COMMONWEALTH OF VIRGINIA

DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT

DIVISION OF MINERAL RESOURCES

TRIASSIC FORMATIONS OF THE DANVILLE BASIN

CARL THEILE MEYERTONS

REPORT OF INVESTIGATIONS 6

VIRGINIA DIVISION OF MINERAL RESOURCES

James L. Calver
Commissioner of Mineral Resources and State Geologist

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Commonwealth of Virginia
Department of Purchases and Supply
Richmond
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TRIASSIC FORMATIONS OF THE DANVILLE BASIN[1]

By

CARL THEILE MEYERTONS[2]

ABSTRACT

The Danville basin in south-central Virginia contains about 15,000 feet of continental sediments and at least 60 diabase and gabbro dikes. Three new formations, the Leakesville,[3] Dry Fork, and the Cedar Forest formations, are proposed in order that the fanglomerates, conglomerates, breccias, graywackes, arkosic sandstones, siltstones, black shales, and red beds may be described. All the Danville basin sediments are derived from rocks of adjacent and nearby areas.

Sporadic movement on the Chatham border fault and subsidence of the basin initiated and accompanied sedimentation. Later, basement movements caused tilting of sedimentary blocks and oblique faulting and raised a quartz monzonite basement block to the surface.

The uppermost Triassic sediments were derived from exposures of these blocks. Intrusive magmas then were forced into some of the earlier fault-plane fractures, and in some places the earlier sediments were altered.

Present geomorphic features reflect erosional responses to differences in character and resistance of the Triassic rocks. Superposition from the regional slope of a post-Triassic sedimentary cover is offered as a possible explanation for the position of the through-flowing rivers, and the direction of flow by other streams is explained as a result of uniclinal shifting.

Rocks suitable for brick and ceramic-ware manufacture and for the production of lightweight aggregate are described. Localities favorable for crushed-stone quarry sites are noted.

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[1] This report is part of a dissertation presented in 1959 for the degree of doctor of philosophy from Virginia Polytechnic Institute.

[2] Humble Oil and Refining Company

[3] Ed. note: The writer's preferred spelling of Leaksville is retained throughout this report.

INTRODUCTION

LOCATION

The Danville basin extends in a northeast-southwest direction and covers about 190 square miles in south-central Virginia (Figure 1). Some 155 square miles of the basin are in Pittsylvania County and about 35 square miles in Campbell County. Very small portions of the area

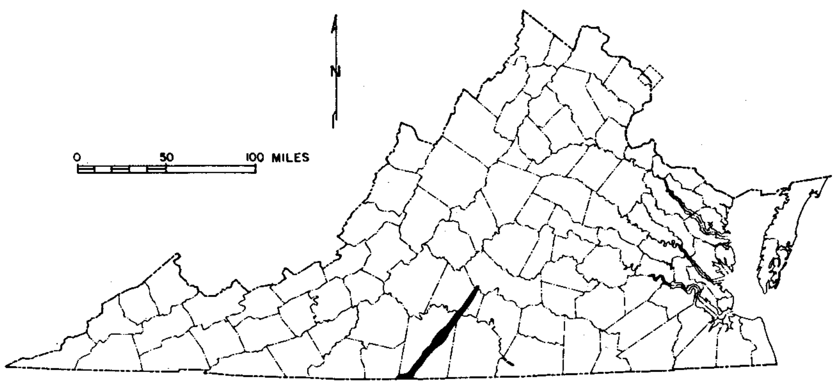


Figure 1. Location of Danville basin in Virginia.

are in Appomattox, Halifax, and Henry counties. The basin is a long narrow trough trending S. 40° W. from the vicinity of Spring Mills, Virginia, to beyond the Virginia-North Carolina state boundary where, south of the Dan River, it has been called the Dan River basin (Roberts, 1928).

RELIEF AND DRAINAGE

The maximum elevation in the Danville basin is on Whiteoak Mountain (1140 feet) near U. S. Highway 29. The minimum elevation is on Banister River (380 feet) where it leaves the basin. A difference in elevation of 440 feet is the greatest local relief, but the average relief is about 150 to 200 feet. The highest elevations are consistently associated with outcrops of graywacke and arkosic sandstone, that form the best tobacco-producing soil in the region.

Major streams include the Dan River, into which flows the drainage of the southern two-thirds of the area, and the Staunton River, into which flows the drainage of the northern third. Smaller steams that may become dry in periods of drought include Sandy Creek, Banister

River, and Falling River. Although stream courses trend generally southeastward, notable exceptions are locally developed. The Banister River flows northeastward for about 16 miles because of the relative erosional resistance of the rocks in Whiteoak Mountain.

GEOLOGIC SETTING

INTRODUCTION

The sedimentary rocks of the Danville basin are claystones, shales, siltstones, sandstones, conglomerates, microbreccias, and fanglomerates of Late Triassic age. They are mostly clastic rocks consisting of continental debris from the pre-Triassic metamorphic and granitic rocks bordering the basin. Lateral and vertical changes in texture and composition are common (Figure 2). The sediments comprise alluvial fans, stream channel deposits, flood plains and lake and swamp deposits. In color and texture most of these are similar to those of other Triassic basins of the eastern United States. The coarsest sediments are found mostly in the central part of the basin especially in the Dry Fork formation. Maximum original thickness of the sediments is estimated to be about 15,000 feet.

A fault block of pre-Triassic quartz monzonite near Renan occurs within the sedimentary sequence. Numerous diabasic igneous dikes cut the sediments at many places, and metamorphic rocks completely surround the basin.

Three lithologic units of formational rank are proposed. These are the Leakesville, Dry Fork and Cedar Forest formations. The Cedar Forest formation unconformably overlies the older and more widespread Dry Fork and Leakesville formations. The Dry Fork is laterally contiguous with the Leakesville formation but can be distinguished from it by marked differences in lithology.

Small surficial gravel deposits are found scattered throughout the area above the earlier Triassic deposits. At least one of the surficial deposits is cut by a basic igneous dike, which suggests a late Triassic or early Jurassic age for the dikes.

SOURCE OF SEDIMENTS

Sericite-chlorite phyllite is the major fine-grained rock adjacent to the Danville basin and is the major source of fine-grained sediment. Where weathered, it resembles the Triassic red sediments and, where fresh, it resembles the green matrix of the Dry Fork formation. Organic matter gives a gray or black color to the fine detritus of the Cow Branch beds. That gneisses and igneous rocks provided most of the coarser detritus is proven by actual rock fragments, fresh mineral fragments, and weathered equivalents found in many of the sediments. Size and shape of fragments and particles preclude extensive transport. A good example of proximity of source to sediment is in the vicinity of the crossing of State Road 863 over the Southern Railway. Massive quartz-feldspar gneisses are present in the railway cut, and large cobbles and boulders of the same rock are found 0.1 mile to the west in a Triassic fanglomerate.

Because of their characteristic rapid and thorough disintegration, the hornblende and quartz-muscovite schists contributed few fragments to the coarser sediments.

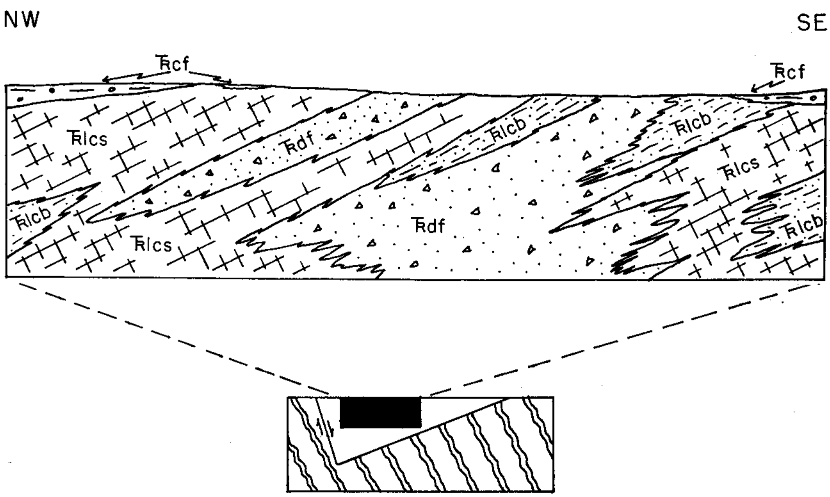
Quartz monzonite of the Renan and Staunton River areas forms a considerable portion of the boulders, cobbles, pebbles, and mineral grains of the Cedar Forest conglomerates and fanglomerates. Fresh and weathered fragments are present, but limited to this formation. The total volume of quartz monzonite is small in the Triassic beds.

The Renan fault block consists of quartz monzonite, and is about 2 square miles in areal extent. It is located approximately 1 mile northwest of Renan, Pittsylvania County (Plate 1).

STRATIGRAPHIC NOMENCLATURE

Most previous workers have recognized three lithologic units in the Virginia Triassic basins, although these units are not necessarily the same in the different basins (Roberts, 1928; Rogers, 1938).

Field mapping of the Danville basin indicates that three lithologic units are also present. These are the Leakesville formation, the time-equivalent Dry Fork formation, and the younger Cedar Forest formation. Dry Fork rocks and Leakesville rocks intertongue and are, therefore, considered contemporaneous lithofacies. Different formation names are applied because of the great differences in color, texture, and other lithologic aspects of the rock types. The Leakesville formation is subdivided on the basis of color into the Cow Branch and Cascade Station members (Figure 2). These members are mappable as separate units. Two major facies of the Dry Fork formation are recognized but not mapped separately because of the gradual and irregular transition from the arkosic facies to the graywacke facies. Groups of red-colored siltstone lenses within the arkosic facies are indicated as a single lens on the geologic map because of map scale limitations.



(Relation of diagram to the Basin)

T̄Rcf — Cedar Forest formation

T̄Rdf — Dry Fork formation with siltstone stringers

T̄Rlcb— Leakesville formation, Cow Branch member

T̄Rlcs — Leakesville formation, Cascade Station member

Figure 2. Diagrammatic representation of Triassic stratigraphy of the Danville basin.

TRIASSIC SEDIMENTARY ROCKS

LEAKESVILLE FORMATION

The name Leakesville formation is proposed here for the predominantly red and black claystones, shales, siltstones, and sandstones and few conglomerates which crop out mainly in the northern, west-central, and southernmost parts of the Danville basin. A few smaller outcrops are also present along parts of both sides of the Dry Fork formation. The formation crops out in about 13 square miles of the Leakesville Junction area (Plate 1, Cross Section J-J′; Figure 3), in about 25 square miles of the Motley's Mill area (Cross Section F-F′), and in about 43 square miles of the Campbell County and north Pitts-

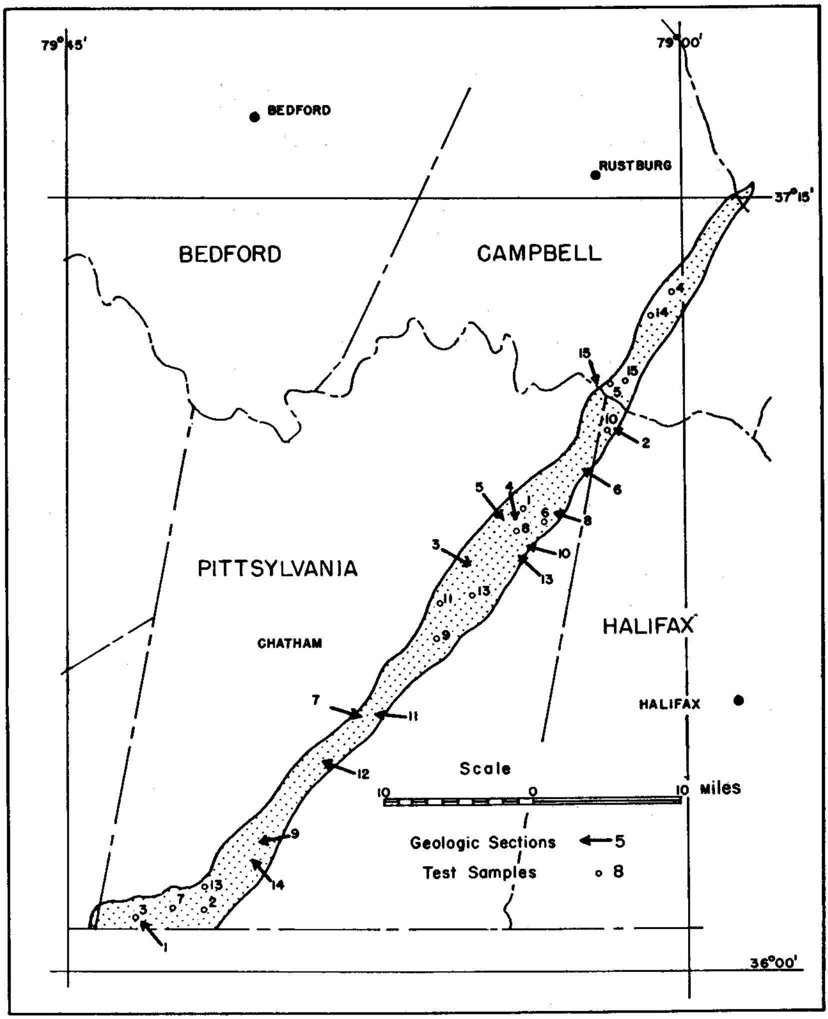


Figure 3. Location of geologic sections and test samples.

sylvania County area. The type section is exposed in Pittsylvania County along State Road 856, from 0.2 mile south of State Road 622 to 0.2 mile north of the Virginia state line. About 1100 feet of beds are exposed here (Figure 3; Appendix, Geologic Section 1).

Outcrop width ranges from almost zero near Spring Mills, Virginia, to about 6 miles near Leakesville Junction. Cross faults and thickening of beds account for the range in width of the outcrop. It is estimated, on the basis of width of exposure and average dip of Leakesville strata, that a maximum of 10,000 to 12,000 feet of beds of that formation were deposited in the basin.

The abrupt eastern and western termination of Leakesville beds against the adjacent metamorphic and granitic rocks, for example at the localities near Long Island, Cascade, Hermosa, Little Straightstone Creek, or Cherrystone Creek, suggests that they have been obliquely faulted into their present position. The strike of the sediments forms an acute angle with the border of the Danville basin as seen at many places along the west border of the basin on the geologic map (Plate 1). This suggests that postdepositional disturbances changed the original attitude of the beds from nearly parallel to the border fault to their present attitude.

Evidence for the existence of Triassic sediments southwest of the oblique-faulted area near Cherrystone Creek is lacking (Plate 1, Cross Section G-G′). The writer believes that some Triassic sediments existed southwest of the present Triassic rocks in this area at the time the oblique faults developed, but that they have subsequently been eroded away. The alternate view that the Triassic beds never extended to the southwest is rejected because they are nearly perpendicular to the edge of the basin here; and this would not be expected if the beds were deposited only within the present confines of the basin. The variation in outcrop width is believed to be primarily the result of the oblique faults, though the increase of thickness of sediments along strike probably accounts for some variations in width of the formations.

For purposes of mapping, the Leakesville formation is subdivided into two members: a Cow Branch member (black) and a Cascade Station member (red). Each member contains both horizontal and vertical variations in color, texture, and composition. Lentils and tongues of each member are interspersed in the larger bodies of the other member. Colors of the beds are fairly diagnostic for field identification. Few color gradations are observable in the field. The Cow Branch member consists of black to dark-gray claystones, shales, siltstones, and a few sandstones. Fossils are not believed to be present but a considerable amount of organic matter is present in the beds. The Cascade Station member consists of maroon, red, and brown claystones, shales, siltstones, and fine- to medium-grained sandstones, and conglomerates. Intertonguing of the Cascade Station red beds and the Cow Branch black beds is common throughout the Leakesville formation. The larger tongues are indicated on the geologic map (Plate 1; Appendix, Geologic Section 1).

A summary of the colors and thicknesses of the major lithologic types is found in Table 1. Shales, siltstones, and claystones form more than 80 percent of the Cascade Station member, and more than 95 percent of the Cow Branch member. Also, more than 70 percent of the Cascade Station member consists of red beds, and more than 80 percent of the Cow Branch member consists of black, gray, or gray-green beds. Because all of the measured sections are taken from at least partially weathered exposures, it is difficult to determine the true percentage of the colors present. Probably the red bed percentages are fairly accurate, but the yellow and brown beds are believed to be weathered black, gray, and gray-green beds.

Table 1. Summary of colors and thicknesses of major lithologic types of Cow Branch and Cascade Station beds of the Leakesville formation from Geologic Sections 1 to 6.

Member	COLOR	CONGLOMERATE		SANDSTONE		SHALE	
		Feet	Percent	Feet	Percent	Feet	Percent
Cascade Station Member	Maroon	...	...	219	6	1564	45
	Red	21	1	118	3	544	16
	Yellow	...	...	16	1	305	9
	Brown	3	1	99	3	172	5
	Black	...	...	...	...	90	3
	Gray	53	1	42	1	...	...
	Gray and gray-green	...	...	...	...	215	6
	Totals	77	2+	494	14+	2890	84
Cow Branch Member	Maroon			...	...	...	...
	Red			...	...	13	3
	Yellow			...	...	30	6
	Brown			...	...	...	...
	Black			...	...	60	13
	Gray			10	2	97	20
	Gray and gray-green			...	...	227	49
	Totals			10	2	469	98

Probably the phyllites, schists, and weathered feldspars of the gneisses and granites adjacent to the basin were the source rocks for most material of this formation. Phyllite is abundant adjacent to the basin in Campbell County, and this is probably the reason for the large outcrops of Leakesville beds found there. Probably some of the finer grained material was carried by basin streams from the central coarser rock area to the northern and southern finer rock areas.

COW BRANCH MEMBER

Definition

Cow Branch member is the name proposed here for the black and dark-gray claystones, shales, siltstones, and sandstones of the Leakesville formation. The name is derived from a small tributary of Cascade Creek near Leakesville Junction. The type section is on State Road 856, 0.2 mile south of State Road 622 and 0.2 mile north of the Virginia state line (Appendix, Geologic Section 1). No completely exposed section of all the Cow Branch member tongues is present in the basin, but a 217-foot and a 329-foot section are present in the type section; probably several times this much is present if the total width of outcrop is indicative of the true thickness.

The black beds intertongue with the Cascade Station member red beds, and smaller lentils are completely surrounded by the red beds. Gradations between the black and red beds are not common, but a few do occur (Appendix, Geologic Section 1, Items 5, 20, 24, 26, and 29).

Exposures

About one-tenth of the total basin is made up of this member. Three areas contain large outcrops of the Cow Branch member (Plate 1). They are the southern Leakesville Junction area with about 6 square miles, the west-central Motley's Mill area with about 11 square miles, and the north Pittsylvania and Campbell counties area, with about 3 square miles. There is also a small patch less than 1 square mile on the east border of the basin near State Highway 40.

In the Leakesville Junction area, the best exposures of the Cow Branch are in the Solite Corporation quarries (Figure 4), south of the Danville and Western Railway. Other good exposures are on Mountain Run and Cow Branch southwest of Boyd Mountain, on Cascade Creek near Leakesville Junction, and along the Danville and Western Railway between State Roads 621 and 860. Two small dikes mark a cross fault in Cow Branch beds south of Boyd Mountain near the Virginia state line.

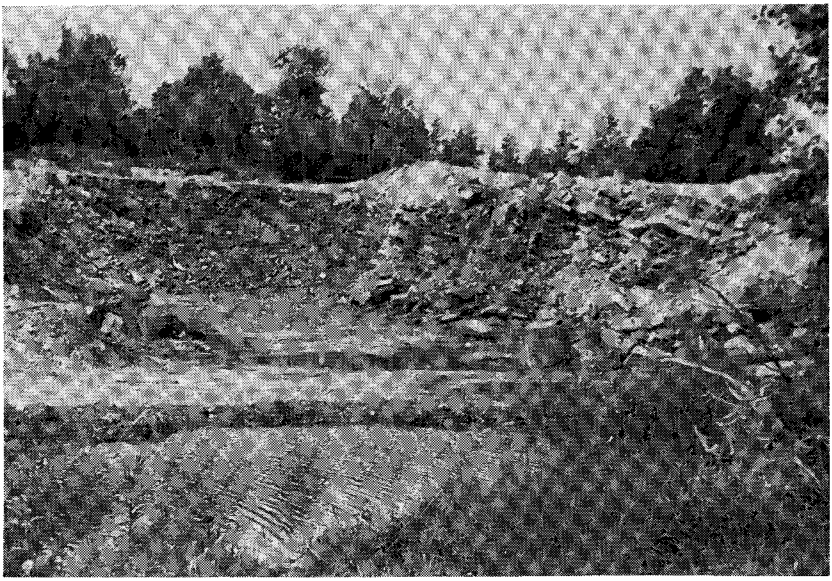
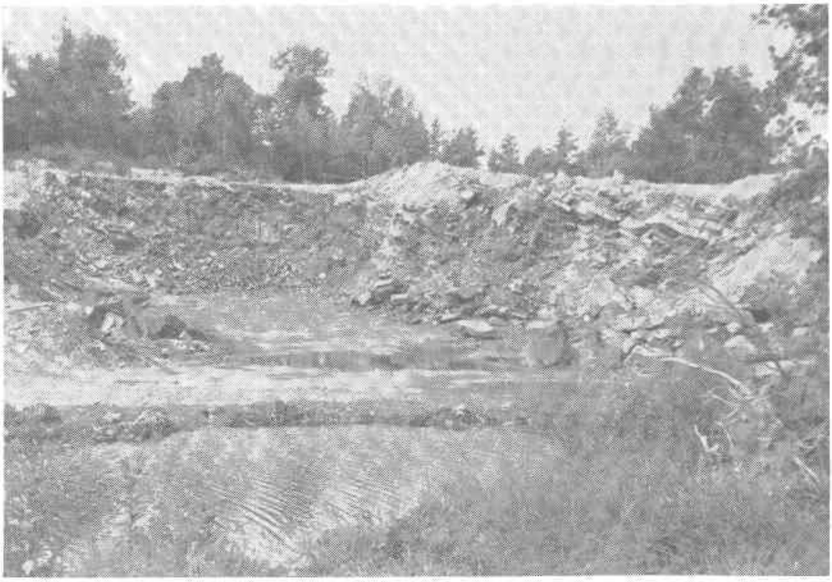


Figure 4. Solite Corporation quarry in the Cow Branch member of the Leakesville formation near Leakesville Junction.

In the Motley's Mill area, good exposures are seen on State Road 683, 0.5 mile south of the junction with State Road 627, in the fields east of State Road 683, and on State Road 682 just east of State Road 686. Other exposures are in a pasture 1 mile N. 30° E. of the junction of State Roads 682 and 686, on State Road 1006 0.5 mile north of State Road 832, on State Road 832 1 mile west of State Road 1006, and on the Banister River north of State Road 832.

Description

The Cow Branch member consists of discontinuous beds, lenses, and tongues of yellow to black, fine-grained clastics containing organic debris. The majority of the rocks are shales and siltstones, with lesser amounts of claystones and sandstones. Most of the fresh samples are calcareous, and some of the shales have calcite grains in them. Gradations in color, texture, and composition are so common and so subtle that it is impossible to estimate the relative proportion of the different rock types accurately. Beds of claystones, siltstones, and shales range fault in Cow Branch beds south of Boyd Mountain near the Virginia state line.



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The fresh rocks are dark gray, gray green, and dull black and most of them are fissile and well bedded. Grains of calcite, and more rarely pyrite and chalcopyrite, are seen in hand specimens. Fine laminae with small quantities of organic matter often form bands in the black shales. Although streaks of organic matter are common, coal is absent in the Danville basin.

The few coarse-grained sandstones are predominantly composed of feldspar and quartz (Table 2). Most of them are feldspathic sandstones (more than 75 percent quartz), but a few arkosic beds with more than 25 percent feldspar are present throughout this member. Gradational types contain grains of quartz or feldspar imbedded in a matrix of finer grained clay minerals and organic matter. The coarser grains are subrounded to subangular, and generally subordinate in quantity to the finer size material. A few frosted well-marked quartz grains disseminated in the shale are believed to have been carried into the basin by wind. Material of this type is exposed in the field east of State Road 859 along Cascade Creek. Porosity and permeability of these rocks are low. The rocks are not fossiliferous like similar rocks in some of the other Triassic basins and outliers in Virginia and North Carolina.

Table 2. Composition of a Cow Branch siltstone from thin section examination.

Mineral	Visual Comparison Percent	Point Count Percent
Quartz	31	13
Microcline	20	17 (Microcline and Plagioclase)
Plagioclase (An_{14-35})	20	
Micas	1	..
Rock fragments	2	10
Iron oxides and sulfides	3	..
Organic matter	1	..
Detritus	22	60

Weathering changes the Cow Branch beds to brown and yellow. Probably this is caused by the combination of increased porosity because of calcite leaching (which accelerates oxidation of pyrite and chalcopyrite) and of decay of organic matter by bacteria. Nevertheless, these colors are distinctive and the beds are easily mapped. A comparison with Cascade Station member reveals illite is present in similar amounts in each member (Table 3).

Table 3. Clay Minerals of the Leakesville formation.

Mineral	Cow Branch Member	Cascade Station Member
Illite	Abundant	Abundant
Vermiculite	Trace	Common
Kaolinite	Trace	Common
Montmorillonite	Trace	Trace

CASCADE STATION MEMBER

Definition

The Cascade Station member is named from a small station on the Carolina and Northwestern Railway about 2 miles northwest of Leakesville Junction. The member consists of maroon, red, and brown claystones, shales, siltstones, fine- to coarse-grained sandstones, and a few conglomerates. The type section is part of the Leakesville type section on State Road 856 (Appendix, Geologic Section 1), 0.25 mile south of State Road 622, and 0.2 mile north of the Virginia state line. No complete section of all the red tongues is exposed in the area, but partial sections of as much as 2360 feet thick have been measured (Appendix, Geologic Sections 2, 3, 4, 5, and 6).

Probably several times this thickness is actually present if the width of outcrop is indicative of the true thickness. Intertonguing of the red Cascade Station member with the black Cow Branch member is common, as previously noted. Textural and compositional changes are also common, as in the Cow Branch member.

The writer believes the basic distinction between the two members is the presence of organic matter in the black rocks and the presence of ferric oxides in the red beds. The percentage composition of a red and a black siltstone thin section seems to verify this (Tables 2, 3).

Exposures

The outcrop areas are shown on the geologic map (Plate 1). About 7 square miles of Cascade Station red beds crop out in the vicinity of the type locality. Also, 40 square miles are covered by this member in the west-central Motley's Mill area, and over 14 square miles of these rocks are found in the north Pittsylvania and Campbell counties area. Nearly 40 percent of the area of the entire basin is made up of this member.

Good exposures are found on State Road 627, 0.3 mile south of State Road 683, west of this locality to Stinking River, and on State Road 691 west of State Road 683 and east of the natural gas pipeline. Others are found on State Road 927 north of State Highway 40, and on State Road 606 between State Roads 640 and 927.

Ripple marks and cross-bedding are best exposed on State Highway 40, 0.1 mile west of State Road 650, on State Road 683, two miles north of State Road 686, on Georges Creek west of State Road 683, and on the Banister River north of State Road 832 (Figure 5). In the northern part of Pittsylvania County, good exposures are present south of State Road 639 on State Road 640, on State Road 669 east of State Road 603, and on State Road 677 south of State Road 667.

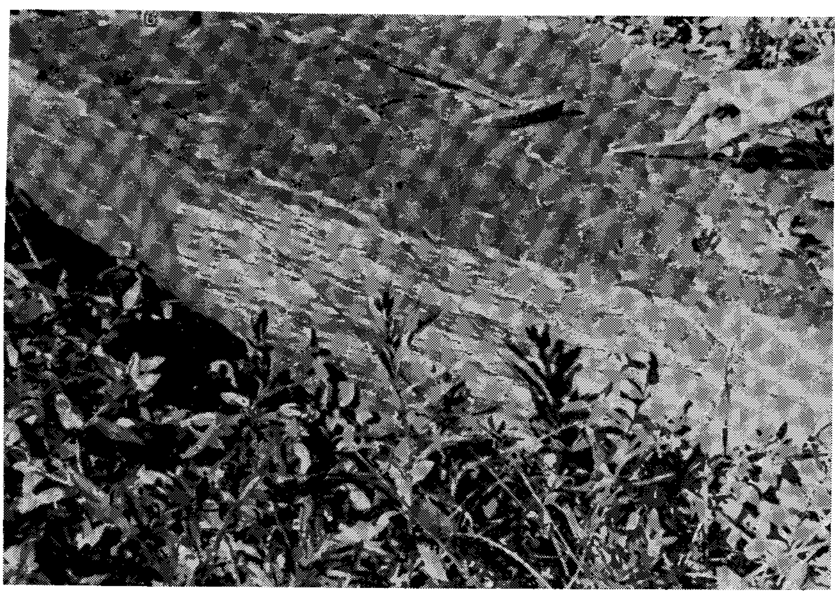

Figure 5. Ripple marks in siltstone of the Cascade Station member, Leakesville formation about 0.2 mile east of State Road 808 on State Highway 40, Pittsylvania County.

In Campbell County, exceptional outcrops occur along State Road 615 west of State Road 648, on State Road 648 from State Road 776 the west-central Motley's Mill area, and over 14 square miles of these rocks are found in the north Pittsylvania and Campbell counties area. Nearly 40 percent of the area of the entire basin is made up of this member.

Good exposures are found on State Road 627, 0.3 mile south of State Road 683, west of this locality to Stinking River, and on State Road 691 west of State Road 683 and east of the natural gas pipeline. Others are found on State Road 927 north of State Highway 40, and on State Road 606 between State Roads 640 and 927.

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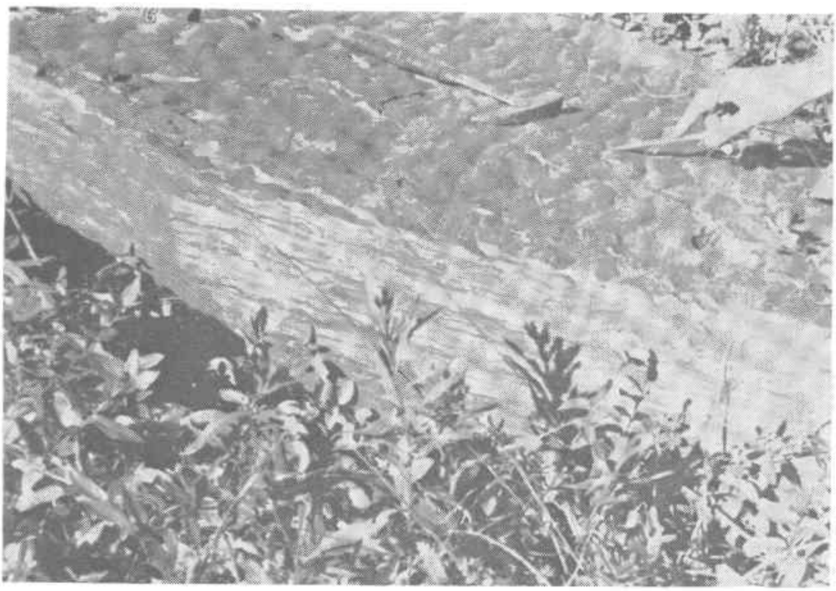

Figure 5. Ripple marks in siltstone of the Cascade Station member, Leakesville formation about 0.2 mile east of State Road 808 on State Highway 40, Pittsylvania County.

In Campbell County, exceptional outcrops occur along State Road 615 west of State Road 648, on State Road 648 from State Road 776 to Snake Creek, along State Road 633 from State Road 638 to State Road 635, and along State Road 637 west of State Road 635. Falling River also shows good exposures near State Road 648.

Description

The two main rock types of the Cascade Station member are shale and sandstone. Lesser amounts of conglomerate, claystone, and siltstone are also present. The rock types occur as beds, lenses, and tongues that are discontinuous and grade into each other. Exposures of claystones, siltstones, and shales range from 3 to 314 feet in thickness, sandstones range from 2 to 33 feet in thickness, and conglomerates range from 3 to 120 feet in thickness. Color, composition, and texture change within short distances so that it is impossible to map a particular bed for any great distance.

About 85 percent of the Cascade Station beds consist of fine-grained rock types which contain mostly clay minerals and iron oxides as well as fine-grained quartz, feldspar, and mica (Table 1). Colors of these fine-grained rocks are darker than the coarse-grained rocks and range

Figure 6. Fine-grained protoquartzite thin section, Cascade Station member, Leakesville formation on State Highway 40 east of State Road 808, Pittsylvania County. 4X. Crossed nicols.

to Snake Creek, along State Road 633 from State Road 638 to State Road 635, and along State Road 637 west of State Road 635. Falling River also shows good exposures near State Road 648.

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Figure 6. Fine-grained protoquartzite thin section, Cascade Station member, Leakesville formation on State Highway 40 east of State Road 808, Pittsylvania County. 4X. Crossed nicols.

from light to dark red and red-brown. A few thin beds of green shales are also present on State Road 633, 0.4 mile west of State Road 634, in Campbell County, Virginia. Fluviatile cross-bedding, oscillatory ripple marks (Figures 5, 6), raindrop impressions, and worm-trail marks are common in rocks of this member.

The siltstones contain quartz, feldspar, and less than 50 percent clays, silts, and iron oxide. The rocks range from red-gray to red in color, are generally fine grained and usually have good bedding with minor cross-bedding and ripple marks. The beds range in thickness from about 300 feet on State Road 640, south of State Road 639, Halifax County, to a few thousand feet along the Banister River north of State Road 832, Pittsylvania County, Virginia. Particles of silt size are generally subangular. The fine-grained rocks are usually well bedded in contrast to the coarser grained deposits. Graded bedding consisting of alternating laminae of coarse particles that grade upward into finer grained particles is common north of State Road 832 along the Banister River. Although each sequence is only about 5 or 6 inches thick, these alternating beds comprise a section totaling more than 100 feet.

Rocks that include arkose, feldspathic, and quartzose sandstone total about 15 percent of the Cascade Station beds (Tables 1, 4). The proportion of each is not determinable because of the intimate mixture and gradation between these rock types. Most particles are subangular to subrounded. The arkoses contain from 25 to 75 percent feldspar and

Table 4. Composition and maturity of a Cascade Station conglomerate and protoquartzite from thin-section examination.

MINERAL	CONGLOMERATE		PROTOQUARTZITE	
	Visual Comparison Percent	Point Count Percent	Visual Comparison Percent	Point Count Percent
Quartz	42	7	82	94
Microcline	31	8	5	1
Plagioclase	17	7	5	....
Micas	2	....	1	....
Clays	1	....	5	....
Iron oxides and sulfides	5	....	2	....
Rock fragments	2	61	....	2
Detritus	....	17	....	3
Maturity	Immature		Mature	

less than 75 percent quartz. Colors include brown, gray red, red, and maroon. Texture of the arkoses is generally medium to coarse grained, and bedding is commonly poor. A few outcrops on State Road 683 about 1.5 miles south of State Road 627, have rocks cemented lightly by quartz or calcite cement. Beds range from a few inches to 32 feet thick on State Highway 40 east of Stinking River, Pittsylvania County, Virginia.

Feldspathic sandstones and protoquartzites contain 75 percent or more quartz and lesser amounts of other materials such as feldspar, mica, clay, and rock fragments. Colors range from brown to maroon and gray. Thickness ranges from 2 to 186 feet (Appendix, Geologic Section 5). Texture is similar to that in the arkoses, with medium- to coarse-grained particles and poor bedding.

Conglomerates form only about 2 percent of this member, and some are very coarse. Colors range from red, maroon, and brown to gray. Thickness of beds ranges from 3 to 120 feet. Most conglomerates and coarse sandstones are predominantly quartz, either as free quartz grains or particles of quartzite. One locality east of State Road 606 on State Highway 40 has a few 6-inch cobbles of quartzite, but this is an exceptional occurrence. Most conglomerates in this member do not contain pebbles larger than 1 inch in diameter.

CONDITIONS OF DEPOSITION

The fine-grained beds of high organic content in the Cow Branch member suggest deposition under reducing lacustrine conditions. Lakes were formed consequent to tectonic movements that obstructed drainage and are believed to be the sites of deposition for the Cow Branch member. Swamp deposits formed under similar conditions are found in the North Carolina part of this basin. A few carbonaceous streaks are scattered in black shales near Leakesville, North Carolina. The fresh-water origin of these deposits is indicated by fossils of the fresh-water crustacean *Cyzicus ovata* (Lea) found in similar beds in an outlier of the Farmville basin of Triassic sediments about 30 miles east near South Boston, Virginia. These fossils have been identified by Dr. G. A. Cooper, U. S. National Museum.

The intimate occurrence of Cascade Station red beds with the Cow Branch black beds, as well as the intertonguing of both types with the green Dry Fork beds suggests abrupt differences in conditions of deposition in adjacent areas. The red beds are probably sediments that were deposited on extensive alluvial plains away from the most intense tectonic areas. The common intertonguing with Cow Branch beds and the less common intertonguing with Dry Fork beds, as well as greater thickness of red beds in comparison to black beds (40 percent versus 10 percent of total) suggests that the red beds represent the most prevalent type of deposition of fine-grained material. Krynine (1950, pp. 143-154) considers the red beds of the Connecticut basin as products of slow erosion of silicate soils formed in humid climates with seasonal rainfall.

Most red beds are found in the northern and central parts of the Danville basin. The writer believes more obstructions to drainage occurred in the south part of the basin, and consequently reducing conditions prevailed there. A different type of deposition occurred in the Dry Fork areas, where less organic matter was preserved with the sediments.

RESISTANCE TO EROSION

Cow Branch beds and shales of the Cascade Station member are the least resistant of all the Triassic rocks. They are found underlying lowlands and broad flat areas generally between the elevations of 560 and 680 feet. The poor erosion resistance of these rocks is believed to be caused by their being both calcareous and fine grained. The Banister River meanders northeastward across several miles of these beds east of Chatham, although this is not the shortest route to the junction with the Dan River. Sandstones and siltstones of the Cascade Station member are found on low hills and ridges intermediate in elevation between the Cow Branch beds and the Dry Fork beds and metamorphic rocks. Generally these intermediate resistance beds are not found above the elevation of 720 feet. These rocks have coarser texture and are generally more indurated than the Cow Branch beds, although not as well indurated as most Dry Fork beds. They are therefore considered as intermediate in erosion resistance.

DRY FORK FORMATION

Dry Fork formation is the name proposed for the graywackes, arkoses, and other rocks that occur between Boyd Mountain near the North Carolina border and the Staunton River on the Pittsylvania-Campbell county line. These rocks occupy most of the central and south-central part of the Danville basin. The name is taken from a settlement on State Road 718 about 0.5 mile west of U. S. Highway 29. The type section of the Dry Fork formation (Appendix, Geogolic Section 7) is found about 0.5 mile south of Dry Fork along the Southern

Railway cut in Pittsylvania County, Virginia. The Dry Fork formation consists of a graywacke and an arkosic facies which grade into each other in the area near Mt. Airy. Table 5 is a summary of the colors and thicknesses of the major lithologic types recorded in the geogolic sections. In this summary, half of the formation consists of sandstones, a third is shale, and the remainder is conglomerate.

Table 5. Summary of colors and thicknesses of major lithologic types of Dry Fork formation from Geologic Sections 7 through 14.

	CONGLOMERATE		SANDSTONE		SHALE	
COLOR	Feet	Percent	Feet	Percent	Feet	Percent
Brown	408	5	1229	14	88	1
Yellow	313	4	770	9	430	5
Gray	419	5	749	8	274	3
Red	63	1	494	6	545	6
Maroon	44	1	446	5	1114	13
White	225	2	344	4	....	....
Gray-green	163	2	166	2	325	3
Total	1635	20	4198	49	2776	31

Outcrop width of Dry Fork terrane ranges from less than 0.5 mile on Boyd Mountain to a maximum of about 2.5 miles south of Motley's Mill. Thickening, thinning, and some oblique faulting are the causes of the present outcrop outline. The belt trends about N. 40° E. and is about 47 miles long. Total area is approximately 101 square miles, and the total thickness is estimated to be about 6000 to 8000 feet. (Appendix, Geogolic Section 9.) The thickness includes most of the arkosic facies on State Road 878.

No distinction is made between the graywacke facies and the arkosic facies on the geologic map (Plate 1) because of the gradations and intertonguing between the two. The major siltstones of the arkosic facies are indicated separately however. The source material for this formation is the metamorphic complex adjacent to the basin. The gneisses, granites, schists, phyllites, and weathered residues from this area contributed most of the material for the sediments.

A quartz monzonite fault block within the Dry Fork formation is found near Renan and is described later in the report. The writer believes that the fault block was formed after the main Dry Fork sedimentation and hence it did not contribute to the Dry Fork sediments.

GRAYWACKE FACIES

Definition

Graywacke-type rocks, as described by Pettijohn (1957, p. 291), are found in much of the Dry Fork formation, but the term "graywacke facies" is restricted to the lithic polymictic conglomerates, lithic graywackes, subgraywackes, and protoquartzites of Pettijohn's classification. These rocks are found mostly in the area north of Renan, west of Riceville, and in the area north and east of Cascade Creek.

Accurate thickness figures are not available, as this facies intertongues with and grades into the arkosic facies at many places, and nowhere is completely exposed. Geologic Section 8 (Appendix) was measured in the best exposure of this facies at the Mt. Airy quarry.

Exposures

This facies is most frequently found as massive or thick-bedded units more than 15 feet thick. It is best exposed in three places: 1) the Mt. Airy quarry on State Road 920, 2) along the Banister River about 0.5 mile south of State Road 640, and 3) on State Highway 40 about 0.3 to 0.8 mile east of State Road 640. An isolated exposure of less than 1 square mile is found on Motley's Creek in Campbell County.

Description

This facies consists primarily of conglomerate and sandstone, with lesser amounts of shale (Table 6). Rocks of this facies are most easily identified in the field by the abundant rock fragments, detrital matrix, gray-green color, and poor sorting of the conglomerates and sandstones. Rock types close to arkosic facies-type composition are impossible to relegate accurately in the field.

This facies is gray and gray green, brown and yellow, and is silty and calcareous. It consists primarily of rock fragments and monomineralic pieces of former rock fragments mixed together with fine-grained micas, quartz, and feldspar. About two-thirds of the rock and mineral grains are larger than 0.062 mm. or very fine sand size. The remainder is composed of smaller grains. Rock fragments, quartz, feldspar, and micaceous minerals are the chief constituents (Figures 7-9). Rock and mineral fragments range from angular to subrounded, and sorting is very poor. Some of the rocks are true sedimentary microbreccias, but the majority of fragments in the rocks have the roundness of those that occur in conglomerates. Porosity and permeability of

Table 6. Percent composition and textural maturity of graywacke facies, polymictic conglomerates, lithic graywackes and subgraywackes from thin section.

Mineral	Conglomerates (average of 6)		Graywackes (average of 8)		Subgraywackes (average of 3)	
	Visual Comparison Percent	Point Count Percent	Visual Comparison Percent	Point Count Percent	Visual Comparison Percent	Point Count Percent
Quartz	21	4	30	7	38	12
Microcline	37	12 (Microcline and Plagioclase)	35	18 (Microcline and Plagioclase)	31	16 (Microcline and Plagioclase)
Plagioclase	23 (An 5-34)		21 (An 6-37)		19 (An 23-34)	
Micas	8	....	8	....	4	....
Clays	1	....	3	....	4	....
Iron oxides and sulfides	2	....	<1	....	1	....
Rock fragments	1	62	1	44	4	63
Detritus and other	7	22	2	31	1	9
Maturity	Immature		2—Immature 6—Submature		Submature	

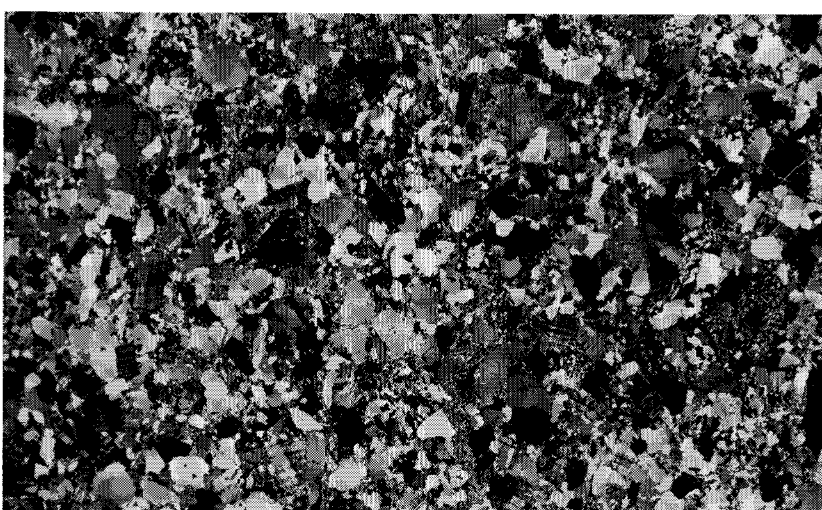

Figure 7. Feldspathic graywacke thin section, graywacke facies, Dry Fork formation at the junction of State Road 863 and Sandy River, Pittsylvania County. 4X. Crossed nicols.

Table 6. Percent composition and textural maturity of graywacke facies, polymictic conglomerates, lithic graywackes and subgraywackes from thin section.

MINERAL	CONGLOMERATES (average of 6)		GRAYWACKES (average of 8)		SUBGRAYWACKES (average of 3)	
	Visual Comparison Percent	Point Count Percent	Visual Comparison Percent	Point Count Percent	Visual Comparison Percent	Point Count Percent
Quartz	21	4	30	7	38	12
Microcline	37	12	35	18	31	16
Plagioclase	23 (An 5-34)		21 (An 6-37)		19 (An 23-34)	
Micas	8	....	8	....	4	....
Clays	1	....	3	....	4	....
Iron oxides and sulfides	2	....	<1	....	1	....
Rock fragments	1	62	1	44	4	63
Detritus and other	7	22	2	31	1	9
Maturity	Immature		2—Immature 6—Submature		Submature	

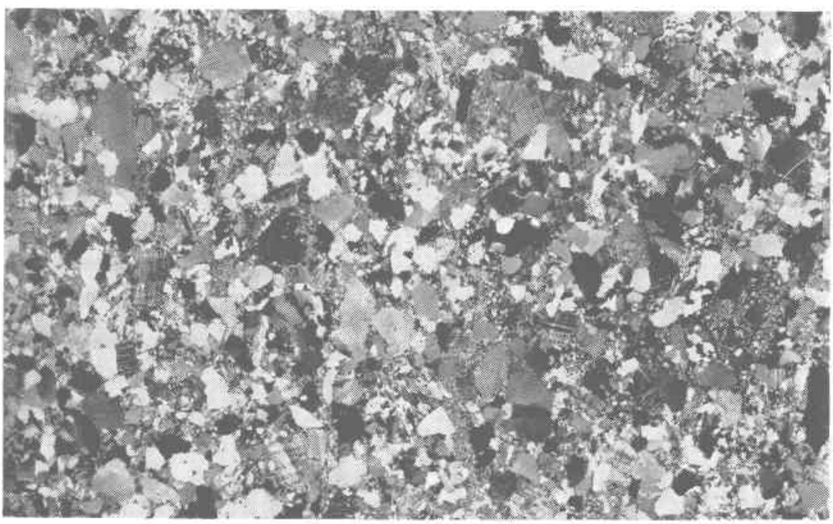

Figure 7. Feldspathic graywacke thin section, graywacke facies, Dry Fork formation at the junction of State Road 863 and Sandy River, Pittsylvania County. 4X. Crossed nicols.

Figure 8. Lithic graywacke thin section, graywacke facies, Dry Fork formation at the junction of State Road 640 and the Banister River, Pittsylvania County. 4X. Crossed nicols.

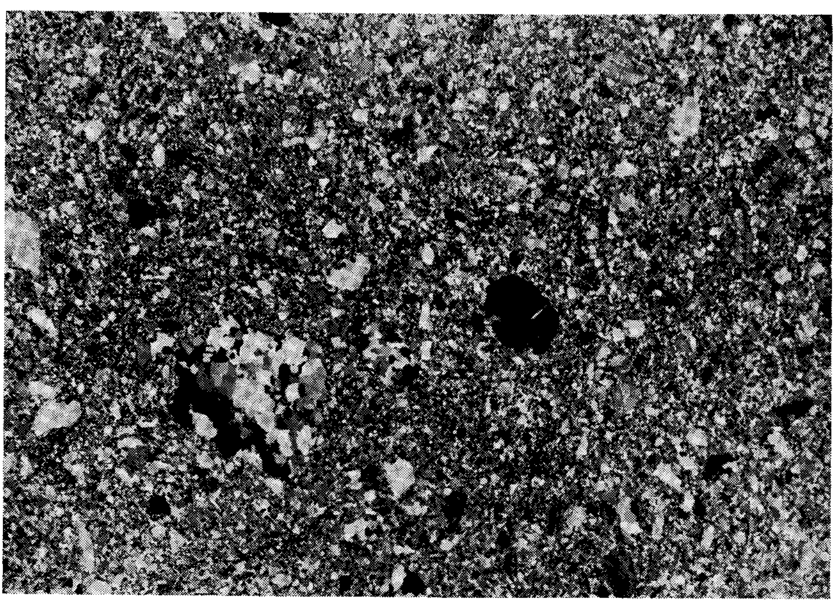

Figure 9. Subgraywacke thin section, graywacke facies, Dry Fork formation at the junction of State Road 863 and State Highway 41, Pittsylvania County. 4X. Crossed nicols.

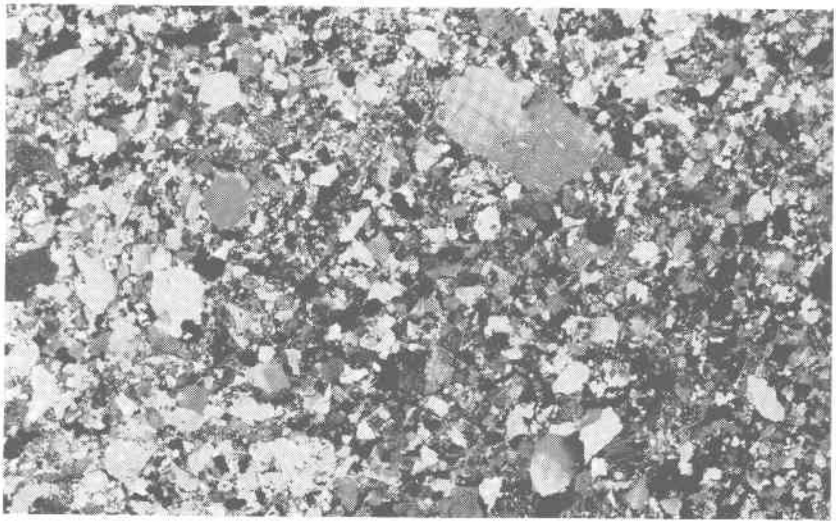

Figure 8. Lithic graywacke thin section, graywacke facies, Dry Fork formation at the junction of State Road 640 and the Banister River, Pittsylvania County. 4X. Crossed nicols.

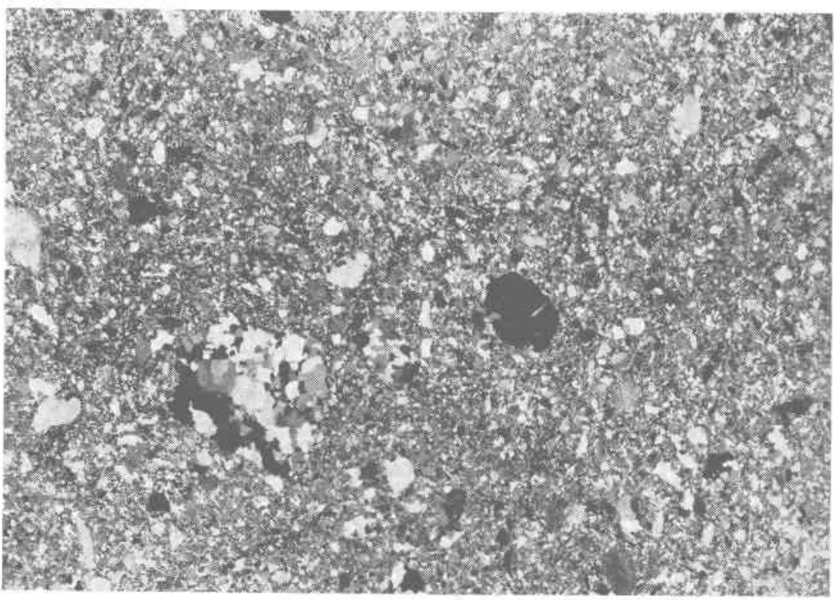

Figure 9. Subgraywacke thin section, graywacke facies, Dry Fork formation at the junction of State Road 863 and State Highway 41, Pittsylvania County. 4X. Crossed nicols.

these rocks are very low. Weathering of the gray and gray-green rocks causes a loss of calcite, oxidation of the iron sulfides to oxides, and change of the rock color to brown or yellow. The rock is weathered to a crumbly arkosic sand.

ARKCSIC FACIES

Definition

Arkosic facies, as used in this report, is restricted to the feldspathic polymictic conglomerates, the feldspathic graywackes, arkoses, and feldspathic sandstones of Pettijohn's (1957) classification. It also includes a few claystones, siltstones, and shales found within the limits of the formation. Most of the Dry Fork formation may be classified as belonging to this facies.

Exposures

Although some rocks of this facies are found in almost all areas where the Dry Fork formation occurs, most of them are found in the area northwest of Gladys in Campbell County, and in Pittsylvania

Figure 10. Massive sandstones and siltstones of the arkosic facies of the Dry Fork formation in a roadcut of U. S. Highway 29 on Whiteoak Mountain, Pittsylvania County.

these rocks are very low. Weathering of the gray and gray-green rocks causes a loss of calcite, oxidation of the iron sulfides to oxides, and change of the rock color to brown or yellow. The rock is weathered to a crumbly arkosic sand.

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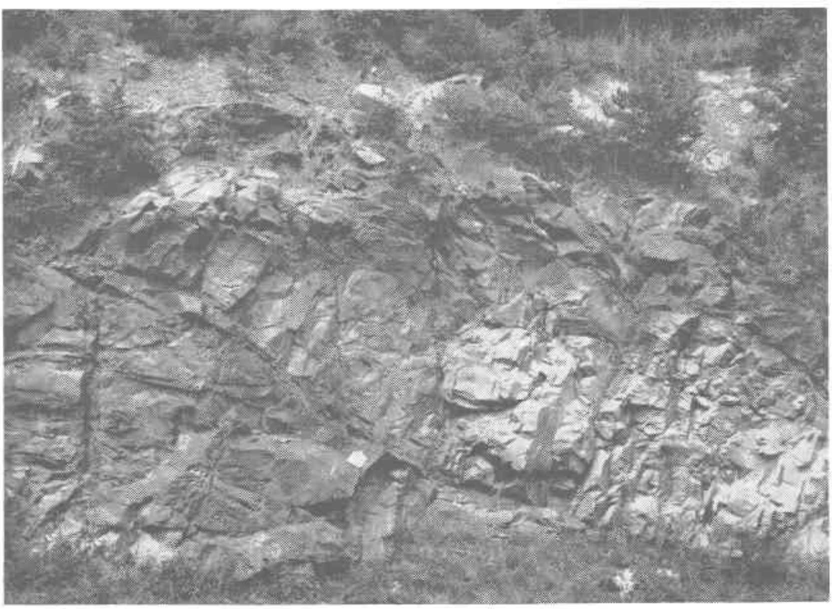

Figure 10. Massive sandstones and siltstones of the arkosic facies of the Dry Fork formation in a roadcut of U. S. Highway 29 on Whiteoak Mountain, Pittsylvania County.

County from Motley's Mill south to the Sandy River. The best outcrops of the arkosic facies are found 1 mile south of Motley's Mill on the Banister River, and also in the cuts of the Southern Railway and U. S. Highway 29 on Whiteoak Mountain (Figure 10). The longest and most complete section is found on State Road 878 between U. S. Highway 51 and State Road 873 (Appendix, Geologic Section 9). All exposed rocks in this section are highly weathered and thus the true colors of the rocks are distorted. Other good exposures are seen on State Highway 40 near Pleasant Gap, on the Sandy River between State Roads 863 and 878, on Trotter's Creek north of State Road 863, and on U. S. Highway 58 just east and west of its junction with U. S. Highway 51.

A small outlier occurs on Cascade Creek northwest of Cascade Station in the southwest part of Pittsylvania County. Geologic Sections 9, 10, 11, 12, 13, and 14 (Appendix) contain descriptions of the good exposures of this facies.

Description

The most common rock in this facies is sandstone, which forms nearly half the exposures; shale forms another third, and the remainder is conglomerate. These rocks are not evenly distributed, however (Table 7).

Claystones, shales, and siltstones range from 1 to 72 feet in thickness; sandstone beds range from 1 to 279 feet in thickness; and conglomerates range from 1 to 170 feet in thickness. Colors, percentages of

Table 7. Comparison of arkosic facies beds in Geologic Sections 7 and 9 through 14.

Geogolic Section	Conglomerate		Sandstone		Shale	
	Feet	Percent	Feet	Percent	Feet	Percent
8	353	22	1143	73	77	5
9	364	8	2201	54	1947	38
10	63	29	19	9	132	62
11	325	40	387	48	100	12
12	516	48	129	12	438	40
13	36	14	196	78	18	8
14	78	46	52	31	39	23
Weighted Average		17		50		33

colors for each major rock type, and total thickness of each rock type exposed in geologic sections are found in Table 5.

Percentagewise, red and maroon beds increase from 18 percent in the conglomerates to over 20 percent of the sandstones, and almost 60 percent of the shales. In contrast, the gray beds decrease from about 25 percent of the conglomerates to less than 20 percent of the sandstones and to about 10 percent of the shales. Other color beds show no relation between color and size of particles. Probably most of the brown, yellow, and white beds are the weathered equivalents of the gray and gray-green beds. Red-bed thicknesses are believed to be accurate, however, as fresh beds weather to almost the same color as the original rock. If all beds except red and maroon beds are lumped together as gray-type beds, and the red and maroon beds are combined, the following figures are obtained: conglomerates contain 93 percent gray-type beds and 7 percent red beds, sandstones have 78 percent gray-type beds and 22 percent red beds, and shales consist of 41 percent gray-type beds and 59 percent red beds in this facies. The evident conclusion is that the coarser beds are predominantly gray and the finer are mostly red.

The polymictic conglomerates of this facies are mostly gray, brown, yellow, white, and gray-green, with a few red and maroon beds. As in the graywacke facies, quartz, feldspar, micaceous minerals, and rock fragments are the principal constituents (Table 8). Rock fragments include quartzite, gneiss, granite, mica schist, hornblende schist, phyllite, and rarely, red siltstone. Minor constituents include chlorite, sericite, clays, pyrite, and chalcopyrite. Fresh exposures are hard and dense and have low porosity and permeability.

The quartzose and arkosic sandstones of this facies have the same colors as the conglomerates, but in different proportions as noted under general features. Mineral composition is similar to that of the conglomerates and also to that of the graywacke sandstones, except the proportions are different. Grains range from subangular to subrounded (Figure 11). A few of the sandstones are true microbreccias.

CONDITIONS OF DEPOSITION

The graywacke facies represents an alluvial fan which was developed from an accumulation of poorly sorted sediments from nearby source areas containing metamorphic rocks. Rapid erosion, transport, and deposition probably account for the relatively unoxidized condition of the sediments. Both graywacke and arkosic beds represent greater mechanical than chemical weathering conditions. Arkosic beds are better sorted and more mature than the graywacke beds.

Table 8. Percent composition and textural maturity of arkosic facies, feldspathic graywacke, arkose, and an arkosic siltstone.

MINERAL	GRAYWACKE (average of 7)		ARKOSE (average of 2)		SILTSTONE	
	Visual Comparison Percent	Point Count Percent	Visual Comparison Percent	Point Count Percent	Visual Comparison Percent	Point Count Percent
Quartz	33	12	66	19	40	9
Microcline	30	36 (Microcline and Plagioclase)	5	51 (Microcline and Plagioclase)	50	11 (Microcline and Plagioclase)
Plagioclase	23 (An_{14-35})		15		4 (An_{26})	
Mica	6	....	3	....	2	....
Clay	1	....	2	....	1	....
Iron oxides and sulfides	1	....	8	....	1	....
Rock fragments	5	21	1	15	2	8
Detritus and other	1	31	1	15	1	72
Maturity	3—Immature 4—Submature 1—Mature		Mature			

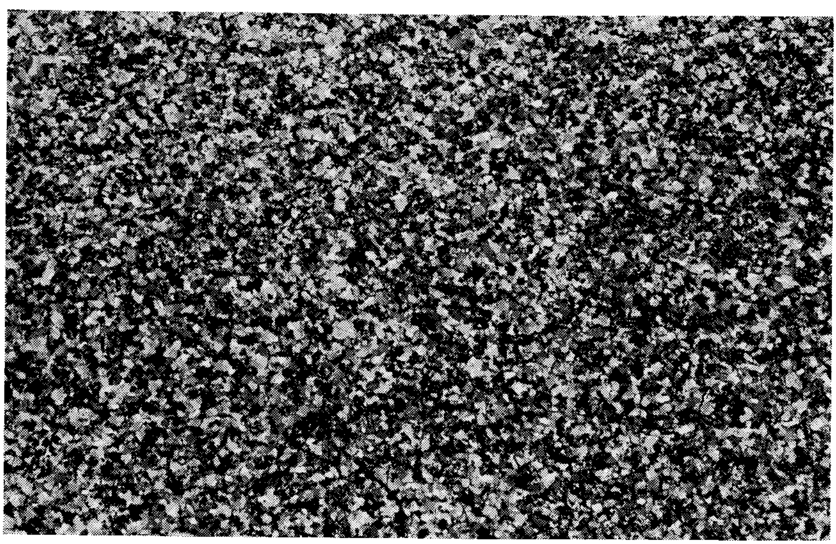

Figure 11. Arkosic sandstone thin section, arkosic facies, Dry Fork formation, 1.6 miles east of State Road 874 on U. S. Highway 58, Pittsylvania County. 4X. Crossed nicols.

Table 8. Percent composition and textural maturity of arkosic facies, feldspathic graywacke, arkose, and an arkosic siltstone.

MINERAL	GRAYWACKE (average of 7)		ARKOSE (average of 2)		SILTSTONE	
	Visual Comparison Percent	Point Count Percent	Visual Comparison Percent	Point Count Percent	Visual Comparison Percent	Point Count Percent
Quartz	33	12	66	19	40	9
Microcline	30	36 (Microcline and Plagioclase)	5	51 (Microcline and Plagioclase)	50	11 (Microcline and Plagioclase)
Plagioclase	23 (An_{14-35})		15		4 (An_{26})	
Mica	6	....	3	....	2	....
Clay	1	....	2	....	1	....
Iron oxides and sulfides	1	....	8	....	1	....
Rock fragments	5	21	1	15	2	8
Detritus and other	1	31	1	15	1	72
Maturity	3—Immature 4—Submature 1—Mature		Mature			

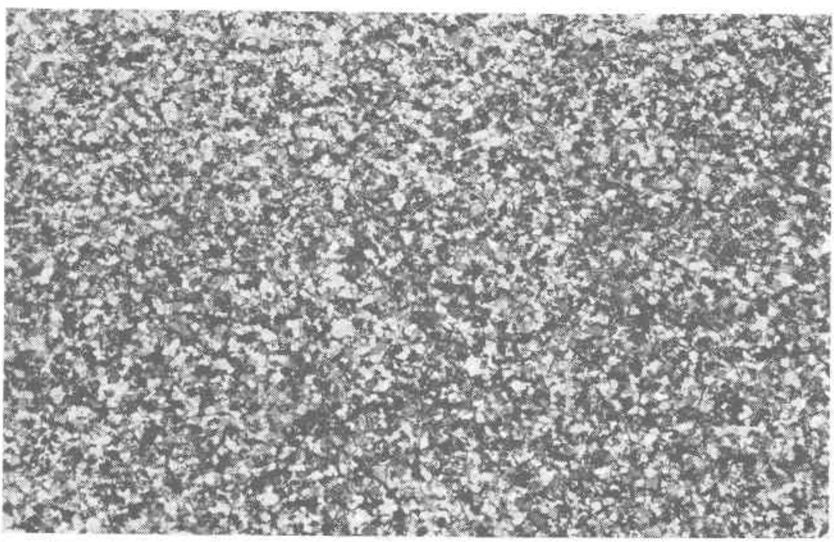

Figure 11. Arkosic sandstone thin section, arkosic facies, Dry Fork formation, 1.6 miles east of State Road 874 on U. S. Highway 58, Pittsylvania County. 4X. Crossed nicols.

It is believed that a major alluvial fan formed near what is now the site of the Mt. Airy quarry, and that most of the later-formed sediments were diverted to the southern part of the Danville basin. Other smaller fans probably were formed both north and south of this fan along the western fault scarp, as for example along Cascade Creek in the extreme southwest corner of the basin. This would account for the predominance of the graywacke facies near this area and also the presence of the lesser amounts of similar rock throughout the remaining area of Dry Fork deposition. It also explains some of the rapid changes in thickness and lithology that occur within the formation. The Mt. Airy area probably marks the site of major drainage into the basin during the time the basin was being formed. Evidence for transport of sediments along the length of the basin is the presence of hornblende schist in samples of lithic graywacke near the junction of State Road 606 and State Highway 40. The nearest hornblende schist outcrops that are known are 12 miles north and 20 miles south of there.

The greenish-gray color of this facies only indicates that the rocks were deposited under reducing conditions. The fresh appearance and angularity of many of the rock and mineral fragments are evidence that erosion and deposition were rapid. Evidence that the average temperature of the climate was above 77°F during accumulation of this facies is the absence of organic matter in the interbedded red silts, indicating rapid bacterial decomposition.

It is possible that the siltstones do not represent sorting of the finer grained material out of the coarser textured rocks, but that they represent finer material brought into the basin under conditions of low capacity for the supplying streams. Because this latter possibility cannot be completely disproved, it thereby becomes difficult to explain the relatively clean sandstones and arkoses which are interbedded with the siltstones.

RESISTANCE TO EROSION

The graywacke facies, together with the arkosic facies, underlies the highest hills in the Danville basin. These two facies also are more resistant rock types than the surrounding metamorphic and igneous rocks. The extension of Whiteoak Mountain to the north of the Motley's Mill area is composed of the graywacke. It is found between 440 to 720 feet in elevation. Arkosic facies beds are slightly more resistant and are found between 740 and 1040 feet in elevation. Only the Banister River has cut across the Dry Fork formation. The river breaches the formation south of Mt. Airy in a valley that contains 0.5 mile of rapids and small water falls.

CEDAR FOREST FORMATION

DEFINITION

The name Cedar Forest formation is proposed here for the red shale and conglomerate sequence that lies disconformably above the Leakesville and Dry Fork formations. The type locality is along the Virginian Railway about 0.5 mile northwest of Long Island station in Campbell County, Virginia. The name Cedar Forest, taken from a small community at the junction of State Roads 761 and 639 in northern Pittsylvania County, is about 2 miles south of the type locality.

EXPOSURES

The formation consists of narrow, local exposures up to 0.5 mile wide along some of the border and oblique faults on both the east and west sides of the Danville basin. Total outcrop area is about 7 square miles. The best exposure is at the type locality (Figure 12). There, eastward-dipping, alternating beds of cobble conglomerate and shale are clearly exposed below surficial stream-channel deposits.

Other exposures in Campbell County include one along Falling River at the Appomattox County line and another about 1 mile southwest of this location on Pulliam Branch. A third small exposure is found about 3.5 miles southeast of Gladys on State Road 635.

In Pittsylvania County, good exposures may be seen on State Road 604, just north of State Road 920 near the Renan fault block, where quartz monzonite boulders 1.5 by 3.5 feet in cross section are found in the roadside ditches. Fair exposures are found on Straightstone Creek near Renan, on State Highway 40 near State Road 808, and on Sandy River near State Road 863 (Figure 13). Other exposures are found about 0.3 mile south of the junction of State Road 649 and the Transco gas pipeline, north and south of State Road 832 on the west side of the basin, and also south of U. S. Highway 58 near the junction of State Road 621 and the west side of the basin.

DESCRIPTION

This formation consists largely of red conglomerate and siltstone beds from 2 to 10 feet thick. Fragments contained within conglomerates range from pebbles to boulders in size, and the conglomerates generally

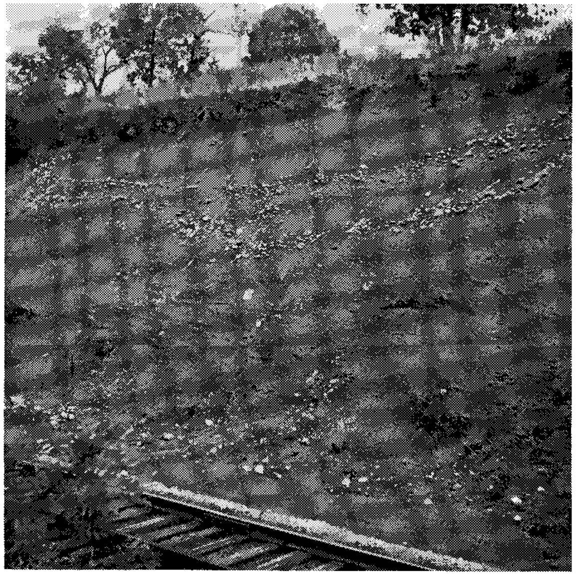

Figure 12. Post-Triassic surficial stream-channel deposits above the type locality of the Cedar Forest formation, 0.5 mile north of Long Island station, Campbell County.

Figure 13. Cedar Forest fanglomerate along the Sandy River near State Road 863, Pittsylvania County.

Figure 12. Post-Triassic surficial stream-channel deposits above the type locality of the Cedar Forest formation, 0.5 mile north of Long Island station, Campbell County.

Figure 13. Cedar Forest fanglomerate along the Sandy River near State Road 863, Pittsylvania County.

resemble nearby metamorphic rocks from which they are derived. Red and maroon conglomerates containing rock fragments of quartz monzonite, quartzite, gneiss, granite, schist, and phyllites from pebbles to boulders in size are the most striking feature of this formation (Figures 13, 14). Red and maroon siltstones and shales are also present between the conglomerate layers.

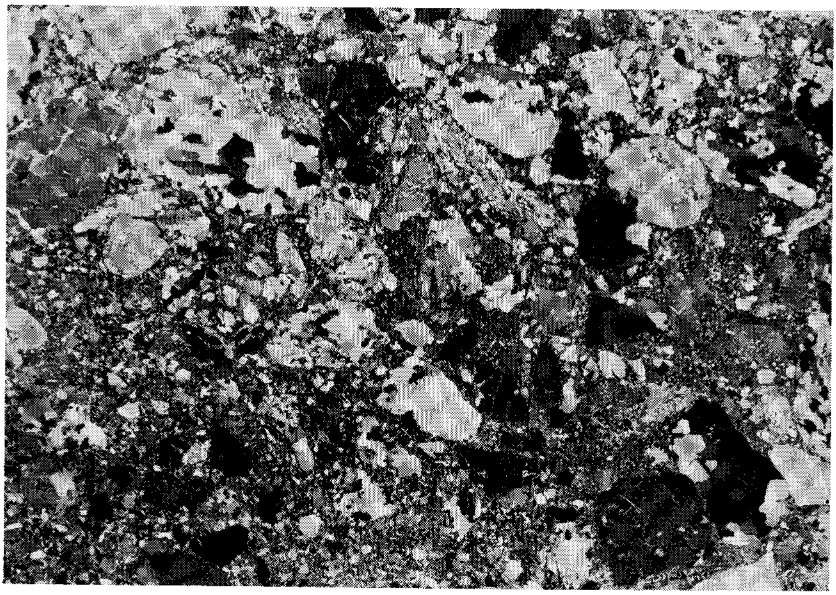

Figure 14. Maroon polymictic conglomerate thin section, Cedar Forest formation at the junction of State Road 808 and State Highway 40, Pittsylvania County. 4X. Crossed nicols.

About 40 percent of the rock fragments are phyllite, 40 percent quartzite, and 20 percent other material in all northern exposures except those adjacent to the Renan fault block. There, most rock fragments are quartz monzonite. In the central and southern areas the conglomerates contain more gneisses and schists, and fewer phyllite fragments. Mineral composition of a fine-grained conglomerate from this formation is presented in Table 9. Average fragment size is 2 inches, and about 95 percent of the conglomerate grains are larger than 5 mm. The rest of the conglomerates and the siltstones and shales are composed of silts and clays. Fragments range from well rounded to subangular. Only phyllite pebbles and cobbles are well rounded and platy; all others are subrounded to subangular and are nearly resemble nearby metamorphic rocks from which they are derived. Red and maroon conglomerates containing rock fragments of quartz monzonite, quartzite, gneiss, granite, schist, and phyllites from pebbles to boulders in size are the most striking feature of this formation (Figures 13, 14). Red and maroon siltstones and shales are also present between the conglomerate layers.

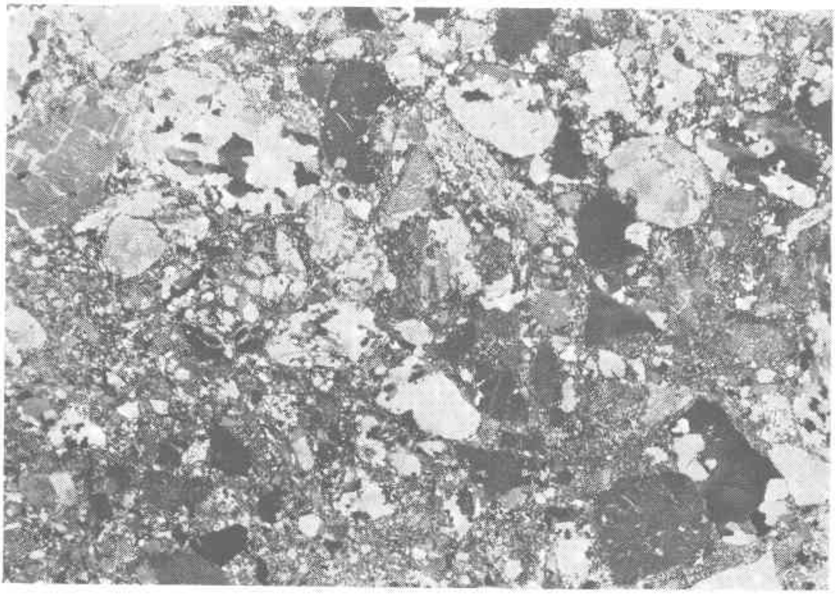

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Table 9. Composition of a Cedar Forest polymictic conglomerate as determined from a thin section.

Mineral	Percent
Quartz	41
Microcline	35
Plagioclase	20
Mica	2
Iron oxides and sulfide	2
Other	1

CONDITIONS OF DEPOSITION

The conglomerates of this formation are believed to have been deposited as fluvial outpourings during times of movement along the oblique faults. Part of the material is probably former residuum and part fresh material that was eroded by short fault-scarp streams. A short distance of transport of this material is evidenced by the angularity and size (up to several feet diameter) of some of the rock fragments. The siltstones between the conglomerates are considered to have been deposited during times of less tectonic activity. Rapid transitions from coarse to fine material are believed to be the result of alternate movement and nonmovement along the oblique faults and of different sources for the sediments. Most of the coarser material was derived from the adjacent metamorphic rocks or the Renan fault block; the finer grained material such as is found in the siltstones is probably derived from the Leakesville beds.

RESISTANCE TO EROSION

The small extent of the exposures of the Cedar Forest formation makes it difficult to estimate the resistance of these rocks to erosion. Probably they are as susceptible to erosion as the Leakesville beds because the grain size and stratigraphic position are similar.

STRATIGRAPHIC RELATIONS OF TRIASSIC FORMATIONS

The Leakesville and Dry Fork formations are partially equivalent as evidenced by intertonguing beds. The Dry Fork formation is composed of a group of sand and conglomerate lenses that emerge from one or more alluvial fans. These lenses grade away from the fans into and intertongue with finer grained clastics of the Leakesville formation.

Both members of the Leakesville formation intertongue with the arkosic facies of the Dry Fork formation. Generally the graywacke facies grades into the arkosic facies, although some graywackes intertongue with Leakesville beds. This is clearly seen on Cascade Creek where black shales of the Cow Branch member intertongue with Cascade Station member and graywacke facies of the Dry Fork formation. Outcrops of the Cascade member intertonguing with arkosic beds of the Dry Fork formation are found on Boyd Mountain. Similar occurrences of this intertonguing are seen south of State Road 677, north of the Banister River, and south of State Road 639 near the Halifax-Pittsylvania county line. The red-bed Cascade Station member and the black-bed Cow Branch member intertongue and grade into each other in the Leakesville Junction, Motley's Mill, and the Campbell County areas of outcrop.

Much of the original continuity of the lenses and beds has been disrupted by the oblique faulting. The faults also have obscured the earlier beds by initiating the deposition of the Cedar Forest formation above the earlier Dry Fork and Leakesville beds. The unconformity separating the Cedar Forest from these beds is marked by anomalous dips of the Cedar Forest beds and by the contrast in lithologies. Cedar Forest beds dip 36° E. in exposures on State Highway 40 near State Road 808 in Pittsylvania County; nearby, in the bed of Stinking River, underlying Leakesville beds dip 32° W. Lithologic contrasts are most pronounced in four places: 1) near the Renan fault block, 2) in the Sandy River bottom, 3) west of State Road 761 near State Road 603, all in Pittsylvania County, and 4) at the type locality of the Cedar Forest formation in Campbell County. The coarse fanglomerate and conglomerate beds in those places have much fresher and larger rock fragments than are found in either the Leakesville or Dry Fork beds. Also, only a few of the Cedar Forest siltstones are fissile, which may mean they are less indurated than the underlying Leakesville shales.

TRIASSIC IGNEOUS ROCKS

DIABASE AND GABBRO DIKES

Exposed dikes range from about 1 to 1500 feet in width and from several feet to 3.5 miles in length in the Danville area. Average width of most dikes is about 30 feet and average length is about 0.6 mile. Nine dikes more than 1 mile in length trend from N. 5° E. to N. 30° W. with an average strike of N. 11° W. Dikes less than 1 mile trend from N. 75° E. to N. 65° W. and have an average strike of N. 10° E.

The largest and best exposures of gabbro and diabase dike rock are found near the Renan fault block, about 29 miles from the north edge of the basin (Figure 15). West of State Road 761 and northwest of the Renan fault block, there are boulders up to 10 feet in diameter in a pasture. Some boulders are split in half as a result of weathering along joint planes (Figure 15). A 3.5 mile long dike is found to extend from south of the Renan fault block near the Mt. Airy quarry to 0.5 mile west of Hermosa. It is 600 feet wide at its widest point south of State Highway 40. A 2-mile long dike, which has a maximum width of about 1500 feet, crops out from north of the junction of State Roads 601 and 761 to south of State Road 668. Other prominent dikes in Pittsylvania County are found at the junction of State Roads 761 and 602, east of Childress Creek and east of Cascade Creek near the Dan River. Other dikes in Pittsylvania County include one about 0.4 mile long south of the junction of State Roads 604 and 761, and another about 0.6 mile long east of State Road 854 on U. S. Highway 58.

En echelon faults are reflected in the outcrop of a dike on State Highway 40, 0.3 mile east of State Road 606. It is not known whether the intrusion or the faults occurred first, but it is possible that the intrusion followed an earlier fault and was later cut by the en echelon faults.

In Campbell County a dike nearly 2 miles long and about 0.1 mile wide is located between State Road 635 and Whipping Creek. Another dike of similar dimensions is found just west of the Triassic beds on Dry Mountain and in Whipping Creek. Other dikes in Campbell County include one about 0.8 mile long east of State Road 761 on State Road 637, another about 0.8 mile long southwest of the junction of State Roads 732 and 635, and a third about 1.2 miles long southwest of the junction of State Road 650 and U. S. Highway 501. Forty-eight smaller dikes of similar shape and composition are scattered throughout and adjacent to the Danville basin (Plate 1). Probably there are many others that are covered by soil.

Igneous rocks ranging from black, fine-grained diabase to gray coarse-grained gabbro form the igneous dikes in the Danville basin. Minerals present in the coarser grained rocks include laths of plagioclase, pyroxene, a few scattered grains of pyrite, magnetite, and some limonite (Table 10). Weathering reduces most of the dikes to boulders with concentric shells of progressively more disintegrated rocks from the inside to the outside. The coarser grained rocks retain their color and appearance, whereas the finer grained rocks generally weather to a porous rust-colored rock.

Table 10. Mineral composition of two thin sections of diabase from dikes* in Pittsylvania County, Virginia.

Mineral	Percent	Mineral	Percent
Plagioclase, An_{60-66}	48–60	Orthoclase	<1
Pigeonite	33–43	Iron Oxides	<1
Olivine	<1	Hornblende	<1
Apatite	<1	Clorite	<1
Quartz	<1	Clay Minerals	<1

*One dike is located near the junction of State Roads 602 and 761; and the other is located near the junction of State Roads 863 and 968.

Figure 15. Medium-grained diabase boulder split by weathering action along a joint plane, north of Renan inlier and State Road 761.

Figure 16. Post-Cedar Forest stream-channel deposit intruded and baked by a diabase dike found about 0.4 mile south of State Road 862 on State Road 863, Pittsylvania County.

Figure 15. Medium-grained diabase boulder split by weathering action along a joint plane, north of Renan inlier and State Road 761.

Figure 16. Post-Cedar Forest stream-channel deposit intruded and baked by a diabase dike found about 0.4 mile south of State Road 862 on State Road 863, Pittsylvania County.

METAMORPHISM OF WALL ROCKS

The dikes in many places in the Danville basin have altered the adjacent sedimentary rocks. This has been most commonly detected by the alteration of red shales, siltstones, and fine sandstones to a lavender-blue color. Roberts (1928, p. 64) reported that the width of the affected zone ranges "from a fraction of a foot up to 15 or 20 feet". He also noted an increase in brittleness in the shales and to a lesser degree in the coarser sediments. Reinemund (1955, p. 60) has noted that contact metamorphic effects have produced magnetite by oxidation of the iron oxides, recrystallization of quartz, and development of sericite and feldspar from kaolinite and other clay minerals. This writer identified finely disseminated magnetite in thin sections of the altered rocks (Table 11).

Good exposures of the intrusive dikes and the adjacent altered sediments are located on State Highway 40 about 1 mile east of State Road 603 and at the junction of State Roads 602 and 761 in Pittsylvania County, and about 0.2 mile south of State Road 639 on State Road 640 in Halifax County. A maroon siltstone that has been only partially altered is found in the roadcut on top of Whiteoak Mountain on U. S. Highway 29. There is a post-Cedar Forest (?) quartz-cobble stream deposit that has been intruded and altered by a diabase dike on State Road 863 about 0.3 mile south of State Road 862 (Figure 16).

Table 11. Mineral composition of a thin section of an "altered" lavender conglomerate.* (Compare with polymictic conglomerate of Table 6.)

Mineral	Percent	Mineral	Percent
Quartz	58	Magnetite	2
Clays, undifferentiated	25	Muscovite	<1
Plagioclase (An_{25})	10	Hematite	<1
Microcline (?)	5		

*Located 0.8 mile east of State Road 603 on State Highway 40.

AGE OF INTRUSIVES

The dikes are probably of Late Triassic or Early Jurassic age. This conclusion is based on the fact that all of the Triassic beds now found in the basin are cut by the dikes. In addition, the surficial stream deposits overlie the Triassic rocks at a few places in the basin. At least one deposit is intruded by a diabase dike. Evidence for a better age determination is lacking because there are no younger beds in the basin. Also, there is no evidence that any of the Cretaceous beds in eastern Virginia have been intruded by dikes.

Reinemund (1955, p. 61) believed that the dikes of the Deep River basin probably were formed in the final stages of faulting near the end of the Triassic, but that they may be a little younger than Triassic. This is because most of the intrusives in that basin follow earlier structures and are rarely offset by later faults.

POST-TRIASSIC SURFICIAL DEPOSITS

Unconsolidated silts, fine sands, and rounded quartz-cobble gravels are found above the Triassic beds at several places in the Danville basin. Similar deposits also are found outside the basin above the metamorphic pre-Triassic rocks.

These unconsolidated materials were deposited as stream-channel and valley fill in the uneven surface that had been formed on the Triassic and adjacent rocks by post-depositional erosion. Probably these deposits were originally more extensive than at present, but much of the material was stripped by later erosion so that only a few exposures are currently visible. Good exposures are found: 1) on State Road 863 about 9.4 miles south of State Road 862, 2) on State Highway 40 about 0.8 mile east of State Road 606, and 3) on the Virginian Railway west of Long Island Station. The first two are in Pittsylvania County, and the third is in Campbell County. The first exposure has a diabase dike intruding it, which suggests that these deposits were formed shortly after the end of Triassic sedimentation. A maximum thickness of 35 feet was observed at the second locality mentioned above. A thin exposure about 2 feet thick also is found above a weathered phyllite outcrop just south of State Road 832 on State Road 701 in Pittsylvania County.

While most of the cobbles and pebbles in the coarser fraction of these beds consist of quartz, there are a few small chips of shale and phyllite which evidently were derived from the underlying Triassic and metamorphic rocks. The matrix of the deposits is fine to coarse angular to subrounded quartz sand embedded in maroon to yellow clay and silt. Reinemund (1955) concluded that similar deposits in the Deep River basin may contain material ranging in age from Cretaceous to Pliocene.

PLEISTOCENE AND RECENT ALLUVIAL DEPOSITS

Unconsolidated silt, sand, and gravel deposits of Recent age are found along the Dan, Falling, and Staunton rivers. Smaller irregular deposits are also found along parts of the Banister and Sandy rivers and Georges, Trotters, Straightstone, Suck, and Whipping creeks. The latter also have bedrock exposed in much of their channels as do most of the smaller streams.

The areas of alluvium shown on Plate 1 include frequently flooded areas and low terraces that are adjacent to the flooded areas. In general, more alluvium is being removed by the Banister River and other "basin streams" than is being deposited. The major through-flowing rivers, such as the Dan and Staunton, appear to be depositing more than they are eroding in the areas of Triassic materials.

STRUCTURAL GEOLOGY

The Danville basin is a downfaulted wedge-shaped trough that trends N. 40° E. and ranges to greater than 6 miles in width, as shown on Plate 1 and Figures 1 and 2. Sediments in the basin dip from 20° to 72° W. and from 11° to 71° but most range between 30° and 50° W.

According to Brown (1954), the metamorphic rocks adjacent to and northwest of the Danville basin form the southeastward-dipping flank of the Sherwill anticline. There are many foliated gneisses on the west side of the basin which correspond to the Lynchburg gneiss (Brown, 1954) and which dip from 21° to 78° SE. These dips may possibly have been caused by arching of the rocks during Chatham fault movement, oblique faulting of the Dry Fork-Leakesville sediments, or possibly even earlier faulting than either of these.

Brown (1954) reports intrusive Precambrian or Lower Paleozoic granitic rocks along most of the east side of the basin. These intrusives also have a southeastward-dipping trend that probably is partly because of their conformity with the adjacent rocks and partly because of regional pressures similar to those that affected the metamorphic rocks.

An eastward-dipping normal fault, herein called the Chatham fault, borders the west side of the basin. Only a few parts of the eastern border of the sediments are marked by normal faults. The rest is represented by a sedimentary overlap. Both the east and west borders are cut by oblique faults that trend from N. 70° E. to N. 60° W. Similar border and oblique faults are reported in other Triassic basins in Virginia (Roberts 1928); in Pennsylvania (White, 1950, p. 1334-1336; and Lester and Allen, 1950); and in North Carolina (Reinemund, 1955, p. 82).

CHATHAM FAULT

The name Chatham fault is here proposed for the normal fault along the western border of the basin. The fault extends for the entire length of the basin and is believed to dip nearly 65° SE.

The border-fault surfaces are best exposed on State Road 633 about 1 mile west of State Road 761 in Campbell County, and on State Road 691, approximately 0.7 mile south of State Road 649. The fault zone is only a few feet wide at each of these places, and it is evident that most of the movement occurred along a single plane at each place. Probably the fault originally was discontinuous and the throw was different from place to place. Near Motley's Mill and Cascade Creek, it is evident that the Chatham fault is actually a series of "step" faults and that only parts of the basins so formed are now preserved. The west border of the basin is offset several miles at each of these places by the "steps" that probably formed because of differing resistance of the basement rocks to faulting.

Later, the oblique faults obscured the original fault plane(s) by offsetting its (their) original position(s). Some of the most conspicuous of these were noted near the junction of State Roads 603 and 761 and northeast of the junction of State Roads 856 and 622, both in Pittsylvania County. Slumpage of Triassic sediments over the fault plane during oblique faulting probably added to the sinuous nature of the fault as did later erosion.

Spasmodic movement along the fault is suggested by the recurrent, alternating beds of coarse arkosic gray and red sandstones of the Dry Fork formation. These beds suggest that fault movements probably occurred just prior to the deposition of the coarser grained beds. Other evidence is the more gentle dip of younger beds that abut against the older beds (Figure 17). Longwell (1937) has shown that a similar fault adjacent to the Connecticut valley was active during deposition.

The writer believes that the best explanation for the thickness and type of sediments present in the Dry Fork formation is spasmodic movement of different throw along a western border fault. Graded beds within the Leakesville and Dry Fork formations may possibly be the result of recurring movements along the border fault (Appendix, Geologic Sections 7, 9, 11, 12, 13, and 14).

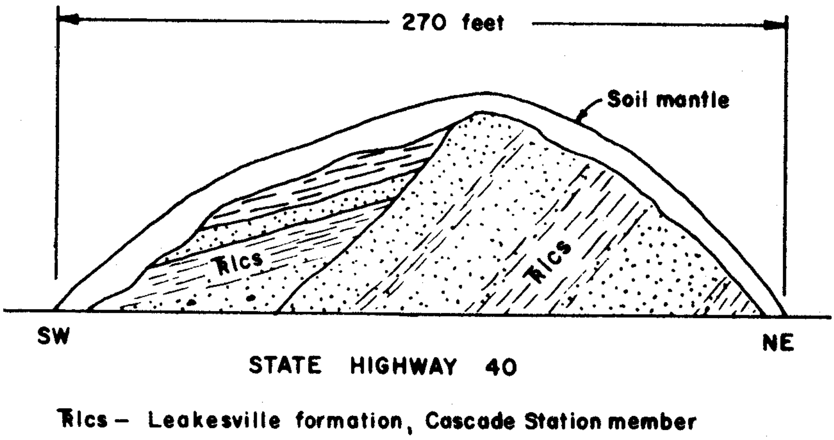


Figure 17. Diagrammatic view of younger beds abutting against steeper dipping older beds.

Present attitudes of all formations are steeper than the original angle of deposition, which was probably only a few degrees at most. The writer believes post-sedimentation tilting caused by rotation of the blocks on both sides of the Border fault, as well as the later oblique faulting, is responsible for the present attitude of the Triassic beds.

The average dip of the Leakesville and Dry Fork formations within 1 mile of the east side of the basin is 41° W., and the average dip of the Leakesville and Dry Fork formations within 1 mile of the west side of the basin is 36° W. The average increase in dip of 5° of the older (easterly) beds over the younger (westerly) beds is explained by renewed subsidence along the Chatham fault during Leakesville-Dry Fork sedimentation (Figure 17). Steep angular foresetting is believed to have occurred only at the alluvial fan deposits that include the poorly bedded graywackes. Better sorted sandstone and shales probably are products of deposition at very small angles.

A small area about 14 miles long in the southern part of the Danville basin has a few Leakesville beds west of the Dry Fork beds. The exposure of this area that extends from near Chatham south to U. S. Highway 58 is probably at least partially the result of border faulting followed by the erosion of the upper beds.

EASTERN BORDER FAULTS

Normal faults are present along part of the east border of the basin. The faults dip steeply westward, and none is believed to be more than a few miles in length.

Evidence for the presence of the faults includes opposing strike and dips of the metamorphic and Triassic rocks, the abrupt and straight contact of the Danville basin, and the presence of local coarse Triassic fanglomerates at the east border of the basin. A cobble conglomerate derived from a gneiss about 0.1 mile east occurs along State Road 863 just west of the intersection with State Road 744, Pittsylvania County, Virginia. The Southern Railway cut east of this junction contains the same gneiss in places.

A similar cobble conglomerate is found on the east side of the basin from U. S. Highway 58 northward to the Sandy River. It is composed of rock fragments from the quartz-feldspar gneiss east of the basin.

The occurrence of these cobble conglomerates along the east border of the basin suggests that these faults are limited in extent. The resemblance of the conglomerates to other Cedar Forest beds and the position of these beds above Dry Fork-Leakesville sediments is believed to indicate a time of formation about the same as that of the oblique faults. Further evidence for a post-Dry Fork-Leakesville time of eastern border faulting is the presence of a small outlier of maroon beds 0.5 mile east of the basin, and 0.3 mile north of Spring Garden on State Road 640 in Pittsylvania County.

OBLIQUE FAULTS

NORMAL FAULTS

These faults range in length from less than 0.1 mile to more than 1 mile and are the most prevalent in the basin; they cut both sides of the basin as well as beds within it. Prevailing strike of most of the dikes is about N. 50° W., but there are many exceptions. Net slip of the faults probably ranges from a few feet to thousands of feet. The downthrown side, where detectable, may be either north or south of the fault.

Good exposures of Triassic beds that abut against metamorphic rocks are found 0.5 mile north of Straightstone, near Hermosa, and also in the southwest corner of Pittsylvania County. These faults are evidently post-Dry Fork-Leakesville sedimentation in age since they all cut the Chatham fault.

The presence of normal faults allowed for uplift of the Renan fault block. Displacement must have amounted to several thousand feet here. The absence of quartz monzonite pebbles in the nearby Dry Fork beds is the strongest argument for a post-Dry Fork time of movement. The present fresh appearance of the quartz monzonite in the fault block contrasts sharply with the weathered appearance of the same rock in the cobbles and boulders of the Cedar Forest beds nearby. This evidence suggests that the quartz monzonite was weathered prior to any Triassic sedimentation. Other smaller and less significant normal faults are scattered throughout the basin (Plate 1). Cedar Forest sediments are found adjacent to some of the normal faults, especially in the central and northern part of the basin.

STRIKE-SLIP FAULTS

Only two localities appear to have strike-slip faults. One is near the junction of Shockoe Creek and Banister River where the southwest block of Dry Fork beds appears to have moved northwestward relative to the northeast block. Movement of the blocks could be mistaken for normal faulting if a third small block between the main blocks had not broken off and moved farther westward than the main southeast block (Plate 1). Several hundred feet of slip probably occurred here. The other locality is near State Road 835 on State Highway 41. Horizontal slickensides are present along an oblique fault developed in a coarse pebbly sandstone of the Dry Fork formation. No igneous intrusions were found along either of these faults.

EN ECHELON FAULTS

A series of individual faults that appear to be en echelon are present near State Highway 40 in the eastern part of the Danville basin. The trend is about N. 30° E. Some individual faults are shorter, than these, and strike almost due north.

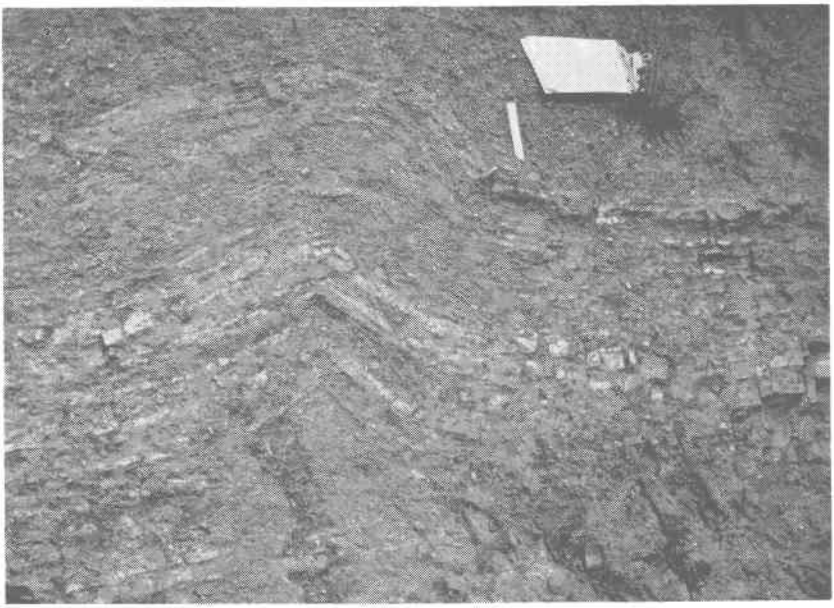
MINOR FOLDS

Minor folds are found in the thin-bedded sequences of alternating fine-grained sandstones and shales of the Dry Fork formation (Figure 18). These small flexures are erratic and discontinuous. The single sharp fold detected on State Road 835 passes rapidly into parallel beds both above and below the fold.

Figure 18. Minor fold in arkosic facies, Dry Fork formation, about 0.3 mile south of State Road 834 on State Road 835, Pittsylvania County.

GEOMORPHIC FEATURES

The Danville basin has some areas which are topographically lower than the adjacent rocks, some at the same level, and some that are higher. This is in contrast to the Deep River basin of North Carol na which Reinemund (1955) describes as a lowland about 50 to 200 feet lower than the adjacent Piedmont upland. Russell (1892, p. 86) also noted the exceptionally high topography of the Triassic beds of the Danville basin. The highest parts of the basin surface coincide with the conglomerates and sandstones of the Dry Fork formation. Most of these rocks are found on Whiteoak Mountain in the central area, or its extensions to the south on Soyar, Perkins, Judy Bird, and Boyd mountains. Average elevations of the tops of these mountains is 920 feet, which is greater than the average of 825 feet for the neighboring Piedmont. The Dry Fork beds are much harder than most other Triassic beds and this probably accounts for their higher togographic character. Other softer Triassic rocks underlie surface areas that are either at elevations equivalent to the Piedmont rocks or at lower levels.



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It is apparent that most stream gradients and drainage patterns are controlled by the character and attitude of the underlying rocks. Two major rivers, however, cut across the strike of the basin. The present position of the Dan and Staunton rivers south and north of the main Dry Fork outcrops, respectively, is an indication that these major streams avoided the harder Triassic rocks in the course of their development. It is possible that their direction of flow is the result of superposition from an overlying sedimentary cover, possibly of Cretaceous age.

The Banister River, in contrast to the larger Dan and Staunton rivers, flows southwestward until it meets the Dry Fork beds, then flows northeastward along a sinuous course adjacent to and then across the Dry Fork beds, and does not turn southwestward again until it enters the metamorphic rocks. Several other small streams cut the Dry Fork rocks but all flow relatively straight courses across these rocks, which suggests that they may follow fault traces.

Comparison of topographic and geologic maps of the area suggests that the softer Triassic shales and siltstones have more perfectly adjusted streams than either harder Triassic rocks or the adjacent metamorphic rocks. Reinemund (1955) states that the exposure of Triassic beds and establishment of a major drainage net had occurred by Pliocene time in the Deep River basin. It is obvious that the present drainage net is not that of Triassic time. Also, the better adjustment of streams in the Triassic areas as compared to that in the Piedmont areas suggests to this writer that erosion from an earlier surface occurred.

Pleistocene glacial stages with their concomitant lower sea levels also influenced the erosion of the Triassic beds. Soft beds in the Triassic sediments probably were eroded as fast as the through streams could entrench themselves in the adjacent Piedmont rocks. Thus far it has not been possible to distinguish between this type of erosion and that caused by regional upwarping of beds.

ORIGIN OF THE DANVILLE BASIN

In the Danville basin, tectonic movements associated with the Chatham fault initiated contemporaneous erosion and sedimentation. Short fault-scarp consequent streams carried weathered residuum from adjacent silicate-rock soils into the basin. This material formed only a small part of the total Triassic sediments, and was of minor importance to the total volume deposited.

Later, as local tectonic activity accelerated with a consequent rise in stream gradient and stream capacity, a major alluvial fan was formed near the present site of the graywacke facies of the Dry Fork formation. Fresh materials consisting of phyllite chips and muds mixed with fragments of granites, gneisses, and schists were deposited rapidly in the area near Renan and Mt. Airy in Pittsylvania County, Virginia. As the fan enlarged, more material was carried away from the fan to be deposited on alluvial plains and also as stream channel deposits. The longer transport of this material caused it to be better sorted and of more uniform composition. Arkosic sands form most of these coarser grained beds of the arkosic facies of the Dry Fork formation. Alternately deposited with these beds were red silt beds similar to the Cascade Station member red beds. Probably they were products of erosion and deposition during periods when the border fault was inactive and when only the residual soils of the adjacent rocks were being removed.

The spasmodic nature of the border fault movements caused two basically different types of material to be eroded from the same source areas. During and shortly after increased tectonism, the source materials of the arkosic facies were removed by undercutting streams. Later, quieter periods results in a removal of only the topmost soils. Sediment type depended on the degree of or place of tectonism, fluidity of the depositing medium, and the source area. The intermittent nature of the downfaulting of the basin resulted in a steeper dip for the lowermost, or eastern beds.

Farther away from the alluvial fan and plains, Dry Fork beds graded into finer materials and intertongued with the red and black beds of the Leakesville formation. Lacustrine conditions, probably formed by faulting, sedimentation, or landslides, existed at different times and places throughout the basin. Reducing conditions prevailed in the lakes and organic material was mixed and buried with the incoming finer sediments of the Cow Branch member of the Leakesville formation. Nearby mud flats were temporarily covered by water, but in general, oxidizing conditions predominated to form the red beds. Oscillatory ripple marks and rain drop impressions in the red colored Cascade Station member beds of the Leakesville formation indicate standing bodies of water and subaerial deposition.

Many factors, such as faulting, rainfall, degree of stream entrenchment in the source areas, and availablility of source materials governed whether red or black beds were deposited. These red and black beds were deposited above the Dry Fork formation also. Probably this reflects the slowing down or cessation of tectonic activity in the central area of the basin.

Spasmodic oblique faulting and some eastern border faulting followed the cessation of Dry Fork-Leakesville deposition. This resulted in the deposition of Cedar Forest boulders, gravels, and silts with a strike askew to the strikes of the earlier deposits. A large block of quartz monzonite called the Renan fault block also was uplifted in the middle of the basin about this time. Detrital material from the fault block was not found in the Dry Fork formation, yet it was found as large fanglomerate deposits in the younger Cedar Forest beds. The absence of any other boulder beds in the Dry Fork beds and the sharp contact of the Dry Fork beds and the quartz monzonite also suggested to this writer that this was a fault block and not an erosional remnant. After, or at least during, the later stages of this activity, diabase and gabbro magmas forced their way through the Triassic rocks along planes of weakness such as joints and some fault traces. Oblique faults were favorable sites for intrusions, but the border fault must have been sealed by these faults for no intrusions are present along it.

The time of formation of the magmas is at least post-oblique faulting since all the Triassic rock types, and in one place a post-Cedar Forest surficial sediment, are intruded. Several stream-channel deposits with a basal layer of quartz cobbles and upper maroon silts were emplaced above the Cedar Forest beds. One of these deposits was intruded and altered by the magma of a dark-gray diabase dike (Figure 16).

ECONOMIC MINERAL DEPOSITS

RAW MATERIALS FOR BRICK AND CERAMIC WARE

Abundant deposits of material suitable for brick and ceramic ware manufacture are present in the Cow Branch and Cascade Station members of the Leakesville formation. Most of the deposits can be excavated with a power shovel and transported by truck to a brick plant.

Selective extraction of beds of different clay, silt, or sand content is essential for proper blending, although this is not a major problem. The only obvious deleterious material present is an occasional bed of highly carbonaceous shale. Bricks made of this material are weak and crumbly. The Roanoke Webster plant near Draper, North Carolina, is using weathered shale from both members of the Leakesville formation. To gain information about the quality of the shales, 15 samples selected throughout the Danville basin were collected to make tests of their plastic, drying, and firing properties. Samples sites are indicated on Figure 3 and located by number on the geologic map (Plate 1). Test data are included in Tables 12 and 13.

Table 12. Plastic and dry properties of Triassic shales

Sample number	1	2	3	4	5	6	7
Plasticity and workability	good	fair	very good	poor	fair	very good	very good
Water of plasticity (%)	24.8	25.8	28.1	23.6	33.0	22.5	25.1
Shrinkage water (%)	8.4	7.4	9.1	3.6	7.6	6.2	6.9
Pore water (%)	16.4	18.4	19.0	20.0	25.4	16.3	18.2
Plastic bulk density (gms/cc)	1.96	1.99	1.94	2.00	1.92	2.04	1.94
Volume shrinkage dry (%)	15.2	13.3	16.1	6.1	12.4	11.6	12.0
Linear shrinkage dry (%)	4.8	4.2	5.1	2.0	4.0	3.7	3.8
Dry bulk density (gms/cc)	1.81	1.80	1.76	1.72	1.62	1.85	1.74
Transverse strength dry (psi)	345	275	470	235	180	415	450

NOTE: Determinations by the V. P. I. Department of Ceramic Engineering, Blacksburg, Virginia

Localities:

Sample 1—Yellow shale, Cow Branch member, 2.2 miles west of State Highway 40 on State Road 606, Pittsylvania County, Virginia.

Sample 2—Maroon shale, Cascade Station member, 0.4 mile north of State Road 863 on State Road 862, Pittsylvania County, Virginia.

Sample 3—Yellow shale, Cow Branch member, 0.2 mile north of Virginia state line on State Road 856, Pittsylvania County, Virginia.

Sample 4—Yellow shale, Cow Branch member, 1.4 miles east of State Road 651 on State Road 652, Campbell County, Virginia.

Sample 5—Maroon siltstone, Cedar Forest formation, on State Road 633 near western edge of Triassic basin, Campbell County, Virginia.

Sample 6—Maroon shale, Cascade Station member, 1.9 miles east of State Road 640 on State Road 677, Pittsylvania County, Virginia.

Sample 7—Yellow shale, Cow Branch member, 0.4 mile south of State Road 621 on State Road 860, Pittsylvania County, Virginia.

Table 12. Plastic and dry properties of Triassic shales (continued)

Sample number	8	9	10	11	12	13	14
Plasticity and workability	good	very good	good	excellent	fair to poor	very good	very good
Water of plasticity (%)	26.3	29.5	23.7	28.9	27.3	36.8	27.6
Shrinkage water (%)	7.3	10.4	7.3	8.8	8.6	14.0	5.8
Pore water (%)	19.0	19.1	16.4	20.1	18.7	22.8	21.8
Plastic bulk density (gms/cc)	1.92	1.88	1.97	1.94	1.89	1.82	1.92
Volume shrinkage dry (%)	12.5	17.8	13.1	15.2	14.7	22.9	9.6
Linear shrinkage dry (%)	4.0	5.6	4.2	4.8	4.7	7.1	3.1
Dry bulk density (gms/cc)	1.72	1.72	1.80	1.74	1.70	1.63	1.64
Transverse strength dry (psi)	610	475	335	700	225	550	240

Localities:

Sample 8—Yellow shale, Cow Branch member, 0.4 mile south of State Road 627 on State Road 683, Pittsylvania County, Virginia.

Sample 9—Yellow shale, Cow Branch member, 0.5 mile east of State Road 649 on State Road 832, Pittsylvania County, Virginia.

Sample 10—Maroon shale, Cascade Station member, 0.7 mile south of State Road 639 on State Road 640, Halifax County, Virginia.

Sample 11—Maroon shale, Cascade Station member, 0.4 mile east of State Road 690 on State Road 691, Pittsylvania County, Virginia.

Sample 12—Maroon clay, Cascade Station member, west of Trotters Creek on State Road 621, Pittsylvania County, Virginia.

Sample 13—Yellow shale, Cow Branch member, 2.75 miles east of State Road 1005 on State Road 686, Pittsylvania County, Virginia.

Sample 14—Maroon shale, Cascade Station member, 0.7 mile east of State Road 680 on State Road 651, Campbell County.

Table 13. Fired properties of shales (See Table 12).

Temperature (°Fahr)	Loss on Ignition (%)	Fired Bulk Density (gms/cc)	Fired Volume Shrinkage (%)	Fired Linear Shrinkage (%)	Total Linear Shrinkage (%)	Absorption (%)	Fired Transverse Strength (p. s. i.)	Hardness	Color
Sample 1									
1800.......	6.1	1.70	0	0	4.8	20.1	505	SS	S
1900.......	6.3	1.75	3.1	1.0	5.8	18.5	875	SS	LR
2000.......	6.4	1.86	9.0	3.1	7.9	14.4	1325	SH	R
2100.......	6.4	1.94	12.8	4.5	9.3	12.5	1445	HS	DR
Sample 2									
1800.......	6.7	1.73	3.4	1.1	5.3	20.2	530	SS	S
1900.......	7.0	1.84	9.4	3.2	7.4	16.6	975	SH	LR
2000.......	7.1	2.00	16.4	5.8	10.0	11.2	1515	SH	R
2100.......	7.1	2.14	21.6	7.8	12.0	7.6	2125	HS	DR
Sample 3									
1800.......	6.6	1.70	3.0	1.0	6.1	21.4	1020	SS	S
1900.......	6.6	1.82	9.4	3.2	8.3	17.8	1940	SH	R
2000.......	6.8	2.02	18.6	6.6	11.7	11.4	2970	HS	R
2100.......	6.8	2.16	24.1	8.8	13.9	6.4	3700	HS	DR
Sample 4									
1800.......	4.6	1.65	0.6	0.2	2.2	22.0	655	SS	S
1900.......	4.6	1.72	4.4	1.5	3.5	19.1	895	SH	LR
2000.......	4.8	2.00	18.4	6.6	8.6	10.3	1710	HS	R
2100.......	4.8	2.40	31.5	11.8	13.8	1.0	4185	HS	DR
Sample 5									
1800.......	8.1	1.70	12.2	4.2	8.2	22.2	1875	SH	R
1900.......	8.3	1.94	23.5	8.5	12.5	14.2	2690	HS	R
2000.......	8.8	2.30	35.8	13.7	17.7	3.4	2880	HS	DR
Sample 6									
1800.......	4.0	1.75	+1.1	+0.4	3.3	19.0	420	SS	S
1900.......	4.3	1.78	0.9	0.3	4.0	17.6	670	SS	LR
2000.......	4.4	1.86	5.0	1.7	5.4	14.6	1000	SH	R
2100.......	4.4	1.91	7.2	2.5	6.2	12.2	1050	SH	DR
Sample 7.....									
1800.......	5.6	1.67	1.9	0.6	4.4	21.1	715	SS	S
1900.......	5.8	1.78	8.5	2.9	6.7	16.8	1350	SH	LR
2000.......	6.0	2.08	22.0	7.9	11.7	8.5	1460	HS	DR
2100.......	6.0	2.12	23.0	8.3	12.1	3.0	2570	HS	DR
Sample 8									
1800.......	6.4	1.72	6.9	2.4	6.4	19.0	1340	SH	LR
1900.......	6.6	1.91	17.1	6.1	10.1	11.6	2895	HS	R
2000.......	7.0	2.18	27.6	10.2	14.2	2.2	3965	HS	DR
2100.......	......	......	......	......	......	......	......	......	......
Sample 9									
1800.......	6.4	1.76	8.2	2.8	8.4	19.4	955	SH	LR
1900.......	6.4	2.02	20.8	7.5	13.1	10.6	2615	HS	R
2000.......	6.7	2.40	31.8	12.0	17.6	0.6	2825	HS	DR
2100.......									

NOTE: Abbreviations under Hardness Column mean: SS (softer than steel); SH (steel hard); and HS (harder than steel).
Abbreviations under Color mean: S (salmon); LR (light red); R (red); DR (dark red). Determinations by the V. P. I. Department of Ceramic Engineering, Blacksburg, Virginia.

Table 13. Fired properties of shales (See Table 12). (con't)

Temperature (°Fahr)	Loss on Ignition (%)	Fired Bulk Density (gms/cc)	Fired Volume Shrinkage (%)	Fired Linear Shrinkage (%)	Total Linear Shrinkage (%)	Absorption (%)	Fired Transverse Strength (p. s. i.)	Hardness	Color
Sample 10									
1800.......	5.0	1.72	0.8	0.3	4.5	18.4	655	SS	S
1900.......	5.1	1.77	3.0	1.0	5.2	16.6	1140	SH	LR
2000.......	5.3	1.88	9.0	3.1	7.3	13.0	2090	HS	LR
2100.......	5.3	2.02	15.5	5.5	9.7	8.9	3395	HS	R
Sample 11									
1800.......	7.7	1.87	14.1	4.9	9.7	15.9	2315	SH	R
1900.......	8.1	2.14	25.1	9.2	14.0	8.0	3205	HS	R
2000.......	8.2	2.39	32.8	12.4	17.2	2.3	3500	HS	DR
2100.......	......	......	......	......	......	......	......	......	......
Sample 12									
1800.......	7.6	1.60	1.6	0.5	5.2	24.5	285	SS	S
1900.......	7.6	1.63	2.8	0.9	5.6	23.4	310	SS	S
2000.......	7.7	1.71	7.5	2.6	7.3	20.1	340	SS	S
2100.......	7.7	1.80	11.7	4.1	8.8	16.8	655	SH	R
Sample 13									
1800.......	10.2	1.64	10.8	3.7	10.8	24.0	425	SH	LR
1900.......	10.5	1.88	22.4	8.1	15.2	15.2	1880	HS	LR
2000.......	11.0	2.21	34.5	13.2	20.3	5.7	2500	HS	R
2100.......	......	......	......	......	......	......	......	......	......
Sample 14									
1800.......	6.0	1.59	2.6	0.9	4.0	23.8	850	SH	LR
1900.......	6.0	1.73	10.1	3.5	6.6	18.5	1525	SH	LR
2000.......	6.2	2.08	25.5	9.3	12.4	7.8	2890	HS	R
2100.......	6.2	2.40	34.8	13.3	16.3	1.4	3545	HS	DR

Six samples, numbers 1, 2, 3, 7, 11, and 14, are satisfactory for the manufacture of building brick and structural wares such as hollow tile, quarry tile, and sewer tile. Six samples, numbers 4, 5, 6, 8, 9, and 10 have firing properties that make them satisfactory for use as building brick only. Two samples, numbers 12 and 13, have poor firing properties and are unsatisfactory for structural wares. Sample 15, a maroon shale from a Cascade Station member of the Leakesville formation, was collected 0.45 mile west of State Road 635 on State Road 637, Campbell County, Virginia. This sample was practically devoid of plasticity after preparation, and repeated attempts to extrude satisfactory test materials met with failure.

LIGHTWEIGHT AGGREGATE

Lightweight aggregate is a strong, cellular product made by heating fragments of shale or clay in a kiln or other device until bloating has occurred. Deposits of material similar to that used in the Solite plant at Leakesville Junction also are found in the northern and central areas of Leakesville formation outcrop. Prospecting for this type of material should include the Leakesville formation because of its generally low sand content.

STONE

Dry Fork sandstones and conglomerates form the most suitable deposits of material for crushed stone. Quartz monzonite in the Renan fault block also affords material for this purpose, although it is found only in a small area. Probably one of the best sites available is in the vicinity of the Mt. Airy quarry. Other good locations for very thick and extensive beds of hard rock are in the Whiteoak Mountain area near U. S. Highway 29, and on Boyd, Judy Bird, Perkins and Soyar mountains.

The Renan fault block contains unweathered quartz monzonite that should be suitable for use as a dimension stone. It will take a polish and be very resistant to weathering. The mixture of pink and gray feldspar provides a pleasing appearance.

APPENDIX

Geologic Section 1. Type section of the Leakesville formation on State Road 856, 0.25 mile south of State Road 622, Pittsylvania County, Virginia

	Thickness Feet
Leakesville formation (1179 feet)	
Cascade Station member (522 feet)	
63. Shale, maroon, crumbly to hard	38
62. Covered	33
61. Shale, gray-green, silty	21
60. Shale, maroon, and siltstone, and covered	34
59. Siltstone, gray, hard	1
58. Siltstone, maroon, hard	6
57. Covered	21
56. Siltstone, dark gray	7
55. Shale, and siltstone, maroon	108
54. Shale, gray-green, silty	7
53. Covered	15
52. Shale, maroon to orange, silty, micaceous, calcareous	113
51. Covered	40
50. Shale, maroon, soft to hard, silty	90
49. Siltstone, dark-gray	1
48. Siltstone, maroon, hard to soft	17
Cow Branch member (328 feet)	
47. Shale, yellow-green, silty	2
46. Claystone, yellow-green, micaceous	36
45. Covered	7
44. Claystone, gray, silty	8
43. Shale, gray, green micaceous	1
42. Covered	4
41. Shale, gray-green, micaceous	10
40. Sandstone, gray-brown, fine-grained	3
39. Claystone, gray-green	4
38. Sandstone, gray-brown, medium-grained, arkosic, calcareous	5
37. Shale, gray-green, micaceous, silty, weathers yellow	57
36. Covered	17
35. Shale, gray-green, hard silty	1
34. Covered	8
33. Shale, maroon, hard, calcareous	1
32. Shale, gray-green, silty	13
31. Shale, maroon, hard, silty	1
30. Covered	7
29. Shale, maroon-black, gray-green, hard, calcareous, silty	31
28. Shale, gray-green, weathers yellow	25
27. Covered	8
26. Shale, gray-green, maroon, silty, calcareous	24
25. Covered	6
24. Shale, gray-green, to maroon, silty	5
23. Covered	4
22. Shale, gray-green to maroon, silty, weathers yellow	12
21. Covered	5
20. Shale, gray-green to maroon, silty	23
Cascade Station member (84 feet)	
19. Shale, red	4
18. Covered	15
17. Shale, maroon, crumbly, silty	25

	Thickness Feet
16. Shale, gray-green, silty	3
15. Shale, maroon, crumbly, silty	16
14. Shale, yellow, weathered	4
13. Shale, red, soft to hard, silty	17
Cow Branch member (217 feet)	
12. Siltstone, gray to yellow, shaly	4
11. Shale, red, silty, soft to hard	5
10. Shale, gray-green, hard, silty	25
9. Claystone, gray	1
8. Shale, red, silty	8
7. Shale, yellow-gray, weathered, silty	17
6. Clay, gray	1
5. Shale, gray-green to maroon, silty	21
4. Sandstone, gray-brown, medium-grained, crumbly	2
3. Shale, gray, silty	20
2. Shale, maroon, silty	5
1. Shale, gray-black, hard, silty, pyritiferous, calcareous, weathers yellow	108

Geologic Section 2. Leakesville formation on State Road 640, 0.4 mile south of State Road 633, Hailfax County, Virginia.

	Thickness Feet
Leakesville formation	
Cascade member (1045 feet)	
13. Shale, maroon	82
12. Sandstone, gray-brown, fine-grained, hard	2
11. Shale, maroon, soft	221
10. Shale, chocolate-brown, soft, arkosic	42
9. Shale, red, soft, clayey	314
8. Siltstone, red, very hard	34
7. Covered	96
6. Shale, maroon, soft	18
5. Conglomerate, red, coarse, mostly quartz pebbles, with red siltstone matrix	3
4. Siltstone, maroon, with arkosic pebbles scattered throughout	140
3. Siltstone, gray, medium hard, metamorphosed by dike	33
2. Covered—probably a diabasic dike as inferred from a few scattered surface boulders	24
1. Siltstone, lavender, arkosic, metamorphosed by dike	36

Geologic Section 3. Leakesville formation on State Road 683, 1 mile north of State Road 938. Pittsylvania County, Virginia.

	Thickness Feet
Leakesville formation	
Cascade Station member (91 feet)	
5. Siltstone, maroon to gray and brown, with fine-grained, hard sandstone layers about 6 inches thick	13
4. Sandstone, gray, fine-grained, thick-bedded, very hard with oscillatory ripple marks, up to 0.5 inch in amplitude, and up to 3 inches in length (Strike N. 80° E.)	4
3. Siltstone, maroon, with sandstone, fine-grained, and in graded beds about 4 inches thick	13
2. Sandstone, maroon, fine-grained, massive, hard, calcareous	33
1. Siltstone, maroon and gray, masive, with raindrop and animal-trail impressions, in beds about 6 feet thick	28

Geologic Section 4. Leakesville formation, on State Highway 40, 0.2 mile east of State Road 606, Pittsylvania County, Virginia.

	Thickness Feet
Leakesville formation	
Cascade Station member (608 feet)	
23. Siltstone, red, sandy, with thin layers of 3-inch pebbles of lavender schist and quartz	118
22. Conglomerate, maroon, sandy, clayey, with a few 6-inch quartz pebbles	8
21. Conglomerate, maroon, sandy, hard, with 1-inch quartz pebbles	42
20. Siltstone, maroon, sandy	3
19. Diabase dike, medium-grained	1
18. Shale, red, with quartz pebble lenses	21
17. Covered	125
16. Sandstone, brown, medium-grained, soft	10
15. Siltstone, maroon, medium-hard	4
14. Sandstone, brown, medium-grained, soft, clayey	7
13. Siltstone, maroon, with gray clay lenses	22
12. Siltstone, maroon, alternating with gray, sandy, conglomerate	92
11. Conglomerate, gray, soft, sandy	5
10. Siltstone, maroon	4
9. Conglomerate, gray, soft, sandy	3
8. Siltstone, maroon, sandy	33
7. Conglomerate, gray-brown, soft, clayey, sandy	9
6. Siltstone, brick-red	18
5. Conglomerate, soft, gray, with blue quartz, and weathered feldspar	2
4. Siltstone, maroon	7
3. Siltstone, maroon, with thin conglomerate streaks, soft, light gray, sandy, clayey	9
2. Sandstone, orange-brown, medium-grained, clayey, with thin maroon and gray shale stringers	21
1. Siltstone, maroon, soft, with soft brown, feldspathic, clayey sandstone stringers	44

Geologic Section 5. Leakesville formation, east of bridge over Stinking River on State Highway 40, Pittsylvania County, Virginia.

	Thickness Feet
Leakesville formation	
23. Covered	217
22. Conglomerate, maroon, sandy, arkosic, soft to hard	120
21. Claystone, yellow, soft	10
20. Shale, alternating maroon, yellow, and brown, sandy (thickness approximate because of minor faults)	196
19. Covered	167
18. Sandstone, buff to yellow, conglomeratic, arkosic, hard	32
17. Conglomerate, gray, clayey, arkosic	37
16. Covered	483
15. Shale, maroon to gray	85
14. Covered	14
13. Shale, maroon, red, brown, sandy	137
12. Covered, dip of beds changes from east to west in this interval probably causing some repetition of beds	237
11. Shale, red	30
10. Shale, maroon, yellow, brown, sandy, and with lenses of gray and brown medium-grained sandstones	89
9. Shale, maroon, red, and yellow	82
8. Siltstone, gray-green	10
7. Shale, maroon, sandy	181

	Thickness Feet
6. Conglomerate, gray, arkosic, hard	4
5. Covered interval, about half a mile along the road	
4. Shale, maroon, ripple-marked, cross-bedded, and with rain-drop impressions	16
3. Shale, yellow	28
2. Siltstone, maroon, sandy	12
1. Sandstone, maroon, silty, with some current ripple marks and minor cross-bedding	186

Geologic Section 6. Leakesville formation, Cascade Station member, eastward from about 0.2 mile east of State Road 603 on Road 668, Pittsylvania County, Virginia.

	Thickness Feet
Leakesville formation	
Cascade Station member (649 feet)	
12. Shale, yellow to maroon	70
11. Covered	83
10. Mudstone, yellow to gray, silty	121
9. Covered	39
8. Sandstone, yellow to tan, arkosic, weathered with yellow clay	31
7. Shale, maroon, yellow, gray, micaceous	39
6. Shale, yellow to brown, contorted so that thickness is only an approximation	57
5. Sandstone, medium-grained, gray to brown, arkosic, hard, grading down to sandstone microbreccia of quartz and feldspar	18
4. Claystone, red and black, with quartz pebbles	113
3. Covered	15
2. Claystone, yellow and black	63
1. Lavender mica schist	

Geologic Section 7. Type section of the Dry Fork formation in cuts westward along Southern Railway on Whiteoak Mountain starting 0.5 mile south of Dry Fork, Pittsylvania County, Virginia.

	Thickness Feet
Dry Fork formation, arkosic facies (1593 feet)	
53. Sandstone, white to tan, fine- to coarse-grained, pebbly, arkosic, with limonite speckles	111
52. Siltstone, maroon	2
51. Sandstone, brown to white, fine-grained, hard	3
50. Siltstone, maroon	6
49. Conglomerate, white, sandy, arkosic, hard	11
48. Siltstone, maroon	17
47. Conglomerate, gray to yellow, sandy, arkosic, soft, thick-bedded	91
46. Siltstone, maroon	6
45. Sandstone, yellow, fine-grained	4
44. Siltstone, red	6
43. Sandstone, tan to white, fine-grained, pebbly, arkosic	19
42. Sandstone, maroon to gray, coarse-grained, silty, thick-bedded	66
41. Sandstone, tan, medium-grained, limonite speckled, thick-bedded	88
40. Siltstone, maroon, clayey	5
39. Sandstone, tan to yellow, hard, speckled with limonite, thick-bedded	73
38. Siltstone, maroon	8
37. Sandstone, yellow, medium- to coarse-grained, hard	10
36. Claystone, maroon to yellow, soft	9

		Thickness Feet
35.	Sandstone, brown, fine-grained	13
34.	Sandstone, tan to white, fine-grained, speckled with limonite	58
33.	Sandsone, maroon, fine-grained	13
32.	Sandstone, gray to tan, fine- to medium-grained, pebbly	42
31.	Siltstone, very hard, thermally metamorphosed	8
30.	Sandstone, tan to white, fine- to coarse-grained, pebbly	9
29.	Siltstone, maroon, hard	30
28.	Conglomerate, gray to tan, arkosic, sedimentary, hard	6
27.	Diabase dike, fine-grained, hard	41
26.	Sandstone, gray to tan, medium- to coarse-grained	55
25.	Sandstone, maroon, fine- tc medium-grained	10
24.	Sandstone, gray, fine- to coarse-grained, pebbly, arkosic	15
23.	Siltstone, maroon to gray, soft to hard	42
22.	Sandstone, gray, fine-grained, arkosic, hard	18
21.	Siltstone, maroon, hard	4
20.	Sandstone, white to tan, coarse-grained, arkosic, pebbly	5
19.	Sandstone, red, fine-grained, silty near top	17
18.	Sandstone, white to tan, fine-grained, with limonite specks	22
17.	Siltstone, maroon, sandy, hard, massive	33
16.	Sandstone, gray to tan, fine- to coarse-grained, sparingly pebbly, thick-bedded, arkosic, massive	173
15.	Sandstone, tan to gray and lavender, coarse-grained, with limonite specks, possibly metamorphosed by a dike	10
14.	Sandstone, tan to gray, medium-grained, quartzose, massive, speckled with limonite	116
13.	Covered, about 0.5 mile	
12.	Conglomerate, tan, soft, sandy with pebble streaks, thick-bedded	147
11.	Covered	8
10.	Sandstone, gray to tan, medium- to coarse-grained, hard, arkosic, pebbly	40
9.	Siltstone, gray-green, sandy grades up to yellow-white, medium-grained, sandstone	27
8.	Sandstone, maroon, medium-grained, thin-bedded	2
7.	Conglomerate, gray, maroon, and gray-green, arkosic, sandy, thick-bedded, with red siltstone stringers	52
6.	Siltstone, red	5
5.	Siltstone, tan, sandy	1
4.	Siltstone, red to gray, clayey	3
3.	Conglomerate, white to tan, arkosic, sandy with limonite specks, soft at top and hard near base with beds of gray-green sandy siltstone near base	36
2.	Siltstone, maroon to gray, with claystone	5
1.	Conglomerate, yellow to brown, arkosic, sandy	20

Geologic Section 8. Geologic section of the graywacke facies of the Dry Fork formation, Mt. Airy quarry, Pittsylvania County, Virginia.

		Thickness Feet
Dry Fork formation, graywacke facies (95 feet)		
4.	Graywacke sandstone, dark gray-green, fine- to medium-grained, pebbly, hard, weathers brown	8
3.	Shale, yellow-orange, sandy, weathered	17
2.	Graywacke sandstone, brown to dark gray, feldspathic with graded-bedding and cross-bedding	14
1.	Graywacke sandstone, lithic, dark gray-green, medium- to coarse-grained, with quartz, feldspar, and rock fragments in a hard, slightly calcareous, chlorite matrix	56

Geologic Section 9. Dry Fork formation on State Road 878 from State Road 873, to U. S. Highway 51, Pittsylvania County, Virginia.

		Thickness Feet
Dry Fork formation, arkosic facies (6522 feet)		
199.	Covered	200
198.	Sandstone, brown, pebbly, hard, calcareous	2
197.	Clay, yellow to red, silty	13
196.	Sandstone, yellow-brown, arkosic, pebbly, clayey	6
195.	Covered	40
194.	Sandstone, yellow to brown, fine- to coarse-grained, pebbly, arkosic	68
193.	Covered	31
192.	Sandstone, gray-white, quartzose, clayey, pebbly, hard, weathers brown	43
191.	Clay, yellow-gray	11
190.	Conglomerate, gray, pebbly, quartzose, with green clay matrix	25
189.	Covered	65
188.	Sandstone, yellow-gray, clayey, fine- to medium-grained	56
187.	Diabase, dark gray, weathered brown on surface	6
186.	Clay, yellow, soft	2
185.	Conglomerate, gray, pebbly, fine-grained, arkosic, hard	17
184.	Siltstone, maroon, clayey	9
183.	Covered, probably a fault	66
182.	Clay, red, sandy, pebbly, mottled at top	38
181.	Covered, with a few patches of claystone and brown, fine-grained, sandstone	69
180.	Sandstone, yellow to brown, fine- to coarse-grained, arkosic	14
179.	Claystone, yellow-red, with medium-grained sandy lenses, pebbly	25
178.	Sandstone, yellow-brown to gray, fine- to coarse-grained, with red clay partings, pebbly	6
177.	Clay, red, silty, with pink and yellow fine-grained sandstone lenses	58
176.	Sandstone, yellow to red, fine- to coarse-grained, pebbly, hard	136
175.	Siltstone, yellow to gray-green, clayey	47
174.	Sandstone, yellow to brown, fine-grained, clayey, quartzose	45
173.	Clay, yellow, weathered	21
172.	Clay, gray-green to brown, calcareous	24
171.	Clay, gray, mottled	8
170.	Sandstone, gray to brown, clayey to pebbly, arkosic	123
169.	Clay, red to gray, sandy, with quartz vein stringers	11
168.	Conglomerate, gray to brown, pebbly, quartzitic	27
167.	Siltstone, yellow-gray, soft	10
166.	Sandstone, yellow-brown, medium-grained, pebbly, arkosic, hard	43
165.	Covered, over stream, with hard, gray, pebbly sandstone exposed in the channel	59
164.	Sandstone, brown to white, coarse-grained, pebbly, arkosic, weathered	52
163.	Siltstone, yellow-green, soft	10
162.	Sandstone, yellow, coarse-grained, arkosic	3
161.	Siltstone, yellow-green, alternating hard to soft, with brown, pebbly sandstone stringers	60
160.	Siltstone, red to yellow, with brown, coarse-grained sandstone stringers	29
159.	Covered, with minor exposures of sandstone as above	12
158.	Sandstone, yellow-green, fine- to coarse-grained, pebbly, arkosic	19
157.	Clay, red	5
156.	Sandstone, green-brown, fine-grained	12
155.	Covered	60
154.	Sandstone, yellow-green to red, fine- to coarse-grained, pebbly	3
153.	Clay, red to yellow, alternating with yellow to brown pebbly sandstone, fine-grained, arkosic, hard	39
152.	Covered	8
151.	Sandstone, yellow, pebbly, arkosic, alternating with maroon siltstone and fine-grained sandstone	12
150.	Covered, with small exposures of hard, maroon siltstone	19
149.	Clay, yellow to red, sandy, pebbly	43

		Thickness Feet
148.	Siltstone, yellow-gray, sandy, arkosic, with gray to brown clay	24
147.	Sandstone, gray-white to yellow, fine- to coarse-grained, micaceous to arkosic, with small lenses of maroon siltstone	17
146.	Siltstone, maroon, sandy	6
145.	Covered	12
144.	Siltstone, maroon, clayey to sandy	15
143.	Sandstone, gray-green to yellow, fine- to coarse-grained, arkosic	10
142.	Siltstone, maroon, with slickensides	39
141.	Sandstone, yellow-green, fine- to coarse-grained, arkosic	18
140.	Siltstone, maroon, clayey	4
139.	Siltstone, gray to yellow, grades up to a gray-brown, coarse-grained, arkosic sandstone	12
138.	Siltstone, maroon, grades up into a brick-red clayey sandstone	7
137.	Sandstone, gray-green, fine- to coarse-grained, arkosic	2
136.	Claystone, red to gray-green, alternating with gray to brown, coarse-grained, arkosic sandstone, in layers from 1 to 5 feet thick	21
135.	Sandstone, gray-brown to yellow-white, fine- to coarse-grained, pebbly, arkosic micaceous with gray to maroon claystones	58
134.	Clay, maroon, silty, with feldspar fragments and thin lenses of gray-green, coarse-grained, pebbly sandstone	72
133.	Sandstone, gray-green to brown, fine- to medium-grained, arkosic with lenses of yellow clayey siltstone	14
132.	Clay, maroon to brown, silty	25
131.	Sandstone, yellow-brown, clayey	3
130.	Clay, brown, silty, with thin, tan, fine-grained, hard sandstone stringers	130
129.	Sandstone, yellow-green, fine-grained to pebbly, soft, arkosic	32
128.	Clay, brown, grades up into siltstone, maroon	16
127.	Sandstone, yellow, fine-grained, weathered	8
126.	Siltstone, maroon, soft, with pebbly, gray-green to maroon sandstone lenses	121
125.	Clay, yellow, silty	18
124.	Sandstone, yellow, coarse-grained, with arkosic pebbles	41
123.	Siltstone, maroon to yellow, with quartz pebbles near top	30
122.	Sandstone, brown, coarse-grained pebbly, arkosic	8
121.	Siltstone, maroon, with hard sandstone lenses up to 4 feet thick	125
120.	Covered	19
119.	Siltstone, maroon	29
118.	Conglomerate, maroon, coarse-grained, arkosic pebbly	6
117.	Siltstone, maroon, with quartz stringers	29
116.	Covered	289
115.	Conglomerate, brown, hard, arkosic	3
114.	Clay, red	5
113.	Conglomerate, brown, hard, arkosic	8
112.	Siltstone, maroon, soft to hard	33
111.	Sandstone, gray-green to yellow, fine-grained, arkosic, soft	48
110.	Clay, gray to maroon, grades up to sandstone	3
109.	Covered	392
108.	Shale, maroon, soft to hard	16
107.	Sandstone, white-brown, pebbly, arkosic	1
106.	Covered	32
105.	Sandstone, yellow, pebbly, arkosic	20
104.	Siltstone, maroon, with quartz pebbles, near top	25
103.	Covered	84
102.	Sandstone, white-brown, coarse-grained, pebbly to clayey, arkosic, with red clay	50
101.	Siltstone, maroon, soft, with arkosic pebbles	14
100.	Claystone, brown, with arkosic pebbles	29
99.	Sandstone, yellow-white, pebbly	4
98.	Siltstone, maroon	13
97.	Sandstone, yellow-white to brown, fine-grained, soft to hard	12
96.	Shale, yellow, gray, to maroon, soft weathered, with fine-grained sandstone lenses near base	64

	Thickness Feet
95. Sandstone, maroon	3
94. Sandstone, yellow, fine-grained, with clay stringers	19
93. Siltstone, maroon, soft to hard, with quartz pebbles and sand lenses scattered throughout	22
92. Sandstone, yellow-brown, fine- to coarse-grained, arkosic	20
91. Siltstone, maroon, with arkosic, pebbly conglomerate lenses	20
90. Sandstone, red to yellow-green, with clay and arkosic conglomerate streaks	18
89. Siltstone, maroon to orange-red	6
88. Sandstone, yellow, fine- to coarse-grained, arkosic	5
87. Clay, red, with gray-brown, medium-grained sandstone and maroon siltstone streaks near top	26
86. Sandstone, brown-white, medium-grained, quartzose with red clay streaks near top	22
85. Sandstone, maroon to gray, medium-grained, with siltstone and arkosic pebbles	31
84. Sandstone, yellow to gray, fine-grained, with clay and shale lenses	17
83. Siltstone, maroon	2
82. Sandstone, gray-brown, fine- to coarse-grained, arkosic	16
81. Clay, yellow-white	10
80. Sandstone, yellow-gray to brown, fine- to coarse-grained, arkosic	11
79. Shale, maroon to yellow-gray, with small limonite concretions	23
78. Sandstone, yellow to gray-green, coarse- to fine-grained, arkosic	24
77. Shale, gray-green to maroon, with arkosic pebbles	17
76. Sandstone, yellow-brown, coarse- to fine-grained, arkosic	2
75. Siltstone, interbedded gray and maroon	23
74. Sandstone, yellow-brown, medium-grained, pebbly	3
73. Siltstone, maroon, hard	22
72. Sandstone, yellow-brown, fine- to coarse-grained	12
71. Shale, yellow, soft	4
70. Sandstone, yellow-brown, medium-grained with arkose pebbles	8
69. Claystone, yellow-gray, grades up to maroon	25
68. Sandstone, maroon and yellow-brown, coarse-grained, arkosic	3
67. Siltstone, maroon, soft	3
66. Sandstone, yellow-gray, fine- to coarse-grained	5
65. Conglomerate, yellow-brown, arkosic, soft	3
64. Shale, maroon and gray	1
63. Sandstone, gray-green, fine-grained, hard	2
62. Siltstone, maroon and gray, hard	4
61. Covered	45
60. Sandstone, gray-brown, coarse- to fine-grained, arkosic	10
59. Siltstone, gray with arkosic pebble lenses	36
58. Sandstone, yellow-brown, with arkosic pebble lenses	15
57. Covered	3
56. Siltstone, gray to maroon, hard with lenses of fine-grained sandstone	22
55. Covered	5
54. Shale, gray-green, maroon, and red	27
53. Covered	15
52. Shale, maroon to gray and yellow, soft, crumbly	68
51. Sandstone, gray to brown and yellow, medium-grained, with arkose pebbles	28
50. Siltstone, yellow to maroon, soft	15
49. Sandstone, orange, fine-grained, weathered	9
48. Claystone, yellow and maroon, with silty lenses	18
47. Covered	217
46. Sandstone, brown-white to yellow, medium-grained, with arkosic pebbles	5
45. Siltstone, yellow-green, shaly	5
44. Sandstone, yellow-brown, coarse-grained, with arkose pebbles and a foot thick maroon siltstone stringer	36
43. Covered	108
42. Siltstone, maroon to yellow-gray near base	4
41. Covered	2

		Thickness Feet
40.	Sandstone, white-brown, silty with arkose pebbles near base	28
39.	Covered	51
38.	Siltstone, yellow-green	62
37.	Covered	30
36.	Sandstone, red, medium-grained, with arkose pebbles	43
35.	Siltstone, gray to maroon	8
34.	Sandstone, yellow, fine-grained, with siltstone lenses	58
33.	Siltstone, maroon, brick-red, and gray to yellow	65
32.	Sandstone, red to brown-white, medium-grained with arkose pebbles, soft	26
31.	Siltstone, maroon to red	16
30.	Covered, with a foot thick brown pebbly sandstone in the middle	93
29.	Siltstone, yellow-green	6
28.	Sandstone, brown, medium-grained with arkose pebbles, hard	43
27.	Covered	24
26.	Sandstone, red, coarse-grained, with arkose pebbles	8
25.	Covered	20
24.	Sandstone, red, coarse-grained, arkosic, grades up into a coarse, brown, arkosic, pebbly sandstone, and with a few small lenses of maroon siltstone	279
23.	Covered	47
22.	Sandstone, yellow-white, coarse-grained with arkose pebbles	49
21.	Clay, yellow-gray, with 7-foot thick maroon siltstone near base	17
20.	Sandstone, yellow-brown, medium-grained, arkosic, with an 11-foot maroon siltstone lense in middle, and gray clay lenses	67
19.	Covered	30
18.	Sandstone, gray, coarse-grained, arkosic, grading up to red-yellow, coarse-grained, arkosic sandstone, with cobbles of black petrified wood	107
17.	Clay, yellow-gray	2
16.	Sandstone, red to gray, clayey, soft	24
15.	Shale, gray-green, grading up to maroon siltstone	6
14.	Sandstone, red and gray, coarse-grained, with arkosic pebbles and pebbles of black petrified wood	53
13.	Clay, gray, with pebbles of black petrified wood	1
12.	Sandstone, red, coarse, arkosic, with 6-foot, brown, arkosic, pebbly, conglomerate near base	70
11.	Siltstone, yellow-green	2
10.	Conglomerate, gray, arkosic, hard, with cobbles of rock fragments up to 6 inches along their maximum dimension	13
9.	Conglomerate, gray, sandy, pebbly, hard	40
8.	Covered	31
7.	Sandstone, red-brown, soft, arkosic, with quartz-feldspar gneiss pebbles	42
6.	Sandstone, red, fine-grained, soft, arkosic, pebbly	23
5.	Covered	56
4.	Conglomerate, red to white, soft, arkosic, pebbly	126
3.	Covered	65
2.	Conglomerate, gray, arkosic, soft, pebbly	91
1.	Covered	12

Geologic Section 10. Dry Fork formation going north on State Road 681 starting 0.25 mile south of State Road 640, Pittsylvania County, Virginia.

		Thickness Feet
Dry Fork formation, arkosic facies (305 feet)		
14.	Siltstone, yellow to maroon, mottled	12
13.	Conglomerate, brown-white, arkosic, with yellow-green clay lenses	21
12.	Siltstone, maroon, yellow-green, hard	8
11.	Conglomerate, brown-yellow, arkosic	19
10.	Shale, maroon, yellow, gray, with slickensides	52

		Thickness Feet
9.	Covered	52
8.	Siltstone, maroon, mottled, gray, medium-hard	21
7.	Conglomerate, brown and white, coarse-grained, arkosic	22
6.	Covered	39
5.	Mudstone, maroon, soft to hard	7
4.	Sandstone, brown to gray, coarse-grained, arkosic, hard, with pebbles 1.5 inches in diameter	19
3.	Siltstone, yellow, gray, soft	6
2.	Conglomerate, gray-white, hard, quartzose, with pebbles to 0.5 inch in diameter	1
1.	Siltstone, red, yellow, gray, soft to hard	26

Geologic Section 11. Dry Fork formation in roadcut on top of Whiteoak Mountain going north on U. S. Highway 29, Pittsylvania County, Virginia.

		Thickness Feet
Dry Fork formation, arkosic facies (1022 feet)		
49.	Conglomerate, yellow-white, sandy	38
48.	Sandstone, maroon, grades to siltstone at base	36
47.	Conglomerate, yellow, sandy, arkosic	5
46.	Sandstone, maroon, fine-grained	14
45.	Sandstone, yellow-brown, fine- to medium-grained, arkosic	17
44.	Sandstone, maroon, silty	11
43.	Conglomerate, yellow-brown, pebbly, soft, arkosic	25
42.	Siltstone, maroon, medium-hard	25
41.	Conglomerate, yellow to tan, pebbly	23
40.	Siltstone, maroon, sandy	5
39.	Sandstone, white to tan, fine-grained	20
38.	Siltstone, maroon, sandy	7
37.	Conglomerate, white to brown, pebbly	8
36.	Sandstone, maroon, silty, calcareous, hard, grades to coarse-grained, gray sandstone at base	63
35.	Conglomerate, white-yellow, pebbly hard, with limonite specks	57
34.	Siltstone, maroon, soft	4
33.	Sandstone, tan, coarse-grained, arkosic, pebbly speckled with limonite	41
32.	Covered	75
31.	Sandstone, maroon, fine- to coarse-grained, speckled with limonite	6
30.	Covered	12
29.	Sandstone, tan, medium-grained, speckled with limonite	17
28.	Covered	93
27.	Sandstone, brown to white, coarse-grained	14
26.	Siltstone, maroon, sandy	7
25.	Sandstone, brown to white, fine- to coarse-grained pebbly	7
24.	Siltstone, maroon, sandy	4
23.	Sandstone, maroon to brown, fine- to coarse-grained, hard	10
22.	Sandstone, gray, coarse-grained, with quartz pebbles near base	35
21.	Siltstone, gray-green, soft, with hard maroon, silty sandstone near base	5
20.	Conglomerate, orange-brown, sandy, arkosic	4
19.	Siltstone, red, sandy	6
18.	Conglomerate, gray to maroon, pebbly, arkosic, with calcareous gray shale partings	20
17.	Sandstone, maroon, silty, calcareous, hard	22
16.	Conglomerate, gray	8
15.	Sandstone, maroon, fine-grained, arkosic, with quartz pebbles	8
14.	Sandstone, gray-green, fine- to medium-grained, slightly calcareous, silty, with thin gray-green hard shale lenses	45

		Thickness Feet
13.	Conglomerate, gray to maroon, pebbly, arkosic	17
12.	Conglomerate, white to buff, pebbly, arkosic	52
11.	Siltstone, maroon, sandy	1
10.	Sandstone, gray-green, fine-grained, hard	2
9.	Sandstone, buff-red, coarse-grained, soft	18
8.	Diabase dike, coarse-grained, weathered into boulders with concentric shells	19
7.	Sandstone, black, fine-grained, hard, altered by dike	4
6.	Conglomerate, buff, pebbly, clayey, arkosic	8
5.	Sandstone, maroon to gray, medium-grained, grades into siltstone at center and conglomerate near base	13
4.	Conglomerate, yellow-brown, pebbly, arkosic, soft, and weathered	49
3.	Sandstone, red, silty, hard, grades into soft siltstone at base	17
2.	Conglomerate, yellow-white, pebbly, arkosic, with gray clay in joints	11
1.	Siltstone, maroon, gray, and yellow	14

Geologic Section 12. Dry Fork formation on State Highway 41, just west of State Road 835, Pittsylvania County, Virginia.

		Thickness Feet
Dry Fork formation, arkosic facies (1376 feet)		
18.	Conglomerate, gray, sandy, arkosic, hard, weathers buff, with lenses of orange to gray clay, pebbles of muscovite schist and arkosic gneiss up to 3.5 inches in diameter	168
17.	Sandstone, dark gray-green, silty, hard, arkosic	159
16.	Conglomerates, dark gray-green to buff, sandy, arkosic	170
15.	Siltstone, red, soft, with streaks of gray clay and fine-grained sandstone	42
14.	Sandstone, gray to white, fine-grained, clayey	33
13.	Siltstone, red to orange, soft, clayey	79
12.	Covered	320
11.	Sandstone, yellow-orange, fine- to coarse-grained, pebbly, arkosic, with red siltstone near top	34
10.	Conglomerate, yellow-orange, coarse-grained, arkosic near base, with clay partings near base	63
9.	Siltstone, maroon, soft	2
8.	Sandstone, yellow-gray, fine-grained, pebbly near base, soft	22
7.	Shale, maroon, soft	7
6.	Sandstone, yellow-brown, fine- to coarse-grained, soft, clayey	27
5.	Siltstone, maroon, with orange-brown claystone lenses	15
4.	Sandstone, yellow, fine-grained, hard	36
3.	Siltstone, red, hard, with soft, orange claystone lenses	41
2.	Conglomerate, orange-yellow, sandy, arkosic, with yellow clay partings	103
1.	Claystone, red-orange, soft	55

Geologic Section 13. Dry Fork formation, arkosic facies, south of State Road 640 along Banister River, Pittsylvania County, Virginia.

		Thickness Feet
Dry Fork formation, arkosic facies (314 feet)		
17.	Siltstone, maroon, hard	10
16.	Sandstone, gray, fine-grained, hard, with limonite specks	1
15.	Sandstone, maroon, fine-grained, siliceous	10
14.	Covered	8
13.	Sandstone, gray, fine- to medium-grained, hard	15
12.	Sandstone, maroon, fine-grained, silty	2
11.	Conglomerate, tan to gray-green, fine-grained, with limonite specks	11

		Thickness Feet
10.	Sandstone, maroon, fine- to coarse-grained, arkosic, with pebbles up to 4 mm.	28
9.	Conglomerate, gray, medium-grained, pebbly, arkosic, with pebbles 3 inches long and 2 inches wide	18
8.	Sandstone, maroon to brown, fine- to coarse-grained, with siltstone and conglomerate lenses	68
7.	Covered	4
6.	Conglomerate, tan-white, fine- to coarse-grained, sandy	3
5.	Sandstone, gray-green, fine-grained, with limonite specks in 8-inch beds alternating with 0.5-inch maroon siltstones	3
4.	Sandstone, brown to maroon, fine-grained, hard	4
3.	Sandstone, tan to gray, fine- to coarse-grained, pebbly, calcareous	42
2.	Covered	32
1.	Sandstone, white to tan, fine- to coarse-grained, arkosic, with limonite specks, (at bridge)	55

Geologic Section 14. Dry Fork formation, about 0.25 mile south of U. S. Highway 58 on State Road 863, Pittsylvania County, Virginia.

		Thickness Feet
Dry	Fork formation, arkosic facies (169 feet)	
15.	Conglomerate, brown, pebbly, sandy, arkosic, hard	12
14.	Siltstone, maroon, hard	6
13.	Conglomerate, brown, coarse-grained, arkosic, hard	4
12.	Sandstone, maroon, fine-grained, hard, grades to siltstone at base	8
11.	Conglomerate, tan to white, sandy arkosic, cross-bedded, with green sandstone present as thin lenses	50
10.	Shale, gray, silty	1
9.	Siltstone, maroon to yellow, with clay partings	17
8.	Sandstone, tan, medium-grained, grades to pebbly conglomerate near top	13
7.	Sandstone, maroon, fine-grained, hard	1
6.	Shale, yellow to gray	3
5.	Sandstone, tan, coarse-grained, hard, medium-bedded, pebbly at base	11
4.	Siltstone, maroon, medium-hard, with basal gray shale	20
3.	Sandstone, tan, medium-grained, pebbly, soft	7
2.	Siltstone, maroon, arkosic	10
1.	Conglomerate, maroon to white, coarse-grained, clayey, arkosic	6

Geologic Section 15. Type section of the Cedar Forest formation along The Virginian Railway, about 0.5 mile northwest of Long Island Station, Campbell County, Virginia.

		Thickness Feet
Cedar	Forest formation (87 feet)	
6.	Siltstone, red, with lenses of coarse-grained maroon sandstone	44
5.	Conglomerate, maroon, very coarse-grained, cobbly with greenstone quartz cobbles 10 inches in diameter, and with a maroon siltstone matrix	5
4.	Siltstone, red, with streaks of quartz and greenstone pebbles	10
3.	Conglomerate, maroon, coarse-grained, cobbly with greenstone and quartz pebbles and maroon silstone matrix	2
2.	Siltstone, red	10
1.	Conglomerate, maroon, cobbly, mostly greenstone and quartz pebbles and cobbles, with some granitic pebbles and red siltstone matrix	16

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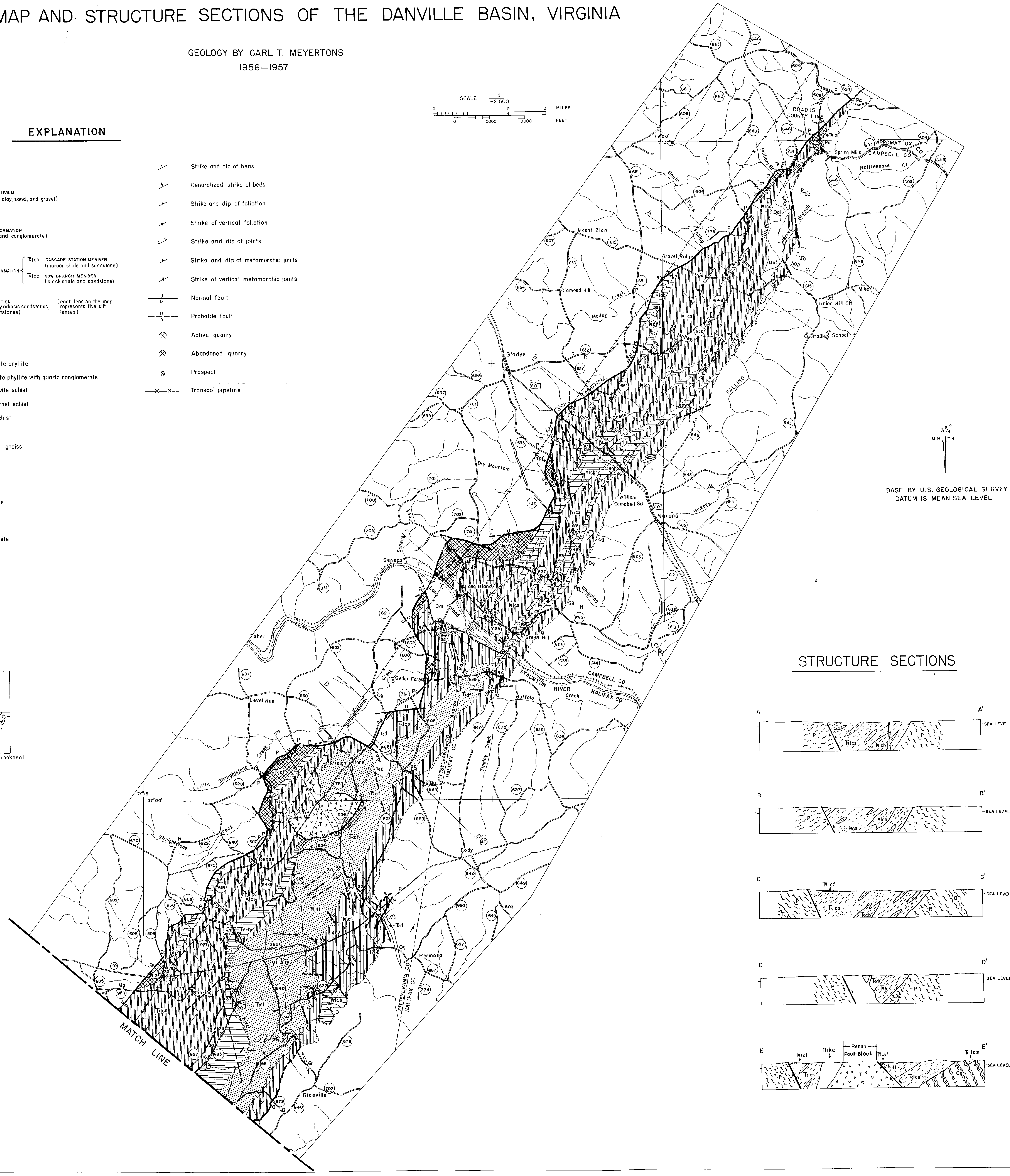
VIRGINIA DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT
DIVISION OF MINERAL RESOURCES
James L. Calver, Commissioner of Mineral Resources and State Geologist

REPORT OF INVESTIGATIONS 6, PLATE 1
(NORTH PART)

GEOLOGIC MAP AND STRUCTURE SECTIONS OF THE DANVILLE BASIN, VIRGINIA

GEOLOGY BY CARL T. MEYERTONS
1956–1957



EXPLANATION

SEDIMENTARY ROCKS

Quaternary

Qal — QUATERNARY ALLUVIUM (unconsolidated clay, sand, and gravel)

Triassic

Ꞧcf — CEDAR FOREST FORMATION (maroon shale and conglomerate)

LEAKESVILLE FORMATION:
- Ꞧlcs — CASCADE STATION MEMBER (maroon shale and sandstone)
- Ꞧlcb — COW BRANCH MEMBER (black shale and sandstone)

Ꞧdf — DRY FORK FORMATION (graywacke, gray arkosic sandstones, and maroon siltstones) (each lens on the map represents five silt lenses)

METAMORPHIC ROCKS

Pre-Triassic

P	Sericite-chlorite phyllite
Pc	Sericite-chlorite phyllite with quartz conglomerate
S	Quartz-muscovite schist
Sg	Muscovite-garnet schist
R	Hornblende schist
Q	Arkosic gneiss
Qg	Arkosic augen-gneiss

IGNEOUS ROCKS

Triassic

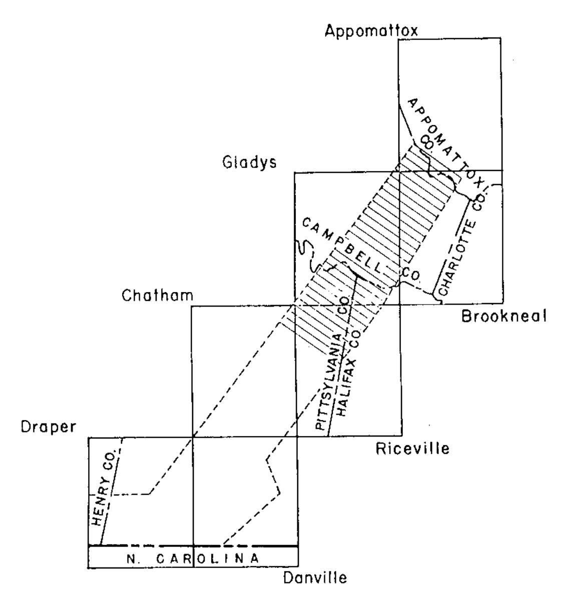
Ꞧd — Diabase dikes

Pre-Ꞓ

T — Quartz monzonite

Strike and dip of beds
Generalized strike of beds
Strike and dip of foliation
Strike of vertical foliation
Strike and dip of joints
Strike and dip of metamorphic joints
Strike of vertical metamorphic joints
Normal fault (U/D)
Probable fault (U/D)
Active quarry
Abandoned quarry
Prospect
"Transco" pipeline

INDEX MAP



BASE BY U.S. GEOLOGICAL SURVEY
DATUM IS MEAN SEA LEVEL

STRUCTURE SECTIONS

A
A'
B
B'
C
C'
D
D'
E
E'
SEA LEVEL
Renan Fault Block
Dike

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