thickest.—The thickness of the formation is about 4,000 ft in its western area and 3,200 ft in the Beargrass Valley. The measured section at Beargrass Run shows 3,900 ft down to the horizon of the Allegrippis sandstone member, which is about 1,800 ft above the bottom of the Chemung, making a total of 5,700 ft. A measurement based on the average dip and the width of outcrop on Brandywine Creek 3,200 ft, East of Stirling Hill the thickness is about 2,800 to 3,000 ft.

**Piney Ridge sandstone member.**—The Piney Ridge sandstone member was named for Piney Ridge, in the southern part of the Huntingdon quadrangle, along which it crops out. It is a persistent bed about 50 ft thick, and 75 to 300 ft above the base of the Chemung. It is greenish gray and impregnated with ferruginous, white to light-gray sandstone. In the section northeast of St. George (No. 5), it is made up of a number of rather thick sandstone layers, separated by soft greenish clay shale. In places, fossils, of which there are several species, are fairly abundant. Alleghany conglomerate member.—The Alleghany conglomerate was named for Alleghany, in the southern part of the Huntingdon quadrangle, along which it crops out. It is a persistent bed about 50 ft thick, and 75 to 300 ft above the base of the Chemung. It is green in color, grayish green, and impregnated with ferruginous, white to light-gray sandstone. In the section northeast of St. George (No. 5), it is made up of a number of rather thick sandstone layers, separated by soft greenish clay shale. In places, fossils, of which there are several species, are fairly abundant. Alleghany conglomerate member.—The Alleghany conglomerate was named for Alleghany, in the southern part of the Huntingdon quadrangle, along which it crops out. It is a persistent bed about 50 ft thick, and 75 to 300 ft above the base of the Chemung. It is green in color, grayish green, and impregnated with ferruginous, white to light-gray sandstone. In the section northeast of St. George (No. 5), it is made up of a number of rather thick sandstone layers, separated by soft greenish clay shale. In places, fossils, of which there are several species, are fairly abundant. Alleghany conglomerate member.—The Alleghany conglomerate was named for Alleghany, in the southern part of the Huntingdon quadrangle, along which it crops out. It is a persistent bed about 50 ft thick, and 75 to 300 ft above the base of the Chemung. It is green in color, grayish green, and impregnated with ferruginous, white to light-gray sandstone. In the section northeast of St. George (No. 5), it is made up of a number of rather thick sandstone layers, separated by soft greenish clay shale. In places, fossils, of which there are several species, are fairly abundant. Alleghany conglomerate member.—The Alleghany conglomerate was named for Alleghany, in the southern part of the Huntingdon quadrangle, along which it crops out. It is a persistent bed about 50 ft thick, and 75 to 300 ft above the base of the Chemung. It is green in color, grayish green, and impregnated with ferruginous, white to light-gray sandstone. In the section northeast of St. George (No. 5), it is made up of a number of rather thick sandstone layers, separated by soft greenish clay shale. In places, fossils, of which there are several species, are fairly abundant. Alleghany conglomerate member.—The Alleghany conglomerate was named for Alleghany, in the southern part of the Huntingdon quadrangle, along which it crops out. It is a persistent bed about 50 ft thick, and 75 to 300 ft above the base of the Chemung. It is green in color, grayish green, and impregnated with ferruginous, white to light-gray sandstone. In the section northeast of St. George (No. 5), it is made up of a number of rather thick sandstone layers, separated by soft greenish clay shale. In places, fossils, of which there are several species, are fairly abundant. Alleghany conglomerate member.—The Alleghany conglomerate was named for Alleghany, in the southern part of the Huntingdon quadrangle, along which it crops out. It is a persistent bed about 50 ft thick, and 75 to 300 ft above the base of the Chemung. It is green in color, grayish green, and impregnated with ferruginous, white to light-gray sandstone. In the section northeast of St. George (No. 5), it is made up of a number of rather thick sandstone layers, separated by soft greenish clay shale. In places, fossils, of which there are several species, are fairly abundant. Alleghany conglomerate member.—The Alleghany conglomerate was named for Alleghany, in the southern part of the Huntingdon quadrangle, along which it crops out. It is a persistent bed about 50 ft thick, and 75 to 300 ft above the base of the Chemung. It is green in color, grayish green, and impregnated with ferruginous, white to light-gray sandstone. In the section northeast of St. George (No. 5), it is made up of a number of rather thick sandstone layers, separated by soft greenish clay shale. In places, fossils, of which there are several species, are fairly abundant.
The Hampshire is fossiliferous throughout. The 311 species collected include those most characteristic of the Mississippian age in the Appalachian region west of the Broad Top Mountain syncline and the Chemung age of the area is unquestionable. Some of the species are cited in the detailed stratigraphic sections.

White-Hampshire boundary—The White-Hampshire boundary is the boundary between the Chemung and Outkill (Hampshire of this report) at the bottom of the lowermost concretionary ("red") layer and the rocks below it are pitted owing to leaching of the more calcareous parts. (See pi. 23.)

The Hampshire west of the Broad Top Mountain syncline is known through testing and well borings to include the equivalent of the Pennsylvanian age of the Allegheny Front. It appears that the rocks in the central and northwestern parts of the State, however, the redbeds of Catskill type are really Carboniferous, and they are so classed by the New York State Geological Survey. In this region the Hampshire-Hampshire boundary will have to be located at lower and lower horizons westward from the Broad Top Mountain syncline.

Hampshire formation

None and definition—The Hampshire formation was named by Deyo in 1895, to the Virginia Geological Survey. It is the uppermost division of the Virginia formation of this report, and it is subdivided into the Pocono, Loyalhanna, and Mauch Chunk formations, and the Pennsylvania formation into the Potomac, Allegheny, Conemaugh, and Moonstone formations, but the last two are not present in the Hollidaysburg and Huntington quadrangles.

None and definition—The Pocono formation was named from its development in the Pocono Mountains of northeastern Pennsylvania. In the Hollidaysburg-Huntingdon area the Pocono includes all the rocks, predominantly gray, between the red Hampshire and the fossiliferous and calcareous Lower Pennsylvanian of Catskill type. It is sharply distinguished from both and easily recognized. The boundary contact is exposed on the Pennsylvania Railroad in the Allegheny Front. (See pi. 23.)

The base 60 feet of the Pocono is marked by a large area in central Pennsylvania where the beds are more than 50 feet thick, including a layer of red shale 50 feet above the bottom. (See pi. 23.)

The Hampshire west of the Broad Top Mountain syncline is known through detailed stratigraphic sections. It is subdivided into the Pocono, Loyalhanna, and Mauch Chunk formations, and the Pennsylvania formation into the Potomac, Allegheny, Conemaugh, and Moonstone formations, but the last two are not present in the Hollidaysburg and Huntington quadrangles.

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which there is a siliciferous cross-bedded siltite. In that region the Ste. Genevieve immediately overlies the Logan formation and is succeeded above by the Gypseous. Now, as already shown, the Logan formation is the same as the Burgoon sandstone immediately beneath the Loyalhaima limestones, and the Gypseous of the Ste. Genevieve is in eastern Kentucky and the main constituent of the Maxville limestone of Ohio, is correlated with its fossils with the Greenbrier limestones member of the Mauch Chunk shale, 20 feet above the Loyalhaima limestone on Coolewitt Rock east of Connellsville and elsewhere in southwestern Pennsylvania and eastern Maryland. On the basis of structure and character, therefore, the Loyalhaima is probably the eastern representative of the Ste. Genevieve.

TRough Creek Formation

Name and definition.—The name Mauch Chunk is taken from Mauch Chunk, in the anthracite region of eastern Pennsylvania, where the formation is typified developed. It overlies the Pennsian formation and underlies the Potsville, and in the Huntingdon quadrangle it includes or near the bottom the Trough Creek limestone member.

Distribution.—The Mauch Chunk is present in the northwestern corner of the Hollidaysburg quadrangle and on the slopes of Broadtop Mountain in the Huntingdon quadrangle. The formation is well exposed at many points in the Trough Creek Valley, and Round Mountain is composed of it except a thin cap of Potville sandstone.

Character.—On the Allegheny Front, immediately above the Loyalhaima limestones, lies 5 to 6 feet of interbedded red sand, silt, and sandstone, and above this 30 to 40 feet of nearly thick-bedded gray to greenish siltstone and sandstone, in the lower part of which occurs a bed of conglomerate, in the Trough Creek valley it is 20 feet thick. This conglomerate is composed of boulders of sandstone and conglomerate, and the boulders are of various sizes, some of them being as large as the boulders in the Eastern Freeport sandstone. In the Fort Knocks of Oil City this conglomerate is represented by the Konnoquenessing conglomerate member of the Ste. Genevieve limestone.

The Trough Creek Valley the Mauch Chunk is almost wholly a solid body of red sand similar to that on the Allegheny Front, and not unlike the Trough Creek member of the Gertsen formation in the Allegheny Valley. The Trough Creek member in the allegheny Valley is 150 feet thick. In the Trough Creek Valley the Mauch Chunk has a thickness of 180 feet, and in the Trough Creek Valley it is 70 feet thick. In the Trough Creek Valley the Mauch Chunk has a thickness of 180 feet, and in the Trough Creek Valley it is 70 feet thick. In the Trough Creek Valley the Mauch Chunk has a thickness of 180 feet, and in the Trough Creek Valley it is 70 feet thick.
Figure 4 shows a section across the Nittany arch and Broadtop syncline, made up by combining structure section F-F' of the Huntingdon quadrangle and section C-C' of the Hollidaysburg quadrangle and restoring the strata that have been eroded from the crest of the arch. The Allegheny formation, the highest in the quadrangles, would on the restored arch be about 5 miles farther apart than now if the strata were restored to horizontality. It would show a broad, nearly flat crest on the Hollidaysburg and Huntington quadrangles, showing restored position of the Allegheny front.

In Goteberg time at least some parts of the land yielded great quantities of quartz sand. A somewhat similar climate may have prevailed, resulting in concentrated saline water that favored the deposition of strata containing large amounts of quartz sand. Where this sand has been eroded, the resulting surface frequently shows a shallow depression, as on the line of section E-E' of the Hollidaysburg quadrangle, and the Allegheny Front is 5 miles farther apart than now if the strata were restored to horizontality.

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become a broad, deceptively shallow gulf agitated by great waves and swept by tides and possibly strong current currents. Conditions were generally favorable to life in this epoch, and at different times the sea bottom must have been covered with shell-bearing animals, for many thin layers of imperishable limestone composed largely of shells are intercalated in the sediments.

In the epoch succeeding the Ordovician there were probably lands of moderate relief on the north of the Appalachian Mountains and to the east and southeast of the Appalachian Plateau. In the Ohio Valley from New York to Alabama and Florida, in the Ohio Valley and the Allegheny region, and on the east of the Appalachian Mountains, there were probably lands of moderate relief. In the Ohio Valley from New York to Alabama and Florida, in the Ohio Valley and the Allegheny region, and on the east of the Appalachian Mountains, there were probably lands of moderate relief.

During the succeeding Mississippian epoch the deposits of sandy and muddy sediments continued. Considerable variation in the kinds of sediments and the nature of the sedimentary environment characterizes this epoch. In the Ohio Valley from New York to Alabama and Florida, in the Ohio Valley and the Allegheny region, and on the east of the Appalachian Mountains, there were probably lands of moderate relief.

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Ammomin limestone — The Ammonian limestone has been quarried on a small scale by farmers and burned for agricultural purposes.

Carolinian and Lateolite limestones — All the large quarries of the region are open on the Georgian and Lateolite limestones, and the completed thickness of about 300 feet is generally quarried. The argillaceous and siliceous Laminar member in the top of the Belgian, unless quarried for ballast or road metal, is infrequently mined.

The composition of these limestones differs from bed to bed, but the average content of insoluble matter for the entire thickness, excluding the Laminar member, is somewhat less than 5 percent. The following statement was given by the superintendent of the quarry:

Average composition of limestones in Blairsville-Washington quarries, about 3.5 miles north of Carlin

- Calcium carbonate (CaCO₃) 92.67
- Iron oxide (Fe₂O₃) 1.90
- Magnesium carbonate (MgCO₃) 4.10
- Silica (SiO₂) 0.90
- Phosphorus (P₂O₅) 0.00

The following analyses show the composition of the limestones in a quarry at Franklin Forge (Gatesville):

<table>
<thead>
<tr>
<th>Composition of limestones from quarry near Martinsburg</th>
</tr>
</thead>
<tbody>
<tr>
<td>(P)</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>0.20</td>
</tr>
<tr>
<td>0.18</td>
</tr>
</tbody>
</table>

Samples that were taken from a quarry near Martinsburg, probably in the Carolinian beds, had the composition shown above:

<table>
<thead>
<tr>
<th>Composition of limestones from quarry near Martinsburg</th>
</tr>
</thead>
<tbody>
<tr>
<td>(P)</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>0.20</td>
</tr>
<tr>
<td>0.18</td>
</tr>
</tbody>
</table>

The composition of the "calico rock" and adjacent beds shown in the following tables, which were furnished by J. K. McLanathan:

<table>
<thead>
<tr>
<th>Composition of samples taken from 3 of 5 quarries, including the &quot;calico rock&quot; and Enotahawk quarry, about 3 miles southwest of Hollisburg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarry</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

Mr. McLanathan states that the "calico rock" at the Reservoir quarry became so silicious along the strike that the quarry had to be abandoned.

St. Clair Limestone Co. at Franklin Forge (Ganister), or operations proceed horizontally. Some quarries begin on the end located just above high-water level along the streams, and operations coincide with the crest of the ridge along the middle of the areal-geology map.

Carlim and Lowville limestones along Clover Creek and Franks-County is the exploitation of the rock known as ganister, from the mountain region of central Pennsylvania and makes the conspicuous ridges of which Tussey and Dunning Mountains are the south side of Scotch Valley, and along Warriors Ridge east of Tussey Mountain the lower 20 feet of the Helderberg bands associated with limestone and shale through a thickness 600 feet west of the outcrop to a limit where the iron ores are of two kinds...The iron ores are of two kinds...The Marklesburg ore bed, just under the Kefer sandstone, has been extensively mined in a narrow area beginning 1 mile north of Marklesburg and extending northward to a point 10 west of McConnellsburg. The bed is a typical fossil on 1 foot to 1 foot thick. The following section was furnished by the operator of a small mine 1 mile north of Marklesburg:

The "block" ore has been found in the following table:

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Name</th>
<th>Analysis Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sesquioxide of iron</td>
<td>23.60</td>
</tr>
<tr>
<td></td>
<td>Iron</td>
<td>11.40</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>34.90</td>
</tr>
</tbody>
</table>

No. 1 is only a ferruginous sandstone here. The Frankstown ore is highly fossiliferous and slightly oolitic, the oolitic grains being flattened and generally of considerable size. It much resembles the Allegheny Clinton ore. Its composition is shown in the following table:

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Name</th>
<th>Analysis Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sesquioxide of iron</td>
<td>17.00</td>
</tr>
<tr>
<td></td>
<td>Iron</td>
<td>11.90</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>28.90</td>
</tr>
</tbody>
</table>

The high lime content indicates hard, unworn ore, and the metallic content shows a high grade for such an unworned Clinton ore.

The port of the outcrop of the Frankstown bed that has been worked is at the south end of Brith Mountain. From this area in both directions the bed thins and becomes worthless. Along Brith Run north of Hollidaysburg the slopes are reported to have extended 600 feet west of the outcrop to a limit where the Marklesburg ore became too thin for profitable mining. The Frankstown mine produced a greater quantity of ore than any other, the output having reached 20,000 tons a year in the seventies. Platt reports the slopes as 710 feet long and 215 feet deep in 1879 or 1880. Since then it has not been worked.

The ore probably carries a small content of calcium carbonate in the unworned condition, limy (lens) ore having been encountered in places. Most of the ore mined, however, is leached, soft, of spongy texture and spangled throughout with small particles said to be specular hematite.

Limonite or Brown Hematite Ore

A full and satisfactory account of the deposits of limonite or brown hematite was given by Platt. The principal old workings were the Springville mine, on Orr Hill; the Henrietta mine, at Henrietta; the Millcreek red ore bed; and the Rebecca mine, near Rebecca Furnace.

Springville mine.—The main pits at Orrimine are on the Gangsberry formation. The ore occurs partly as lenses in a residual mass of clay, sand, and sandstone fragments more than 200 feet deep, inclined by rock walls on the north, east, and west. The ore on the bottom is a layer of thick ore of limy ore in lumps and blocks embedded in clay. Most of this material was passed through the washer. Some of the ore was of excellent grade. The following analyses show its composition:

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Name</th>
<th>Analysis Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sesquioxide of iron</td>
<td>23.00</td>
</tr>
<tr>
<td></td>
<td>Iron</td>
<td>11.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>34.00</td>
</tr>
</tbody>
</table>

The samples analyzed, except No. 3, were taken from the washer and represent the ore as it went to the furnace.

The Blomond mine, on the ridge south of Orr Hill, like the Springville mines, are on the Gangsberry formation. The ore is in all respects similar to that at Spring-
field. The ore-bearing red beds extend over a space 7,200 feet long and 1,000 to 1,500 feet wide, and the known depth is more than 300 feet. The deposit is chiefly above the deep rock depression bordered on the north, west, and south and perhaps on the east also by rock walls. The Bloomfield ore area averages, according to source data published by Platt, 5 feet of ore, 0.5 feet of gravel, and 0.1 foot of sand. The 32 to 55 percent metallic iron ore described above is utilised for making fire brick, converter linings, and furance works. The origin and mode of occurrence have been already described in connection with the ore deposits at Orefield and Oreford Hill. (See pp. 27.) Their composition is shown below.

## Composition of clay and shale at Orefield

<table>
<thead>
<tr>
<th>Component</th>
<th>wt %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic matter</td>
<td>7.3</td>
</tr>
<tr>
<td>Silica</td>
<td>69.5</td>
</tr>
<tr>
<td>Alumina</td>
<td>18.8</td>
</tr>
<tr>
<td>Magnesia</td>
<td>4.4</td>
</tr>
<tr>
<td>Sulfate</td>
<td>1.0</td>
</tr>
<tr>
<td>Water</td>
<td>0.8</td>
</tr>
</tbody>
</table>

## Other components

- **Slate** contains 80.7% silica, 19.2% alumina, and 0.1% water.
- **Silt loam** contains 70.8% silica, 27.5% alumina, and 1.7% water.
- **Sandy loam** contains 60.8% silica, 32.9% alumina, and 6.3% water.

## Sand and gravel

- **Sand** contains 90.6% silica, 8.4% alumina, and 0.6% water.
- **Gravel** contains 86.2% silica, 13.1% alumina, and 0.6% water.

By courtesy of A. S. McCreath.

## Note on the coal fields of Pennsylvania

- **Hollidaysburg** and Huntingdon.
- **Carbondale** and **Lancaster**.
- **Flemington** and **New Hope**.
- **Reading** and **Philadelphia**.

The deposits of clay are too irregular in thickness and area extent to permit any realistic estimates of quantity. The main bodies for so far as known fall into a few main categories:

- **Sanford** and **Kittanning**.
- **New Kensington** and **Northwood**.
- **Eldora** and **Oxford**.

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By courtesy of A. S. McCreath.
each. These outcrop areas are deeply covered with coarse sand, which acts as a natural reservoir for the water falling upon it, and the formation itself is composed of rather open-textured dolomite and sandstone, through which the water finds an easy passage. The Big Springs at Williamsburg are reported to yield more than 4,000 gallons a minute, and Roaring Spring about 5,500 gallons a minute. These springs supply paper mills at Williamsburg and Roaring Spring. Another spring at Royer, which issues from the Bellefonte dolomite, has an estimated yield of 1,500 gallons a minute. Small springs are extensively used for domestic supplies, particularly in some of the valleys that are bordered by high ridges. Most of the water from wells and springs is of good quality, but some of the limestone waters, especially from the Cayuga group, are too hard for use in boilers.