# KENTUCKY GEOLOGICAL SOCIETY

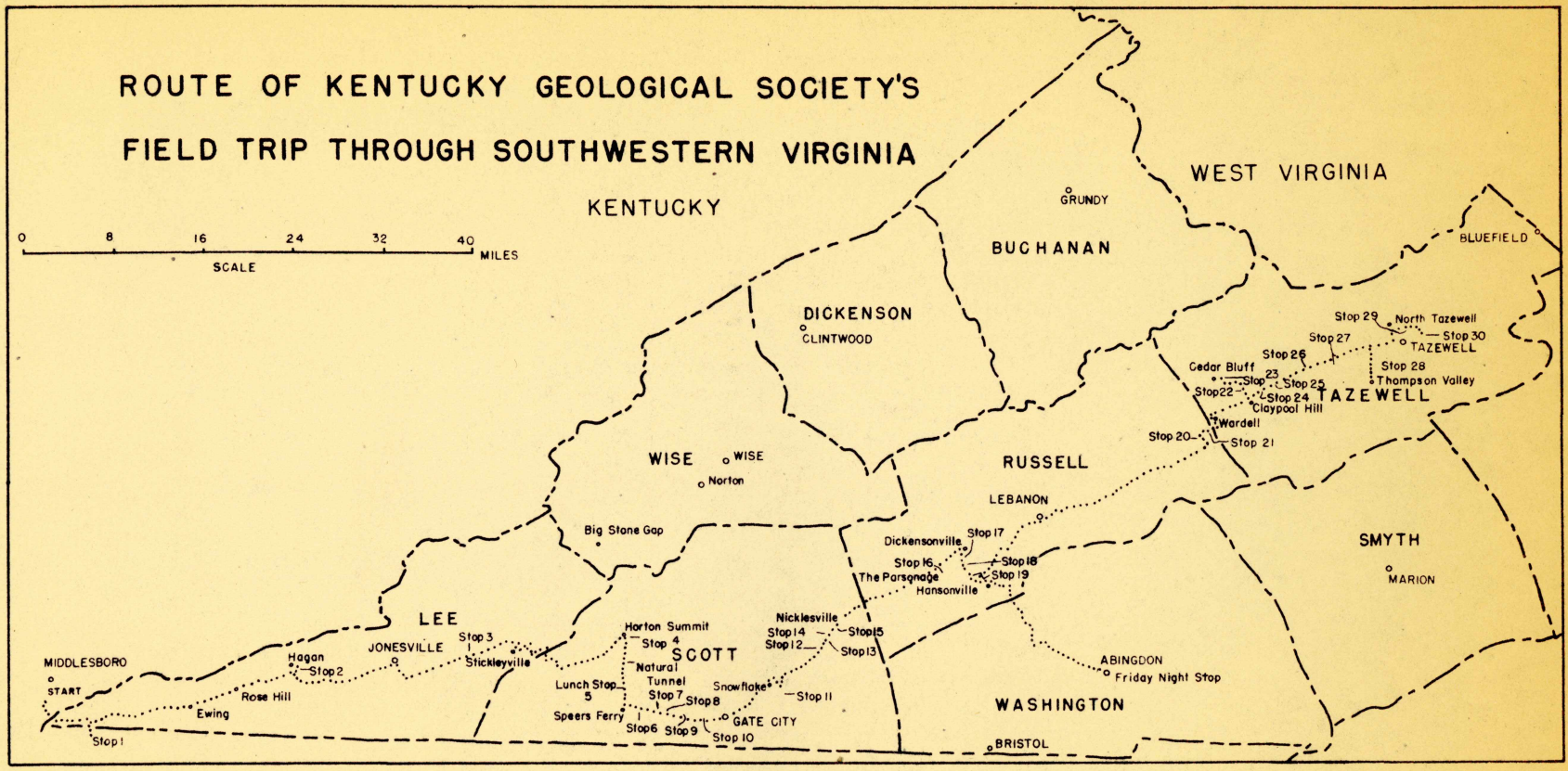
## 1950 FIELD EXCURSION

## IN

## SOUTHWESTERN VIRGINIA

MAY 5, 6, 7

Byron N. Cooper, Leader
Virginia Polytechnic Institute


ROUTE OF KENTUCKY GEOLOGICAL SOCIETY'S
FIELD TRIP THROUGH SOUTHWESTERN VIRGINIA
KENTUCKY
WEST VIRGINIA
0 8 16 24 32 40 MILES
SCALE
GRUNDY
BUCHANAN
BLUEFIELD
DICKENSON
CLINTWOOD
Stop 29
North Tazewell
Stop 30
Stop 27
TAZEWELL
Stop 26
Stop 28
Thompson Valley
Cedar Bluff
Stop 23
Stop 25
Stop22
Stop 24
Claypool Hill
TAZEWELL
Wardell
Stop 20
Stop 21
WISE
WISE
Norton
RUSSELL
LEBANON
Big Stone Gap
Dickensonville
Stop 17
Stop 16
Stop 18
Stop 19
The Parsonage
Hansonville
SMYTH
MARION
LEE
Nicklesville
Stop 14
Stop 15
Stop 12
Stop 13
Horton Summit
Stop 4
Stop 3
JONESVILLE
Stickleyville
MIDDLESBORO
START
Hagan
Stop 2
SCOTT
Natural
Tunnel
Lunch Stop
5
Stop 7
Stop 8
Snowflake
Stop 11
ABINGDON
Friday Night Stop
Rose Hill
Ewing
Speers Ferry
Stop6
Stop 9
GATE CITY
Stop 10
WASHINGTON
Stop 1
BRISTOL

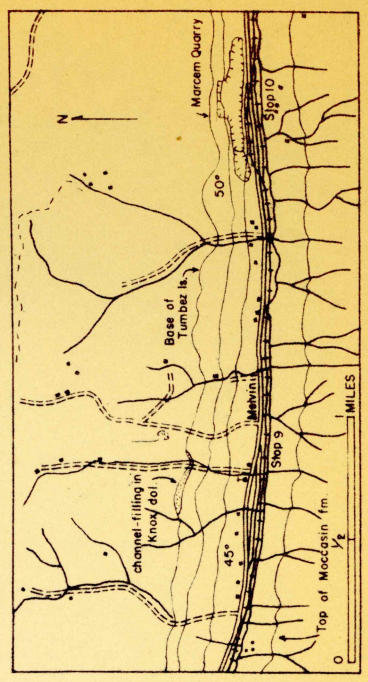
GSKGB 1950

Lithology and Thickness constant throughout Clinch Valley

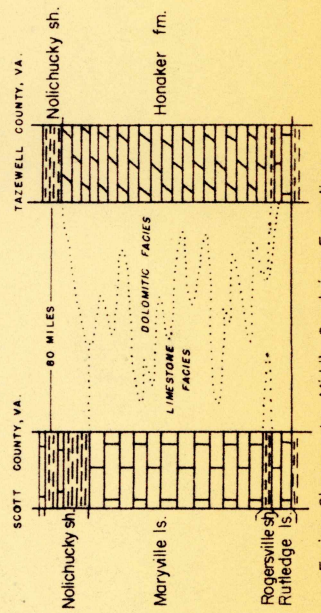
Thins to northeast

Supplanted by Honaker dolomite in eastern Russell and Tazewell counties

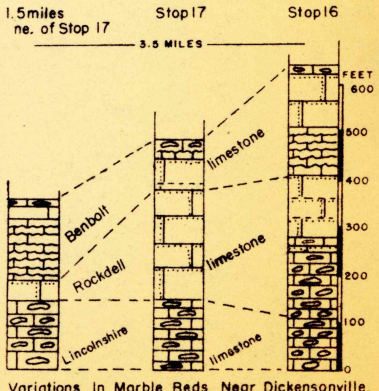
| | | |
|---|---|---|
| Knox dolomite | Mascot | Gray granular cherty dolomite with pinkish streaks: pink dolomite member. |
| | Kingsport | Pearl-gray cherty dolomite: upper cherty member. |
| | Longview | Light-gray fine-grained limestone: limy member. |
| | Chepultepec | Light-gray granular cherty dolomite: lower cherty member. |
| | | Dark- to light-gray granular sandy dolomite with intercalated beds of quartz sandstone: sandy member. |
| | | ---------- Cambrian-Ordovician Boundary ---- |
| | Copper Ridge (Feet 500 / 0) | Light- to medium-gray granular dolomite with many thin partings of black oolitic Cryptozoon-bearing chert; quarriable thicknesses of high-magnesium dolomite occur locally: oolitic member |
| Nolichucky | | Maynardville limestone member: dark-gray, banded. |
| | | Drab-gray to reddish-brown shales with intercalated limestones and sandy beds. |
| Maryville | | Dark bluish-gray banded magnesian limestone and dark-gray granular oolitic limestone. |
| Rogersville | | Drab-gray shale. |
| Rutledge | | Dark bluish-gray banded limestone and dolomite. |




Middle Ordovician Limestones West Of Gate City, Scott County, Va.

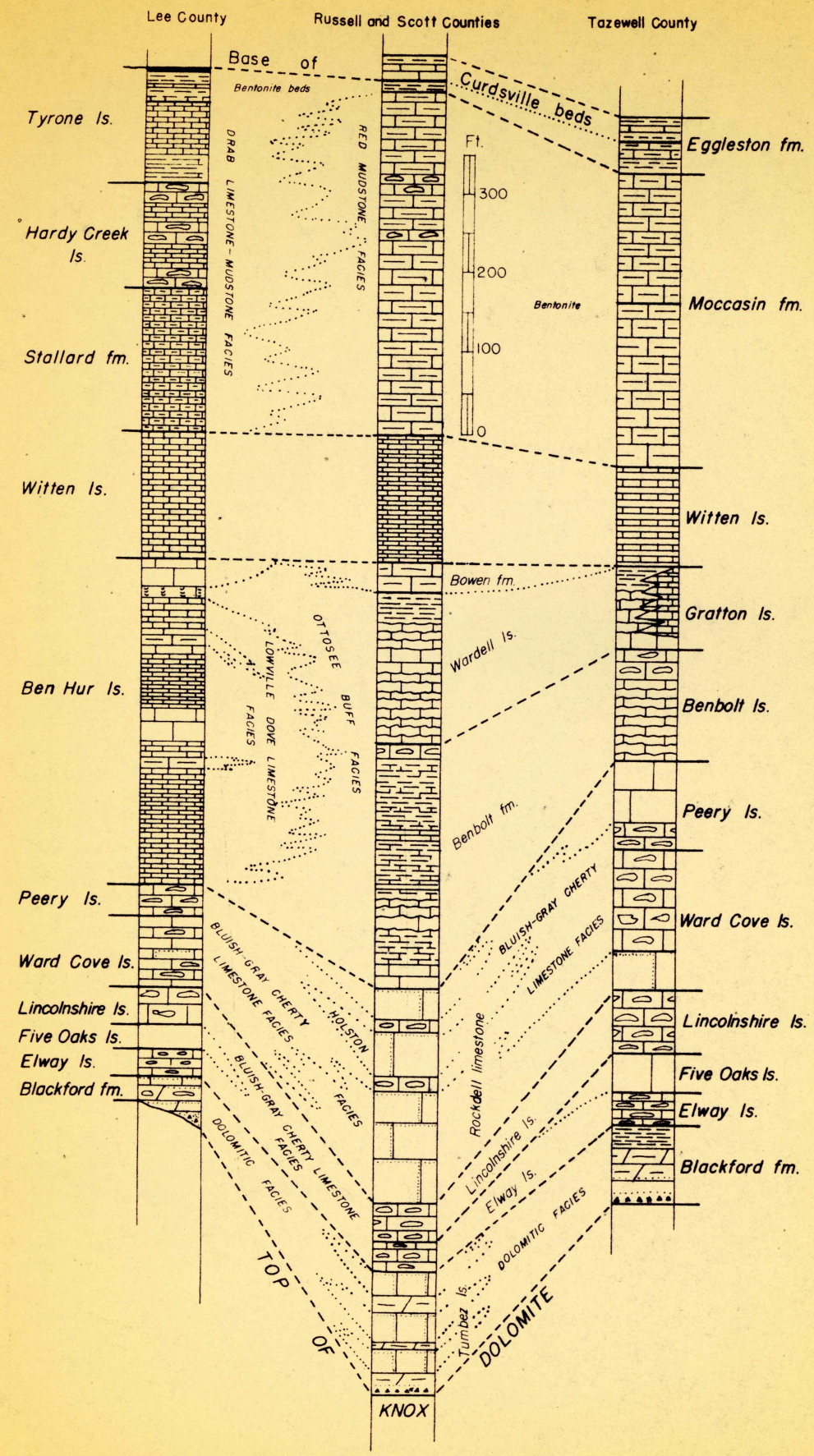



Facies Changes In Middle Cambrian Formations.




Variations In Marble Beds Near Dickensonville, Russell County, Virginia

# COLUMNAR SECTION OF CAMBRO-ORDOVICIAN BEDS




Middle Ordovician Limestones From Cumberland Gap to Bluefield, Virginia

KENTUCKY GEOLOGICAL SOCIETY

ROAD LOG FOR THE 1950 FIELD TRIP

STARTING POINT: Cumberland Mountain Hotel and Cottages, 4 miles south of Middlesboro, on U. S. Route 25E.

STARTING TIME: 8:30 A. M., Friday morning, May 5, 1950.

LEADER: Byron Cooper, Virginia Polytechnic Institute

INSTRUCTIONS: Trip will be guided by an officer of the Virginia State Police. At the various steps, please park off the hard surface wherever possible. Watch traffic; leave cars from left side only after watching for break in traffic.

Call Martha Washington Inn for Friday nite reservations, if you have not done so already.

Have sandwiches for lunch when you start. Soft drinks only will be available at Lunch Stop.

| Trip | MILEAGE Place To Place | Your Speedometer Readings | DESCRIPTIVE COMMENTARY |
|---|---|---|---|
| | | | Note: In first blank space below, record your speedometer reading at start. Secure readings for subsequent notations in the log by adding the figure in the middle column opposite each blank to the previous speedometer reading (on preceding notation). |
| 00.00 | 0.00 | _____ | Cars assemble on parking area in front of hotel, headed south up Cumberland Mountain. |
| 00.56 | 0.56 | _____ | State line; enter Virginia. Stony Gap sandstone (high Miss.) exposed back of Standard Filling Station |
| 00.70 | 0.14 | _____ | Oolitic limestone of Glen Dean (Chester) age. |
| 00.82 | 0.12 | _____ | Shale of Glen Dean age. |
| 01.00 | 0.18 | _____ | Cudjo's Cave Exit (Gasper limestone). |
| 01.10 | 0.10 | _____ | Ste. Genevieve and St. Louis limestones; and New Providence shale below. |
| 01.25 | 0.15 | _____ | TURN LEFT ONTO U. S. Route 58. Chattanooga shale on left. From here eastward to first stop, section down to Middle Ordovician is traversed. |

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| 01.48 | 0.24 | _____ | Crossing Rose Hill (Clinton) formation and Clinch sandstone (Medinan) on Poor Valley Ridge. |
| 02.3 | 0.82 | _____ | High on Cumberland Mountain are bold ledges of Mississippian Greenbrier limestones. |
| 02.55 | 0.25 | _____ | Sequatchie-Maysville red beds on left. |
| 02.90 | 0.35 | _____ | Reedsville shale on right. |
| 03.20 | 0.30 | _____ | Trenton limestones: Catheys, Cannon, and Hermitage formations. |
| 03.90 | 0.70 | _____ | TURN RIGHT ON SECONDARY ROAD. |
| 04.05 | 0.15 | _____ | BEAR RIGHT Circle and park. |
| 04.05 | | | STOP 1. 20 minutes. In quarry along Station Creek, key beds of the Ben Hur limestone are exposed. The 5-foot dark bed midway up on the quarry face in the center of the cut is a Stromatocerium biostrome widely recognized in Lee County. This bed is full of the crusty-looking wrinkled heads of the hydrozoan Stromatocerium, which weather out and form conspicuous cobbles on weathered surfaces and outcrops. Directly above the biostrome are shaly beds of limestone 3 to 5 feet thick, which contain abundant Opikina, Hesperorthis, and Strophomena---all of which are completely silicified and which can be etched out as beautiful specimens showing internal and external features. The brachiopod beds and Stromatocerium biostrome are underlain by dove limestones with shaly partings containing perfect Ancistrorhyncha costata which weather out of the shaly partings. This fossil, together with those in the succeeding layers are found in the Ridley limestone of Central Tennessee (Stones River age) and also in the Wardell formation to be seen later today. The Dove beds are full of Tetradium cellulosum also. Biostromes are excellent mapping horizons within the localized areas where they may prevail. Note dove-limestone facies; this is the characteristic type of rock in the Ben Hur formation. This quarry is actually just across the line in Tennessee. |
| | | | RETURN TO CARS and retrace route to highway. |
| 04.60 | 0.55 | _____ | TURN RIGHT ON U. S. ROUTE 58. |
| 05.10 | 0.50 | _____ | Railroad underpass. Ordovician limestone along road to |
| 15.90 | 10.80 | _____ | Ewing (Lee County oil field to south). |

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| 20.90 | 05.00 | _____ | Rose Hill, straight ahead. |
| 21.40 | 0.50 | _____ | Keep left on U. S. Route 58 in eastern limits of town. |
| 25.63 | 4.23 | _____ | Five Oaks limestone along road on right. This bed has been called Mosheim limestone. |
| 25.88 | 0.25 | _____ | Turn left onto unpaved road, cross Hardy Creek, bear left at road forks ahead; park along side of road. |
| 26.38 | 0.5 | _____ | STOP 2. Climb embankment to railroad level and examine section from Curdsville limestone down to Knox dolomite. See Geologic Sections 14 and 16, and descriptions of Hardy Creek limestone, Stallard formation, Witten limestone, Peery limestone, Ward Cove limestone, Lincolnshire limestone, Five Oaks limestone, Elway limestone, Blackford formation, and Mascot dolomite. Note particularly, the bentonites, silicified zones immediately beneath the ash beds; the red-bed intercalations in the Ben Hur limestone; and the different lithologies in the lower part of the section. This is one of the best exposed sections in the entire Powell Valley area; the section north of the water tower ranges up to the Chattanooga black shale which forms the south portal to the L & N tunnel through Cumberland Mountain. The Rose Hill (Clinton formation is well exposed along the tracks curving to the west (left). The Mississippian limestones tower above the tunnel entrance. |
| | | | Return to cars, continue north to Hagan Store; turn around and retrace route to main highway |
| 27.58 | 1.20 | _____ | TURN LEFT ON U. S. ROUTE 58. |
| 29.14 | 1.56 | _____ | Gas well on right side of road penetrated Pine Mountain thrust about 800 feet. |
| 37.18 | 8.04 | _____ | Cedar glade on right is typical of Middle Ordovician limestone terranes. |
| 38.36 | 1.18 | _____ | Jonesville, county seat of Lee. |
| 38.36 | 1.18 | _____ | TURN RIGHT ON U.S.ROUTE 58. |
| 40.78 | 2.42 | _____ | LEFT ON ROUTE 58 at junction with State Highway 70. |

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| 41.18 | 0.40 | _____ | Begin narrow highway. Eastward for 3 miles, the road crosses the outcrop of the Knox dolomite, presence of which is indicated chiefly by residual chert. |
| 45.78 | 4.6 | _____ | Descend steep wall of Powell Valley; upper Knox exposed along roadside. |
| 46.38 | 0.6 | _____ | Cross Powell River. |
| 47.33 | 0.95 | _____ | STOP 3. Excellent exposure of the beds directly overlying the Knox dolomites. The Blackford beds form the basal overlapping deposit. They are typically reddish dolomitic mudstones and interbedded drab-gray dolomites. Some detrital chert occurs in the lowest layers. The strike of the beds is across the road at this point. From this point eastward to the top of Wallen Ridge, the route crosses the outcrop of successively younger formations up to the Clinch and Rose Hill formations of Silurian age, atop the mountain. |
| 47.63 | 0.30 | _____ | Elway cherty limestone overlying the Blackford fm. |
| 47.98 | 0.35 | _____ | Ben Hur limestone. |
| 49.28 | 1.30 | _____ | Note cedar glade ahead on left; this marks the outcrop of the Witten limestone. |
| 51.08 | 1.80 | _____ | Tyrone beds with bentonites. |
| 53.57 | 2.49 | _____ | Clinch sandstone overlying Sequatchie red beds. Top Wallen Ridge. Shales and sandstones of Clinton age (Rose Hill formation). |
| 54.48 | 0.91 | _____ | Stickleyville, continue on Route 58. Ascend Powell Mountain, crossing outcrop of Ordovician limestones and shales. |
| 57.14 | 2.56 | _____ | Top of Powell Mountain. Descending this ridge to south are excellent exposures of the Clinch sandstone (near top) and Clinton shales and sandstones. |
| 59.27 | 2.13 | _____ | Cayugan-Helderberg succession, with thin Huntersville chert just under the Chattanooga shale. Keep left. |
| 63.78 | 4.51 | _____ | Junction of U. S. Routes 23 and 58. Duffield, Va. Fine exposure of Chattanooga shale in vicinity of Duffield, about 600 feet thick. Straight ahead. Road follows Mississippian Warsaw-Keokuk-Burlington mudstones (Maccrady facies). Overthrust Cambrian limestones form hills to right of road. Hunter Valley fault along base of hills. |

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| 67.29 | 4.51 | ——— | Horton Summit, cross railway (Southern) overpass. Park by filling station on right. |
| 67.29 | | | STOP 4. Study contact of Cambrian limestone succession with overturned Chattanooga shale, along Hunter Valley fault. This thrust seems to be the southwest continuant of the great St. Clair overthrust to be noted farther north. This fault is a clean-cut shear without appreciable brecciation. The shale forms an effective lubricant for thrusting. The exact sequence south of the fault is not entirely clear. The Rutledge limestone (Plate 2) appears to overlie the fault surface, then the Rogersville shale is recognizable across from the filling station. To the south, along the descending highway grade, about 1350 feet of banded, striped Maryville limestone is exposed. If this is a normal section, it is thicker than the Maryville elsewhere in this area, but there are signs that the sequence is thickened by repetition of the upper half several times. |
| 67.78 | 0.49 | ——— | Nolichucky shale, several hundred feet thick, well exposed on railroad to right above highway. Going southward now, the route ascends the entire thickness of the Knox dolomite to |
| 68.93 | 1.15 | ——— | NATURAL TUNNEL. Axis of Purshase Ridge syncline. The Tunnel is about 800 feet long and some 350 feet below the walkway which skirts the chasm. The rock forming the span above the tunnel is the Chepultepec formation (lower cherty member of the Knox succession). It is noteworthy that the conditions at Natural Tunnel almost duplicate those prevailing at the world-famous Natural Bridge of Virginia, which is also cut in the Chepultepec formation. Woodward (1937) has given a clear and accurate account of the formation of this amazing feature. The Southern Railway uses the tunnel in passing under Purchase Ridge. |
| 69.43 | 0.50 | ——— | Glenita Quarry, in the oolitic member of the Knox dolomite (i. e. Copper Ridge dolomite). From here southward, the route crosses steeply dipping sequences repeated by faulting. |
| 70.28 | 0.75 | ——— | Nolichucky shale. Maryville limestone (inverted). |
| 70.48 | 0.20 | ——— | Fault. |
| 70.98 | 0.50 | ——— | Rome formation, oldest exposed Middle Cambrian beds seen on field excursion; crops out on right. |
| 71.38 | 0.40 | ——— | Clinchport town limits; keep on Route 23-58. Rutledge-Rogersville-Maryville succession exposed along the highway at and south of Clinchport. |

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| 72.00 | 0.62 | _____ | Nolichucky shale. Followed by the full 2300-foot thickness of the Knox dolomite. |
| 72.98 | 0.98 | _____ | LUNCH STOP. 25 minutes. On high railway trestle to east of road and river is Clinchfield Railroad, which follows Clinch River northeastward from Clinchport to St. Paul, Wise County, Virginia. At north end of trestle, the Rome shale is thrust upon the Middle Ordovician limestone, along the Copper Creek fault. The route crosses this faultin two places later today. From the Lunch Stop (#5) south along the highways to Speers Ferry, the Rutledge-Rogersville-Maryville succession, followed by the Nolichucky and Knox dolomite, crop out in ascending order. Clinch River crossing at Speers Ferry is the approximate contact of Nolichucky with Maryville. River is located on the Nolichucky downstream to right of bridge.<br><br>Continue southward on U. S. Routes 23 and 58 after lunch. |
| 74.48 | 1.50 | _____ | Top of Knox, contact with Middle Ordovician beds. |
| 74.57 | 0.09 | _____ | Bear left on Routes 23 and 58 under Clinchfield Railroad which tunnels Clinch Mountain on the south. |
| 74.88 | 0.31 | _____ | STOP 6. 20 minutes. Examine the shaly Benbolt and Wardell limestones (Plate 3) which between here and Gate City strongly exhibit the familiar Ottosee buff shaly facies of the Middle Ordovician limestone. Continue eastward a short distance to |
| 75.73 | 1.16 | _____ | STOP 7. Examine the Bowen formation, here almost vertical; characterized by profusion of beautiful mudcracks. The Bowen, only about 60 feet thick is closely paralleled by the highway for some distance eastward, where the mudcracks and ripplemarks continue to be conspicuous. Mudcracks are similarly abundant in every single exposure of the Bowen, known to the writer. The Bowen introduces the Moccasin redbed facies, but the Bowen is actually classed as pre-Moccasin (i. e. the mapping unit defined by Campbell, 1894). Continue eastward. |
| 76.38 | 0.65 | _____ | STOP 8. Witten limestone, characterized by slabby layers crowded with fossils, including Cryptophragmus. Note ripple marks. 10 minutes. Continue eastward. |
| 77.48 | 1.10 | _____ | Buff shaly layers of Ottosee facies occurring in the upper part of the Wardell formation. |
| 78.58 | 1.10 | _____ | Danlboone Yard of Southern Railway. |
| 80.28 | 1.70 | _____ | Pink Holston-type reefy limestone in Wardell formation. |

80.78 0.50 _____ STOP 9. Marble Church. Park cars on right and walk left back of church and through field along lane to base of Tumbez limestone (See Plate 2). Note unique coarse clastics filling deep channel in the Knox dolomite. This is a special, localized phase of the lower part of the Tumbez limestone which normally carries detrital chert pebbles. 20 minutes. Return to cars and continue eastward. It should be mentioned that in the Speers Ferry-Gate City belt, the Paleozoic strata actually strike southeast instead of the conventional northeast direction.

82.18 1.40 _____ STOP 10. Marcem Quarry. This large quarry in the Middle Ordovician limestone is used in obtaining limestone used in the manufacture of Portland Cement at Kingsport, Tennessee, a few miles south of here. The foot wall of the quarry is near the base of the Tumbez limestone. Most of this formation is a pure coarse-grained Holston-marble facies, along with the overlying Elway limestone. The north cut in the quarry is developed in the Tumbez and Elway formations. The projecting rib of black shaly limestone is the impure cherty Lincolnshire limestone. Beautifully silicified Lincolnshire fossils occur atop the projecting rib on the left side. The main part of the quarry is in the Rockdell formation. Abrupt variations in the thickness of the Rockdell take place within this quarry. On the west side the unit is 160 feet thick and contains two intercalations of black cherty limestone, which separate the Hoston-type rock into 8-, 47-, and 25-foot zones. Along the eastern wall of the quarry, the Rockdell is at least 250 feet thick and contains no impure intercalations. This difference explains the present operations in the east end. 20 minutes. Return to cars and continue eastward.

82.78 0.60 _____ Gate City. Straight ahead.

83.98 1.2 _____ KEEP STRAIGHT AHEAD, departing from U. S . Routes 23 and 58 and following State Highway 71. Follow outcrop of the Middle Ordovician limestones, several exposures of the Rockdell coarse-grained limestone (Holston) type on roadside.

91.15 8.37 _____ TURN RIGHT on dirt road.

91.70 0.55 _____ TURN RIGHT on road to quarry, watch out for trucks. LOCK YOUR CARS AT THE NEXT STOP. PRISON LABOR USED IN QUARRY.

92.2 0.50 _____ STOP 11. Prison Quarry. Circle and park cars. This quarry is in a localized bioherm in the Wardell formation, which is marked by the development of a considerable thickness of Stromatocerium- and Tetradium-bearing reefy limestones. Note Geologic Section 13. Examine the structureless reef rock, including the pockets of clastic limestone embedded in the surrounding fine-grained rock. Examine the overlying bedded rock with

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| | 30 minutes | | profuse fossils including Favistella halli and Batostoma sevieri. This bioherm is restricted to a very narrow interval along the strike; see description of the Wardell formation for further details. Return to cars and retrace route to |
| 92.70 | 0.50 | _____ | TURN RIGHT. Continue uphil to intersection; thence right on State Highway 71. |
| 93.28 | 0.58 | _____ | Cherty Elway limestone on left. Begin ascent of Moccasin Ridge. Note deep soil profile developed on Knox dolomite: characteristic of all upland areas of Knox which are drained by subsurface conduits. |
| 96.10 | 3.40 | _____ | Crest of Moccasin Ridge. |
| 96.25 | 0.15 | _____ | STOP 12. Basal straticulate beds of Copper Ridge dolomite, in contact with high Nolichucky Maynardville limestone member. This lithology characteristic of the Nolichucky (or Conasauga)--Knox contact zone throughout much of southern Appalachian region. 15 minutes. Return to cars and continue northeast on Route 71. |
| 96.46 | 0.21 | _____ | Maryville limestone. |
| 96.90 | 0.44 | _____ | Copper Creek fault (same as seen at Lunch Stop). Moccasin formation below fault |
| 97.20 | 0.30 | _____ | Bowen and Witten formations on left and right of road.<br>STOP 13. Examine Witten and Bowen beds briefly. 10 minutes. |
| 97.70 | 0.50 | _____ | Benbolt shaly beds along highway near Copper Creek crossing. Ascend grade to northeast to |
| 97.75 | 0.05 | _____ | STOP 14. Examine the Rockdell and Lincolnshire formations, noting the Tennessee-marble lithology of much of the Rockdell formation. The cherty Lincolnshire limestone is well developed just ahead. 10 minutes. Return to cars and continue northeastward. |
| 98.10 | 0.40 | _____ | Elway limestone and cherty mantle. STOP 15 (if time permits). |
| 98.30 | 0.20 | _____ | Blackford beds on right; now onto Knox dolomite for several miles. Note sinkhole topography and general absence of surface drainage. |
| 98.70 | 0.40 | _____ | Nicklesville. Straight ahead, slow down for school. |

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| 102.10 | 3.30 | Intersection of Routes 174 and 71; continue on Route 71. |
| 103.60 | 1.50 | Russell County line; begin narrow road; watch bumps and curves. |
| 107.00 | 3.40 | Top of Knox dolomite; onto Middle Ordovician limestone near Mason Store. |
| 109.40 | 2.40 | Lakeview Church. Excellent exposure of fossiliferous Benbolt formation, including large ball cystoids (Echinosphaerites). |
| 110.85 | 1.45 | Note alternate resistant and nonresistant beds on right. The purer layers make the bolder outcrops. |
| 111.00 | 0.15 | Pinkish to lavender beds on left mark the Blackford formation; the mantle from this formation makes the famous "Blue ground" of Russell county. |
| 112.40 | 1.40 | The Parsonage. |
| 112.59 | 0.19 | Intersection of State Highways 64 and 71. Proceed to parking place just beyond intersection. |
| 112.60 | 0.01 | STOP 16. Proceed to the fields and exposures through the cattle guard. This stop is included to show the normal development of the Benbolt formation and the Rockdell limestone. (See Plate 2). In this section the Rockdell consists of about 180 feet of dark-gray cherty limestone overlain by 115 feet of Holston-like limestone. About 100 feet of nodular Benbolt limestone succeeds the Holston-like beds of the Rockdell; the upper part of the Benbolt is also a pinkish-gray marble a little over 100 feet thick. 20 minutes. Return to cars and proceed to |
| 114.50 | 1.90 | TURN RIGHT ON ROUTE 64 at Dickenson and park. |
| 114.50 | | Stop 16. Exposed along the road is an enormous swelling in thickness of the Rockdell. All of the formation is coarse-grained or fine-grained reefy limestone. Many reefy beds are seen along the roadside. Similar rock, though reddish in color, forms the lower two-thirds of the Benbolt also. Evidently reef conditions and marginal banks of shell sand prevailed locally in the Dickensonville area without affecting neighboring parts of the sea bottom. About 1.5 miles northeast of Dickensonville, beyond Stop 16, the only coarse-grained or reefy rock occurring in the Middle Ordovician consists of about 20 feet of pink rock. This contrasts sharply with the 300-foot thickness of Holston type rock at Stop 16. Down the road a short distance is the Favistella halli bed of the Wardell formation. Return to cars and continue down highway. |
| 114.80 | 0.30 | Bowen, Witten, and lower Moccasin beds. |

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| 115.30 | 0.50 | _____ | Moccasin mudstone. |
| 115.48 | 0.18 | _____ | Copper Creek fault; with Rome formation forming sole of thrust. Farther southward, the Rutledge limestone, Rogersville shale, and Maryville limestone are seen well exposed. The Maryville contains considerable dolomite here, indicating facies gradation into the Honaker dolomite (see Plate 2). |
| 116.58 | 1.28 | _____ | Nolichucky shale. (See Geologic section 2). |
| 116.70 | 0.12 | _____ | STOP 18. Straticulate beds at base of Knox; and upper limy beds (Maynardville) of Nolichucky. Note deep soil profile on left. 10 minutes. |
| 117.25 | 0.55 | _____ | STOP 19. Characteristic details of the Copper Ridge dolomite. Siliceous partings in dolomite beds are well developed; Cryptozoon cherts and black oolitic cherts are abundant, and appear to be regularly repeated. In parts of Clinch Valley, the Copper Ridge appears to consist of cyclothems of the lithologies shown in these exposures. Continue across middle and upper Knox to |
| 120.35 | 3.10 | _____ | JUNCTION WITH U. S ROUTE 19. |

End of first day's excursion. Cars will assemble at this point Saturday morning at 8:30 A. M. faced to continue northeast on Route 19.

Follow U. S. Route 19 to Abingdon, turn left at principal intersection to Martha Washington Inn.

## SATURDAY, MAY 6, 1950

| | | |
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| 0.00 | | Cars assemble at road intersection near Hansonville, Virginia. Headed northeast toward Lebanon. |
| 0.55 | 0.55 | Elway limestone on left. |
| 1.55 | 1.00 | Fossil bioherm in the Rockdell limestone on right. |
| 3.40 | 1.85 | Basal Blackford beds on Knox dolomite. |
| 4.90 | 1.50 | Crossing Knox dolomite. |
| 5.40 | 0.60 | Crossing Nolichucky and Honaker formations; travelling toward the Copper Creek fault. |
| 5.80 | 0.40 | Note quarry on right; complete absence of mantle rock. Honaker dolomite close to Copper Creek fault. |
| 5.95 | 0.15 | Cross Copper Creek fault. Now on Moccasin limestone; follow Ordovician limestone beds (Ottosee facies) to Lebanon, Russell County. Straight ahead through town on Route 19. |
| 7.79 | 1.84 | Lebanon Court House. Straight ahead through town. |
| 10.10 | 2.49 | Cedar Creek Bridge. |
| 11.05 | 0.95 | Brecciated Honaker dolomite on right side of road. |
| 11.55 | 0.50 | Nolichucky shale in cut. |
| 14.03 | 2.48 | High peak ahead is Beartown, a spur of Clinch Mountain; elevation 4604'. |
| 15.15 | 1.12 | Intersection Route 80 and U. S. Route 19; STRAIGHT AHEAD. |
| 15.90 | 0.75 | On left is Elk Garden Ridge, a hogback from which the Clinch sandstone has been almost completely removed from the trough of a syncline whose axis coincides with the mountain. The scalloped crest indicates the rapid dissection of the Martinsburg formation. |
| 19.40 | 4.25 | House and Barn Mountain on left. The name is taken from the resemblance of large monolithic blocks of Clinch Sandstone to the "house" and "barn". This mountain is synclinal instructure, with the Clinch lying flat atop the mountain and occupying the trough of the structure. |
| 26.20 | 10.30 | STOP 20. The Wardell and overlying Bowen formations are well exposed here, where Receptaculites biconstrictus is common. The Bowen formation here carries at the base a thin concretionary sandstone. 10 minutes. |

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| 26.70 | 0.50 | _____ | STOP 21. Note profusion of mudcracks in the Bowen formation, also the regularity of jointing. |
| 27.10 | 0.40 | _____ | Indian Creek. |
| 27.35 | 0.25 | _____ | Tazewell County line. |
| 27.80 | .45 | _____ | Martinsburg shale in trough of syncline. Cross syncline showing both limbs in Moccasin formation. |
| 31.20 | 3.40 | _____ | Blue Bonnet. |
| 32.00 | 0.80 | _____ | TURN LEFT ON ROUTE 460. |
| 32.80 | 0.80 | _____ | STOP 22. Examine the peculiar flesh-colored sandy dolomites of the Mascot formation (Upper Knox). 15 minutes. Return to cars and continue north across outcrop (poor) of Kingsport dolomite. |
| 33.00 | 0.2 | _____ | First of several sandstone exposures in the Chepultepec horizon of the Knox. |
| 33.20 | 0.2 | _____ | Nolichucky shale |
| 33.40 | 0.2 | _____ | STOP if time permits. Examine the Honaker dolomite; see section Geologic Section 1. The Honaker is distinctive in its low silica content, in contrast to practically all of the Knox dolomites. |
| 33.60 | 0.2 | _____ | Rutledge-Rogersville-Maryville limestones. |
| 34.00 | 0.40 | _____ | STOP 23. Climb onto N & W tracks. Inspect the St. Clair fault, showing the Devonian black shale in contact with a dolomite of Rome age. Return to cars and retrace route to junction with U. S. Route 19 at Claypool Hill. 15 minutes. |
| 36.30 | 2.70 | _____ | TURN RIGHT ON U. S. ROUTE 19-460. |
| 36.85 | 0.55 | _____ | STOP 24. Examine Peery limestone in quarry to right of road. In this place the Peery limestone consists of two members, an upper dove limestone (like the Mosheim) rather impure and about 60 feet thick, and a basal zone of black cherty limestone. Marked changes in the thickness of the Peery will be noted in subsequent stops. 15 minutes. |
| 38.30 | 1.55 | _____ | Just to right of road on Jim Sam Gillespie farm a 3.5 carat rough diamond crystal was found. Origin of stone unknown. |
| 38.80 | 0.50 | _____ | STOP 25. Examine the basal clastics of the Blackford formation. Very strongly developed here, filling a trench in the upper Knox. 10 minutes Return to cars and continue. |

39.44 0.64 _____ Pounding Mill quarry on right. Large operation supplying crushed stone and fluxing stone, the latter shipped via the Iaeger Branch of N & W to Williamson and Portsmouth.

41.70 2.26 _____ Gillespie Station. Opposite this place the dove limestones in the upper Peery are 75 feet thick.

42.70 1.00 _____ STOP 26. Examine a greatly expanded thickness of dove limestone in the Peery formation. The upper 145 feet of the Peery formation is dove-gray, high-calcium limestone; the lower 72 feet is dark-gray, nodular above and cherty near the base. From here east to Maxwell, one of the largest reserves of high-calcium limestone in Virginia occurs. 15 minutes. Return to cars.

44.40 1.70 _____ Mt. Pleasant Church. Back of this church is a thick deposit of high-calcium stone in the Peery formation, more than 100 feet thick and about 97.5% calcium carbonate.

45.10 0.70 _____ STOP 27. Maxwell. Cross fence and climb to top of knoll, across dove beds of the Peery (110 feet thick), across a thin development of nodular Benbolt limestone (gray in contrast to buff color near Lebanon and Gate City), to Gratton dove limestone. See section Geologic section 11 for details. Note the Stromatocerium biostrome---about the same position as the biostrome at Stop 1 in Lee County, and also approximately the same as the reefy rock at Stop 11, near Snowflake, Scott County, Virginia. The Gratton replaces the Wardell formation east of Tazewell. In this section, the uppermost Wardell overlaps the Gratton biostrome. Less than a mile east of this section, the Peery limestone pinches down to less than 80 feet and the dove limestone noted at Maxwell and to the west for 2 or 3 miles is too thin to be quarried. Return to cars and continue east on Route 19 to

49.50 4.40 _____ TURN LEFT WITH ROUTE 19 at junction with State Highway 91.

49.65 0.15 _____ LUNCH STOP. 30 MINUTES.

49.65 _____ Follow Route 16 across broad syncline where Ordovician limestones up into the Trenton beds is crossed. Note well developed fracture-cleavage in places in the mudstones.

51.10 1.45 _____ STOP 28 and study the Ordovician section given below:

Geologic Section 17.- Eggleston and older formations exposed along State Highway 16, 4 miles southwest of Tazewell, Virginia.

| | Thickness Feet |
|---|---|
| Martinsburg formation | |

Eggleston formation

| | |
|---|---|
| Metabentonite, buff, waxy... | 0.5 |
| Siltstone, cuneiform-jointed, siliceous, bluish gray | .6 |
| Mudrock, greenish-gray, calcareous | 2.4 |
| Limestone, greenish-gray, clayey | 1.9 |
| Metabentonite, buff | 1.8 |
| Mudrock, dove-gray, cuneiform-jointed | 3.0 |
| Metabentonite, buff, waxy | .3 |
| Limestone, bluish-gray, siliceous, cobbly, thin bedded; ripple-marked chert bands contain Resserella rogata, Refinesquina alternata, and Sowerbyella curdsvillensis | 4.2 |
| Shale, greenish-gray | 3.5 |
| Shale, bentonitic | 4.3 |
| Limestone, partly silicified, greenish-gray | 7.0 |
| Limestone, thin bedded, cobbly, with partings of greenish mudstone; fossils include Eurychilina subradiata, Leperditella sulcata, and a very large species of Isochilina | 12.20 |
| Shale, greenish gray, bentonitic, one 1.5 intercalation of maroon shale in the middle | .6 |
| Mudrock, greenish-gray, top surface silicified | 8.0 |
| Limestone, cuneiform-jointed, silicified; contains greenish shale | 5.1 |
| Clay, bentonitic, arkosic | 1.0 |
| Metabentonite, buff, blocky | .3 |
| Clay, bentonitic, maroon-drab | 2.2 |
| Limestone, greenish-gray; large species of Isochilina, and Achatella transecta | 2.0 |
| Mudrock, drab-gray, nodular, vugs of calcite; Escharopora subrecta in shale at top of unit | 4.5 |

Moccasin formation

| | |
|---|---|
| Mudrock, maroon-drab, silty; interbedded with waxy red bentonites | 107.5 |

Shale, waxy, bentonitic, in sheared zone (atop crest of anticline).... 1.1

Mudrock, maroon-drab, with minor interbeds of dove greenish-gray ls... 70.6

Limestone, dove-gray, fine grained, slabby..... ..... 13.5

Mudrock, bluish-gray..... 1.7

Limestone, dove-gray, calcite eyes, slabby..... 4.6

Mudrock, brick-red, with intercalations of greenish-gray fine-grained limestone..... 17.6

Limestone, light-gray, slabby..... ..... 16.6

Mudrock, maroon-drab, silty..... 51.0

Maroon-drab mudrock, calcareous..... 8.0

Mudrock, greenish-gray and maroon-drab, very calcareous..... 51.0

Witten limestone

Limestone, slabby, dove-gray, with Camarocladia..... 12

Limestone, granular shelly layers interbedded with dove slabby rock containing Camarocladia..... 4

Limestone, slabby, dove-gray, fine grained; abundant Camarocladia..... 42.5

Limestone, fine to coarse grained, contains Pianodema minuscula, Cryptophragmus antiquatus, Buthotrephis, and Rhinidictya..... 20.0

Limestone, golden-gray, fine grained, slabby..... 12.2

Limestone, fine grained, platy..... 3.0

Bowen formation

Mudrock, maroon-drab, straticulate, mudcracked and columnar-jointed.. 20.0

Wardell formation

Shale, smoke-gray, weathers buff..... 47.5

Limestone, coarse-grained, light-gray, shaly partings..... 20.0

Limestone, nodular, argillaceous, smoke-gray, weathers buff; contains Rostricellula and Receptaculites biconstrictus..... 14.0

Limestone, coarse grained, Holston-type, cross bedded..... 1.3

Limestone, gray, uneven texture; Stromatocerium, and Favistella halli...13.3

Gratton limestone

Limestone, dove-gray, medium bedded, fine grained; contains Tetradium racemosum; quarried at Scales..... 65.00

Limestone, laminated, buff and gray..... 4.50

Benbolt limestone

Limestone, corss-bedded, granular..... 30.00

Limestone, nodular, and crumbly; contains Minella superba, Opikina, and Dinorthis transversa..... 15.00

Peery limestone

Limestone, dove-gray, fine grained, compact..... 3.0

Limestone, gray, granular, clastic texture..... 17.00

Limestone, dark-bluish gray, cherty; Lophospira..... 48.00

Ward Cove Limestone

Limestone, dark-gray, cherty, contains several layers crowded with Nidulites pyriformis and Receptaculites. Sowerbyella neerita also abundant.....125.00

Limestone, coarse-grained; contains fragmented fossils, also Oligorhynchia and Gonioceras, approximate base at USGS benchmark near road intersection..... 60.00

Lincolnshire limestone

********

| | | | |
|---|---|---|---|
| 51.10 | | _____ | Return to cars, proceed south to intersection of Routes 604 and 16; retrace route to Route 460 and 19 at Frog Level Filling Station. |
| 53.40 | 2.30 | _____ | TURN RIGHT ON U. S. ROUTES 19 and 460. Moccasin and Witten exposed along road. |
| 55.1 | 1.70 | _____ | TURN LEFT on Route 610. |
| 56.00 | 0.90 | _____ | Tazewell Fair Grounds. |
| 56.80 | 0.80 | _____ | TURN RIGHT ON STATE HIGHWAY 61. |
| 56.90 | 0.10 | _____ | North Tazewell. Straight ahead in town. |
| 58.90 | 2.0 | _____ | Peery Lime Company Quarry. In this section, the Peery and Ward Cove limestones are almost wholly dove limestone, which is pure enough to be burned for lime. STOP 29. At this quarry, the Benbolt formation is completely absent by unformity. The Gratton formation rests on the Peery limestone (type locality). Actually, there are at least a dozen different kinds of lime- |

stone in this section, each with different burning characteristics. Examine the fossiliferous Gratton limestone along railroad for fossils (Tetradium cellulosum and T. racemosum). Return to cars and proceed eastward.

59.00 0.10 _____ Moccasin formation.

60.35 1.35 _____ TURN RIGHT ON ROUTE 61; cross tracks and park at intersection.

60.40 0.05 _____ STOP 30. Martinsburg formation exposed in an amazingly contorted zone. The exposure shows nine repetitions of a thin graptolite-bearing limestone. Complexity of structure belied by smooth contours of these hills so common near Tazewell. Most remarkable display of folding evident in southwestern Virginia. Detailed study shows both fracture and flow cleavage, as well as great thickening of limestone beds on crest of folds, and consequent thinning on flanks.

END OF TRIP

Highway information and road maps available.

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# KENTUCKY GEOLOGICAL SOCIETY

## FIELD EXCURSION

## May 5-7, 1950

This field excursion covers a route which is particularly rich in variety of geological features. Limitations of time have made it necessary to concentrate the attention of the party on a few major aspects of the geology along this route. Many interesting features are unmentioned in this guidebook, but wherever possible some note of the most outstanding features is made in the road log of the excursion. Most of the stops made along the route are concerned with the stratigraphy of formations of Canadian and Champlainian age. Some attention is also paid to Middle and Upper Cambrian formations, but the primary emphasis falls on the the lower half of the Ordovician system. Special emphasis is placed upon unusual variations in thickness and facies of various units, upon reef structures, and upon key beds. Wherever feasible, some attention is given to faunal zones and index fossils which facilitate an understanding of the relationships of various facies.

In the interests of emphasis on Cambrian and Ordovician stratigraphy, little mention is made of the formations above the Curdsville horizon. Silurian, Devonian, and Mississippian formations provide their share of stratigraphic problems and phenomena. In centering attention on the lower half of the Ordovician system, the party will be examining the particular succession which has aroused so much interest (and controversy) during the past decade. No attempt will be made to review various interpretations held by as many geologists, which have been discussed in other publications. In connection with detailed discussions of various topics, numerous references are made to previous work. These references are summarized at the end of the guidebook. The major portion of the excursion is in the Clinch Valley region of Scott, Russell, and Tazewell counties, Virginia. Most of the geological features mentioned in this guidebook are discussed more fully in "Industrial Limestones and Dolomites of Virginia: Clinch Valley District," Virginia Geological Survey Bulletin 66 (in press).

The route of the excursion is indicated on Plate 1. The stratigraphy of the Cambrian and Ordovician formations studied is summarized on Plates 2 and 3.

Hearty thanks are expressed to Col. Woodson, Chief of the Virginia State Police, for providing police escort for the field excursion. It will be greatly appreciated if all car drivers will take special precautions to safeguard their cars and the safety of those accompanying them by watching for special signals from the officer and by parking entirely off the hard surface.

## STRATIGRAPHY

Considering the oldest and youngest formations traversed on this excursion, the trip crosses the outcrop of more than 12,000 feet of sedimentary beds ranging in age from Middle Cambrian to lower Pennsylvanian. At the starting point of the excursion, on the northwest slope of Cumberland Mountain, the beds are part of the Lee formation of Pottsville age. The oldest formation traversed on this trip is the Rome formation, which forms the sole of several overthrust blocks. All of the outcrops of the Rome, which are seen on this trip, are bordered on the northwest side by great overthrust faults. Because of the generally steep dips of the beds from Jonesville, Virginia, to Tazewell, Virginia, great thicknesses of strata are crossed in relatively short distances.

### Cambrian Formations

### Rome Formation

The Rome formation is primarily a succession of maroon-drab, green, and buff siliceous shales but contains prominent intercalations of sandstone and dolomite. Several horizons in the Rome formation are marked by the presence of glauconite, which is not particularly common in the Appalachian Paleozoic succession. The total thickness of the Rome formation is not exposed along the route of this excursion, but in other belts of outcrop, particularly near the Blue Ridge along the southeastern side of the Appalachian Valley, the Rome is more than 2,000 feet thick. The upper few hundred feet of the formation, marked by the characteristic maroon-drab and pale-green shales, is well exposed in two belts between Natural Tunnel and Speers Ferry. South of Dickensonville, Russell County, the Rome has been thrust over the Middle Ordovician Moccasin formation which is also red. The two formations are readily distinguished by the fact that the Moccasin is calcareous, slabby, and lumpy, whereas the Rome beds are rather siliceous, fissile, and thoroughly fractured. At Cedar Bluff, Tazewell County, the Rome is primarily a dolomite which lies in fault contact with Middle Devonian black shale.

### Rutledge Limestone

This unit is the lowest or oldest limestone formation traversed on this excursion. The lower 55 feet of the formation is generally very granular, dense, and bluish-gray; the middle 80 feet or so is very dolomitic and weathers a rusty brown; and the upper 60 feet is a bluish-gray and buff banded rock which is less magnesian than the middle unit. Some oolitic beds occur in the lower division. Only the upper 60 feet or so of the Rutledge occurs above the Hunter Valley fault at Horton Summit, Scott County, but a few miles farther south the full thickness of the formation is present and is exposed in a series of knobs along Clinch River and the Clinchfield Railroad northeast of Clinchport, Scott County, Virginia. Rutledge beds are also exposed along State Highway 64 about 300 feet south of the trace of the Copper Creek fault. At Cedar Bluff, Tazewell County, the Rutledge is represented by only 60 feet of beds.

## Rogersville Shale

This unit consists of drab-colored calcareous shales which weather to a bright-buff color. The Rogersville shale contains relatively abundant representatives of an easily recognized fauna of trilobites, characterized by the genus Ehmaniella. The thickness of the Rogersville in Scott County is 100 feet or less, and a much-thinned tongue-like extension of the formation is known to persist as far northeast as Wittens Mills, Tazewell County, where a 20-foot succession of buff calcareous shale overlies a few feet of banded limestone containing Rutledge trilobites.

## Maryville Limestone

The Maryville limestone is primarily a ribbon-banded limestone consisting of dark-bluish gray bands of magnesian limestone with discontinuous partings of buff-weathering silty, dolomitic material. This particular lithology is not confined to the Maryville limestone and is known from parts of the Rome formation upward in the section as high as the lower part of the Copper Ridge dolomite. The type of rock is therefore regarded as a special facies of Cambrian beds. Like the Rutledge, the Maryville contains intercalated beds of oolitic limestone and granular layers which are rather sparsely fossiliferous. The thickness of the unit varies considerably, but in the best exposed section of the Maryville formation, located 3 miles southwest of the Speers Ferry bridge across Clinch River in Scott County, the thickness is 724 feet.

Starting a hundred feet or so south of the exposure of the Hunter Valley fault at Horton Summit, Scott County, and continuing downhill to the south for well over half a mile, beds of Maryville age are exposed. If there is no repetition of strata in this section, the Maryville is about 1,350 feet thick, but there are indications that the middle part of the formation is repeated by folding and minor faulting perhaps four or five times. This section is worthy of examination because it illustrates the typical lithology of the formation. The age of the Maryville is either late Acadian or early St. Croixan, depending upon whether certain trilobites reported to have been collected from the Maryville actually came from that formation or from the basal limy layers of the Nolichucky formation.

## Honaker Dolomite

The Honaker dolomite embraces a time-rock interval equivalent to the Rutledge-Rogersville-Maryville succession (predominantly limestone) as developed in Scott County, Virginia. The Honaker formation is typically developed in Russell and Tazewell counties, Virginia, and is

perhaps best exposed along Route 460 about 1.5 miles north of Claypool Hill, Tazewell County. Plate 2 contains a diagram showing the relations of the Honaker dolomite to the Rutledge-Rogersville-Maryville beds of Scott County. Actually, in the section between Claypool Hill and Cedar Bluff, Tazewell County, the Rutledge and Rogersville elements in the lower Honaker are readily recognized, and a few beds of typical Maryville lithology occur in the predominantly dolomitic middle and upper parts of the formation.

The dolomite beds in the Honaker are very distinctive. Although varying in color from very light-gray to nearly black, all of the dolomites are relatively pure. Chert is almost completely absent, and the alumina and silica in the dolomites characteristically averages less than 4.00 per cent. In many places, particularly in Russell and Tazewell counties, the Honaker dolomites have been very thoroughly brecciated to a fine, powdery rubble. Many of the localized developments of powdery dolomite appear to be related to minor faults or shear zones.

Geologic Section 1.- Honaker dolomite along U. S. Route 460, near Cedar Bluff, Tazewell County, Virginia.

| | Thickness Feet |
|---|---|
| Nolichucky formation | |
| Honaker dolomite | |
| Limestone, dark-bluish gray, coarse grained, oolitic; contains thin interbeds of edgewise conglomerate | 40 |
| Limestone, magnesian, medium to fine grained, ribbon banded, weathers striped | 50 |
| Limestone, bluish-gray, medium to fine grained, sparsely oolitic and conglomeratic; thick-bedded and relatively pure | 26 |
| Limestone, bluish-gray, banded; contains interbeds of drab-gray and chocolate-brown shale | 27 |
| Limestone, dark-bluish gray, banded, clayey, magnesian | 16 |
| Shale, olive-drab, contains fucoids | 3 |
| Limestone, dark bluish-gray, banded | 6 |
| Shale, olive-drab, contains fucoids | 3 |
| Limestone, dark-bluish gray, banded | 3 |
| Shale, buff to olive-drab | 1.6 |
| Limestone, dark-bluish gray, banded, magnesian | 27 |

Dolomite, dark-bluish gray, granular..... 64

Dolomite, light-gray, fine grained, dense..... 8

Limestone, dark-bluish gray, fine grained, dense, banded..... 13

Dolomite, dark-gray, thoroughly fractured..... 6

Dolomite, light-gray, fine grained, dense..... 12

Dolomite, dark-gray, thoroughly fractured..... 21

Dolomite, dark-gray, fine grained, medium bedded..... 46

Dolomite, light-gray with reddish streaks, fine grained..... 46

Dolomite, dark- to medium gray, dense, fine grained..... 12

Dolomite, medium-gray, fine grained, shaly partings..... 32

Dolomite, dark-bluish gray, fine grained, vugs of secondary dolomite..... 2.7

Dolomite, dark-gray, fine grained, dense..... 8

Dolomite, medium-gray, dense; vugs of secondary dolomite..... 31

Dolomite, dark-bluish gray, fine grained, dense..... 96

Dolomite, steel-gray to bluish-gray, finely granular.....339

Dolomite, dark-bluish gray, medium bedded, fine grained.....118

Dolomite interbedded with magnesian limestone, dark-gray, blocky... 35

Limestone, magnesian, shaly..... 34

Shale and shaly limestone, interbedded, bluish-gray to greenish-gray, contains Ehmaniella fauna of trilobites; represents a tongue of Rogersville shale..... 24.1

Limestone, dark-bluish gray, banded; contains intercalated dolomitic layers; Rutledge equivalent..... 51

Rome formation

Numerous sections of the Honaker, exposed in western Russell County, show varying proportions of dolomite to limestone. These sections provide the basis for the diagram shown on Plate 2.

## Nolichucky Formation

The Nolichucky is predominantly a drab-colored shale containing intercalated limestones and edgewise limestone-pebble conglomerates. Quite commonly, the formation as developed in Scott and Russell counties, Virginia, contains intercalated zones of chocolate-brown shale such as characterize the Conasauga formation of Alabama. The upper part of the formation is a banded magnesian limestone, much like the typical beds of the Maryville limestone. This upper limy division of the Nolichucky is known as the Maynardville limestone member. Fossils are not common in the Maynardville beds, but they are rather common in a number of limy shales in the middle and lower parts of the Nolichucky formation. The presence of these fossils is often very difficult to discover, because the greater part of the shales are apparently unfossiliferous, and the barren beds yield a rubble of shale chips, which effectively masks the thin, fossiliferous zones. The most fossiliferous section of the Nolichucky formation known anywhere in Virginia occurs along State Highway 64 south of Dickensonville.

Geologic Section 2. Nolichucky formation along State Highway 64, south of Dickensonville, Russell County, Virginia.

| | Thickness Feet |
|---|---|
| Copper Ridge dolomite | |
| Nolichucky formation | |
| Limestone, bluish-gray, banded.. ..... ..... | 45 |
| Not exposed..... | 20 |
| Shale, greenish-gray, soft..... | 5 |
| Not exposed..... ..... | 10 |
| Limestone, banded..... | 5 |
| Shale, soft, greenish-gray, contains Linguleps walcotti and Aphelaspis.....10 | |
| Not exposed..... | 40 |
| Shale, greenish-gray soft..... | 25 |
| Limestone, thick bedded..... | 15 |
| Shale, soft, greenish-gray; interbeds of limestone conglomerate..... | 30 |
| Limestone, glauconitic; contains Coosia, Oedorhachis boltonensis, and Tricrepicephalus..... | 2 |
| Not exposed..... | 15 |
| Limestone..... | 2 |

Shale..... .... ..... 5

Limestone, thin and thick bedded, clayey, banded, sandy..... 30

Sandstone and limestone, thinly laminated..... 45

Not exposed..... 15

Shale, finely fissile, greenish-gray; contains Agnostus, Norwoodella saffordi, and cystid plates..... 25

Limestone, thin bedded, clay banded, bluish-gray..... 25

Honaker dolomite

The thickness of the Nolichucky decreases northeastward in Virginia. South of Horton Summit, the Nolichucky is about 500 feet thick. The sections of the formation exposed in Russell County range from 500 feet in the Cleveland district to about 250 feet north of Old Rosedale, a few miles southwest of the Russell Tazewell county line. At Wittens Mills, 4 miles northeast of Tazewell, the Nolichucky is less than 50 feet thick. The Nolichucky shale is responsible for the conspicuous ridges known as Moccasin Ridge and Copper Ridge, which cross Scott and Russell counties. The shale is more resistant than the overlying dolomite or underlying beds of the Maryville or Honaker formations.

## Cambrian-Ordovician Beds

### Knox Dolomite Group

For many years, the great succession of dolomitic formations succeeding the Nolichucky or Conasauga formation was referred to in Tennessee as the Knox dolomite. This name never enjoyed wide usage in Virginia, although other Tennessee names for various stratigraphic units were recognized and used in Virginia. Butts (1932; 1933; 1940) classified the Cambrian-Ordovician beds into the following formations:

| | |
|---|---|
| Canadian (Lower Ordovician) Series | Beekmantown dolomite and limestone |
| | Bellefonte equivalent |
| | Nittany equivalent |
| | Axeman equivalent |
| | Stonehenge equivalent |
| ------unconformity------ | |
| Ozarkian System | Chepultepec formation |
| | Copper Ridge dolomite |
| Cambrian System | Nolichucky shale |

Time has shown that the units Butts proposed to be recognized in the succession of formations formerly called the Knox dolomite are scarcely worthy of recognition. Certainly the criteria Butts used for recognition of the above named units fail to yield satisfactory results when applied in southwestern Virginia.

For example, the characteristic sandstone beds of Butts' Copper Ridge formation in southwestern Virginia are intercalated in dolomitic beds discovered to contain Chepultepec fossils. Changes in terminology of the formation names for mappable units in the Knox dolomite of Tennessee, which have been introduced during the past 13 years, have given a much more reliable basis for subdivision of the succession of beds contained in the Knox group.

Detailed study of this succession in southwestern Virginia is now under way, and results up to the present time indicate that the Tennessee nomenclature is applicable in the district of southwestern Virginia which lies northwest of the Saltville fault, that is, in Tazewell, Bland, Russell, Scott, and Lee counties.

In 1942-43, when the writer began a detailed study of the Knox beds in southwestern Virginia, he set out to recognize as many mappable divisions in the Knox group as seemed feasible. Six divisions seemed to be clearly recognizable: an "oolitic member", at the base, directly succeeding the Nolichucky formation, which is characterized by numerous horizons of Cryptozoon-bearing chert, numerous siliceous partings which give the beds a laminated appearance, and numerous oolitic cherts, many of which are associated with the Cryptozoon structures--totalling about 760 to 860 feet thick; a "sandy member" composed of interbedded dolomites, dolomitic limestones and prominent sandy beds, with a total thickness of 350 to 500 feet; a "lower cherty zone" composed chiefly of light-gray fine-grained dolomite with conspicuous interbeds of chert, with a total thickness of 400 to 500 feet; a "limy member" composed of gray granular dolomites and characteristic beds of dove-gray to bluish-gray very fine-grained rather pure limestone containing numerous fossils, such as Lecanospira, and averaging 50 to 100 feet thick; an "upper cherty member" 250 to 350 feet thick, light-gray, and very fine grained, with numerous thick beds of chert; and a "pink dolomite member" 150 to 250 feet thick, with some partings of red shale, and characteristic beds of flesh-colored dolomite with disseminated sand grains and some spongy-weathering fossiliferous chert with Orospira, Eurystomites, Coelocaulus, and Hormotoma artemesia. These divisions have been found to correspond rather closely to the Copper Ridge dolomite, the Chepultepec dolomite (= sandy member plus the lower cherty member), Longview limestone (limy member), Kingsport dolomite (upper cherty member), and Mascot dolomite (pink dolomite member).

The general character and six-fold subdivisions of the Knox group show relatively little variation throughout the area covered by this excursion. The characteristics and subdivisions of the Knox are summarized on Plate 2. One notable feature of the Knox group, which should be emphasized is that almost the entire succession is so siliceous as to be inferior for most commercial purposes. In a few places, a 200- to 300-foot thickness of rock in the lower part of the Copper Ridge dolomite averages less than 4.00 silica. Part of this zone is exposed in the stone quarry at Glenita, just south of Natural Tunnel, Scott County. The following section is typical of the Knox group, as developed in southwestern Virginia.

Geologic Section 3.- Knox dolomite exposed along Blackford Branch of the Norfolk and Western Railway, from Hubbard Junction to Blackford, Russell County, Virginia.

| | Thickness Feet |
|---|---|
| Blackford formation | |
| Knox dolomite group (2,096 feet) | |
| Pink dolomite member (139 feet) | |
| Dolomite, pearl-gray, fine grained, dense, straticulate... | 8 |
| Dolomite, fine grained, pearl-gray with pinkish streaks... | 4 |
| Covered..... | 13 |
| Dolomite, pinkish and gray, fine grained, platy..... | 18 |
| Dolomite, dark-grained, granular, pinkish streaks..... | 36 |
| Dolomite, pearl-gray to dark-gray, fine grained, with pinkish laminations..... | 8 |
| Dolomite and chert, poorly exposed..... | 4 |
| Dolomite, dark-gray, medium grained, even bedded..... | 7 |
| Dolomite, dark-gray, granular..... | 3 |
| Dolomite, pearl-gray to pinkish, fine grained; some grains of sand scattered throughout the rock..... | 15 |
| Dolomite, greenish-gray with pinkish blotches..... | 12 |
| Upper cherty member (236 feet) | |
| Dolomite, very light-gray, fine grained, compact..... | 25 |
| Dolomite, drab-gray, fine grained..... | 14 |
| Dolomite, light-gray, fine grained..... | 28 |
| Dolomite, dark-gray, fine grained, dense..... | 23 |
| Dolomite, dark-gray, coarse grained..... | 8 |
| Dolomite, light-gray, fine grained, straticulate, cherty.. | 20 |
| Dolomite, pearl-gray, fine grained, platy..... | 33 |
| Dolomite, medium gray, medium grained..... | 12 |
| Dolomite, pinkish, fine grained..... | 24 |

Dolomite, reddish with greenish streaks, medium to coarse grained, cherty..... 32

Dolomite, flesh-colored, medium grained, weathers friable; contains abundant chert..... 17

Limy member (80 feet)

Limestone, dove-gray, platy; contains siliceous partings..... 28

Poorly exposed interval; several ledges of gray fossiliferous limestone with Lecanospira; soil choked with blocks of Lecanospira-bearing chert suggesting numerous beds of chert.. 52

Lower cherty member (397 feet)

Dolomite, medium-gray, coarse grained.. ..... 22

Dolomite, light-gray, fine grained, cherty, clayey..... 15

Dolomite, coarse grained, oolitic; mottled buff and gray..... 15

Dolomite, pearl-gray, cherty..... 34

Dolomite, steel-gray, medium grained, cherty..... 85

Dolomite, buff-gray, medium grained, even bedded..... 85

Dolomite, mottled gray and dark-brown..... 105

Dolomite, same as above but with flattened chert nodules..... 18

Dolomite, brownish-gray, crumbly..... 28

Sandy member (483 feet)

Dolomite, brownish-gray, sandy, even bedded..... 102

Sandstone, brownish-gray, dolomitic..... 1

Dolomite, drab-gray, medium grained, even bedded..... 74

Sandstone and sandy dolomite, buff..... 38

Dolomite, light gray, medium to coarse grained, wavy bedded.... 35

Covered interval, mantle rock contains blocks of sandstone and sandy dolomite..... 180

Dolomite, dark-bluish gray, even bedded..... 52

Sandstone, friable, rusty-brown..... 1

Oolitic member (761 feet)

Dolomite, dark-bluish gray..... 25

Dolomite, drab-gray, oolitic, thick bedded..... 128

Dolomite, brownish-gray, even bedded..... 122

Dolomite, dark-bluish gray, medium to coarse grained..... 36

Dolomite and sandstone..... 4

Dolomite, bluish-gray, medium grained, irregularly bedded..... 27

Dolomite, very coarse grained, oolitic, light-gray, thick bedded..... 113

Dolomite, bluish-gray, medium grained..... 81

Dolomite, brownish-gray, medium grained, even bedded..... 129

Dolomite, fine grained, light-gray, banded..... 96

Nolichucky formation

Perhaps the most distinctive beds in the entire Knox group are the straticulate dolomites directly overlying the limy beds at the top of the Nolichucky formation. These banded beds appear to be transitional with the subjacent Maynardville banded limestones, where that facies constitutes the upper Nolichucky. An excellent exposure of the basal straticulate beds occurs just below the crest of Moccasin Ridge along State Highway 71 northeast of Gate City, Scott County.

## Unconformity At Top of the Knox Dolomite

The most widespread and easily recognized break in the entire Paleozoic succession in southwestern Virginia occurs at the top of the Knox. The break is reflected in sharp variations in thickness of the top member of the Knox, by local irregularities of the contact between the dolomite and superjacent formations, by a coarse, conglomeratic overlapping deposit containing large amounts of detrital chert. Local study of the unconformity in Tazewell and Russell counties has disclosed a relief of 350 feet which prevails locally on the old surface of unconformity. In many places, all of the uppermost fossiliferous zone of the Knox has been removed by erosion prior to deposition of the Middle Ordovician formations. This fossiliferous zone, containing gastropods and cephalopods characteristic of the later Cotter and Powell formations of the Missouri Canadian series, is deeply leached wherever present and is generally indicated by a rubble of vuggy chert.

## Champlainian Series

### Blackford Formation

In Tazewell County, Virginia, the erosional surface of unconformity at the top of the Knox group is covered by a succession of silty dolomites and dolomitic mudstones, the basal layers of which contain a profusion of detrital chert pebbles. These dolomitic clayey layers which contain pebbles of chert represent the material washed off an old land surface developed on the Knox dolomite. The characteristic color of the beds is reddish-brown, but many layers are greenish-gray or mottled with green and brown. This material varies in thickness from a few feet to more than 100 feet, the net effect of the beds being to eliminate the sharp irregularities of the erosion surface on which the Blackford formation was deposited. Generally at the top of the formation is a thickness of from 10 to 40 feet of ash-gray, mealy-weathering calcareous shales and argillaceous fine-grained limestones. This division is very easily recognized in several places along the route of the field excursion (see road log for localities). In Clinch Valley, which includes Tazewell, Russell, and Scott counties, the Blackford red beds crop out in two principal belts. One follows along the northwest base of Clinch Mountain, and the other follows Clinch River to a point about 10 miles southwest of Blackford, Russell County, Virginia, and thence along the northwest base of Moccasin Ridge and bordering the Copper Creek fault. These two belts will be referred to as the Clinch Mountain and Copper Creek or Clinch River belts.

The Blackford formation maintains the above described character to a point about 1 mile southwest of U. S. Route 19 near Hansonville, Russell County, where it gives way to an equivalent succession of coarse-grained Holston type limestone which is herein described as the Tumbez limestone. In the Clinch River-Moccasin Ridge-Copper Creek belt, the Blackford formation maintains its identity as far as the Tennessee line, with almost no indications of the coarse-grained Tumbez type of rock in the entire thickness. In Lee County, the Blackford formation is somewhat thinner and lacks the detrital chert present in the basal layers of the formation in the Clinch Valley belts. In Lee County, most of the thickness of the Blackford formation is a relatively thick-bedded very argillaceous and silty dolomite which weathers drab colored. These layers show up prominently in the south end of the Hagan section, 4 miles east of Rose Hill, at Stop 2. Some red beds are present at Stop 3 in Lee County.

One very peculiar feature of the Blackford formation is the shelly or conchoidal fracture of the beds. This feature serves to identify the Blackford where the characteristic red color is lacking. The impure dolomitic layers weather very rapidly. Pieces a foot or so in diameter will disintegrate to a powdery rubble in a few weeks, if exposed on several sides to sun and rain.

The outcrop of the Blackford is quite frequently marked by a distinctive purplish-colored soil which the farmers call "blue ground". Blackford soils are very productive wherever they occur on relatively gentle slopes.

The details of the basal layers of the Blackford vary considerably, depending on the nature and irregularity of the contact with the Knox dolomite. In a few places in Russell and Tazewell counties, some of the red muddy sediment evidently filtered down into crevices or solution channels in the upper Knox. One of these peculiar features occurs along the Norfolk and Western Railway about half a mile west of Pounding Mill, near Stop 24.

The age of the Blackford red beds is reasoned from the interfingering layers of Tumbez limestone noted in the formation near Hansonville, Russell County, which corresponds in fauna to the lower division of the Lenoir limestone as the latter is developed in the Lenoir City-Philadelphia belt of Tennessee. The Blackford was regarded by Butts (1940, p. 120-135) as Murfreesboro age, although none of the Blackford type rock occurs in the real Murfreesboro limestone of Rutherford County, Tennessee, nor does any Murfreesboro fossil occur in the Blackford beds. The establishment of the basal Lenoir age of the Blackford beds has contributed much to the understanding of the Middle Ordovician limestones of the southern Appalachian region (Cooper, 1945; Cooper and Cooper, 1946).

## Tumbez Limestone

Along Clinch Mountain in western Russell County, the Blackford red beds give way to a succession of coarse-grained layers of limestone similar to the Holston of Tennessee. This limestone is quite fossiliferous and is invariably found to yield a great profusion of the small rhynchonellid, Rostricellula pristina. This fossil is confined to the lower division of the type Lenoir of Tennessee and under the original name of Camarotoechia pristina was cited years ago by Raymond (1928) as a valid Chazy guide fossil. Actually, at the type locality of the Tumbez, about 12 miles southwest of Hansonville and a mile or so south of the village (?) of Tumbez, Russell County, both Blackford red-bed facies and Tumbez "marble" facies are developed, but farther southwest in the vicinity of Gate City, the entire formation except for the bottom layers is coarse-grained gray and pinkish limestone marble. The formation is well exposed just above the footwall of the Marcem quarry of the Penn-Dixie Cement Corp., just west of Gate City. At Stop 9, a unique variation in the basal layers of the Tumbez consists of a deep channel cut into the Knox, which is filled with coarse conglomeratic quartz rock, some of which is very ferruginous. In most places, as at Marcem, the very basal layers of the Tumbez contain the same type of detrital chert pebbles as characterize the basal part of the equivalent Blackford formation. Some of the cherty marble beds of the Tumbez can be seen at Stop 9. The following two sections are regarded as typical for the Tumbez in the area covered by the excursion.

Geologic Section 4.- Tumbez limestone about 4 miles southwest of Speers Ferry P. O., Scott County, Virginia.

| | Thickness Feet |
|---|---|
| Elway limestone | |
| Tumbez limestone (175 feet) | |
| Limestone, light-gray to pinkish; Solenopora very common.. | 23 |
| Shale, ash-gray; interbedded with coarse-grained pinkish limestones containing Mimella nucleus; flattened lenses of buff-weathering chert in limy beds..... | 63 |
| Limestone, light-gray, pinkish; contains many Rostricellula pristina..... | 4.5 |
| Shale, shaly limestone, and black chert..... | 85 |
| Knox dolomite | |

Geologic Section 5.- Type section of Tumbez limestone, along Moccasin Creek, about 1.5 miles south of Tumbez, Russell County, Virginia.

| | Thickness Feet |
|---|---|
| Elway limestone | |
| Tumbez limestone (120 feet) | |
| Limestone, pinkish, coarse grained, cross laminated, cherty; contains abundant Solenopora..... | 80 |
| Shale, ash-gray..... | 7 |
| Limestone, conglomeratic, cherty, coarse-grained, pinkish; contains Solenopora..... | 17 |
| Mudrock, maroon-drab, shaly..... | 4 |
| Limestone, medium grained, light-gray, cross laminated..... | 2.4 |
| Shale, ash-gray..... | 5.5 |
| Limestone, light-gray coarse grained, cherty..... | 40-50 |
| Covered interval (across bridge)..... | 10-20 |

Dolomite, light-gray with pinkish blotches; clastic texture.. 13

Limestone, greenish-gray, coarse grained..... 2

Limestone, cross laminated, gray and pinkish mottled; contains abundant Rostricellula pristina..... 11.5

Dolomite, conglomeratic, speckled red and pale green; contains small angular fragments of pinkish chert.....11

Chert breccia, dolomitic matrix, flesh-colored..... 2

Boulder conglomerate, large fragments of chert up to 8 inches in diameter..... 4

Knox dolomite

The peculiar development of the Tumbez formation at Stop 9, north of Marble Church is recorded in the following section.

Geologic Section 6.- Tumbez limestone just north of Marble Church, about 0.5 miles northwest of Melvin, Scott County, Virginia.

Thickness
Feet

Elway limestone

Tumbez limestone (88 feet)

Limestone, light-gray, coarse grained, cherty; contains Solenopora..... 40

Shale, ash-gray; thickens and thins locally..... 20

Sandstone, reddish-brown, coarse-grained, ferruginous..... 23

Chert conglomerate, and chert breccia, ferruginous..... 5

Knox dolomite

## Elway Limestone

The Ellway limestone, where typically developed in Tazewell and eastern Russell Counties, Virginia, consists of about 40 feet of very cherty limestone, which invariably contains a distinctive species of the trilobite genus Calliops and the brachiopod Dinorthis holdeni. In most places, the rock has been decalcified to a siliceous residue. Along the Clinch River-Copper Creek belt of outcrop, the Elway maintains a constant appearance at least as far southwest as the Tennessee line, but along the northwest base of Clinch Mountain, the Elway changes from the characteristically fine-grained limestone to a coarse grained rock tinted pinkish like the Holston marble. In spite of

this change in texture of the limestone, the presence of chert and the characteristic fossils serve to mark the formation wherever it is present. In Lee County, the formation is not so abundantly fossiliferous and in some places the limestone consists of alternately coarse-grained and fine-grained layers. Wherever seen, the mantle rock or weathered residuum from the Elway is so choked with chert as to be virtually useless for agricultural purposes.

The age of the Elway limestone is believed to be Chazy, but it must be admitted that the grounds for this conclusion are not very certainly known. None of the Elway's fossils are known from any of the Chazy formations of New York; however, the superjacent Lincolnshire limestone does contain some Chazy fossils.

## Five Oaks Limestone

The Five Oaks limestone is one of several dove fine-grained limestones which have in years past been referred to as the Mosheim limestone. The Mosheim, however, is considerably older than the Five Oaks limestone, but they resemble one another lithologically. The type locality at Five Oaks, Tazewell County, was formerly the site of an active lime-burning operation, and in many places the relative purity of the rock has led farmers and other small quarry operators to utilize the stone for agricultural liming purposes.

In the Clinch Mountain belt of outcrop, the Five Oaks limestone is not distinguishable southwest of Hansonville, Russell County, but in the Copper Creek-Clinch Valley belt, the formation can be traced as far southwest as the Tennessee line. In the Ewing-Rose Hill-Hagan district, the Five Oaks limestone is conspicuously developed, particularly along the highway just west of the Hagan section where the unit is about 45 feet thick. The characteristic features of the Five Oaks ---cryptocrystalline texture, compactness, conchoidal fracture, and calcite "eyes"---are all strongly developed in the vicinity of Hagan.

One of the confusing aspects of the stratigraphy in Tazewell County is the presence of a bed almost identical to the Five Oaks but some 450 feet higher in the section than the latter. Butts (1932) called both dove limestones the Mosheim. Mapping of the two dove zones across the county disclosed their different positions in the section. The age of the Five Oaks is believed to be Chazy, but no Chazy fossils have so far been found in the unit.

## Lincolnshire Limestone

This formation is one of the most widespread and easily recognized units in the Appalachian Ordovician section. It consists of 50 to 125 feet of dark-gray, almost black cherty limestone. Fossils are not abundant in the unit except in a few places, but almost every exposure will disclose the presence of two species which, so far as known, as valid guides to the formation. These are Dinorthis atavoides

and Sowerbyites triseptatus. The Lincolnshire is the footwall rock in the Pounding Mill quarry in Tazewell County and forms the prominent dark-col red rib of inferior stone which projects into Marcem quarry at Gate City, Scott County. Locally, in both the Clinch Mountain and Copper Creek belts of outcrop, the Lincolnshire contains interbeds of coarse-grained Holston-type limestone. In Lee County, near Hagan, the upper and lower limits of the Lincolnshire are difficult to determine, but the total thickness probably does not exceed 30 feet.

## Ward Cove Limestone

In Tazewell County, the Lincolnshire limestone is succeeded by about 125 feet of rock readily divisible into two members: a lower coarsely granular dark-gray limestone which is always devoid of chert, and an upper zone generally 75 to 100 feet thick which is thin-bedded, dark-gray, much like the Lincolnshire in being abundantly cherty, but characterized by different fossils. The brachiopods Sowerbyella negrita and Strophomena tenuitesta are common, but perhaps the best known and most usable fossil is Nidulites pyriformis. The latter is particularly abundant in western Tazewell County.

Southwestward from the Russell-Tazewell line, the Ward Cove limestone begins to lose its identity and together with the cherty limestone which succeeds it in the vicinity of Tazewell, passes laterally along the base of Clinch Mountain near Elk Garden into a thick body of coarse-grained Holston type limestone, herein called the Rockdell formation. In the Clinch River-Copper Creek belt of outcrop, the Ward Cove limestone is locally identifiable as far southwest as a small isolated area of outcrop in Rye Cove, Scott County, which is located due east from Natural Tunnel.

In Lee County, the Ward Cove limestone is rather thinly developed, except along the base of Wallen Ridge where as much as 100 feet of the formation occurs. Near Hagan, the interval of the Ward Cove limestone probably does not exceed 50 feet.

## Peery limestone

This formation is present in Tazewell County and in Lee County, but cannot be separately recognized and distinguished from the Ward Cove limestone in most of Russell and Scott counties. The Peery limestone in Lee County consists of about 60 feet of cherty limestone which contains many Lophospira gastropods, abundant Tetradium syringoporoides and a small brachiopod, Ancistrorhyncha costata. The latter, as well as the same species of Lophospira occurs in the Murfreesboro limestone of the Stones River group in Central Tennessee. In the spring of this year the writer retrieved from ledges of the Peery formation in the Hagan cut a specimen of Calyptaulax troosti, the type of which comes from the Murfreesboro and Pierce limestones in Central Tennessee. Some of the cherty beds of the Peery in Lee County contain Polylopia, which although not diagnostic of the Murfreesboro limestone, corroborates

the evidence of other fossils, which suggests Murfreesboro affinities of the Peery fauna.

The maximum development of the Peery formation is in western Tazewell County in the belt that parallels Clinch River and the Tazewell-Pounding Mill highway. In this sector, the Peery can be readily differentiated into two divisions, a lower cherty limestone averaging about 35 feet thick and an upper dove-gray cryptocrystalline limestone or calcilutite. The variations in thickness and purity of this upper member constitutes an outstanding example of facies variation and serve to localize one of the purest deposits of limestone in Virginia. The Peery near Claypool Hill consists of 40 feet of dove limestone above and 34 feet of dark-gray cherty limestone below. A few miles east of Pounding Mill, near Maxwell, the dove-gray calcilutite member of the Peery is more than 100 feet thick and averages above 97.00%$CaCO_3$ and less than 1.5%$MgCO_3$. Less than 1 mile east of Maxwell, the dove limestone thins to less than 50 feet and declines in calcium carbonate content so that the rock is inferior for use in chemical lime. Between Pounding Mill and Maxwell the Peery locally swells to more than 200 feet in thickness, but elsewhere in Tazewell County, the total thickness very seldom exceeds 60 feet and the dove limestone of the Maxwell area is either absent or only a very few feet thick. At the Pounding Mill Quarry, the dove limestone of the Peery is 57 feet thick and sufficiently pure to be shipped to Portsmouth, Ohio, for fluxing stone.

Geologic Section 7.- Peery limestone at the Pounding Mill Quarry, Tazewell County, Virginia.

| | Thickness Feet |
|---|---|
| Benbolt limestone | |
| Peery limestone (107 feet) | |
| Limestone, dove-gray, thick bedded..... | 57 |
| Limestone, light- to medium-gray, coarse-grained..... | 12 |
| Limestone, black, fine grained, cherty..... | 19 |
| Limestone, dark-gray, sparsely cherty, fossiliferous... | 19 |
| Ward Cove limestone | |

In Lee County, Virginia, the limits of the Peery are very hard to recognize, because the contact of the Peery with the overlying limestones is nearly everywhere concealed (as in the Hagan cut). The total thickness probably does not exceed 65 feet anywhere in Lee County.

## Rockdell Limestone

Along Clinch Mountain in Russell and Scott counties, the interval between the top of the Lincolnshire limestone and the base of the Benbolt limestone is occupied by a relatively thick body of coarse-grained limestone of Holston type. This rock is very pure and in many places between Speers Ferry and Rockdell (near Elk Garden) is thick enough to be potentially valuable as a source of high-calcium limestone. A few miles northeast of Elk Garden, the Rockdell passes laterally into impure limestone nearly all of which is very cherty. The change marks the merging of the Peery and Ward Cove limestones with the Holston limestone facies. It is noteworthy that many miles southwest of the primary locus of the facies change that the Rockdell limestone contains thin interbeds of dark-gray cherty limestone with the same fossils as characterize the Peery and Ward Cove cherty limestones in Tazewell County. The following sections are typical of the Rockdell limestone in Clinch Valley.

Geologic Section 8.- Rockdell limestone about 1 mile west of Marble Church, Scott County, Virginia.

| | Thickness Feet |
|---|---|
| Benbolt limestone | |
| Rockdell limestone (257 feet) | |
| Limestone, light-gray, coarse to fine grained, pinkish... | 104 |
| Limestone, dark-bluish gray, cherty; contains Sowerbyella negrita and Receptaculites..... | 20 |
| Limestone dark-gray, crumbly, weathers cobbly..... | 35 |
| Limestone, coarse grained, light-gray to pinkish, pure... | 68 |
| Lincolnshire limestone | |

Geologic Section 9.- Rockdell limestone along State Highway 71 near Dorton Fort, Scott County, Virginia.

| | Thickness Feet |
|---|---|
| Limestone, light-gray to pinkish; contains siliceous partings; weathers slabby to platy..... | 62 |
| Limestone, dark-bluish gray..... | 10 |
| Limestone, light-gray to pinkish, coarse grained..... | 15 |
| Limestone, cedar-red to pinkish, coarse grained..... | 47 |

Limestone, light-gray, coarse grained..... 20

Limestone, coarse grained, weathers buff and crumbly..... 18

Limestone, dark-gray to medium-gray; contains wavy black streaks. 86

Lincolnshire limestone

The Rockdell and Lincolnshire in the above section are to be studied at Stop 14.

The age of the Rockdell limestone and of the equivalent Ward Cove and Peery limestones is still not precisely known. The Murfreesboro age of the Peery seems to be strongly indicated by their faunal similarities. The Ward Cove limestone contains many fossils which occur elsewhere in the Appalachian Valley of Virginia in beds which Butts (1940) has called Athens and Chambersburg. These two formations were until 1946 (Cooper and Cooper, 1946) regarded as very different in age, but the two are now known to be roughly equivalent. The Ward Cove limestone is believed to represent a limestone facies of the graptolite-bearing black shale and black limestone which has been so widely misidentified as Athens in the Appalachian Valley. There are no faunal reasons to class either the Ward Cove or Peery with the Chazy. The Peery and Murfreesboro faunas bear rather strong similatity to the New York Black River formation, the Pamelia limestone. It must be remembered that the New York Black River group is an extra-geosynclinal group, having been deposited considerably farther west than the western limits of the Appalachian trough. On the other hand, the Chazy group is intrageosynclinal in every respect. It has been assumed for many years that the New York section of the Middle Ordovician is fairly complete, and many geologists have reasoned that determination of a stratigraphic unit as pre-Black River, post-Canadian in age automatically implied that the unit was Chazy in age.

This type of misplaced confidence in the New York Middle Ordovician section as the standard section of reference for correlation has retarded the proper understanding of the Middle Ordovician of the Appalachian region for a long time. It seems inescapable that we must conclude the Appalachian Ordovician to be considerably more nearly complete and a more desirable section for a standard reference in correlation than anywhere else in the eastern United States.

The difficulties experienced with attempting to correlate the Appalachian units with New York formations seem to the writer to be largely attributable to the fact that the New York units embrace a record of deposition far less nearly complete than the record preserved in the Appalachian region of Virginia and Tennessee.

Benbolt Limestone

The Benbolt formation was first described from Tazewell County where it consists of four divisions: a basal 15-foot zone of granular dark-gray limestone, overlain by about 100 feet of dark-gray nodular limestone which is rather fossiliferous, a third zone composed largely

of coarse-grained cross-laminated limestone generally bluish-gray in color. Locally, the formation may be less than 100 feet thick and in such places is almost invariably composed entirely of nodular gray clayey limestone. The Benbolt seems to be thinner where the subjacent Peery limestone is relatively thick. In places where the formation is fully developed, the top is generally marked by a few cherty layers of dark-gray, cross-bedded limestone.

Along the base of Clinch Mountain in western Tazewell County, the above-described development of the Benbolt changes facies into a body of buff shale and buff very shaly nodular limestone. The buff beds correspond to what has been called Ottosee in parts of Tennessee. The change in facies is a gradual one, taking the form of an almost imperceptible gradation from gray limestone to buff rock. This buff lithology is not particularly prominent in the Benbolt even in eastern Russell County, but the Abingdon-Lebanon road (U. S. 19) traverses a section where little else but buff shaly rock occurs.

Throughout Scott County, the Bebnolt is predominantly buff rock. The section examined near Speers Ferry is typical of the Benbolt limestone in Russell and Scott counties.

Geologic Section 10.- Benbolt formation north of U. S. Route 23, 58, and 421, about 2 miles east of Speers Ferry P. O., Scott County, Va.

| | Thickness Feet |
|---|---|
| Wardell formation | |
| Benbolt formation (386 feet) | |
| Limestone, dark-bluish gray; weathers cobbly; very sparsely cherty | 5-10 |
| Shale and shaly limestone, buff | 35 |
| Limestone, medium grained, very clayey; bright buff; contains Dinorthis transversa and Mimella superba | 59 |
| Shale, weathers buff; contains interbeds of buff nodular limestone | 172 |
| Shale, buff, platy; interbeds of fossiliferous limestone with Campylorthis, Opikina, Dinorthis transversa, and Platycostites faberi | 92 |
| Limestone, thin bedded, coarse grained; composed largely of fragmental cystoids | 2 |
| Shale with lenses of coarse-grained limestone | 3 |
| Limestone, clayey, granular, buff-gray; contains Echinosphaerites aurantium, Paleocrinus striatus, Camerella, Gonioceras, Strophomena, and Oxoplecia simulatrix | 18 |
| Rockdell limestone | |

In the parts of Lee County traversed by this excursion, the Benbolt formation is represented by entirely different facies, which necessitates use of different formational nomenclature.

The age of the Benbolt in terms of the New York formations is impossible to reckon, but it can be said that the Benbolt is equivalent to part of what Butts called Athens and Chambersburg in other belts of the Appalachian Valley of Virginia. The post-Chazy age of the Benbolt seems definitely established, although Ulrich and Butts regarded the Ottosee as Chazyan in their classification.

## Gratton Limestone

This unit is principally confined to the western Appalachian belts northeast of Tazewell and is not encountered along the route of the excursion until Stop 27 at Maxwell, Tazewell County.

Geologic Section 11.- Gratton limestone at Blue Grass Lime quarry, Maxwell, Tazewell County, Virginia.

| | Thickness Feet |
|---|---|
| Gratton limestone (100 feet) | |
| Limestone, thin bedded, fine grained, dove-gray.... | 13 |
| Limestone, dark-gray; interbedded with buff shaly limestone..... | 25 |
| Limestone, conglomeratic; pebbles of fine grained limestone..... | 4 |
| Limestone, dark-gray, granular, sparsely cherty.... | 9 |
| Limestone, thin-bedded. laminated..... | 10 |
| Limestone, dove-gray, medium bedded; contains reefy layers with Stromatocerium and Favistella..... | 37 |
| Limestone, buff-gray, finely laminated..... | 2 |
| Benbolt limestone | |

At Stop 27, where the Gratton is traversed a short distance from the Blue Grass Lime Company's operation, the coral-bearing beds of the Gratton are well exhibited. The formation is also seen at the Peery Lime Company's plant at North Tazewell, where beds along the railroad contain great profusion of Tetradium corals.

The age of the Gratton is closely linked to the New York Black River group. The obvious connection between the two, so far as age is concerned, stems from the fact that the Gratton is of the same facies as the Lowville limestone of New York. The faunas of these

dove limestones is more characteristic of the particular facies than of any precise time of deposition.

In the vicinity of Maxwell, at Stop 27, the Gratton is overlapped by the upper part of the Wardell formation. When the writer published his original revision of the Middle Ordovician stratigraphy of Tazewell County, in 1943 (Cooper and Prouty, 1943), he regarded the Wardell formation as entirely younger than the Gratton, but later work shows the two are essentially the same age, with only the upper beds of the Wardell locally overlapping the Gratton where the latter is thin and is wedging out to the southwest of Maxwell.

As will be noted later in this guidebook, the Wardell formation includes intercalations of rock identical to the Gratton, which suggests additional evidence that the two are but facies of one another. The Gratton limestone is not recognized in Lee County, but the formation is undoubtedly represented in the Ben Hur limestone.

## Wardell Limestone

The Wardell formation is developed principally in Russell and Scott counties, but was defined from a slightly thinned phase in western Tazewell County. Normally, the formation directly overlies the Benbolt formation, but in the vicinity of Maxwell, Tazewell County, the upper two divisions of the four which characterize the Wardell actually overlie the Gratton limestone. The main part of the Wardell and the Gratton probably intertongue with one another and are therefore equivalent.

The Wardell is well exposed along U. S. Routes 23, 58, and 421 between Speers Ferry and Daniboone Yard. The following section typifies the Wardell in this sector.

Geologic Section 12.- Wardell formation about 2 miles east of Speers Ferry P. O., Scott County, Virginia.

| | Thickness Feet |
|---|---|
| Bowen formation | |
| Wardell formation (162 feet) | |
| Shale, buff, platy; contains thin intercalated sandstones..... | 13 |
| Limestone, coarse grained, crinoidal; contains Girvanella, Stromatocerium, and Favistella..... ..... | 7 |
| Limestone, bluish-gray, medium grained, thin bedded..... | 6.5 |

Limestone, medium-gray, buff-weathering, contains sandy partings; cherty layer at top..... 12

Shale, buff, platy..... 55

Limestone, medium grained, very shaly, weathers buff; contains Receptaculites biconstrictus, Campylorthis, and Hesperorthis..... 12

Limestone, gray, coarse grained, cross bedded..... 23

Limestone, buff, nodular-weathering; contains abundant Solenopora..... 22

Limestone, medium bedded, thin clayey stringers; weathers gray to buff; contains Solenopora and Girvanella..... 11

Benbolt limestone

The nodular buff beds of the Wardell are perhaps the most characteristic part of the formation. They are well exposed along U. S. Routes 23, 58, and 421 just west of Danlboon Yard, a short distance east of Stop 8. The platy buff shales in the upper part of the formation are very distinctive. Although coarse-grained limestones are relatively scarce in the formation, one very outstanding exception to this must be noted. At Stop 11, near Snowflake, Scott County, the Wardell has its thickest development anywhere in Virginia. The formation includes a local but prominent reef or bioherm.

Geologic Section 13.- Wardell formation in quarry one mile southeast of Snowflake, Scott County, Virginia.

Thickness
Feet

Wardell formation

Shale, platy, buff-weathering, contains intercalated sandy layers..... 40

Limestone, nodular, buff-gray, very poorly exposed..... 30-50

Limestone, coarse grained, buff; contains great profusion of bryozans and corals. Fossils include Favistella halli, Lichenaria carterensis, Receptaculites biconstrictus, Solenopora compacta, Girvanella sp., and Stromatocerium rugosum..... 10-12

Limestone, light-gray to pinkish, fine grained, reefy; contains Stromatocerium, Dystactospongia, and Tetradium cellulosum..... 13

Limestone, massive, almost devoid of bedding, contains lenses and pockets of coarse-grained pinkish and cedar-red limestone; mainly fine grained; Stromatocerium and Dystactospongia very abundant..... 20

Limestone, very fine grained with streaks of coarse-grained pinkish limestone; reefy structure; contains Tetradium cellullsum and T. racemosum..... 16

Limestone, pink and gray, fine grained, thin greenish siliceous partings..... 3.5

Limestone, mottled gray and pinkish, contains Ancistrorhyncha and Oligorhynchia..... 3

Limestone, pink and gray, very fine grained..... 5

Limestone, coarse-grained, pinkish, very fossiliferous; argillaceous partings abundant..... 21

Limestone, crumbly, irregular texture; contains abundant Girvanella..... 9

Limestone, light-gray to pinkish, coarse-grained, lower half contains intercalated 5-foot bed of dove-gray calcilutite..... 24

Covered interval to approximate base of formation..... 28

Benbolt formation

The above section cannot be traced more than a few hundred feet to the northeast of the quarry, and was not identified west of the quarry in the next ravine a few hundred feet away. The bioherm seems to be a localized phenomenon which replaces much of the nodular limestone zone which constitutes elsewhere at least 50% of the formation. Smaller less spectacular showings of reef rock in the Wardell occur along the roadside east and west of Danlboone Yard.

The Wardell formation is not separately recognizable in Lee County, but faunal zones in the Ben Hur limestone show definitely that this unit is in part equivalent to the Wardell. The Wardell shows faunal affinities to the upper Ridley and lower Lebanon limestones of Central Tennessee and with the Chaumont limestone of New York. The latter is regarded as upper Black River by Kay and others.

## Bowen Formation

In western Tazewell County, Russell County, and Scott County, the Wardell formation is directly overlain by 30 to 60 feet of red straticulate mudstones which are everywhere characterized by mudcracks and ripple marks. The Bowen formation forms one of the key beds in the Middle Ordovician. In many places the basal few feet of the formation consist of calcareous concretionary sandstone ---the only sandstone occurring in the Middle Ordovician of Clinch Valley. The Bowen is well shown along U. S. Routes 23, 58, and 421

between Speers Ferry and Danlboone Yard. The unit is not developed in Lee County and is not known very far east of Tazewell, Virginia. Near North Tazewell, the red color of the formation begins to disappear and the division is difficult to distinguish from the superjacent Witten limestone. Locally the Bowen is marked by polygonal joints which give rise to a columnar jointing. The joints are definitely desiccation fractures and are rather remarkable because they are locally preserved through as much as 8 feet thickness of strata.

## Ben Hur Limestone

This name has not yet been formally proposed in print but is fully described and explained in a comprehensive summary of Middle Ordovician stratigraphy now in manuscript form, which has been prepared by the writer in collaboration with G. A. Cooper, of the U. S. National Museum.

The Ben Hur limestone is named for a thick succession of dove limestones with a few lithologically dissimilar interbeds, which is typically developed at Hagan, near Rose Hill, Lee County, Virginia. This unit has not been hitherto named in an accurate way. Part of it was referred to by Huffman (1945) as "Ottosee", by Miller (1948) as "Lowville". The following section of the formation occurs along and just east of Hagan Spur.

Geologic Section 14.- Ben Hur limestone along and near Hagan Spur of the Louisville and Nashville Railroad, Hagan, Lee County, Va.

| | Thickness Feet |
|---|---|
| Witten limestone | |
| Ben Hur limestone (350 feet) | |
| Limestone, dove-gray, slabby, with interbeds of coarse-grained limestone contains Ancistrorhyncha and Fascifera. | 12 |
| Limestone, fine-grained, impure, shaly partings; contains silicified Opikina septata and Hesperorthis..... | 1.5 |
| Limestone, gray, nodular-weathering, mottled gray and buff; outcrop marked by loose encrusted masses of Stromatocerium (same bed as at Stop 1)..... | 4 |
| Limestone, dove-gray, slabby, about one-third exposed; contains Tetradium cellulosum and bathyurid trilobites... | 38 |
| Limestone, drab-gray, slabby; contains Tetradium..... | 7 |

Limestone, dove-gray, thick bedded, calcite eyes..... 8

Limestone, dove-gray, impure, buff-gray, laminated..... 8

Mudstone, gray to reddish; interbedded with drab-gray calcareous shale..... 19

Limestone, dove-gray, thick bedded, purest zone in entire formation; makes bold ledge unlike other parts of the formation; Tetradium corals on top bedding surface..... 36

Mudstone, reddish-gray..... 2

Limestone, thick-bedded, dove-gray, good ledge-maker..... 11

Mudstone, reddish-brown; and buff limestone..... 3

Limestone, medium-bedded; contains Tetradium racemosum..... 4

Limestone, buff-weathering, very impure, slabby; few Plectocamera, such as occur in Rye Cove lower Ottosee beds of Butts (1940)..... 7

Limestone, granular, gray, clayey stringers..... 6

Limestone, medium-gray to golden-gray, medium bedded; contains bathyurid trilobites and Tetradium..... 55

Limestone, very slabby; contains abundant Tetradium ..... 72

Limestone, slabby, contains minor interbeds of buff shale; bedding planes rough and irregular; abundant Tetradium... 57

Peery limestone

The Ben Hur limestone occupies the stratigraphic interval of the Benbolt, Wardell, and Bowen formations of the Clinch Valley district. The upper part of the formation, particularly the Stromatocerium and Hesperorthis beds link the unit with the Wardell limestone of the Clinch Valley area. Zones of buff shale, many with abundant fossils, occur in the lower half of the unit along Wallen Ridge on the south side of the Powell Valley anticline in Lee County. These beds and their fossils, which include Opikina, Campylorthis, Strophomena, and Oxoplecia simulatrix indicate that the contained sequence is of Benbolt age. This limestone succession is not, as was formerly supposed, the precise equivalent of the New York Lowville. The Tetradium species which pervade the entire thickness are more a mark of the dove-limestone facies rather than any precise time-stratigraphic zone.

The Stromatocerium biostrome noted in the quarry at Stop 1, the reddish mudstone zones, and the 36-foot ledge-making limestone included by the red mudstone zones comprise widespread key horizons for surface mapping and also for subsurface correlation in a few of the deeper wells in the Rose Hill field.

## Witten Limestone

The Witten limestone is the most distinctive, persistent, and readily identifiable unit in the Middle Ordovician of southwestern Virginia. This formation is characteristically well exposed, quite abundantly fossiliferous, and very slabby in all but the lowermost beds. Generally, a four-fold development of the formation is evident. The basal few feet are commonly straticulate and striped; the second zone composed of 4- to 6-inch layers of golden-gray calcilutite with Tetradium cellulosum and T. clarki abundant; a third zone made up of thin granular limestones with Zygospira recurvirostris and Pianodema minuscula and the well-known fossil Cryptophragmus antiquatus; and a top division of slabby rock carrying marks of Buthotrephis and Camarocladia, but with Cryptophragmus, Pianodema, Rostricellula, and Opikina also common.

Geologic Section 15.- Witten limestone southeast of Danlboone Yard, Scott County, Virginia.

| | Thickness Feet |
|---|---|
| Moccasin formation | |
| Witten limestone (144 feet) | |
| Limestone, golden-gray, slabby; abundant Camarocladia.... | 80 |
| Limestone, coarse-grained, gray, thin bedded; contains Zygospira recurvirostris ..... | 10 |
| Limestone, olive-drab to buff gray; thin partings of coarse-grained limestone with Cryptophragmus..... | 18 |
| Limestone, light-bluish gray, even bedded, very fine grained..... | 22 |
| Limestone, buff-gray, crumbly..... | 14 |
| Bowen formation | |

Generally, about 60 feet below the top of the formation is a thin zone of cherty limestone. Edgewise conglomerates are numerous in the lower half of the formation, particularly in the coarse-grained Zygospira-bearing beds and in the subjacent golden-gray calcilutites.

In Lee County, the Witten is about 200 feet thick. The layers with Cryptophragmus are exceptionally well developed. The fauna and general lithology of the Camarocladia-bearing beds is so like the Lebanon limestone of Central Tennessee that there can be no doubt as to the certainty of their equivalency. Even the manner of outcrop of the Witten duplicates the Lebanon limestone type of outcrop, which in Central Tennessee is characterized by cedar glades. The Witten is not the sole representative of the Lebanon in the Lee County area, but the succeeding Stallard limestone and lower part of the Tyrone beds are of Lebanon age. It is not unlikely that the Witten and the Lebanon are actually Trenton in age, corresponding to the Rockland-Hull sequence of the Trenton of Ontario.

## Stallard Limestone

This unit is composed primarily of greenish-gray calcareous mudstone and clayey limestone, with intercalations of buff shale and dove limestone. Thin interbeds of Camarocladia-bearing limestone containing the same fossils as found in the Witten below suggest that the Stallard formation is also Lebanon in age. The thickness of the Stallard formation is approximately 185 feet in the Hagan section.

The name used for this unit is being formally introduced in a manuscript on the Middle Ordovician stratigraphy of the southern Appalachian region. The type locality is Stallard Ford, near Dryden, Lee County, Virginia.

The Stallard formation corresponds to the lower part of the Moccasin formation, as that formation is developed along Clinch Mountain. The Stallard might be said to be the Moccasin lithology minus the characteristic maroon-drab color.

## Hardy Creek Limestone

The Hardy Creek limestone is a 135- to 160-foot succession of dove limestones, brownish-gray siliceous limestones, and layers containing nodules of chert. The formation contains thin partings like the characteristic lithic type of the Stallard formation, and also a very few fossiliferous beds seemingly identical to the fossiliferous rock in the Witten limestone. The Hardy Creek limestone is probably also of Lebanon age. It corresponds to the upper part of the Moccasin formation, which southwest of Speers Ferry con-

tains intercalations of cherty limestone identical to those in the Hardy Creek limestone. The name Hardy Creek was introduced by Miller as a member name for a part of the unit he called Moccasin (Miller, 1948).

## Moccasin Formation

This unit is so distinctive and well known that it scarcely needs description. Throughout Clinch Valley in Virginia, the Moccasin is 325 to 450 feet thick and composed of mudstone of greenish-gray layers and maroon-drab layers, the latter far more abundant than the former. The top part of the Moccasin is a black-weathering siltstone. In a few places where the Moccasin is very well exposed, interbeded bentonites occur. These partings serve as gliding surfaces along which the superjacent beds crumple and shear without affecting the beds below the bentonites. These bentonitic shear zones are beautifully shown in the fine section along State Highway 16, southwest of Tazewell, at Stop 28.

For many years, the Bowen beds, the Witten, and superjacent Moccasin formation were all considered parts of the same unit, the Lowville-Moccasin formation. It was argued by Butts (1932, 1933, 1940) that the intercalation of limestone (called Witten by the writer) was Lowville in age and therefore the enclosing Moccasin red beds were Lowville. Actually, by original definition (Campbell, 1894) the beds herein called Witten, as well as the thin subjacent Bowen red beds were excluded from the Moccasin formation. Also the stamp of finality which was formerly attributed to the Witten beds when they were called Lowville limestone by Butts (1940) has ceased to enjoy universal favor. The writer favors the correlation of the Moccasin with the upper Lebanon, and on the Maynardville-Tazewell highway in Tennessee, north of Lone Mountain, the Moccasin red beds and Lebanon-type limestone are seen to interfinger with one another. The Moccasin is accorded an early Trenton age in this report, primarily because the fossiliferous beds with which it interfingers are largely believed to be of early Trenton age.

## Eggleston Formation

This formation was named by Mathews (1934) for a succession of drab limestones, mudrocks, and intercalated bentonites occurring in Giles County, Virginia, directly above the Moccasin formation and below the Martinsburg formation of Trenton, Eden, and early Maysville age. Contrary to general knowledge or belief, the Eggleston formation is not entirely pre-Trenton in any sense of the word. As shown in Geologic Section 17, the Eggleston formation contains fossils of Curdsville age, which definitely link that part of the formation with the Middle Trenton and also with the lower Martinsburg which also contains Curdsville fossils.

The Eggleston formation is best developed in Tazewell County, and Giles County, but it can be traced southwestward at least as far as Speers Ferry, Scott County. One characteristic of the formation is the presence of silicified beds with peculiar "cuneiform" fracture, which underlie the bentonite zones. The bentonite beds are not generally seen in natural exposures, but the sharply angular blocks with cuneiform jointing are a telltale sign of the presence of bentonitic material. The explanation of the silicified, cuneiform-jointed layers in the Eggleston formation is as follows. The ash beds were altered to bentonitic clays after deposition. This process was accompanied by release of much silica which was carried downward into the limestone layers immediately under the bentonites, in some instances replacing the limestones entirely. So complete is the process of silicification in some places that the bed under the bentonites has been altered to chert. In the writer's opinion, the age of the Eggleston at the type locality and also in Clinch Valley is Curdsville, or middle Trenton.

## Tyrone Formation

In Lee County, the Hardy Creek limestone is succeeded by a 140 to 155-foot succession of impure limestones, greenish mudstones, and intercalated slabby limestones, with three conspicuous bentonites. Huffman (1945) identified the succession as the Eggleston formation, but apparently without reliable basis. The Lee County beds contain none of the fossils in the Eggleston of Tazewell and Giles counties. The correlation was based largely on bentonites, but with several bentonites developed in the same general part of the stratigraphic column, the correlation of any two is purely an arbitrary matter, unless a sequence of similar beds can be established in the two areas. This cannot be done in connection with the Eggleston and Lee County beds called by that name by Huffman and also by Miller (1948). The Tyrone age of the Lee County beds is clearly indicated by fossils, and the bentonites support the identification. The Tyrone of Kentucky and Central Tennessee has for years been considered to be Black River or Louville, but the writer regards the Tyrone as lower Trenton, along with the Lebanon and Witten, and Moccasin formations.

Geologic Section 16.- Tyrone formation along Louisville and Nashville Railroad, near Hagan, Lee County, Virginia.

| | Thickness Feet |
|---|---|
| Curdsville limestone | |
| Tyrone formation | |
| Limestone, dove-gray, fine grained, nodular with partings of greenish-gray shale..... | 1.5 |

Bentonite, greenish-gray, flecked with black biotite flakes; weathers buff..... 3.8

Chert, black..... .3

Limestone, dove-gray to lilac-gray, impure; contains thin coarse-grained limestone intercalations with fossils including Pianodema minuscula, Zygospira..... 6.0

Limestone, gray, thoroughly fractured, very argillaceous, mealy-weathering.....16

Limestone, medium to fine grained, gray; contains coarse-grained fossiliferous interbeds with Zygospira, Pianodema, Eucharopora, and Rhinidictya..... 14

Bentonite, yellowish-green to greenish-gray, speckled with biotite..... 3

Chert, black..... .3

Limestone, fine grained, dove-gray; contains coarse-grained limestone layers with abundant fossils, including all of above genera, and Callions callicephalus, Arthroclema, Tetradium cellulosum, and a small coral common in the Tyrone near Lebanon, Tennessee..... 38

Shale, buff, bentonitic..... .6

Limestone, dove-gray, dense, shaly..... 20

Mudstone, bluish-gray to greenish-gray, lumpy..... 34

Limestone, dove-gray, blocky bedded, cut by fault..... 6.5

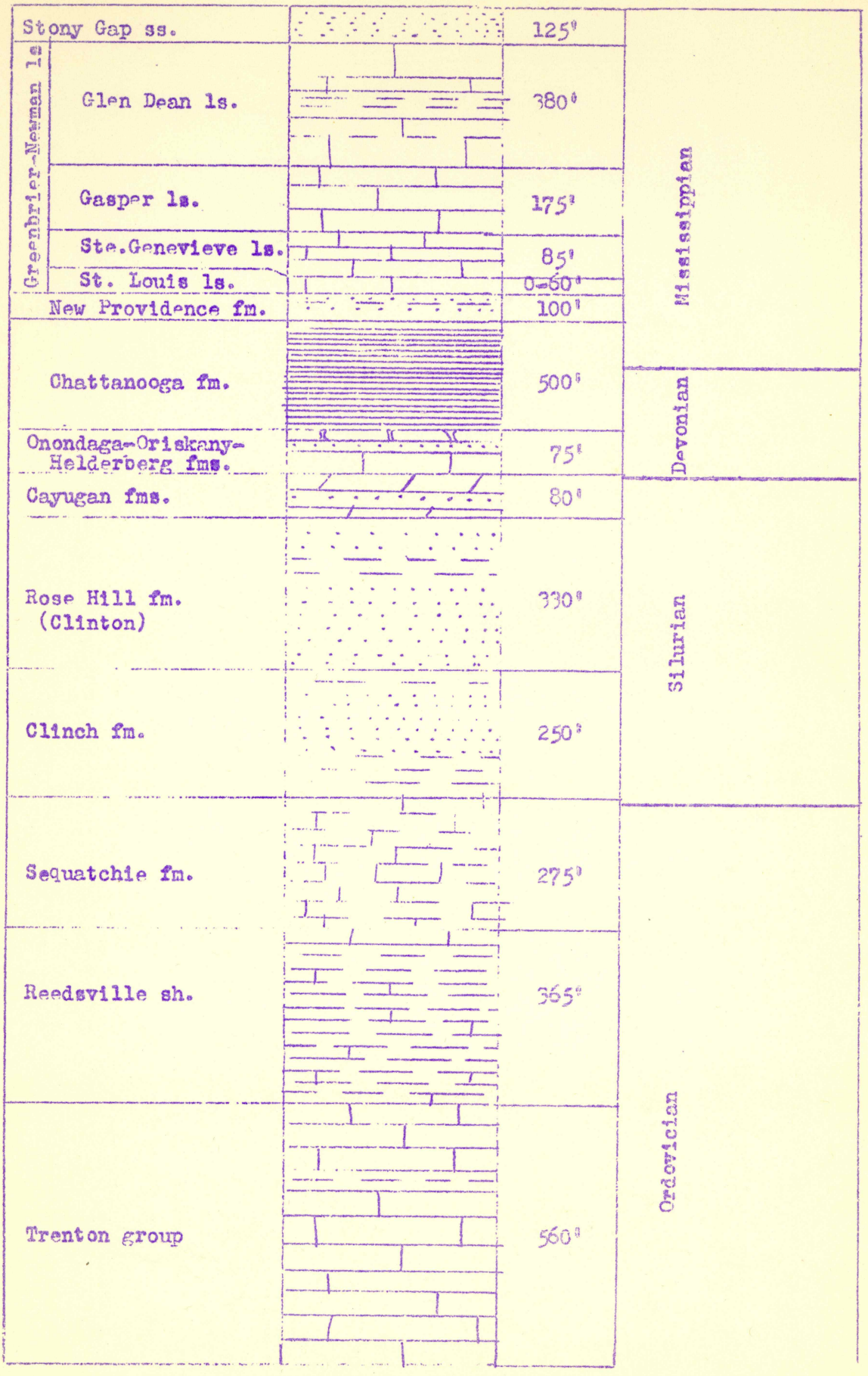
Shale, greenish-gray, fractured..... .7

Bentonite, greenish-gray..... .6

Hardy Creek limestone

## Younger Formations

As previously mentioned, this field excursion is devoting its attention to formations described in the foregoing pages; formations of the Ordovician younger than the Tyrone or Eggleston, and all the Silurian, Devonian, Mississippian, and lower Pennsylvanian formations traversed on the excursion are summarized on columnar sections immediately following this page.




COLUMNAR SECTION OF POST-TYRONE FORMATIONS TRAVERSED ON EXCURSION

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