COMMONWEALTH OF VIRGINIA
DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
DIVISION OF MINERAL RESOURCES

GEOLOGY OF THE DALEVILLE QUADRANGLE, VIRGINIA

ODELL S. McGUIRE

REPORT OF INVESTIGATIONS 42

VIRGINIA DIVISION OF MINERAL RESOURCES
James L. Calver
Commissioner of Mineral Resources and State Geologist

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GEOLOGY OF THE DALEVILLE QUADRANGLE, VIRGINIA

By

Odell S. McGuire[1]

ABSTRACT

The Daleville quadrangle is located in Botetourt and Roanoke counties, Virginia in the Valley and Ridge physiographic province. Bedrock in the area ranges in age from Early Cambrian to Early Mississippian with a total thickness of about 15,000 feet (4, 572 m).

Thrust sheet B, located in the northeastern half of the quadrangle, contains Cambrian and Ordovician clastic and carbonate rocks which have been thrust over the Catawba syncline. This sheet has been subjected to complex folding and faulting. Fault B is contiguous with the Pulaski-Staunton fault to the north. Thrust sheet A in the southeastern part of the area has Cambrian rocks which have been thrust over sheet B. The Catawba syncline, located in the southwestern half of the quadrangle, contains Cambrian to Devonian clastic and carbonate rocks and lies beneath thrust sheets A and B. The eastern part of this syncline has been complexly folded and faulted.

Cement is being produced from limestones and calcareous shale quarried in the quadrangle. Crushed stone, iron, coal, marl, and barite have been obtained in the past. Potential mineral resources include construction sand and gravel, shale for decorative brick, high-silica sandstone, and carbonates for industrial use.

INTRODUCTION

The Daleville 7.5-minute quadrangle is located mostly in Botetourt County southwest of Fincastle, but includes a small area of Roanoke County in the southwest corner (Figure 1). The area lies between 37°22′30″ and 37°30′00″ north latitude and 79°52′30″ and 80°00′00″ west longitude.

Previous geologic mapping in this area includes Woodward's (1932) map of the Roanoke area on a scale of 1:125,000; this has been used for most subsequently published maps of the

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region. Andrews (1952), Nichol (1959), and Hazlett (1968) produced larger scale unpublished field maps, which include portions of the Daleville quadrangle. Hazlett's map of the southeastern portion of the quadrangle coincides with that of the writer except in matters of detail.

McGuire's (1970) map of the Oriskany 7.5-minute quadrangle adjoins the Daleville quadrangle to the north. There are two areas in which geologic mapping does not agree across the quadrangle boundary. A dotted contact between the Conococheague and Copper Ridge formations is shown 1.0 mile (1.6 km) east of the west edge of the Oriskany sheet in an area of very poor exposures. Mapping to the south in the Daleville quadrangle where exposures are adequate reveals that this contact is 0.5 mile (0.8 km) farther east than shown and that the unusually wide outcrop belt of Copper Ridge is due to repetition by faulting. In the area immediately west of Fincastle the author's mapping in the Oriskany quadrangle fails to show a cross fault which exposes Upper Cambrian limestones and dolomites in a small area mapped as Elbrook at the south edge of the sheet. The sketch map (Figure 2) shows the revised interpretation of these exposures on the Oriskany sheet.

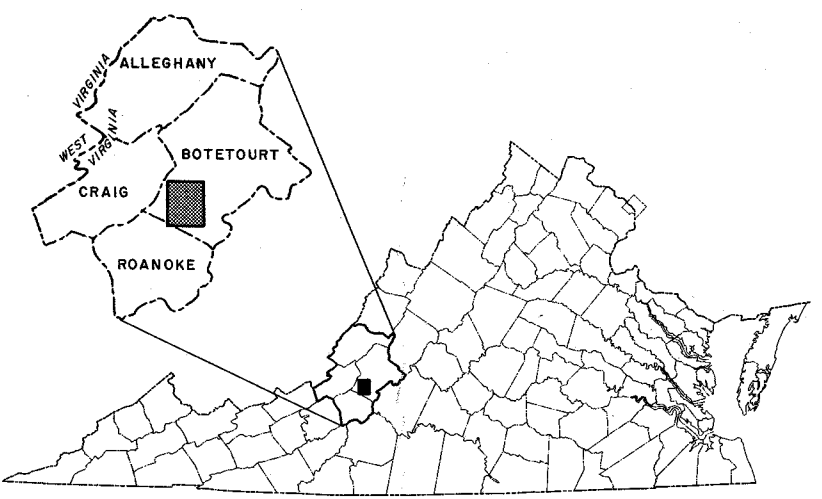

Figure 1. Index map showing location of the Daleville quadrangle.

Field work was done during the summers of 1970, 1971, 1972, and 1973. James Hibbard assisted the writer during the summer of 1972; E. K. Rader helped to complete field work in June 1973, to write parts of the text, and to map the alluvium. John W. Wunder assisted in mapping the alluvium. The author has benefited from discussions with E. W. Spencer of particular problems in the area. Mata and Melanie McGuire helped get the material ready for publication.

The map area lies in the Valley and Ridge physiographic province. There is about 1,900 feet (579 m) of relief with the lowest elevation of 1,080 feet (329 m) along Catawba Creek at the north edge of the quadrangle and the highest of 2,960 feet (902 m) on Tinker Mountain near the west edge. The

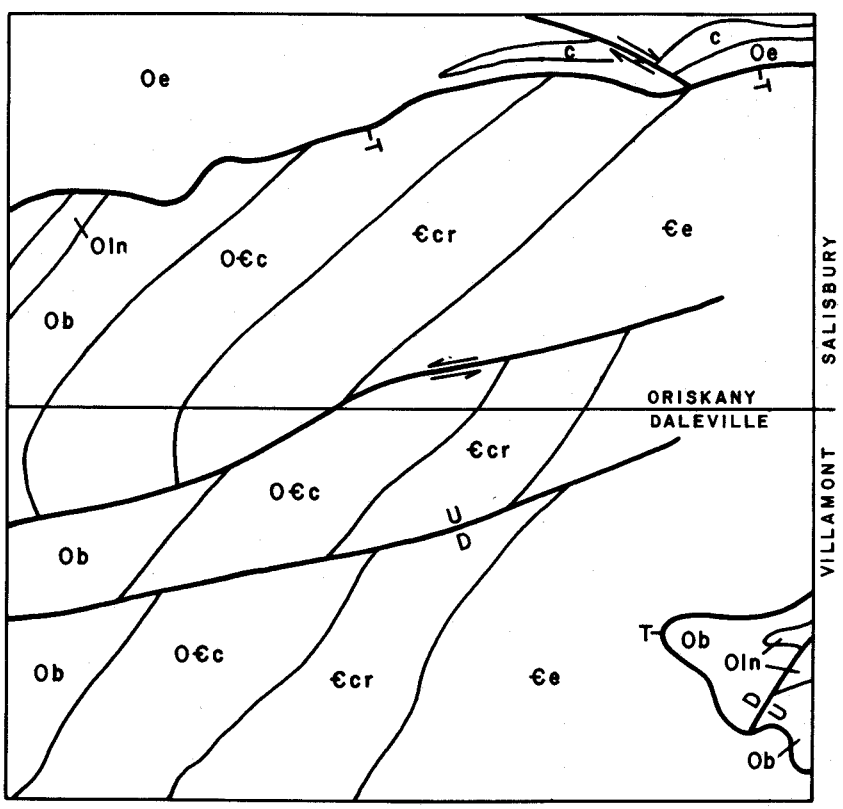

Figure 2. Revised interpretation of the geologic mapping in the southeast corner of the adjoining Oriskany quadrangle.

northeastern two thirds of the quadrangle is in the Fincastle Valley, a rolling lowland of elevation between 1,100 and 1,600 feet (335 and 488 m) above sea level underlain mainly by Cambrian and Ordovician shales and carbonates. Karst features are present but weakly developed. Catawba Creek, an easterly flowing tributary of the James River, drains the north half of this area. Tinker Creek of the Roanoke River system flows southeasterly along the foot of Tinker Mountain, draining the rest of the valley and the mountain flank.

In the extreme northwest corner of the quadrangle is the southeast slope of Caldwell Mountain, a northeastward-trending feature underlain by Mississippian clastics. About 1.0 mile (1.6 km) south of Troutville is the western end of Fullhart Knob, an outlier of the Blue Ridge province which is capped by Cambrian quartzite (Figure 3). Both of these features reach elevations of about 2,000 feet (610 m) within the quadrangle boundaries.

Tinker Mountain extends along an irregular northerly to northwesterly course from the center of the south edge of the quadrangle to the center of the west edge. At the west edge

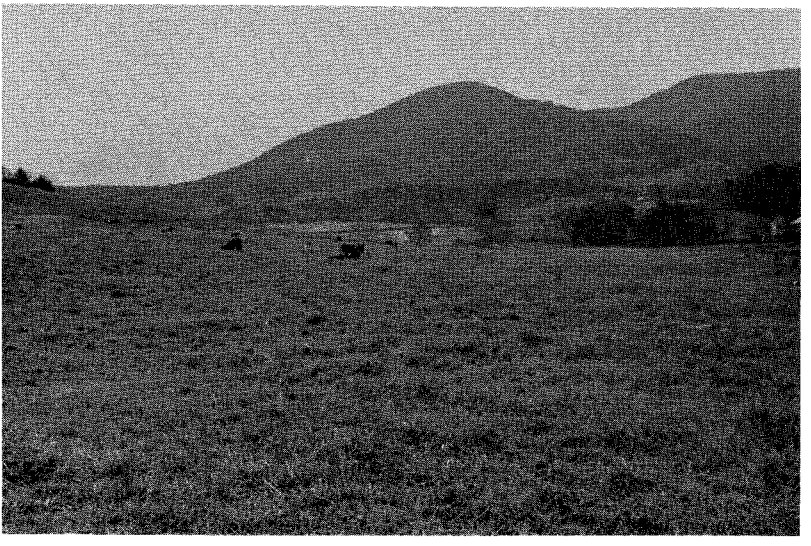

Figure 3. Fullhart Knob in center, Daleville and Villamont quadrangles; looking northeast; Erwin quartzites are thrust onto Rome Formation (left side of knob).

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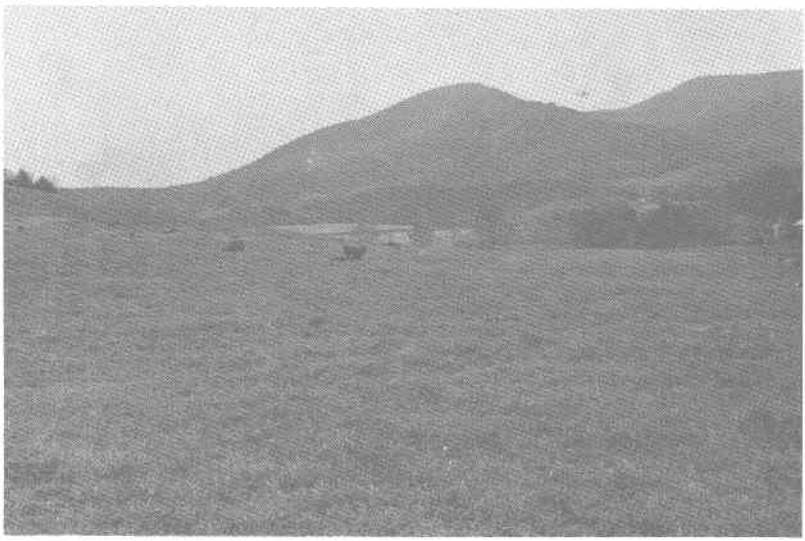

Figure 3. Fullhart Knob in center, Daleville and Villamont quadrangles; looking northeast; Erwin quartzites are thrust onto Rome Formation (left side of knob).

this ridge changes direction to a southerly course for almost 2 miles (3 km) before it swings slightly westward to the edge of the quadrangle. To avoid confusion in the following discussion the writer will refer to the western and northeastern sectors of Tinker Mountain for these differently trending ridges. Tinker Mountain is capped by Silurian quartzites and reaches a maximum elevation of almost 3,000 feet (914 m) in the western sector. The Appalachian Trail for the most part is located along the crest of this mountain.

In the southwest corner of the quadrangle is the nose of the northeastward-trending ridge, Brushy Mountain, which reaches an elevation of 2,428 feet (740 m). It is capped by Devonian sandstone.

A horseshoe-shaped depression, Carvin Cove, is located between Brushy Mountain and the various sectors of Tinker Mountain. Devonian shale and siltstone underlie the cove. A reservoir for the Roanoke city water supply, with a spillway elevation of 1,170 feet (357 m), is located in the eastern two thirds of the cove. This cove is drained by Carvin Creek which is also part of the Roanoke River system.

Though most of the mapped area is rural, suburban development from the City of Roanoke to the south and from local industry is spreading northward. Fincastle, the county seat of Botetourt County is located at the northeastern corner of the quadrangle. The area northeast of Tinker Mountain has a transportation network consisting of Interstate Highway 81, U. S. Highways 11 and 220, a network of State Roads, and the Norfolk and Western Railway. Multiple-use lands of the Jefferson National Forest are located in the northwest and southeast portions of the quadrangle. Restricted-use land of the Roanoke water-supply reservation is situated in the southwestern quarter of the mapped area.

Numbers preceded by "R" in parentheses (R-5623) correspond to localities where rock samples were collected (Plate 1). Samples are on file in the repository of the Virginia Division of Mineral Resources.

STRATIGRAPHY

The stratigraphic units of the mapped area consist of sedimentary rocks ranging from Early Cambrian through Early Mississippian in age and of Quaternary alluvium (Table 1)

Table 1.—Geologic formations in the Daleville quadrangle.

Age	Name	Character	Thickness in feet (meters)
Quaternary	Alluvium	Varicolored unconsolidated sand, gravel, and clay.	
Mississippian	Price Formation	Quartz-pebble conglomerate, sandstone, gray shale, mudrock, and coal.	700± (213±)
Devonian	Chemung Formation	Tan, greenish-gray, brown, and maroon sandstone and lumpy shale with thin quartz-pebble conglomerates; fossiliferous.	600± (183±)
	Brallier Formation	Hard, fissile, greenish-gray shale with gray siltstone and fine-grained sandstone.	1,600-1,800 (488-549)
	Millboro Shale	Black fissile shale with ironstone concretions and some pyrite.	800 (244)
	Needmore Formation	Olive-drab, calcareous shale, some decalcified limestone stringers.	
	Huntersville Formation	Lumpy, dark green, sandy glauconitic shale and dense, pinkish-white, brown-weathering chert.	13 (4)
— — — — —	Unidentified sandstone	Medium to very coarse-grained, friable, cross-bedded, limonitic sandstone.	4-10 (1-3)
— — — — —	Keefer Sandstone	Pinkish-white to tan, fine to coarse-grained orthoquartzite.	200± (61±)
Silurian	Rose Hill Formation	Greenish-gray shale with maroon hematitic sandstone.	75± (23±)
	Tuscarora Formation	White and tan, medium- to coarse-grained, conglomeratic orthoquartzite.	10-50 (3-15)
Ordovician	Martinsburg Formation	Gray, yellow-weathering, calcareous shale; olive-gray and gray limestone; and greenish-gray siltstone and fine-grained sandstone; fossiliferous.	1,600 (488)

Age	Name	Character	Thickness in feet (meters)
Ordovician	Bays Formation	Red, brown, olive-drab, and greenish-gray, fine-grained sandstone, siltstone, shale, and mudrock.	90-220 (27-67)
	Edinburg Formation	Dark-gray to black, medium-bedded, calcareous shale and fine-grained limestone southwest of faults A and B (Liberty Hall). Black, fissile, noncalcareous shale to the north and east. Thick-bedded to massive, light-gray, coarsely fragmental limestone; fossilferous (Effna).	1,000-1,800 (305-549)
	Lincolnshire Formation	Dark-gray, cobbly limestone with nodular chert; fossiliferous.	80-150 (24-46)
	New Market Limestone	Dove-gray, compact limestone with conglomerate of limestone, dolomite, and some sandstone; chert near base.	10-100 (3-30)
	Beekmantown Formation	Medium-gray, massive and thick-bedded, fractured dolomite with weathered residues of gnarly chert. Minor sandstone southwest of faults A and B. Much bluish-gray compact limestone to north; sparingly fossiliferous.	500-1,500 (152-457)
	Chepultepec Formation	Light-gray to black, fine-grained, compact limestone with oolitic chert.	1,200 (366)
Cambrian	Conococheague Formation	Medium bluish-gray, medium-grained, sandy limestone and dolomite with sandstone interbeds.	
	Copper Ridge Formation	Gray, thick-bedded and laminated dolomite with coarse-grained, calcareous, quartzose sandstone; laminated or oolitic chert rare.	800-1,100 (244-335)

Age	Name	Character	Thickness in feet (meters)
Cambrian	Elbrook Formation	Bluish-gray, laminated, fine-grained limestone with intraformational limestone conglomerate and algal structures at top; gray and brown dolomite; gray to greenish-gray shale; sparsely fossiliferous.	1,200± (366±)
	Rome Formation	Red, maroon, green and yellow shale, mudrock, and siltstone with mottled to crinkly laminated limestone and dolomite.	2,000+ (610)
	Erwin Formation	Massive, tan, brittle quartzite with casts of *Skolithos;* fossiliferous.	

The maximum thickness is approximately 15,000 feet (4,572 m). The Shady Formation, which in normal succession lies between the Erwin and Rome formations, has not been identified in the quadrangle and is interpreted to be absent by faulting. Thrust faults A and B have a northwesterly trend across the area along a line connecting Daleville, Mt. Union, and Haymakertown (Plate 1). Because these faults bring unlike facies of the same formations into juxtaposition it is necessary to make frequent reference to them in the following descriptions of stratigraphic units.

Due to the structural complexity of the area and lack of outcrops no definitive single lithology can be listed as top and bottom criteria for some stratigraphic units. These are mapped on the basis of similar rock assemblages.

CAMBRIAN SYSTEM

Erwin Formation

Outcrops of massive, tan, *Skolithos*-bearing, fossiliferous, brittle quartzite, which is in places brecciated and mineralized with iron oxides, occur along the east edge of the quadrangle about 1.0 mile (1.6 km) south of Troutville (Figure 3). Wood-

ward (1932) and subsequent workers have mapped these and the contiguous extensive belt of outcrops on the adjoining Villamont quadrangle as the Erwin Formation.

Rome Formation

The Rome Formation underlies much of the quadrangle southeast of fault A. It consists of a heterogeneous sequence of variegated shale, mudrock, and siltstone with lesser amounts of limestone and dolomite and a little sandstone (Figure 4).

The diagnostic lithologies of the Rome are subfissile, silty, red, maroon, green, and yellow shale, mudrock, and siltstone that are present as chips in the thin soils of hillsides and hilltops underlain by the formation. Medium-bedded, blue, gray, and tan limestone and dolomite ledges are intercalated with the shale lithologies wherever these are well exposed in creeks and roadcuts.

The Rome Formation contains at least one fairly thick zone of thin-bedded, gray dolomite with lesser amounts of blue limestone and gray shale, some of it sericitic. These are indistinguishable from Elbrook lithologies. One belt of this character crops out along the line from Troutville south-southwest to the

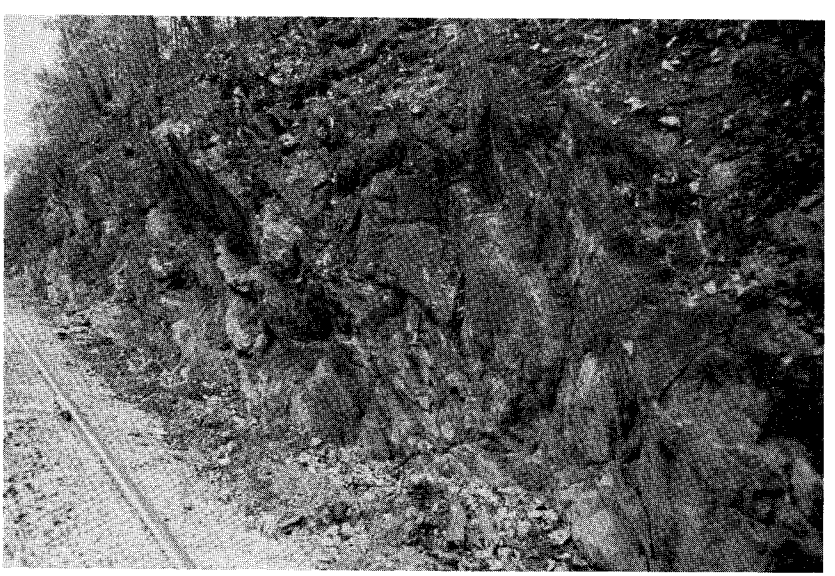

Figure 4. Crumpled shale and carbonate of the Rome Formation along the Norfolk and Western Railway southwest of Troutville.

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The Rome Formation underlies much of the quadrangle southeast of fault A. It consists of a heterogeneous sequence of variegated shale, mudrock, and siltstone with lesser amounts of limestone and dolomite and a little sandstone (Figure 4).

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Figure 4. Crumpled shale and carbonate of the Rome Formation along the Norfolk and Western Railway southwest of Troutville.

roadcuts around the overpass of Interstate Highway 81 at State Road 779. Another may be seen in Interstate Highway 81 roadcuts 0.25 mile (0.40 km) north of State Road 651. Similar lithologies south of Amsterdam (R-5623) have also been interpreted as Rome by the writer but these might represent an infold or a fault slice from the Elbrook Formation.

The thickness of the Rome is not determinable within the quadrangle; Hazlett (1968) has estimated a thickness in excess of 2,000 feet (610 m). The more typical Rome lithologies are best exposed in the Norfolk and Western Railway cuts between State Roads 652 and 653 southwest of Troutville.

Elbrook Formation

The Elbrook Formation underlies much of the triangle formed by Troutville, Fincastle, and Haymarkertown. Smaller areas of exposure occur west of State Road 600 near the northwest corner and in a strip southeast of Daleville.

Three characteristic lithologies are present in the Elbrook Formation. There are a few exposures of gray and greenish-gray shale with scattered outcrops of medium-bedded blue and gray dolomite and limestone. The dolomites are typically ferruginous and weather to a yellowish- or pinkish-brown. Less frequently there are fairly uniform sequences of medium-bedded, gray dolomite with shaly partings similar to lithologies in the overlying Copper Ridge Formation. At the top of the formation is a 200-foot (61-m) sequence of bluish-gray algal limestone; blue intraformational limestone conglomerate; bluish-gray, laminated, fine-grained limestone; shaly to platy to medium-bedded, brown-weathering dolomite and hard to soft, gray shale. This upper sequence is unmistakable and is well exposed northeast of the traces of faults A and B. It is one of the key mapping horizons of the region. West of the faults the top of the Elbrook is mapped on a similar but more dolomitic and perhaps thinner sequence which is not so prominently exposed. All carbonates in the Elbrook may bear small quantities of fine-grained sand and silt.

The thickness of the formation is not determinable in this area. Woodward (1932) estimated the thickness to be in excess of 1,200 feet (366 m).

Copper Ridge Formation

The Copper Ridge Formation is exposed in a northwestward-trending belt southwest of faults A and B from the southeast corner of the map to Stone Coal Creek near the northwest corner. A second extensive belt trends northeastward from Haymakertown to Fincastle. Two other belts are exposed approximately 1.0 and 2.0 miles (1.6 and 3.2 km) north-northwest of Haymakertown.

Interbedded sandy, gray, thick-bedded dolomite with positive weathering, lighter gray laminae and coarse-grained, cross-bedded, calcite-cemented, quartzose sandstones characterize the Copper Ridge. Intervals of silty, thin-bedded dolomite with shaly partings are present. Limestone is rare. Dense, laminated or oolitic, bedded or nodular, light or dark chert occurs sparingly in the upper part.

Characteristically, the Copper Ridge consists of occasional outcrops of sandy dolomite ledges and float of coarse-grained, loosely cemented, buff, quartzose sandstone blocks up to 6 inches (15 cm) in a dimension perpendicular to bedding. A sand-rich interval showing cross-bedded sandstone with outcrops up to 6 feet (2 m) thick typically occurs from about 75 to 150 feet (23-46 m) above the contact with the underlying Elbrook. The top of the unit is picked beneath the lowest beds of bluish-gray limestone of the Conococheague. The most diagnostic features are an abundance of coarse-grained sandstone and the nearly complete absence of limestone in exposed carbonate portions of the section.

There are no outstanding exposures of this unit in the quadrangle but good small outcrops may be seen along Catawba Creek upstream from its confluence with Stone Coal Creek near the northwestern corner of the quadrangle.

Northeast of faults A and B the thickness of the unit is estimated to be 800 to 900 feet (244-274 m). To the southwest it is thicker; Hazlett (1968) estimates 1,000 to 1,100 feet (305-335 m).

ORDOVICIAN AND CAMBRIAN ROCKS

Conococheague and Chepultepec Formations

The combined Chepultepec-Conococheague mapping unit has two areas of outcrop: (1) the faulted synclinal structure to

the west of Fincastle and (2) in the vicinity of the traces of faults A and B along a northwestward-southeastward trend from west of Haymakertown to near the southeastern corner of the quadrangle.

In the area of this report the Conococheague and Chepultepec formations have been considered as a single unit for the purposes of mapping because of poor exposures and the lack of distinctive lithologic differences. Northeast of the Daleville quadrangle, Spencer (1968) mapped the Conococheague and Chepultepec as separate units; however he did not recognize the Copper Ridge. Hazlett (1968) divided the rocks between the Elbrook and Beekmantown into two mapping units—Copper Ridge and Chepultepec formations. The present writer was not able to make the distinction and has preferred to follow his earlier practice (McGuire, 1970, p. 10-11) of excluding limestones from the Copper Ridge and mapping the entire limestone-dominated sequence between the Copper Ridge and Beekmantown as a single unit.

Northeast of faults A and B the Conococheague consists of limestone and dolomite with sandstone interbeds. The limestones are mainly medium bluish gray, medium grained, and sandy. Raised lighter colored laminae occur on the weathered ledges. The unit is much like the Copper Ridge except that it is less sandy and contains much limestone. The Conococheague grades upward into poorly exposed, fine-grained, compact limestone ranging in color from light gray to nearly black. Some dolomite is also exposed. Sandstone is absent in the upper part, but oolitic cherts are prominent. These rocks are fossiliferous in other areas (Butts, 1940; Spencer, 1968) and contain a fauna closely allied or identical to the lower Ordovician Chepultepec fauna of Alabama. These upper beds are probably about 150 feet (46 m) thick but are only occasionally well exposed; they are probably gradational with typical Conococheague lithologies through an interval in excess of 100 feet (30 m). These combined units lying above the Copper Ridge and beneath the Beekmantown northeastward from the traces of faults A and B are about 1,200 feet (366 m) thick. Westward from the trace of fault B the entire Conococheague-Chepultepec interval is very poorly exposed and much thinner. The unit has been mapped on scattered outcrops of oolitic chert

and bluish-gray limestone. The maximum aggregate thickness is probably not over 350 feet (107 m).

ORDOVICIAN SYSTEM

Beekmantown Formation

The Beekmantown Formation extends in a belt southwest of faults A and B from near the southeast corner of the map to Catawba Creek on the northwest edge. Parallel to and west of Catawba Creek the Beekmantown is exposed in several fault slices. Its characteristic lithologies are massive and thick-bedded, brittle, thoroughly fractured, medium-gray, fine- to medium-grained dolomite and prominent-weathering residues of gnarly chert made cavernous by dolomolds.

Northeastward from the traces of faults A and B many gray and bluish-gray, aphanitic limestone ledges occur in the unit, especially in its upper and lower portions. Much laminated light to moderately dark chert is also present.

Westward from the trace of fault B there is little limestone in the Beekmantown. A prominent zone of mixed chert types and decalcified carbonates occurs near the middle of the formation and contains the gastropod *Lecanospira* (Hazlett, 1968). This zone is best exposed in the Daleville quadrangle in the first roadcuts east of the Norfolk and Western Railway crossing on State Road 654 in the southeast corner of the quadrangle. In the lower half of the formation and also just beneath the New Market Limestone in the upper portion, bedded sandy dolomites are locally exposed and these are frequently accompanied by some sandstone in beds up to several inches thick. These zones are not distinguishable from Copper Ridge or Conococheague lithologies and the possibility of misidentification is great where the Chepultepec is absent by faulting or cannot be located. This problem does not arise, however, northeastward from fault B where the Beekmantown is free of sand.

The Beekmantown appears to be about 1,500 feet (457 m) thick over much of the quadrangle, but it is much less than that in the area south of Glebe Mills and southwest of fault B. There it may be as little as 500 feet (152 m) thick in places. These rocks are overridden and overturned by thrust sheets A and B so that some structural attenuation is probable but

the degree of structural reduction in thickness in carbonate sequences along this belt is not impressive in the better exposures. The writer agrees with Hazlett (1968) that the thinning may be mainly stratigraphic.

New Market Limestone

The New Market Limestone flanks the faulted syncline west of Fincastle and occurs in an outcrop belt roughly parallel to Tinker Mountain. In the area the upper limit of the Beekmantown is everywhere marked by a prominent surface of erosion. The New Market Limestone of Middle Ordovician age (Cooper and Cooper, 1946), which overlies this erosional surface, consists of a basal conglomerate ranging in coarseness from grit to boulders and in thickness from a few inches to 75 feet (23 m). The clasts consist mainly of dolomite and limestone with occasional chert and sandstone in a matrix of dove-gray, compact calcilutite. Above the basal part the main lithology is compact, dove-gray limestone (R-5624) with blebs of sparry calcite occurring in massive ledges several feet thick. The thickness of the New Market ranges from 10 feet (3 m) or less to over 100 feet (30 m) in the Fincastle area. The New Market is thick and conglomeratic along the south bank of Catawba Creek southwest of Howell Mills. Karst topography is well developed in the New Market along Catawba Creek.

Southwestward from the traces of faults A and B and south of Glebe Mills the New Market and other Middle Ordovician limestones (Lincolnshire and Effna) are thin and outcrops are few. The discontinuity of the limestone outcrop in this belt might be due to structural thinning (see discussion under Beekmantown), to stratigraphic causes (Hazlett, 1968), or to poor exposures. Where the units are absent, as in the area just west of the U. S. Highway 220 and Interstate Highway 81 interchange, there is typically a completely covered zone lying between poor exposures of deeply weathered decalcified Beekmantown dolomite and deeply weathered Edinburg shale and limestone.

Lincolnshire Formation

The Lincolnshire Formation occupies the same outcrop belts as those of the New Market Limestone; these units are com-

bined for mapping purposes. The Lincolnshire consists of dark-gray, medium- and coarse-grained, impure, cobbly weathering, fossiliferous limestone containing black nodular chert and a few beds or lenses of lighter colored, bioclastic limestone in the upper part and some gray calcilutite near the base. The unit is gradational with the New Market below and may grade upward either into the calcarenites and bioclastic and biostromal limestones of the Effna unit of the Edinburg Formation or into the calcareous shale and shale-limestone interbeds of the Liberty Hall unit of the Edinburg Formation southwest of the traces of faults A and B. Northeast of the trace of fault B a similar but relatively chert-free unit also grades downward into the New Market but upward it appears to be in sharp contact with the noncalcareous, highly fissile shale of the Edinburg in the Fincastle Valley.

The Lincolnshire ranges in thickness from a few feet to the south of Glebe Mills to about 80 feet (24 m) at Lone Star to nearly 150 feet (46 m) along Catawba Creek south of Howell Mills (Nichol, 1959).

Edinburg Formation

The Edinburg Formation in the mapped area contains three distinct lithologic facies: (1) interbedded calcareous shale and argillaceous limestone (Liberty Hall); (2) noncalcareous, fissile shale; and (3) coarse-grained limestone (Effna). Facies 2 is in thrust sheet B in the north-central portion of the quadrangle. Southwest of fault B the Liberty Hall overlies the Effna.

From the quarry at Lone Star (Plate 1, active quarry number 1) and extending southeastward nearly to Glebe Mills is the outcrop belt of Effna limestone. It is a thick lens of light-gray, coarse-grained, bioclastic, biostromal, and calcarenitic limestone (R-5625), which succeeds the dark-gray, cherty phase of the Lincolnshire but contains lenses and beds of that phase nearly to the top of the unit. It is one of the main quarry rocks at Lone Star. Near Lexington (Cooper and Cooper, 1946) and Eagle Rock (McGuire, 1970), similar light-gray rock is referred to the Murat facies of the Lincolnshire Formation; however, Cooper (1944b) considered the Lone Star sequence to be the equivalent of the Effna (Cooper, 1944a), named from Walker Mountain in Bland County, southwestern Virginia. The

Effna was thought by Cooper and Cooper (1946) and Cooper (1956) to be mainly post-Lincolnshire in age and therefore only partially equivalent to the Murat. In the writer's opinion the age relationship among these lensatic buildups of limestone between the Lincolnshire and Edinburg units has not been well established, and thus, the Effna is included in the Edinburg with which it is partially equivalant in age (Cooper, 1965, Chart 1).

The Effna has a maximum thickness in excess of 500 feet (152 m) just south of Lone Star and thins to a few feet west of Glebe Mills.

The Liberty Hall occupies the outcrop belt of upper Edinburg southwest of the traces of faults A and B. Northeast of these faults the Edinburg interval of the Fincastle Valley is occupied by black, noncalcareous, fissile shale which does not resemble the lithology of the Edinburg described from other areas (McGuire, 1970). The Edinburg (Liberty Hall) of the southern belt appears to be about 1,000 feet (305 m) thick. The narrowing of the outcrop belt southwest of Daleville may be due to structural thinning. McGuire (1970) estimated the thickness of the Edinburg in the Fincastle area to be 1,800 feet (549 m), but other estimates (Decker, 1952) are much higher.

Bays Formation

The Bays and succeeding Paleozoic formations are limited in occurrence to a single outcrop belt to the southwest of the traces of faults A and B. Here an unfossiliferous sequence of red, brown, olive-drab, and greenish-gray sandstone (R-5622), siltstone (R-5621), shale, and mudrock succeeds the Edinburg. The terms Bays has been applied to these rocks because of their lithologic resemblance to the type Bays of the "Knobs" area of east Tennessee (Nichol, 1959; Hergenroder, 1966). The Bays forms a series of topographic knobs along the northeast flank of Tinker Mountain.

Nichol (1959) reports a thickness of 93 feet (28 m) for the unit near Lone Star and 220 feet (67 m) west of Daleville. The best exposures are in the railroad cuts 0.5 mile (0.8 km) southwest of Daleville where a complete section has been measured by Nichol (1959).

Martinsburg Formation

The Martinsburg Formation is present in scattered outcrops occupying a wide belt along the flanks of Tinker Mountain. It consists of gray and tan, yellow-weathering, calcareous shale; thin beds of gray and olive-gray, fossiliferous limestone; and a few thin beds of greenish-gray sandstone and siltstone. The unit contains some greenish-gray siltstone and fine-grained sandstone along with characteristic shale and minor limestone near its contact with the underlying Bays and is apparently gradational with that unit. A good exposure of the upper contact has not been found. The nearest measured section of Martinsburg is about 4 miles (6 km) from the southwest corner of the quadrangle along State Highway 311 southeast of Catawba Post Office where Nichol (1959) reports a thickness of 1,600 feet (488 m).

SILURIAN SYSTEM

Three formations — the Tuscarora Formation, Rose Hill Formation, and Keefer Sandstone — belonging to the Silurian System are separately mapped in most of the southwest quarter of the quadrangle.

Southwest of Daleville along Tinker Mountain, however, the belt of Rose Hill which separates the Tuscarora and Keefer becomes less and less evident; the complex structure, the essential similarity of the lithology of the Keefer and Tuscarora, and absence of prominent Rose Hill makes a valid mapping separation of the three units doubtful. Accordingly, the writer has combined the three formations as a single map unit, *Silurian rocks, undivided,* which is mostly white and tan conglomeratic sandstone (Figure 6).

Tuscarora Formation

The Tuscarora Formation, located along the top and flanks of Tinker Mountain consists of 10 to 50 feet (3-15 m) of geomorphically resistant, white and tan, medium- to coarse-grained conglomeratic orthoquartzite. It alternates with the Keefer Sandstone in forming the crest of Tinker Mountain.

Rose Hill Formation

The Rose Hill Formation crops out along Tinker Mountain in a belt parallel to that of the Tuscarora Formation. Typical

expression of the Rose Hill is a geomorphically weak belt between the Keefer and Tuscarora quartzites which yields a few outcrops of greenish-gray shale and an abundance of intensely hued maroon, hematitic, sandstone float. Upper and lower contacts are seldom visible because of its negative weathering character. The unit is probably no more than 75 feet (23 m) thick along the west and northeast sectors of Tinker Mountain. It is not present in identifiable thicknesses to the southwest of Daleville.

Keefer Sandstone

The Keefer Sandstone extends along Tinker Mountain and consists mainly of medium- and thick-bedded, pinkish-white to tan, fine- to coarse-grained orthoquartzite with some thick conglomeratic beds which are not distinguishable in small outcrops from the Tuscarora. A fow shale beds may occur (Nichol, 1959) but these have not been seen by the writer. The Keefer is about 200 feet (61 m) thick over most of the area.

LOWER DEVONIAN AND UPPER SILURIAN ROCKS

Huntersville Formation and Unidentified Sandstone

Exposed along the private road on the southernmost flank of Tinker Mountain at its first crossing beneath the power transmission line is an overturned section of rocks lying stratigraphically above Keefer quartzite and beneath Needmore shale. It consists from older to younger rocks of 10 feet (3 m) (base not exposed) of medium- to very coarse-grained, friable, cross-bedded sandstone with many irregular limonitic bands and seams overlain by the Huntersville Formation consisting of 4 feet (1 m) of sandy, lumpy, dark-green, glauconitic shale and at the top by 9 feet (3 m) of dense, pinkish-white, brown-weathering chert containing green shale stringers (top not exposed). A similar but thinner section (also overturned) is exposed along State Road 648, 0.5 mile (0.8 km) south of Carvin Cove recreation area. Scattered exposures of rocks with similar lithologies are present between the Keefer quartzites and Devonian shales elsewhere along Tinker Mountain.

Limonitic sandstones similar to those at the base of the above-described sequence occur along State Highway 311, 4 miles (6 km) south of the southwest corner of the quadrangle.

Tillman (1963) has suggested on faunal evidence that these are partly correlative to the Keyser Formation of Late Silurian age and partly to the Rocky Gap Sandstone of late Helderberg age. Hazlett (1968) argues for a Ridgeley (?) Sandstone designation of the sandstones mainly on the basis of their lithologic resemblance (especially by the presence of conglomeratic zones) to sandstones containing Deerpark and Onesquethaw fossils in the area east of Blacksburg. The sandstone is fully exposed, conglomeratic with black-shale pebbles, and apparently only 4 feet (1 m) thick at a water diversion tunnel entrance about 1.0 mile (1.6 km) west of the mouth of Sawmill Branch on the flank of the western sector of Tinker Mountain.

The chert and lumpy, sandy shales at the top of the sequence on Tinker Mountain correlate with the Huntersville Chert of Price (1929) which is of Onesquethaw age. On the adjoining Salem quadrangle Amato (1974) mapped these rocks as the Huntersville Formation and they are considered such in the Daleville quadrangle (Plate 1). The entire shale, sandstone, and chert sequence is mapped by this writer as a single map unit, *Lower Devonian and Upper Silurian rocks.*

DEVONIAN SYSTEM

The Needmore Formation is combined with the overlying Millboro Shale as a single map unit (Plate 1). The thickness of the Millboro and Needmore in the Carvin Cove area is about 800 feet (244 m).

Needmore Formation

A few, small weathered outcrops of olive-drab shale with decalcified limestone stringers occur in a narrow belt around the Carvin Cove Reservoir between the chert of the Huntersville and the black, fissile shale of the Millboro. These outcrops are similar in appearance to shale identified by Dennison (1961) as Needmore Formation along the same outcrop belt to the southwest.

Millboro Shale

The Millboro Shale underlies much of the Carvin Cove area and consists of black, pyritic, fissile shale with zones of large, subspheroidal ironstone concretions and a few siltstones. Only

poor, thin residual soils develop on it and it is surprisingly well exposed except where overlain by colluvium from Silurian sandstones.

A single outcrop of noncalcareous, black, fissile shale occurs in the southeast corner of the quadrangle in close juxtaposition to Cambrian dolomite. The outcrop belongs to the Read and Coyner mountains structure (mainly in the Villamont and Stewartsville quadrangles to the east and southeast) and is separated in the Daleville quadrangle from the Cambrian by faulting. Hazlett (1968) identifies the outcrop as Millboro, and though no fossils could be found, the writer has no cause to doubt this identification. The only other lithologies in the region which resemble this outcrop belong to the Edinburg Formation of the Fincastle Valley.

Brallier Formation

The Brallier Formation supports the lower slopes of Brushy Mountain. It consists of a thick sequence of hard, greenish-gray to dark-gray, stiff, fissile, micaceous, silty shale with frequent thin to medium interbeds of blocky, gray, reddish-weathering siltstone and fine-grained sandstone. The unit is about 1,600 to 1,800 feet (488-549 m) thick in the Carvin Cove-Brushy Mountain area.

Chemung Formation

The Chemung Formation crops out along the crest and upper flanks of Brushy Mountain where it consists of tan, greenish-gray, reddish-brown, and maroon sandstone and lumpy shale with a few thin beds of quartz-pebble conglomerate. Large brachiopod molds are common in many of the sandstones and pelecypod and echinoderm stem impressions occur in some beds. The Chemung is geomorphically resistant and forms high ridges where it outcrops. About 600 feet (183 m) of the formation is exposed above the Brallier on Brushy Mountain; the top of the unit is not present.

MISSISSIPPIAN SYSTEM

Price Formation

The Price Formation is exposed in the northwest corner of the quadrangle where it is composed of quartz-pebble con-

glomerate; coarse-grained, hard, light purplish-gray, quartzose and feldspathic sandstone; cross-bedded, ferruginous sandstone; lumpy gray shale and mudrock; yellowish, limonitic claystone; and low-grade coal. Conglomerates are present in all parts of the formation but are best developed in the lower 100 feet (30 m). The estimated exposed thickness is about 700 feet (213 m); neither top nor bottom of this unit is present.

QUATERNARY SYSTEM

Surficial Deposits

Some thin, discontinuous alluvial deposits of varicolored, unconsolidated sand, gravel, and clay occur along Carvin, Tinker, and Catawba creeks (Plate 1). Thick to thin colluvial aprons are common along the mountain slopes south of Troutville, in the vicinity of Tinker Mountain, and in the northwest corner of the quadrangle. Colluvial deposits make mapping uncertain in some areas where the relationship of fault A to other structures is masked. Thick carbonate residuum west of U. S. Highway 220 between Daleville and Interstate Highway 81 severely limits bedrock exposures.

STRUCTURE

Three major structural elements separated by thrust faults are well exposed in the Daleville quadrangle. Thrust sheet A rests on thrust sheet B. These two elements occupy the northeastern half of the quadrangle and are underlain by the Catawba syncline that occupies the remainder southwest of the trend of faults A and B. In addition there are small areas of exposures of rocks belonging to the Blue Ridge thrust sheet and to the Read and Coyner mountains structure exposed near the east edge of the quadrangle south of Troutville. In the northwest corner of the quadrangle are exposures of the Mississippian Price Formation, which are separated from the Catawba syncline by the Pulaski fault of Butts (1933).

Hazlett (1968) mapped two faults (Salem and Max Meadows) extending from the area east of Coyner Mountain (on the adjoining Roanoke quadrangle) passing south of Troutville into the area of Daleville. These match the positions of the traces of faults A and B. Inasmuch as the Salem and Max Meadows

faults have not been traced into this area in published detailed mapping, the use of letter designations seems preferable.

BLUE RIDGE THRUST SHEET

Blue Ridge Fault

Erwin quartzite, exposed in a small area at the east edge of the quadrangle south of Troutville and more extensively on Fullhart Knob (Figure 3) to the immediate east in the adjoining Villamont quadrangle has been thrust over the Rome Formation of thrust sheet A along the Blue Ridge fault (Chen, 1959; Hazlett, 1968).

THRUST SHEET A

Fault A

The trace of fault A is everywhere marked by breccias. Similar breccias also occur at several localities within the Rome Formation which crops out in most areas of the sheet. Structure within the Rome appears complex. A synclinal infold of the Elbrook and Copper Ridge formations has a northeastward trend along the northern margin of the sheet. About 0.7 mile (1.1 km) southeast of Trinity this structure is eroded through to expose Rome beds of the underlying thrust sheet B or of the Catawba syncline. Fault A can be traced eastward to the edge of the quadrangle east of Trinity. To the southwest the fault assumes a southerly, then southeasterly course across Interstate Highway 81 into the area south of Troutville.

Whether fault A should be considered a major thrust or a prominent splay off fault B is not known. It is shown as a splay in the cross sections (Plate 1).

THRUST SHEET B

Fault B

Woodward (1932) and Butts (1940) considered the northeast and southwest halves of the quadrangle to represent a coherent structural block. Andrews (1952) drew a regional sketch map accompanied by cross sections which showed the Blue Ridge fault as having a northwestward strike from the vicinity of the exposures of the Erwin Formation south of Troutville along the general course of faults A and B to merge with or override

the Pulaski fault of Butts (1933) in the northwestern corner of the quadrangle.

Nichol (1959) mapped a large area reaching from Catawba Sanitorium on the adjoining Catawba quadrangle to beyond Fincastle on the northeast and including Daleville on the southeast. He recognized a major thrust fault lying partly along and partly to the southwest of faults A and B. This was mapped to turn northeastward in the vicinity of Mount Union and continue to a junction with the thrust fault which juxtaposes Middle Cambrian and Middle Ordovician beds in the vicinity of Fincastle. Nichol believed this fault to be the Salem fault of Woodward (1932).

Northwest of Nichol's "Salem fault" is a major synclinal structure which exposes Middle Ordovician shales, sandstones, and conglomerates. McGuire's maps (1970) of the Oriskany and Salisbury quadrangles show that this fault cuts stratigraphically upward through the overturned Paleozoic sequence of the upper sheet until Edinburg is faulted against Edinburg in the main trough of the syncline. On the Daleville quadrangle the fault is seen at the south edge of Fincastle where a breached reentrant in the upper sheet exposes tightly folded Ordovician rocks. Within the main trough of the syncline to the west the fault is splayed out westward into a complex series of thrust slices. Within the southeastern slice high-angle faults are present which are well marked by Middle Ordovician limestone of the New Market and Lincolnshire formations. The syncline and its associated faults terminate abruptly at the trace of fault B which is marked by a zone of breccia. This zone of breccia accompanied by changes in strikes and lithologies trends northward just east of Mt. Union, through Haymakertown and across Catawba Creek to within 0.5 mile (0.8 km) of Mississippian outcrops in the northwest corner of the quadrangle. There it is difficult to trace through the scattered outcrops beneath a dense colluvial apron, but the writer believes there can be little doubt that it passes over the Pulaski fault of Butts (1933) of the Catawba Creek Valley and swings northeastward to join the Pulaski-Staunton fault of McGuire (1970) and Spencer (1969). The latter fault effects a similar juxtaposition of facies to that described above for fault B (McGuire, 1970).

Nichol's main evidence that the fault at Mt. Union does not continue northward is the existence of two continuous zones of

oolitic chert which he followed around the north end of Tinker Mountain to the vicinity of Mt. Union. Those cherts appear to be correctly mapped, and the trace of fault B lies consistently to the east of them.

The writer believes that the term Pulaski-Staunton fault should therefore be abandoned. Fault B is the southeastward continuation of the Staunton fault. The Pulaski fault of Butts (1933) of the Catawba Creek Valley might well emerge from beneath the Staunton sheet on the adjoining Oriskany quadrangle at the northeast end of Caldwell Mountain where a complex of faults bordered on the northwest by a thrust appears and follows the Switzer-Rathole Mountain trend (McGuire, 1970). This trend of faulting continues into the North Mountains (Spencer, 1967) and is lost in Middle Silurian clastics about 4.0 miles (6.4 km) northeast of Longdale Furnace in Alleghany County (Kozak, 1965). It involves rocks ranging in age from Early Ordovician to Late Devonian.

From north of Mt. Union and continuing southeastward to Glebe Mills, fault B is branched and the western slice appears to be backfaulted. At Glebe Mills thrust sheet B is overridden by thrust sheet A. Southeast of Daleville a wedge of Elbrook lying beneath fault A appears to be in fault contact with the indigenous belt of Copper Ridge dolomite to the southwest along a zone of breccia. This contact is mapped as fault B; mapping is uncertain in the poor exposures southwest of Troutville.

CATAWBA SYNCLINE

This structural element underlies that part of the map area southwest of thrust sheets A and B and consists of an asymetrical syncline having a west-southwesterly plunge with moderate to gentle dips on the northwestern limb, a markedly blunted nose with steep dips to overturned beds on the northeast, and a southeast limb with steep dips to overturned beds on the southeast. Rocks of Late Devonian age are the youngest exposed along the axis. The axis of the syncline branches into northwestward- and eastward-trending troughs near the northeast end of Brushy Mountain. The eastward-trending trough leads into a complicated structure which exhibits overturning or steep dips on both limbs. The beds trending northwestward from this structure form an alternation of very steeply plunging to overturned synforms and antiforms as far as Glebe Mills.

To the northwest of Glebe Mills the Keefer Sandstone has a gentle southwesterly dip but beds farther up the plunge near fault B are either overturned or very steeply dipping. To either side of the northwestward-trending branch of the trough the east and southwest slopes of Tinker Mountain are mostly moderate or gentle dip slopes developed on Silurian sandstones, but flexuring and deep erosion have exposed the Martinsburg Formation near the notch at the northwest corner of Tinker Mountain.

The partly overturned and blunted nose of the Catawba syncline as shown by its topographic expression in the northeast sector of Tinker Mountain is one of the most prominent cross structures in the Valley and Ridge physiographic province (Figures 5 and 6, Plate 1). It is interpreted here as formed by drag from thrust sheets A and B. This implies a southwesterly component of movement for the overriding thrust sheets. This might be derived from a general westerly transport at a location where the decollement zone was rising from the Rome to higher stratigraphic levels along a northwestward-striking surface. The steep to overturned southeastern limb of the syncline was also formed by overriding of the westward-

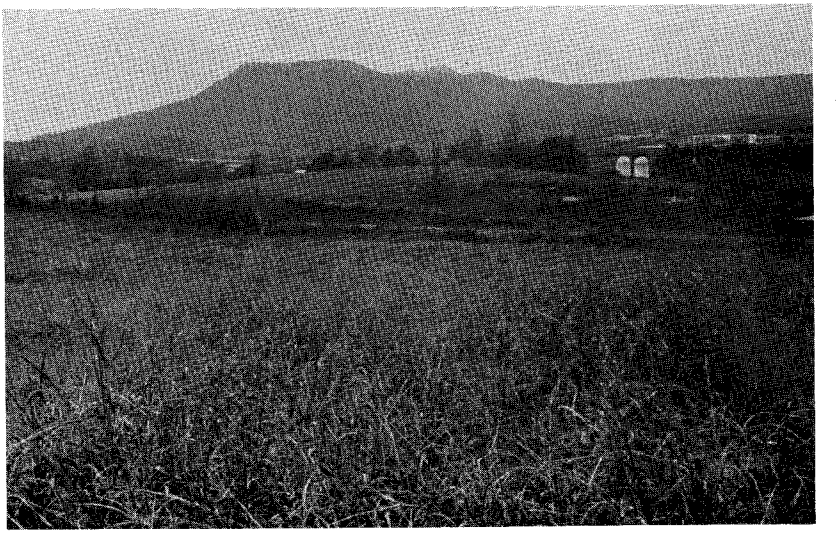

Figure 5. Southwestward view of Tinker Mountain, which is supported by Silurian sandstone and conglomerate. Faults A and B lie beyond silos in middle distance.

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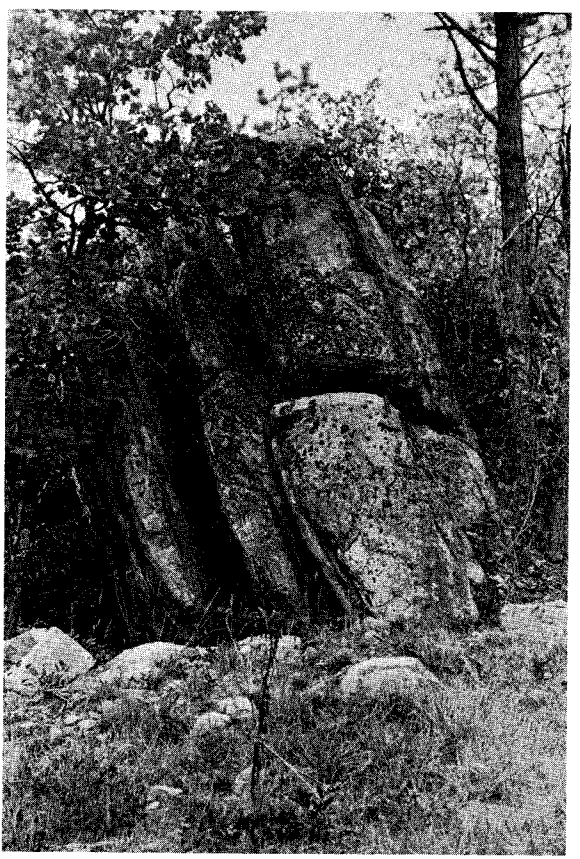

Figure 6. Undifferientiated Silurian sandstone on northeast flank of Catawba syncline along the Appalachian Trail north of a private road on Tinker Mountain. Beds are overturned and have a dip toward the Fincastle Valley.

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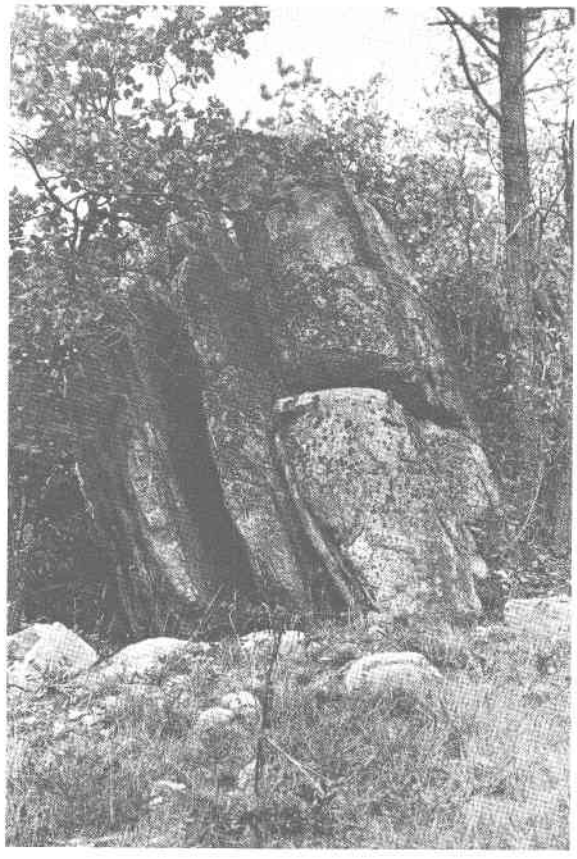

Figure 6. Undifferientiated Silurian sandstone on northeast flank of Catawba syncline along the Appalachian Trail north of a private road on Tinker Mountain. Beds are overturned and have a dip toward the Fincastle Valley.

along the headwaters of Rocky Branch is due to folding which followed overturning of the beds. Similar structures along Tinker Mountain to the northwest were probably formed in the same manner.

In the extreme northwest corner of the quadrangle Cambrian rocks of the Catawba syncline are in fault contact with the Mississippian rocks along the "Pulaski fault" as mapped by Woodward (1932) and as it appears on subsequent published maps. As here interpreted this fault does not join the "Pulaski-Staunton fault" as mapped to the north by McGuire (1970) but passes beneath it or its continuation southeastward as fault B.

READ AND COYNER MOUNTANS STRUCTURE

The only expression of this structure in the Daleville quadrangle is the outcrop of Devonian Millboro Shale in the southeastern corner of the quadrangle. Here the shale outcrops appear to lie above the older carbonates along a relatively horizontal fault surface. Hazlett (1968) mapped a similar fault along this structural front about 0.8 mile (1.3 km) to the south at the only good exposure of the fault along the entire northwest edge of the Read and Coyner mountains structure. This fault was interpreted by Hazlett as a thrust which developed in the autochthon after the Pulaski sheet had ridden over it, thus causing a sheet of the indigenous structure to ride northwestward over the allocthon. The Devonian rocks are interpreted to lie within a fenster, as Woodward (1932) and Butts (1940) had earlier mapped them, despite the fact that on the west they rest above the overriding plate. Another possible interpretation is that an early high-angle fault bringing younger rocks on the east into contact with Cambrian rocks on the west has been overridden and rotated into a position of near recumbency by Hazlett's (1968) Salem and Max Meadows sheets.

ECONOMIC GEOLOGY

By

John M. Wunder

Calcareous shale and high-calcium limestone in the Daleville quadrangle are used in the manufacture of cement. Crushed

stone for building roads was formerly quarried; and certain rock units have possible use as sources of aggregate. Clay and shale potentially useful in the structural clay products industry and orthoquartzites potentially useful for high-silica sand are available. Coal beds occur in the extreme northwest corner of the quadrangle. Miscellaneous resources include sand and gravel, iron and manganese oxides, barite, and marl.

INDUSTRIAL LIMESTONE AND DOLOMITE

The Citadel Cement Corporation produces limestone and calcareous shale for use in the manufacture of portland and masonry cement from quarries approximately 1.5 miles (2.4 km) northwest of Mt. Union adjacent to State Road 779 (Plate 1, active quarry numbers 1, 2).

Quarrying has been done at Lone Star since 1951 and the Citadel Cement Corporation plant has a capacity of 1.2 million tons (1.1 million metric tons) of cement annually (Figure 7).

The major quarry rocks used in the Citadel operation are the dark, calcareous shale and limestone beds of the Liberty

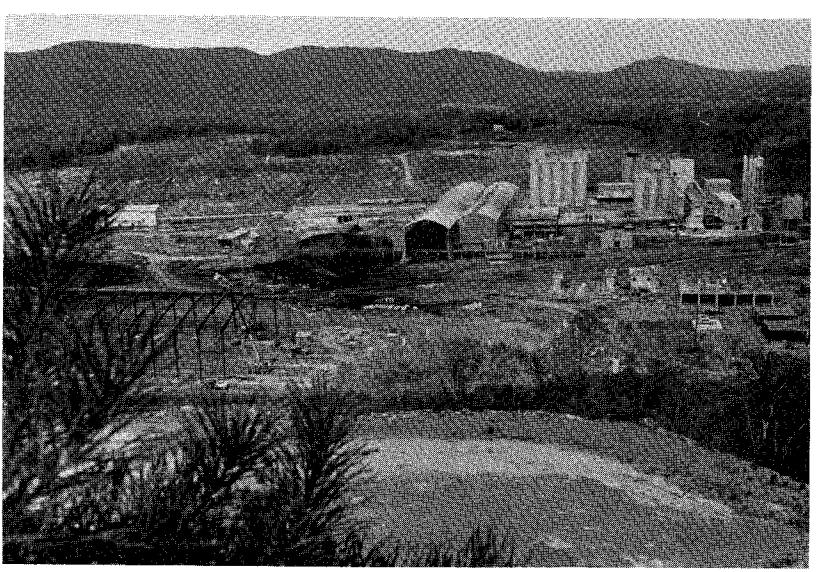

Figure 7. Citadel Cement Corporation plant and quarries; looking north. Fincastle Valley and Caldwell-Switzer mountain trend in background. (Photograph taken September 1974.)

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The major quarry rocks used in the Citadel operation are the dark, calcareous shale and limestone beds of the Liberty

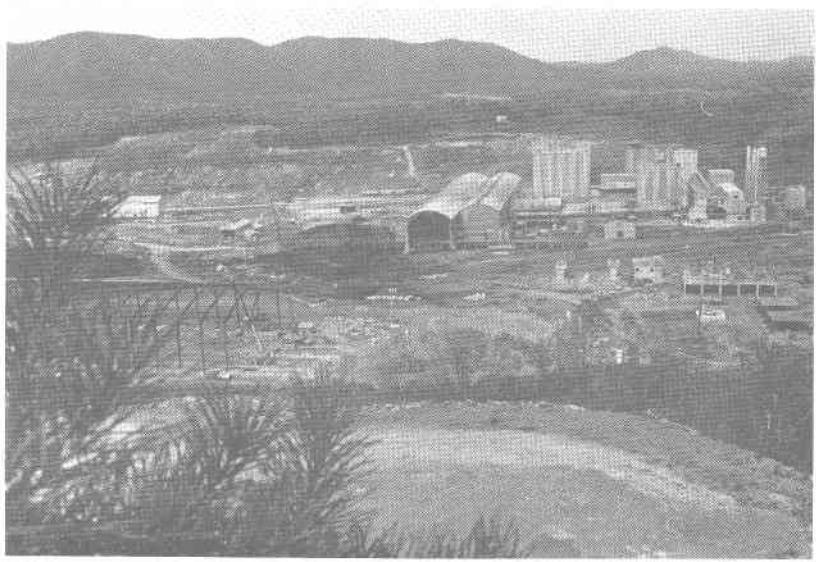

Figure 7. Citadel Cement Corporation plant and quarries; looking north. Fincastle Valley and Caldwell-Switzer mountain trend in background. (Photograph taken September 1974.)

Hall unit and the very coarse-grained, light-gray, high-calcium limestone of the Effna unit, both of which are in the Edinburg Formation.

Approximately 75 percent of the rock quarried at Lone Star is from the Liberty Hall (Plate 1, active quarry number 2). The high clay content makes this rock an excellent raw material for cement production. This unit is approximately 1,000 feet (305 m) thick in the vicinity of Lone Star, and thins to the southeast in an outcrop belt parallel to Tinker Creek.

The thickness of the Effna is more than 500 feet (152 m) (Plate 1, active quarry number 1). Cooper (1944b, p. 77) reported that this sector of the Catawba Valley contains the thickest section of coarse-grained, high-calcium limestone in the Appalachian Valley of Virginia. Large reserves of Effna limestone occur just southeast of Lone Star, but the unit rapidly thins to only a few feet west of Glebe Mills. The only exposures of this unit within the Daleville quadrangle are along this belt.

New Market and Lincolnshire limestones are also quarried at Lone Star. Because if its high clay content, the dark-gray, medium- to coarse-grained, impure Lincolnshire is useful in the production of cement. Because of its high calcium content the dove-gray New Market is also used. Chemical composition of rocks sampled from the vicinity of Lone Star are shown in Table 2.

The New Market Limestone thins to the southeast of Lone Star. South of Glebe Mills the formation is thin and has little potential economic value. However, the New Market has potential value southwest of Fincastle along the south bank of Catawba Creek where the unit is massive and is locally over 100 feet thick. Analysis of the New Market just west of State Road 670 near the crossing of Catawba Creek was reported (Edmundson, 1958, p. 59) as follows: $CaCO_3$, 93.03 percent; $MgCO_3$, 4.94 percent; SiO_2, 2.04 percent; Al_2O_3, 0.12 percent; and Fe_2O_3, 0.24 percent.

The Beekmantown Formation is a possible source of commercially economic dolomite, although it may contain too many impurities for some industrial uses. An analysis of the Beekmantown 1.75 miles north of Cloverdale along the Norfolk and Western Railway was reported by Cooper (1944b, p. 90-91). At this locality, the Beekmantown was found to contain:

Table 2.—Chemical composition of limestones from selected localities in the vicinity of Lone Star, Virginia (modified after Cooper, 1944b, p. 79-80).

Location	Formation	Sampled thickness in Feet	(Meters)	Chemical Composition (in percent) $CaCO_3$	$MgCO_3$	SiO_2	Al_2O_3	Fe_2O_3
Approximately 1.0 mile (1.6 km) northwest of Mt. Union on State Road 779	Edinburg (Effna)	380	(116)	97.30	0.91	0.58	0.75	0.32
	Edinburg (Effna)	125	(38)	97.65	0.77	0.65	0.68	0.30
	New Market	120	(37)	95.69	1.79	1.02	0.82	0.30
Approximately 1.75 mile (2.80 km) northwest of Mt. Union on State Road 779	Edinburg (Effna)	275	(84)	97.91	0.80	0.59	0.57	0.32

$CaCO_3$, 63.49 percent; $MgCO_3$, 31.05 percent; SiO_2, 3.82 percent; Al_2O_3, 1.40 percent; and Fe_2O_3, 0.76 percent.

Limestones and dolomites are also present in the Rome, Elbrook, Conococheague, and Chepultepec formations. However, their commercial potential has not been fully evaluated.

CRUSHED STONE

One of the important mineral industries in Virginia is the production of crushed stone for use as highway aggregate, concrete construction, and other construction purposes. In order to be useful as a source of aggregate a rock must possess specific physical properties for various end uses. These properties include high resistance to abrasion, low moisture absorption, high specific gravity, high resistance to freeze-thaw weathering, and high affinity for bituminous material (Gooch, Wood, and Parrott, 1960; Parrott, 1954).

Parrott (1954) reported tests of rock samples within the Daleville quadrangle for possible sources of coarse aggregate. Two localities had good potential and were given Grade A classification.

The Copper Ridge Formation was once quarried for highway aggregate at a location 2 miles (3 km) southwest of Fincastle along State Road 630 (Plate 1, abandoned quarry number 1). This formation is characteristically a thick-bedded dolomite with interbedded quartzose sandstone. It has a total thickness of 800 to 1,100 feet (244-335 m).

CLAY AND SHALE

In order for clay or shale to be utilized in the structural clay products industry, the physical properties of the unfired and fired material must meet certain specifications. These specifications include workability, water of plasticity, green strength, drying characteristics, and drying shrinkage in the unfired state. Maturing temperature, hardness, absorption, shrinkage, and color are important for fired products (Sweet, 1973, p. 175-176).

At the present time there are no operations utilizing clay or shale resources for structural-clay products in the Daleville quadrangle. However, Calver, Smith, and Le Van (1964) and Reis and Somers (1920) describe potential uses of clay and

Table 3.—Potential use of clay material from the Daleville quadrangle (modified after Calver, Smith, and Le Van, 1964, p. 100).

Location	Formation	Sampled Interval	Potential Use
In roadcut on the east side of State Road 648 about 2.1 miles (3.4 km) north of the intersection with U. S. Highway 11 (repository number R-1776)[1]	Millboro (?)	Representative exposure, 8 feet (2 m) in height, sampled for a distance of 125 feet (38 m). Dark-gray shale weathering to form light olive-gray and grayish-orange angular and peg-shaped fragments	Decorative brick

[1]Sample is on file in the Virginia Division of Mineral Resources repository where it is available for examination.

shale resources from the quadrangle (R-1776) and adjacent regions. An evaluation of a locality sampled within the study area is compiled in Table 3.

Residual clays developed from carbonate rocks as well as Quaternary clays found in alluvial deposits possibly may have future economic value. Fireclays have been reported by Campbell and others (1925, p. 277-278) beneath coal beds within the Price Formation.

HIGH-SILICA SANDSTONE

The Tuscarora Formation and the Keefer Sandstone, where free of impurities, may have potential as a source of silica. The Tuscarora is an orthoquartzite, 10 to 50 feet (3-15 m) thick; and the Keefer is predominately an orthoquartzite, about 200 feet (61 m) thick. In the adjacent Catawba quadrangle to the west, these same sandstone units have been used as a sand source for glass manufacture at Salem (Woodward, 1932, p. 136-137).

MISCELLANEOUS MINERAL RESOURCES

Coal from the Price Formation was mined along Stone Coal Creek for local use, mainly prior to 1864. It was used as a fuel at the old Catawba iron furnace near Haymakertown. Two main coal beds of variable thickness were reported by Campbell and others (1925 p. 276-278) along Stone Coal Creek. Further studies and exploration, however, are needed to determine if the coal has economic potential.

Many locations suitable for the potential production of sand and gravel are present along Tinker Creek and Catawba Creek. This material is found as alluvial deposits a few feet thick.

The Rose Hill Formation contains hematitic sandstones and occurs on Tinker Mountain. Hematitic sandstones from the Rose Hill were mined from adjacent areas and smelted at the old Catawba iron furnace that was built about 1820 and abandoned about the time of the War between the States (Woodward, 1932). However, the iron-bearing rocks do not appear to have economic potential at the present time.

Small amounts of residual limonite from Upper Cambrian and Lower Ordovician carbonates and red hematitic-cemented sandstone, apparently from the Rose Hill Formation which was transported from Tinker Mountain, occur one half mile southwest of Haymakertown (Nichol, 1959, p. 61).

Woodward (1932, p. 112) has reported disseminated masses of oxides of iron-manganese occuring in a yellowish, coarse, friable sandstone in the Lower Devonian Helderberg beds on Tinker Mountain.

Small quantities of barite are present but are no longer being worked. Edmundson (1938, p. 58-62) described five barite mines and prospects four of which are located north of Haymakertown and one north of Cloverdale. The barite occurs as a residual deposit from underlying carbonate rocks.

Marl about 15 feet (5 m) thick was quarried for use as a fertilizer at a location 0.5 mile (0.8 km) northwest of Daleville (Woodward, 1932, p. 137). Commercial operations involving the extraction of marl within the study area are not known to have occurred since the 1930's.

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APPENDIX

ROAD LOG

By

Eugene K. Rader and John M. Wunder

The following road log is a guide to important geologic features that can be see along or near highways in the Daleville 7.5-minute quadrangle. Distance between points of interest, as well as cumulative mileages, are shown. The stops are places where features such as formational contacts, structures, fossils, and interesting rock types or minerals may be observed.

The road log begins on the adjoining Roanoke 7.5-minute quadrangle and ends at Haymakertown, Daleville 7.5 minute quadrangle. Three stops are on private property. *Be sure to obtain permission before examining exposures on private property.*

Cumulative Miles (km)	*Distance*	*Explanation*
0.0	0.0	Begin road log on U. S. Highway 11 at the entrance to Hollins College. Head north toward Troutville. (Roanoke 7.5-minute quadrangle.)
0.7 (1.1)	0.7 (1.1)	Roanoke-Botetourt county boundary.
1.2 (1.9)	0.5 (0.8)	Note Tinker Mountain to west (left).
1.6 (2.6)	0.4 (0.6)	Note Read and Coyners mountains to east (right). These mountains underlain by Upper Ordovician, Silurian, and Devonian rocks and surrounded by Cambrian rocks have been interpreted by many geologists as structural windows (Woodward, 1932; Hazlett, 1968; Andrews, 1952; Butts, 1942).
2.7 (4.3)	1.1 (1.8)	Cross Tinker Creek.
3.5 (5.6)	0.8 (1.3)	Turn east (right) on State Road 604 (labeled State Road 654 on Plate 1). Note black shale in Edinburg Formation to west (left) of intersection. (Daleville 7.5-minute quadrangle.)
3.65 (5.87)	0.15 (0.24)	Note highly contorted shale of the Edinburg Formation.

Cumulative Miles (km)	*Distance*	*Explanation*
3.9 (6.3)	0.25 (0.40)	Cross Norfolk and Western Railway tracks.
4.05 (6.51)	0.15 (0.24)	*STOP. 1.* Fossilferous chert of Beekmantown Formation in north (left) roadcut. *Lecanospira* and unidentified high-spired gastropods are common. Continue on State Road 604.
4.6 (7.5)	0.55 (0.88)	Note Beekmantown chert in roadcuts.
5.0 (8.0)	0.40 (0.64)	Junction of State Roads 604 and 605. Turn north (left) on State Road 605. (Roanoke 7.5-minute quadrangle.)
5.3 (8.5)	0.30 (0.48)	Note flood plain and low terrace.
5.6 (9.0)	0.30 (0.48)	Not terrace to east (right). Daleville 7.5-minute quadrangle.)
5.65 (9.07)	0.05 (0.08)	*STOP 2.* Black Millboro shale overlain by terrace gravel exposed in driveway. The Millboro is beneath the Copper Ridge Formation and is related to the Read and Coyners mountains structure. Continue on State Road 605. (Villamont 7.5-minute quadrangle.)
6.5 (10.4)	0.85 (1.37)	Junction of State Roads 605 and 652. Turn west (left) on State Road 652.
7.8 (12.5)	1.3 (2.1)	Junction of State Roads 652 and 653. Continue on State Road 652. (Daleville 7.5-minute quadrangle.)
9.0 (14.5)	1.2 (1.9)	Note exposures of red and green shale and siltstone, and gray limestone and dolomite of the Rome Formation to south (left).
9.2 (14.8)	0.2 (0.3)	*STOP 3.* Red and green shale and siltstone and gray, fine-grained dolomite and limestone of the Rome Formation exposed in north (right) roadcut. Continue west on State Road 652.
9.3 (14.9)	0.1 (0.2)	Junction of U. S. highway 11 and State Road 652. Turn south (left) on U. S. Highway 11. Note Rome exposures west of junction.
11.3 (18.2)	2.0 (3.3)	Junction of U. S. Highways 11 and 220. Turn west (right) on U. S. Highway 220.
11.5 (18.5)	0.2 (0.3)	Interstate Highway 81 bridge.
11.7	0.2	Junction U. S. Highway 220 and State Road 816.

Cumulative Miles (km)	*Distance*	*Explanation*
(18.8)	(0.3)	Turn west (left) on State Road 816 and bear left. (816 is not numbered on map).
11.9 (19.1)	0.2 (0.3)	Note gravel deposit overlying chert from Beekmantown Formation.
12.0 (19.3)	0.1 (0.2)	*STOP 4.* Black shale of the Edinburg Formation well exposed in low cut to right of road near house. Continue on State Road 816 to Norfolk and Western Railway tracks.
12.4 (19.9)	0.40 (0.64)	*STOP 5.* Park near railroad tracks. Walk south along tracks for 100 yards to section. Martinsburg shale and siltstone exposed; locally fossiliferous—brachipods and crinoids. Bays Formation ahead to the southeast—red, green, and brown shale, siltstone (R-5621), sandstone (R-5622), and mudrock. Turn around and return to U. S. Highway 220.
13.1 (21.0)	0.7 (1.1)	Junction of U. S. Highway 220 and State Road 816. Turn north (left) on U. S. Highway 220.
14.55 (23.38)	1.45 (2.33)	Junction of U. S. Highway 220 and State Road 779 at Daleville. Continue on U. S. Highway 220
15.8 (25.3)	1.25 (2.01)	*STOP 6.* Large cut to east (right) of northbound lane is in the Rome Formation. Limestone and dolomite, bedded breccias (R-5623), and shaly limestones are exposed. Proceed to crossover to southbound lane and turn south (left).
16.4 (26.4)	0.6 (1.0)	Junction of U. S. Highway 220 and State Road 675. Turn west (right) on State Road 675.
16.8 (27.0)	0.4 (0.6)	Turn north (right) on unnumbered paved road into subdivision.
17.05 (27.40)	0.25 (0.40)	Note red and green shale of Rome Formation exposed in cut to east (right).
17.3 (27.8)	0.25 (0.40)	At road junction turn left on unnamed street.
17.35 (27.88)	0.05 (10.08)	*STOP 7.* Park in circle and walk 100 feet northwest along dirt road. To the right of road tectonic breccia within the Rome Formation is exposed. A larger exposure is located 0.15 mile (0.24 km) north-northwest at the lake spillway. Turn around and return to State Road 675.

Cumulative Miles (km)	*Distance*	*Explanation*
17.9 (28.8)	0.55 (0.88)	Junction of State Road 675 and unnumbered road. Turn west (right) on State Road 675.
18.7 (30.0)	0.8 (1.3)	Junction of State Roads 675 and 779. Turn north (right) on State Road 779.
19.0 (30.5)	0.3 (0.5)	*STOP 8.* Large cut to right of road exposes the Beekmantown Formation in the footwall of fault B. Light-gray, fine-grained, brecciated dolomite and limestone; weathered chert. Continue on State Road 779.
19.2 (30.85)	0.2 (0.32)	*STOP 9.* Glebe Mills. Park near junction of State Roads 779 and 672; walk 100 yards north along State Road 672. Brecciated dolomite similar to Stop 8 exposed in cuts to west of road. Continue on State Road 779 .
19.6 (31.5)	0.4 (0.6)	Note good exposures of Beekmantown lithologies in double roadcut.
21.3 (34.2)	1.7 (2.7)	Note flood plain and alluvium of Tinker Creek.
22.15 (35.60)	0.85 (1.37)	Junction of State Roads 779 and 630. Continue on State Road 779.
22.5 (36.2)	0.35 (0.56)	Junction of State Roads 779 and 666. Continue on State Road 779.
22.95 (36.88)	0.45 (0.72)	Note good exposure of Effna unit of the Edinburg Formation.
23.25 (37.36)	0.3 (0.5)	Junction of State Roads 779 and 664 (not numbered on map). Continue on State Road 779.
23.65 (38.00)	0.4 (0.6)	*STOP 10.* Citadel Cement Corporation quarries in Beekmantown, New Market, Lincolnshire, and Edinburg. *Prior permission to visit quarries must be* obtained by writing Assistant Plant Manager, Citadel Cement Corporation, P. O. Box 27, Cloverdale, Va. 24077. The upper Beekmantown dolomite, New Market high-calcium limestone (R-5624), Lincolnshire dark-gray limestone, Effna bioclastic limestone (R-5625), and Edinburg black limestone are well exposed in the quarry north of the plant and State Road 779. South of the plant Edinburg black limestone and shale are exposed in the "shale" quarry. Continue on State Road 779.

Cumulative Miles (km)	*Distance*	*Explanation*
24.65 (39.61)	1.0 (1.6)	Junction of State Roads 779 and 600. Turn north (right) on State Road 600. (Catawba 7.5-minute quadrangle.)
25.1 (40.7)	0.45 (0.72)	Catawba Creek.
25.65 (41.21)	0.55 (0.88)	Junction of State Road 600 and private road. *Obtain permission at house at junction to continue* to Stop 11. (Daleville 7.5-minute quadrangle.)
25.9 (41.6)	0.25 (0.40)	*STOP 11.* Park across from ruins. To the right of fence line on the hillside thick sandstone and dolomites of the Copper Ridge Formation are exposed. Turn around and return to State Road 600.
26.15 (42.01)	0.25 (0.40)	Junction of State Road 600 and private road. Turn northeast (left) on State Road 600.
26.7 (42.9)	0.55 (0.48)	Junction of State Roads 600 and 748. Turn northwest (left) on State Road 748.
27.7 (44.5)	1.0 (1.6)	End of State Road 748. Begin Forest Service Road 183.
27.85 (44.74)	0.15 (0.24)	*STOP 12.* On the right large exposure of Price sandstone, slightly conglomeratic. Good exposures west (left) of road in Stone Coal Creek. Continue on Forest Service Road 183.
28.05 (45.06)	0.2 (0.3)	*STOP 13.* Park in curve on right and cross creek. Thin Price coal bed exposed on north side of Stone Creek. Turn around and return to State Road 600.
29.4 (47.2)	1.35 (2.17)	Junction of State Roads 600 and 748. Turn northeast (left) on State Road 600.
29.7 (47.7)	0.3 (0.5)	Junction of State Roads 600 and 655. Turn right on State Road 665.
30.2 (48.5)	0.5 (0.8)	*STOP 14.* Tectonic breccia exposed in drainage in field to north (left) of road. *Obtain permission at house east of drainage before entering property.* Breccia composed of blocks of limestone and dolomite in a fine-grained matrix; associated with fault B.
30.65 (49.23)	0.45 (0.72)	Junction of State Roads 665 and 666. Turn right across Catawba Creek on State Road 666.

Cumulative Miles (km)	*Distance*	*Explanation*
30.95 (49.71)	0.3 (0.5)	Junction of State Roads 666 and 665 at Haymakertown. Continue on State Road 666 to State Road 779. Turn left on State Road 779 and proceed to Daleville. END OF ROAD LOG

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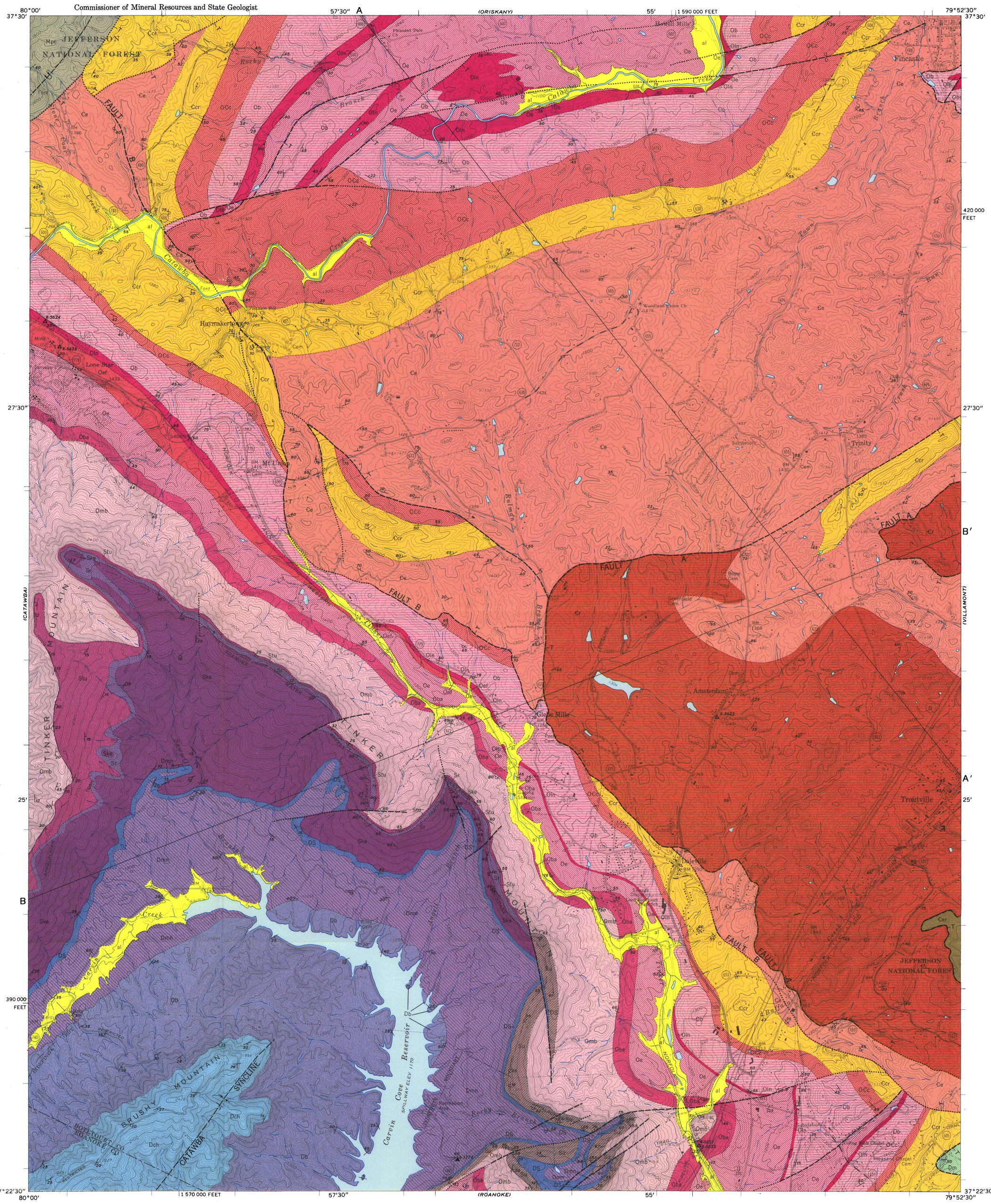
COMMONWEALTH OF VIRGINIA
DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT
DIVISION OF MINERAL RESOURCES
James L. Calver
Commissioner of Mineral Resources and State Geologist



Base map from U.S. Geological Survey, 1963-(72 PR)
Daleville Quadrangle, 7½-Minute Series

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GEOLOGIC MAP OF THE DALEVILLE QUADRANGLE, VIRGINIA

Geology by Odell S. McGuire

MN GN
4½° 80 MILS | 0°39′ 12 MILS
UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000
1 ½ 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

VIRGINIA
QUADRANGLE LOCATION

1975

EXPLANATION

CENOZOIC — QUATERNARY

al — Alluvium
Varicolored unconsolidated sand, gravel, and clay.

PALEOZOIC — MISSISSIPPIAN

Mpr — Price Formation
Quartz-pebble conglomerate, sandstone, gray shale, mudrock, and coal.

PALEOZOIC — DEVONIAN

Dch — Chemung Formation
Tan, greenish-gray, reddish-brown, and maroon sandstone and lumpy shale with thin beds of quartz-pebble conglomerate; fossiliferous.

Db — Brallier Formation
Greenish-gray to dark-gray, fissile shale with gray siltstone and fine-grained sandstone.

Dm — Millboro Shale
Black, fissile shale.

Dmn — Millboro Shale and Needmore Formation
Millboro: black, fissile shale with ironstone concretions and some pyrite. Needmore: olive drab, calcareous shale.

DS — Lower Devonian and Upper Silurian rocks
Huntersville Formation: pinkish-white chert and dark-green, sandy, lumpy, glauconitic shale. Unidentified sandstone: medium to very coarse-grained, friable, cross-bedded, limonitic sandstone.

PALEOZOIC — SILURIAN

Su — Silurian rocks, undivided
(Keefer Sandstone, Rose Hill Formation, and Tuscarora Formation)

Ske — Keefer Sandstone
Pinkish white to tan, fine- to coarse-grained orthoquartzite.

Sr — Rose Hill Formation
Greenish-gray shale with maroon, hematitic sandstone.

Stu — Tuscarora Formation
White and tan, medium- to coarse-grained, conglomeratic orthoquartzite.

PALEOZOIC — ORDOVICIAN

Omb — Martinsburg Formation
Yellow-weathering, gray, calcareous shale; olive-gray and gray limestone; and greenish-gray siltstone and fine-grained sandstone.

Oba — Bays Formation
Red, brown, olive-drab, and greenish-gray, fine-grained sandstone, siltstone, shale, and mudrock.

Oe / Oef — Edinburg Formation
Oe, *dark-gray to black, medium-bedded, calcareous shale and fine-grained limestone in the west-central to southeastern part (Liberty Hall). Black, fissile, non-calcareous shale in the northern part.* Oef, *light gray, thick-bedded to massive, coarsely fragmental limestone; fossiliferous (Effna).*

Oln — Lincolnshire Formation and New Market Limestone
Lincolnshire: dark gray, cobbly limestone with nodular chert; fossiliferous. New Market: dove gray, compact limestone with basal conglomerate of limestone, dolomite, and some sandstone; chert.

Ob — Beekmantown Formation
Medium gray, massive and thick-bedded dolomite with weathered residues of gnarly chert; much bluish-gray limestone and light to dark chert in the north part; sparsely fossiliferous.

OCc — Chepultepec Formation and Conococheague Formation
Chepultepec: black to light-gray, fine-grained limestone with oolitic chert. Conococheague: medium bluish-gray, medium-grained, sandy limestone and dolomite with sandstone interbeds.

PALEOZOIC — CAMBRIAN

Ꞓcr — Copper Ridge Formation
Gray, thick-bedded and laminated dolomite with coarse-grained, calcareous, quartzose sandstone; laminated or oolitic chert rare.

Ꞓe — Elbrook Formation
Bluish-gray, laminated, fine-grained limestone with intraformational conglomerate and algal structures; gray and brown dolomite; gray to greenish-gray shale; sparsely fossiliferous.

Ꞓr — Rome Formation
Red, maroon, green, and yellow shale, mudrock, and siltstone with mottled to crinkly laminated limestone and dolomite.

Ꞓer — Erwin Formation
Massive, tan, brittle quartzite with casts of Skolithos; fossiliferous.

CONTACTS

Solid where exposed, dashed where approximate, dotted where covered or inferred

FOLDS

Syncline—trace of fold

Overturned syncline — trace of fold

FAULTS

Solid where exposed, dashed where approximate, dotted where covered or inferred; tick mark indicates direction of dip; U, upthrown side; D, downthrown side; T, upper sheet; arrows indicate relative direction of movement

ATTITUDE OF ROCKS

45 — Strike and dip of beds
70 — Strike and dip of overturned beds
Strike of vertical beds
Horizontal beds

QUARRIES

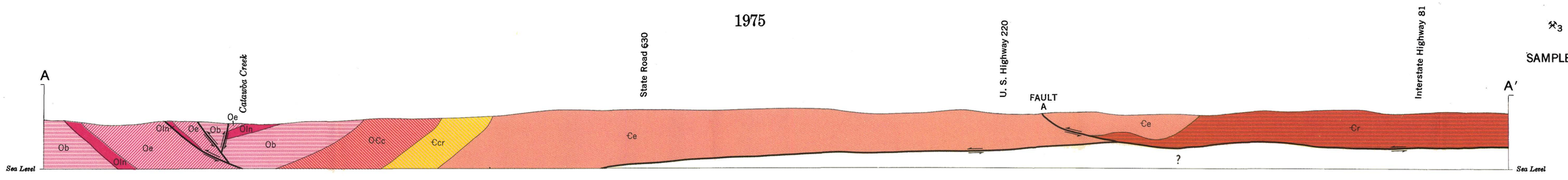
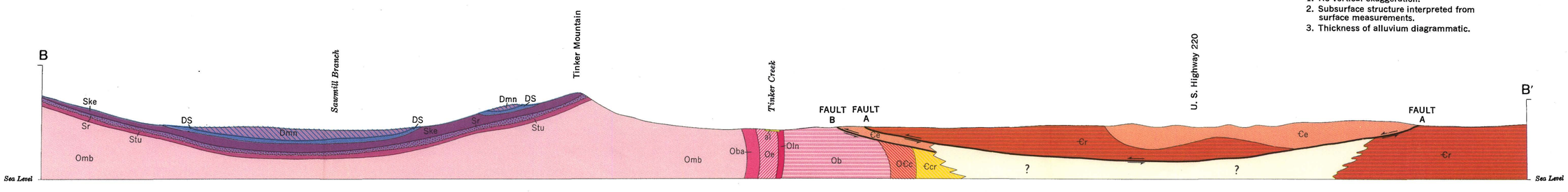
1 — Active quarry
1. Citadel Cement Corporation (limestone)
2. Citadel Cement Corporation (shale)

3 — Abandoned quarry
3. Crushed stone

SAMPLE LOCATIONS

R-5624 — R, repository number of sample

R-1776 — Sample of raw material having potential commercial use; R, repository number



1. No vertical exaggeration.
2. Subsurface structure interpreted from surface measurements.
3. Thickness of alluvium diagrammatic.