Silurian Nomenclature and Correlations in Southwest Virginia and Northeast Tennessee

GEOLOGICAL SURVEY BULLETIN 1405-H

Silurian Nomenclature and Correlations in Southwest Virginia and Northeast Tennessee

By RALPH L. MILLER

CONTRIBUTIONS TO STRATIGRAPHY

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Establishes a reference section for the Clinch Sandstone, extends the name Rose Hill Formation to southwest Virginia and northernmost Tennessee, and clarifies the relations between the Clinch Sandstone, Rose Hill Formation, and Rockwood Formation

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1976

UNITED STATES DEPARTMENT OF THE INTERIOR

THOMAS S. KLEPPE, *Secretary*

GEOLOGICAL SURVEY

V. E. McKelvey, *Director*

Library of Congress Cataloging in Publication Data

Miller, Ralph LeRoy, 1909-
Silurian nomenclature and correlations in southwest Virginia and northeast Tennessee.
(Contributions to stratigraphy)

(Geological Survey Bulletin 1405-H)
Bibliography: p. 23-25.
Supt. of Docs. no.: I 19.3:1405-H
1. Geology, Stratigraphic–Silurian. 2. Geology, Stratigraphic–Nomenclature–Virginia. 3. Geology, Stratigraphic–Nomenclature–Tennessee. 4. Stratigraphic correlation–Virginia. Geological Survey Bulletin 1405-H.
QE75.B9 no. 1405-H [QE66] 550'.8s[551.7'32'097557] 75-619502

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington, D. C. 20402

Stock Number 024-001-02787-9

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SILURIAN NOMENCLATURE AND CORRELATIONS IN SOUTHWEST VIRGINIA AND NORTHEAST TENNESSEE

By RALPH L. MILLER

ABSTRACT

Silurian clastic formations in southwest Virginia and northeast Tennessee have been named Clinch Sandstone, Clinton Formation, and Rockwood Formation. In Lee County, Va., and adjacent areas, two members of the Clinch have been mapped, a lower Hagan Shale Member and an upper Poor Valley Ridge (sandstone) Member.

The Clinch Sandstone takes its name from Clinch Mountain, a prominent ridge 140 miles (225 km) long in Tennessee and Virginia. Although the formation has been recognized and mapped in both States for more than 100 years, until very recently no type section was ever designated. Sections of the formation were examined along all roads that cross the mountain, and excellent exposures were found at Little Moccasin Gap, Washington County, Va. As a type section has now been described in east Tennessee, the Virginia section is here designated a reference section and is described.

Overlying the Clinch Sandstone in southwest Virginia and northeast Tennessee is a clastic sequence, predominantly shale, of Middle Silurian age, that has been called the Clinton Formation, from a location in central New York. In western Maryland, however, a sequence of the same age and similar lithology is named the Rose Hill Formation, and this name is in general use for these beds in West Virginia and in parts of western Virginia. In west-central Virginia, the name Cacapon Sandstone Member of the Clinton Formation has also been applied to a sequence approximately equivalent to the Rose Hill Formation, but the Middle Silurian rocks of southwest Virginia more closely resemble the Rose Hill Formation than they do the more sandy Cacapon.

Because of the remoteness of the type area of the Clinton Group from southwest Virginia and northeast Tennessee and the intervention of an established and extremely well documented alternative name for the beds in question, the name Clinton Formation should be dropped in southwest Virginia and northeast Tennessee in favor of Rose Hill Formation.

The Clinch Sandstone is of Early Silurian age in the outcrop belts in Lee County, Va., but in Clinch Mountain, beds of early Middle Silurian age may be included at the top. The Rose Hill Formation is Middle Silurian.

In ridges in Tennessee west of Clinch Mountain, the Silurian clastic rocks were examined at 13 localities in three belts of outcrop. The Poor Valley Ridge (sandstone) Member, the mountain-forming member of the Clinch, thins by loss of sandstone units in a southwestward direction along the Big Ridge belt. Near the crossing of Lone Mountain by U.S. Interstate 75, the underlying Hagan Shale Member and the overlying Rose Hill Formation come together. From here southwestward, the combined sequence constitutes the Rockwood Formation. Northeast of I–75, however, the Clinch Sandstone, including both its members, and the overlying Rose Hill Formation are identifiable and can be mapped separately. In the Poor Valley Ridge outcrop belt farther west, the Clinch Sandstone and the Rose Hill Formation are identifiable in Tennessee as in Virginia; in the Dutch Valley belt to the south and the Elk Valley belt to the west, no Poor Valley Ridge Member is present, and the name Rockwood Formation is applicable.

INTRODUCTION

Silurian formations of southwest Virginia and northeast Tennessee crop out in long northeast-trending belts which are separated from each other by major overthrust faults. Most of the belts terminate laterally against overthrust faults. In much of this region, the entire Silurian sequence consists of clastic sediments of Early and Middle Silurian age, some of which are resistant sandstones that form ridges or imposing mountains. Elsewhere, however, a carbonate formation of Late Silurian age intervenes between the clastic beds and the overlying Devonian formations.

In southwest Virginia, the Silurian formations are the Clinch Sandstone, the Clinton Formation, and the Hancock Limestone (or Dolomite). In Tennessee, the Clinch Sandstone and the Clinton Formation are recognized in some mountain belts; elsewhere Silurian clastic rocks have been called the Rockwood Formation, and the overlying carbonate rocks (if present) are the Hancock Limestone. In southwestermost Virginia and northernmost Tennessee, the Clinch is divided into a lower Hagan Shale Member and an upper Poor Valley Ridge Member. The name Rose Hill Formation is here introduced for rocks previously called Clinton Formation.

This study was undertaken (1) to determine the lithology and thickness of the Clinch Sandstone in its type area in Clinch Mountain and to establish a reference section for the formation somewhere along Clinch Mountain; (2) to determine the areal extent over which the two members of the Clinch can be recognized and mapped; (3) to examine the suitability of the name Clinton Formation in this region; (4) to determine the relations between the Clinch Sandstone, or the Clinch Sandstone and Clinton Formation combined, of Virginia and the Rockwood Formation of Tennessee.

Fieldwork contributing to the present investigation has been carried on by the author for many years in southwest Virginia and northeast Tennessee. Specific localities discussed in this report in Virginia and Tennessee were visited or revisited in June 1973. The author has also drawn on published reports, principally modern geologic quadrangle maps, for material in areas not visited.

ACKNOWLEDGMENTS

I am indebted to Robert Milici of the Tennessee Division of Geology and Helmuth Wedow, Jr., of the U.S. Geological Survey, not only for providing valuable information on the Rockwood Formation during 2 days in the field, but also for allowing access to their unpublished material on the Upper Ordovician and Silurian stratigraphy in Sequatchie Valley and parts of the adjacent Valley and Ridge,

Tennessee. They have been concerned with Silurian rocks in east-central and southeast Tennessee, whereas this paper is devoted to northeast Tennessee and adjacent Virginia.

REGIONAL SETTING

Silurian rocks crop out linearly in the Valley and Ridge province from southeastern New York to Alabama. Most of the Silurian System is represented by clastic rocks, of which the oldest formations (Shawangunk Conglomerate (or Formation) in New York, New Jersey, and eastern Pennsylvania; Tuscarora Sandstone in central Pennsylvania, Maryland, and northern Virginia; and Clinch Sandstone in southern Virginia and Tennessee) commonly form the highest and most prominent ridges in the province. Overlying these formations in many belts of outcrop is a sequence of beds, predominantly marine shale, which in western Maryland has been named the Rose Hill Formation (of the Clinton Group), by some authors but which in Virginia and Tennessee has in most reports been called the Clinton Formation. A carbonate formation of Late Silurian age, the Hancock Limestone (Sneedville Limestone of some authors), is present in some places in southwest Virginia and Tennessee overlying the clastic rocks but is absent elsewhere.

The linear belts of outcrop in southwest Virginia and northeast Tennessee are shown in figure 1. They are separated from each other by major overthrust faults dipping southeast, along which forward movement is measurable in miles. The outcrop belts strike northeast, which was also the approximate trend of the shorelines in Silurian time. Hence, the lithofacies are quite similar for many miles along the individual belts but differ materially from one belt to the next across the strike. This has been the principal factor in the problems of nomenclature and correlation with which this report is concerned.

ORIGIN AND USAGE OF FORMATION NAMES

CLINCH SANDSTONE

Safford (1856) named the Clinch Sandstone to include the white relatively thick bedded sandstone and conglomerate, several hundred feet thick, that caps Clinch Mountain and other ridges in east Tennessee. Geographically, the name Clinch Mountain is applied to a continuous ridge extending from Burkes Garden near Tazewell in Tazewell County, Va., for 140 miles (225 km) southwest to an abrupt termination in Union and Grainger Counties, Tenn., where the belt of Clinch at the surface is cut off by the Saltville fault. Safford (1869) later further described the Clinch Sandstone but provisionally included in the formation the underlying red calcareous shale which

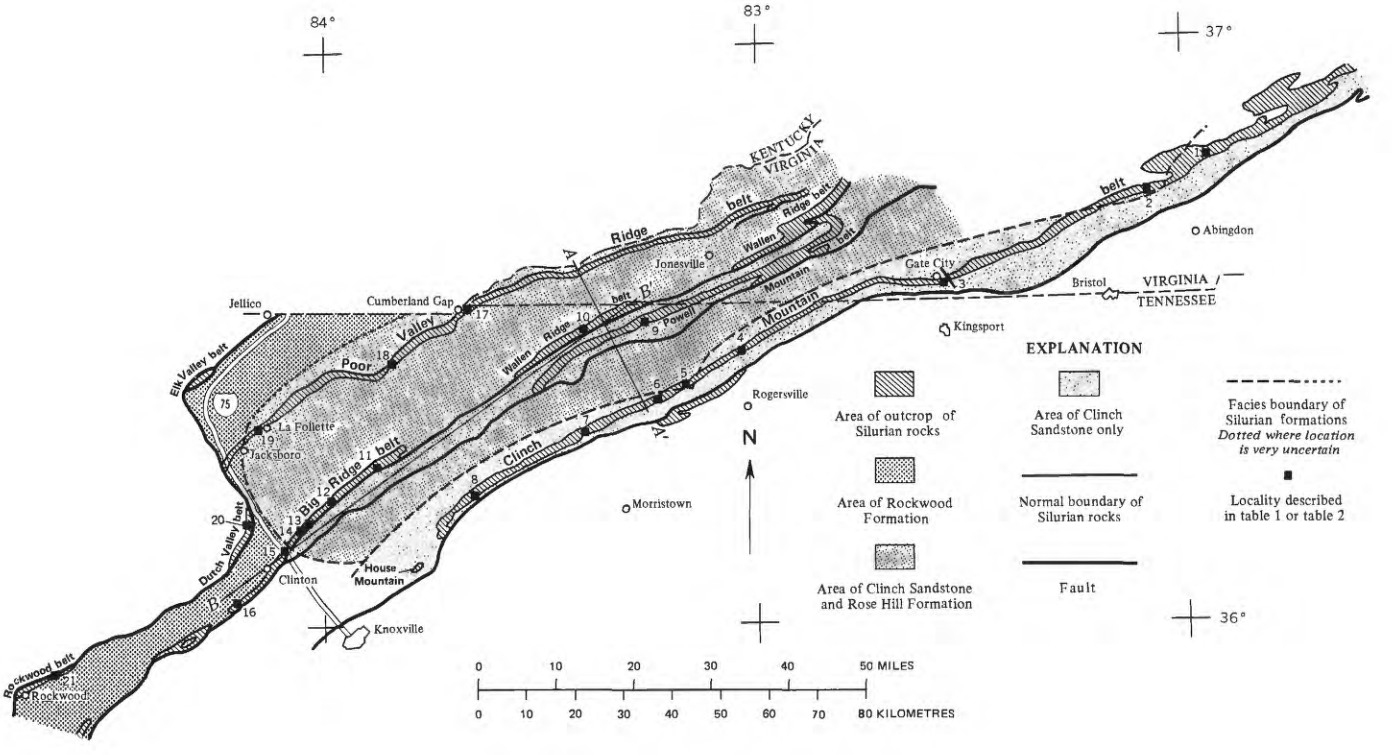

FIGURE 1.—Map of southwest Virginia and northeast Tennessee showing belts of outcrop of Silurian formations, localities mentioned in text numbered 1 to 21, location of the lines of restored sections *A–A'* (fig. 2) and *B–B'* (fig. 3), and areas in which Clinch Sandstone, Clinch Sandstone and Rose Hill Formation, and Rockwood Formation were deposited. The same locality numbers are used in tables 1 and 2.

has subsequently been designated as the Juniata or Sequatchie Formation and dated as Late Ordovician. He did not designate a type section for the Clinch Sandstone, a common omission of those times. Later work, principally in U.S. Geological Survey folios, restricted the name Clinch to Safford's white sandstone unit, excluding the underlying red beds of Late Ordovician age. This work also extended the type area to include Clinch Mountain in Scott County, Va.

Miller and Fuller (1947, 1954), Miller and Brosgé (1950, 1954), Miller (1965), and Miller and Roen (1971, 1973) identified and mapped members of the Clinch Sandstone in the belts of outcrop northwest of Clinch Mountain in Lee and Wise Counties, Va. These are designated in figure 1 as the Powell Mountain belt, the Wallen Ridge belt, and the Poor Valley Ridge belt. The members are the Hagan Shale Member below and the Poor Valley Ridge (sandstone) Member above. Others have mapped these divisions of the Clinch in the Powell Mountain and Wallen Ridge belts to the southwest in Tennessee (Harris and others, 1962; Harris, 1965; Harris and Mixon, 1970). Others (Englund and others, 1961, 1963; Englund, 1964) have recognized the two lithologic divisions of the Clinch in the Poor Valley Ridge belt but have not used the formal member names or mapped them separately. Recent mapping that has included the Clinch Mountain belt has used the name Clinch Sandstone for the mountain-forming sandstones except in reports on the Bristol and Wallace quadrangles (Bartlett and Webb, 1971) and the Clinchport quadrangle (Brent, 1963), all in Virginia, where the name Tuscarora Sandstone from the central Appalachians was used.

CLINTON FORMATION–ROSE HILL FORMATION

The Clinton Group was named by T. A. Conrad in 1842 for exposures near Clinton in central New York. The name has had a long and varied history, but in the central Appalachians both historically and in recent years it has been maintained in group status. In the southern Appalachians, however, especially in southwestern Virginia and northern Tennessee, it has been considered a formation of Middle Silurian age between the Clinch Sandstone below and the Hancock (Sneedville of some authors) Limestone above. It has also been thought to be the formation that contains the "Clinton type" sedimentary hematitic iron ores. Miller and Fuller (1954), however, have shown that the Clinch Sandstone also locally includes "Clinton type" iron-rich beds, and R. C. Milici and Helmuth Wedow, Jr. (unpub. data, 1974), have also found "Clinton type" iron-rich beds both in the Early Silurian part of the Rockwood Formation in central Tennessee and in the Shellmound (equivalent to Sequatchie) Formation of Late Ordovician age in southern Tennessee. Although the name Clinton Formation has been used by many workers in southwest Virginia and

east Tennessee, including Butts (1940), Miller and Fuller (1954), Miller and Brosgé (1954), Harris (1965), and others, it seems an ill-advised choice for these rocks, partly because of their remoteness from the type region in New York State and partly because of a history of disagreements as to what units should be included in the Clinton Group of the central Appalachians. Different usages are documented in the Lexicon of Geologic Names of the United States (Wilmarth, 1938; Keroher, 1966).

Meanwhile, an excellent alternative to the use of the name Clinton in the southern Appalachians has existed since 1923. This is the Rose Hill Formation of western Maryland which has its type region almost midway between Clinton, N.Y. and southwest Virginia. The formation was named and meticulously described by Swartz (1923) and Prouty and Swartz (1923). The formation is still excellently exposed in railroad and highway cuts at Rose Hill on the west edge of Cumberland, Allegany County, Md. In western Maryland, the sequence of shale, thin-bedded sandstone, and hematitic "iron ore" beds is lithologically very similar to the Clinton Formation of southwest Virginia, and Miller and Fuller (1954) have shown that the ostracode zones (as identified by F. M. Swartz, written commun., 1945) of the lower and upper part of the Clinton are the same as those of the Rose Hill. The name Rose Hill Formation was adopted for use in West Virginia by Woodward (1941), and it appears as one of the formations of the Clinton Group on the State Geologic Map of West Virginia (Caldwell and others, 1968). Cooper (1944) used the name Rose Hill in his report on the Burkes Garden quadrangle in Tazewell and adjacent counties of southwest Virginia and also in a field-trip guidebook (1961), but other workers did not follow his lead.

In westernmost Maryland and adjacent West Virginia, another name, Cacapon Sandstone, was applied by Darton and Taff (1896) to a red flaggy sandstone approximately equivalent to the lower part of the Rose Hill Formation. In the middle part of the Appalachian Valley of Virginia, Butts (1940) used Cacapon as the lower "division" of his Clinton Formation; the Cacapon is composed of shale and sandstone including "highly ferruginous sandstone of distinctive character." On the other hand, Lesure (1957) used the name Rose Hill Formation in the Clifton Forge region of west-central Virginia for beds that are lithologically similar to the type Rose Hill but that contain a large proportion of the distinctive red or reddish-purple ferruginous sandstone described by Butts. More recently, quadrangle mappers (Bick, 1962; Kozak, 1965, 1970; Rader, 1967, 1969; Spencer, 1968; McGuire, 1970) in and near the region of Lesure's work have applied the old name Cacapon Sandstone of Darton and Taff to these same beds. The lithology of the Middle Silurian beds of southwest Virginia,

however, more closely resembles the Rose Hill Formation of western Maryland and eastern West Virginia than it does the ferruginous sandstone facies to which the name Cacapon has been applied. The Virginia Geological Survey is now dropping the name Cacapon in favor of Rose Hill Formation (Young and Rader, 1974). For all of the above reasons, therefore, it is recommended that the name Clinton Formation that has frequently been used in southwest Virginia and northeast Tennessee be superseded by the name Rose Hill Formation.

ROCKWOOD FORMATION

One purpose of the present investigation was to determine the relations between the Clinch and so-called Clinton (or Rose Hill) Formations of southwest Virginia and the Rockwood Formation of east Tennessee. In general, the practice in east Tennessee has been to map the Clinch Sandstone where it is thick and forms prominent mountain ranges but to apply the name Rockwood where the Silurian clastic rocks are dominantly shale and siltstone and where any ridges held up by these rocks are relatively low compared with the mountains to the east (Clinch Mountain, Powell Mountain, and Wallen Ridge).

The Rockwood Formation was named by Hayes (1891, p. 143) from the town of Rockwood, Roane County, Tenn. The name appeared in a graphic column without any description of the formation. In the Kingston (Tenn.) Folio, however, Hayes (1894) described the Rockwood Formation and included in it not only the Silurian clastic rocks but also the red calcareous mudstone, now named the Sequatchie Formation and dated as Late Ordovician. The name Rockwood has since been restricted to the overlying Silurian beds, which are lithologically quite distinctive and are easily separable from the Sequatchie beds (E.O. Ulrich, in Burchard, 1913, p. 31; Rodgers, 1953, p. 100).

The equivalence of the Rockwood to other named Silurian clastic formations in the bistate area has been unclear. The Rockwood has been considered (1) the fine-grained western equivalent of the Clinch Sandstone and of Early Silurian (Brassfield) age (Ulrich, in Burchard, 1913, p. 31; Berry and Boucot, 1970); (2) the equivalent of the Clinch and Clinton (Rose Hill) Formations of northernmost Tennessee west of Clinch Mountain, and of southwest Virginia, thus of Early and Middle Silurian age (Swingle, 1960a, b; Englund, 1964); and (3) the Tennessee equivalent of the Clinton (Rose Hill) of southwest Virginia and hence of Middle Silurian age (Englund, 1968; Swingle and others, 1966).

CLINCH SANDSTONE

CLINCH MOUNTAIN BELT AND REFERENCE SECTION

The type area of the Clinch Sandstone, as previously indicated, is

Clinch Mountain in northeast Tennessee and southwest Virginia. The formation dips consistently southeast with dips from 15° to nearly vertical. The lowermost beds crop out a few tens of feet northwest of the crest of the mountain; the rest of the formation occupies the upper and middle slopes of the southeast flank. In places, dip slopes have formed for hundreds of feet, but in general the beds dip somewhat more steeply than the mountain slope. Because of the abundant cover of colluvium, the long difficult traverses required in trying to measure sections of the Clinch along sidehill roads or trails, and the unsatisfactory number of outcrops down the mountain side, it is understandable that only one section of the Clinch on Clinch Mountain has been published in all the years since Safford named the formation. Even the thickness of the formation is difficult to determine, and published thicknesses have been highly generalized, for example, "200 feet," "300 feet," "maximum approximately 500 feet." Their order of magnitude is somewhat suspect.

The writer has examined every potential section along the roads that overtop the mountain from Russell County, Va., to Knox County, Tenn., and also potential sections in the two water gaps that cut the mountain, both in Virginia. A summary of each of these is shown in table 1, the numbers keyed to the numbering system on figure 1.

The best section of the Clinch, in the writer's opinion, is in the water gap where Little Moccasin Creek and U.S. Highways 19 and Alternate 58 penetrate Clinch Mountain 8 miles (13 km) north of Abingdon, Va. (fig. 1, No. 2). This is named Moccasin Gap on the Brumley (1:24,000) topographic quadrangle map but is here referred to as Little Moccasin Gap to avoid confusion with the water gap at Gate City (fig. 1, No. 3) where Big Moccasin Creek cuts through the mountain, and which is also named Moccasin Gap on the Gate City (1:24,000) topographic map.

Butts (1940, p. 231) measured and published a stratigraphic section through Little Moccasin Gap, assigning 125 feet (38 m) of even-bedded white sandstone in one undivided unit to the Clinch Sandstone and 361 feet (110 m) of overlying beds, predominantly sandstone, to the overlying Clinton Formation. Since Butts' work, a new superhighway has been constructed through the gap with longer roadcuts, creating excellent exposures of most of the Clinch and the lower part of the overlying Rose Hill (Clinton) Formation. The author intended to designate this as the type section of the Clinch Sandstone. Dennison (Dennison and Boucot, 1974), however, has published a detailed section of the Clinch at Little War Gap, Kyles Ford quadrangle, Tennessee (fig. 1, No. 4), and has designated this as the type section of the Clinch Sandstone. The section given below is therefore here designated as a reference section of the Clinch.

Section of Clinch Sandstone (reference section) and lower part of Rose Hill Formation

[Measured along U.S. 19 and 58 Alt. in Little Moccasin Gap through Clinch Mountain (Brumley quadrangle, 1:24,000) 8 miles (13 km) north-northwest of Abingdon, Washington County, Va. All the section is on west side of divided four-lane highway. Section begins 100 feet (30 m) north of turn-around lane directly south of John Douglas Memorial Wayside and ends at area of deformed slumped beds near south end of cut. Dip of beds 25° SSE]

	Thickness (feet)	Thickness (metres)
Slumped beds, dipping anomalously, to south end of highway cut.		
Rose Hill Formation (in part):		
26. Sandstone, light-gray, fine-grained, resistant; zone of shale in middle. Beds somewhat disturbed by slumping and by small fault above	25+	7.6+
25. Shale, medium-gray; some has a red cast. Fault, probably small, at top of unit	29	8.8
24. Siltstone, medium-dark-gray. Contains crinoid columnals. Resistant unit	1–3	0.3–0.9
23. Shale, medium-gray; contains a few pale-red beds and a few beds of siltstone 1–2 in. (2.5–5 cm) thick. Contains *Eocoelia hemisphaerica* (brachiopod), *Mastigobolbina lata* (ostracode), crinoid columnals, fucoids, and worm trails	18	5.5
22. Sandstone, very fine grained; coated with films of greenish-gray mudstone and contains patches of grayish-red sandstone in lower part	10	3.1
21. Sandstone, fine-grained; in beds as much as 3 ft (1 m) thick, coated with films of mudstone. Moderately resistant	8	2.4
20. Sandstone, fine-grained; platy bedded in lower half, changing to medium-gray shale in upper half. Irregular bedding surfaces coated with mudstone	6	1.8
19. Shale, medium-gray, and sandstone, light-gray, very fine grained, with undulatory bedding. Each sandstone bed is sandwiched by shale layers. In lowest 2 ft (0.6 m), sandstone composes 60 percent of unit, but upper part of unit is almost entirely shale. Basal bed contains shale pellets as much as ½ in. (1.3 cm) in size and other trash	9	2.7
Thickness of lower part of Rose Hill Formation	107+	32.5+
Clinch Sandstone:		
18. Sandstone, light-gray, very fine grained; in beds 1–4 in. (2.5–9 cm) thick. Transition zone	4	1.2
17. Sandstone, light-gray, very fine grained; laminated, in one massive resistant unit	5	1.5
16. Siltstone, gray (faint grayish-red tint at top), nubbly	4	1.2
15. Shale, gray, weathered	2	.6
14. Sandstone, gray, and siltstone containing a 1-ft-thick (0.3 m) grayish-red zone in middle	11	3.4
13. Siltstone, mottled grayish-red and medium-gray. Conspicuous where weathering has accentuated the colors. Some black manganese oxide staining. Similar beds have been found near the top of the Clinch Sandstone in other outcrop belts	6	1.8

Section of Clinch Sandstone (reference section) and lower part of Rose Hill Formation—Continued

	Thickness (feet)	Thickness (metres)
12. Siltstone, greenish-gray, mottled, earthy; weathers yellowish and reddish brown. Thin bedded but poorly defined bedding in more massive units	17	5.2
11. Sandstone, fine-grained, moderately quartzose; contains a few shale partings as much as 4 in. (10 cm) thick	19	5.8
10. Sandstone, thin-bedded, and shale medium-gray, interbedded	4	1.2
9. Sandstone, light-gray, fine-grained, moderately quartzose; in beds 2 in. (5 cm) to 2 ft (0.6 m) thick	26	7.9
8. Shale, medium-gray, and sandstone, thin-bedded, interbedded. Lowermost shale zone in Clinch	4	1.2
7. Sandstone, light- and medium-gray, moderately quartzose; in beds 1 to 2 ft (0.3–0.6 m) thick	22	6.7
6. Sandstone, fine-grained, and a little siltstone in beds ½ in. to 2 ft (1–60 cm) thick. Thinner bedded and less quartzose than units 3 and 4. *Arthrophycus* near base	42	12.8
5. Largely covered but a few beds exposed of fine-grained sandstone, thinner bedded and less quartzose than underlying units	52	15.9
4. Sandstone, white, quartzose; medium grained in lower part, changing to fine grained upward. Some beds have shallow oval pits where clay or shale galls have weathered out	55	16.8
3. Sandstone, white, medium-grained, quartzose; in massive beds as much as 5 ft (1.5 m) thick	21	6.4
Total thickness of Clinch Sandstone	294	89.6
Juniata Formation (in part):		
2. Covered, but largely or entirely Juniata	19	5.8
1. Siltstone, grayish-red and greenish-gray; contains a little mudstone. Even bedded but weathers into irregularly shaped crumbly cobbles. Most beds are 1–6 in. (2.5–15 cm) thick	12+	3.7+
Thickness of Juniata Formation (in part)	31+	9.4+

The large discrepancy between Butts' (1940) thickness of the Clinch and the thickness given in the above reference section is largely because Butts included in his Clinch Sandstone only the lowermost white massive-bedded sandstone, more or less equivalent to units 3, 4, and probably part of 5. The overlying beds, here included in the Clinch Sandstone, were assigned by him to the Clinton Formation (Rose Hill Formation of this report), probably in part because of the thinner bedding and the presence of some interbedded shale. In many other places, along Clinch Mountain and in the ranges to the west, the

author has seen thin units of shale in the middle and upper parts of the Clinch. The sandstone beds in this upper part of the Clinch Sandstone are indeed less quartzose than in the lower part of the formation, but they have clay galls, worm tubes, and other littoral-type features, and they lack marine fossils. Butts (1940, p. 231) remarked on the "lumpy mottled red and green rocks*** persistent in this region" which are probably units 12 and 13 of the above section. The writer has noted this lithology in the upper part of the Clinch Sandstone, not only elsewhere along Clinch Mountain where the Rose Hill was entirely lacking, but also in the Poor Valley Ridge Member of the Clinch in mountain ranges to the west. The evidence thus seems to justify placing in the Clinch some 170 feet (52 m) of beds that Butts included in his Clinton Formation.

Other sections along Clinch Mountain in Virginia and Tennessee are described briefly in table 1; at most of these places it would be extremely difficult to get a good measured section along the present roads or by traversing down the steep, timbered, and largely colluvium-veneered slopes.

It should be noted in table 1 that only at Big War Gap, Lee Valley quadrangle, Tennessee (fig. 1, No. 5), were any Rose Hill rocks found overlying the Clinch, as they do conspicuously at Little Moccasin Gap. At Big War Gap 2 feet (0.6 m) of Rose Hill was exposed. Elsewhere, a few feet (about 1 m) to perhaps 20 or more feet (6 m) of the Wildcat Valley Sandstone of Early Devonian age lies between the Clinch and the overlying thick Middle and Upper Devonian dark-gray shales (Chattanooga Shale and equivalent formations).

RIDGES WEST AND NORTH OF CLINCH MOUNTAIN

In the three Silurian belts west and north of Clinch Mountain in southwest Virginia and northernmost Tennessee, the basal unit of the Clinch Sandstone is not the resistant mountain-forming sandstone typical of Clinch Mountain, but rather a gray shale unit containing a few thin beds of platy fine-grained sandstone, and (or) silty to sandy limestone. At many localities there is a basal bed 1 to 3 feet (0.3–0.9 m) thick of resistant medium-grained sandstone. This sequence was named the Hagan Shale Member of the Clinch (Miller and Fuller, 1954). The member ranges from 50 to 130 feet (15–40 m) in thickness.

The Hagan Shale Member is overlain by resistant beds of medium-grained sandstone similar to the mountain-forming sandstones of Clinch Mountain. These beds were designated the Poor Valley Ridge Member of the Clinch Sandstone by Miller and Fuller (1954). The Poor Valley Ridge Member is almost entirely fluvial in the Powell Mountain and Wallen Ridge belts, where it is about 180 feet (55 m) thick. It is somewhat thinner and also contains many tongues of

TABLE 1.—*Clinch Sandstone along roads crossing Clinch Mountain, Va. and Tenn.*

Name of section	No. in fig. 1	Quadrangle (1:24,000)	Number and quality of outcrops	Description	Underlying formation	Overlying formation
Hayters Gap.	1	Hayters Gap, Va.	Abundant and good in lower part of formation only. Poor place for measured section.	Coarse quartzose sandstone at base, overlain by medium-grained sandstone in beds 2½ in. (10 cm) to 2 ft (0.6 m) thick. One zone of hematitic sandstone about 2½ in. (10 cm) thick near top.	Juniata Formation	Wildcat Valley Sandstone.
Little Moccasin Gap.	2	Brumley, Va.	Abundant and excellent except in middle part of formation (reference section).	Sandstone, white, medium-grained in lower part; sandstone, gray, fine-grained, containing shale and siltstone beds in upper part. See measured section for details.	Juniata Formation	Rose Hill Formation.
Big Moccasin Gap.	3	Gate City, Va.	Major fault traverses gap. Silurian formations largely absent at creek, highway and railroad level.	No section possible because of faulting.		

Little War Gap.	4	Kyles Ford, Tenn.	Lower and upper contacts well exposed. Many discontinuous outcrops in between.	White, quartzose, locally pebbly in lower part. Upper part finer grained, less quartzose; purplish and iron-stained beds near top.	Juniata Formation	Thin Wildcat Valley Sandstone (17 ft, 5 m) overlain by basal beds of Chattanooga Shale.
Big War Gap.	5	Lee Valley, Tenn.	Few outcrops. No section possible.		Juniata Formation	Rose Hill Formation(?) (about 2 ft, 0.6 m). Poor exposures.
Flat Gap ------	6	Lee Valley, Tenn.	Excellent exposures of lower part. Very few outcrops of middle and upper parts.	Lowermost beds of Clinch fine-grained quartzose sandstone, becoming medium grained upward. Two zones of red and green shale near base.	Juniata Formation (very well exposed). Conformable contact with Clinch.	Upper part of Clinch and overlying beds covered.
Bean Gap ----	7	Avondale, Tenn.	Base excellently exposed. Scattered exposures of overlying lower part. A few outcrops near top.	Basal Clinch fine-grained moderately quartzose sandstone. Lower part fine and medium-grained sandstone.	Juniata Formation. Conformable contact with Clinch.	Wildcat Valley Sandstone (deeply weathered), overlain by Chattanooga Shale.
Powder Spring Gap.	8	Luttrell, Tenn.	Few outcrops. No section possible. Lower and upper contacts and most of Clinch covered.		Juniata Formation	Wildcat Valley Sandstone.

fossiliferous shale in the Poor Valley Ridge belt. As a result, Poor Valley Ridge is a lower and much less prominent ridge.

In all outcrop belts, the Clinch Sandstone lies disconformably on the Sequatchie Formation (Upper Ordovician), a red calcareous siltstone and mudstone, or on its red largely noncalcareous eastern equivalent, the Juniata Formation.

AGE

The Clinch is essentially unfossiliferous in Clinch Mountain, except for worm burrows such as *Arthrophycus* and *Scolithus*. In the belts to the west, however, the Hagan Shale Member is sparingly fossiliferous in most localities, as is the overlying Poor Valley Ridge Member. At Cumberland Gap, Tenn., in the Poor Valley Ridge belt, however, Butts (1940, p. 235–237) has described an abundant marine fauna from the Clinch. Butts' measured section at this locality (1940, p. 232) is incorrect because of an error in projecting from a highway cut for the lower part of the section to a railroad cut for the upper part (Miller and Fuller, 1954, p. 147–148, pl. 29), but the validity of his fossil evidence is unaffected. On the basis of this fauna, Butts correlated the Clinch with the Albion Sandstone of New York and the Brassfield Limestone of Ohio, both Early Silurian in age. In the three mountain belts west of Clinch Mountain, the lowermost beds of the overlying Rose Hill Formation contain abundant *Eocoelia hemisphaerica* (formerly *Coelospira hemisphaerica*). The ostracode *Zygobolba anticostiensis* has also been found in these lowermost beds of the Rose Hill. This ostracode is considered diagnostic of the earliest Niagaran Series in its type area in Maryland (Swartz, 1923, p. 30) and is early Middle Silurian in age. Hence, the Clinch of the western belts in southwest Virginia and northeast Tennessee is Early Silurian.

In the reference section of the Clinch at Little Moccasin Gap through Clinch Mountain, the lowermost fossiliferous beds of the overlying Rose Hill, 23 feet (7 m) above the base of the formation, contain *Mastigobolbina lata*. This ostracode is considered diagnostic of the middle part of the Rose Hill Formation and is of Middle Silurian age. The Clinch gives way upward to the overlying Rose Hill through a 4-foot-thick (1.2-m) transition zone, no unconformity or disconformity being present. It is thus possible that the Clinch at this reference section is both Early Silurian and early Middle Silurian in age. Whether this is also possible elsewhere in the Clinch Mountain belt is unknown, but the presence of varicolored mottled purplish beds near the top of the formation in several Tennessee localities, matching similar beds in about the same position in Virginia, suggests continuity of these beds from one end of Clinch Mountain to the other.

ROSE HILL FORMATION

The Clinch is overlain in the Powell Mountain, Wallen Ridge, and Poor Valley Ridge belts by the Rose Hill Formation. The Rose Hill is predominantly shale but contains platy beds of fine-grained sandstone and hematitic beds from fractions of an inch to 2 feet (0.6 m) thick in its lower part. Locally it also contains a few thicker sandstone units which somewhat resemble some of the sandstone beds in the upper part of the Clinch but which are separated from the Clinch and from each other by much greater thicknesses of shale than are present in the Clinch.

The Rose Hill Formation is dated as Middle Silurian, predominantly by its ostracode faunas. In Lee County, Va., a distinct sedimentary break exists between the Clinch and the overlying Rose Hill; an abrupt lithologic change takes place at the contact, and abundant fossils are present in the lowermost Rose Hill beds, including particularly the small brachiopod *Eocoelia hemisphaerica*. Elsewhere, however, the exact contact between the Clinch Sandstone and Rose Hill Formation is difficult to select because shale partings and beds are present in the uppermost part of the Clinch, and fairly thick bedded sandstone units that resemble the quartzose fine-grained Clinch are locally present in the lowermost part of the Rose Hill Formation.

The Rose Hill Formation is about 325 feet (100 m) to 400 feet (120 m) thick in the Powell Mountain, Wallen Ridge, and Poor Valley Ridge belts. Measured sections under the name Clinton Shale have been published by Miller and Fuller (1954, p. 188) and Miller and Brosgé (1954, p. 124–125). In the Clinch Mountain belt, the Rose Hill is absent at most localities; at Little Moccasin Gap, it is more than 88 feet (27 m) thick, and at Big War Gap, 2 feet (0.6 m) of exposed beds seem to belong to this formation. This suggests that the formation was probably deposited in the Clinch Mountain region but that at most localities it was removed by erosion in the diastem that encompassed all of Late Silurian time and Early Devonian time.

In the restored section (fig. 2) along the line *A–A'* (fig. 1), the intertonguing relation of the Clinch Sandstone in Clinch Mountain to the Clinch and Rose Hill Formations to the northwest is shown.

ROCKWOOD FORMATION

As previously noted, the Clinch Sandstone, containing two members, and the Rose Hill Formation are present in the Powell Mountain and Wallen Ridge belts in southwest Virginia and northernmost Tennessee. Father south and west, however, the resistant ridge-forming sandstone units of the Clinch Sandstone (Poor Valley Ridge Member) become thinner, and the name Rockwood Formation is in common use for the entire Silurian clastic sequence.

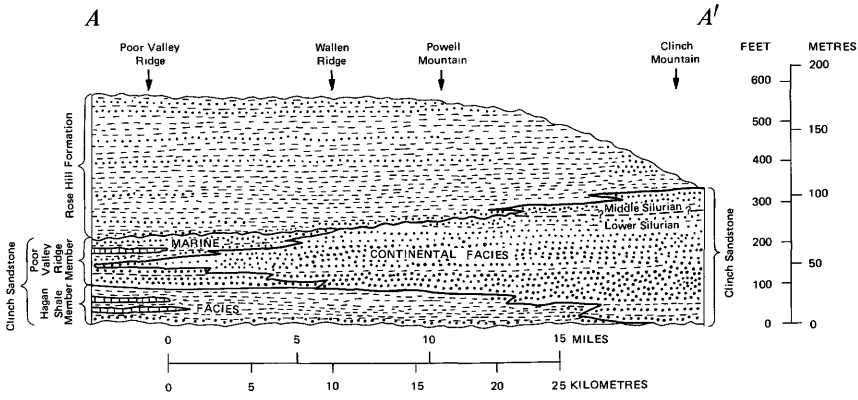

FIGURE 2.—Restored section along the line *A–A'* (fig. 1) showing the changes in facies and nomenclature from Clinch Mountain northwestward to Poor Valley Ridge.

The author has visited 11 localities in the Big Ridge, Dutch Valley, and Poor Valley Ridge belts of outcrop that seemed most favorable for good exposures of the Rockwood Formation. These localities are shown in figure 1, number 11–21, and the rock sections are summarized in table 2. In the northern and eastern localities, both members of the Clinch Sandstone are recognizable and mappable, as is the overlying Rose Hill Formation. To the southwest, however, the Poor Valley Ridge (sandstone) Member pinches out, and the entire sequence is predominantly shale and thin platy-bedded sandstone to which the name Rockwood Formation is applied. These relations are described below by outcrop belt.

BIG RIDGE BELT

In the Big Ridge belt, the name Rockwood Formation has been used for the Silurian clastic rocks. In the northern part of the belt, however, (fig. 1) the sequence of rock units is the same as in Wallen Ridge, which is northeastward in the same fault belt. A well-developed Hagan Shale Member of the Clinch, a thinned but still resistant Poor Valley Ridge Member of the Clinch, and an overlying Rose Hill Formation are recognizable and mappable at Big Ridge (fig. 1, No. 11) and Andersonville Dock (fig. 1, No. 12). At Andersonville Dock, the Hagan Shale Member is more than 50 feet (15 m) thick, the Poor Valley Ridge Member, about 25 feet (8 m) thick, and the Rose Hill Formation, apparently several hundred feet (100 m) thick but faulted. At Big Ridge, the Hagan Shale Member is at least as thick as at Andersonville Dock. The Poor Valley Ridge Member appears thicker, but poor exposures make it impossible to establish how much thicker. Here, also, fossiliferous Rose Hill beds overlie the Clinch along the shore of

TABLE 2.—*Silurian clastic formations at selected localities in southwest Virginia and northeast Tennessee*

Name of section	No. in fig. 1	Name of outcrop belt	Quadrangle (1:24,000)	Silurian clastic formation present and exposed	Number and Quality of outcrops	Description	Reference
No specific sections.	9 and 10	Powell Mountain and Wallen Ridge.	Coleman Gap, Tenn.-Va. Howard Quarter, Tenn. Tazewell, Tenn.	Rose Hill Formation (Clinton Formation) and Clinch Formation (Poor Valley Ridge Member and Hagan Shale Member).	Fair	Rose Hill Formation: shale, siltstone, and sandstone. A few oolitic hematite beds—325 ft (100 m) Clinch Sandstone: Poor Valley Ridge Member—sandstone very light gray, fine- and medium-grained; top 20 ft (7 m) grayish red—140–170 ft (45–52 m). Hagan Shale Member—shale, pale-olive, containing a few beds of very fine grained sandstone at and near base— 90 ft (27 m).	Harris, Stephens, and Miller (1962); Harris and Mixon (1970); Harris (1965).
Big Ridge	11	Big Ridge	Maynardville, Tenn.	Rose Hill Formation and Clinch Sandstone (Poor Valley Ridge Member and Hagan Shale Member).	Fair to poor.	Traverse across Big Ridge, due south of Ousley Cemetery. Float of fossiliferous platy sandstone of Rose Hill Formation along shore of Norris Reservoir. Float and a few outcrops of sandstone of Poor Valley Ridge Member of Clinch from crest of Big Ridge southward to within 800 ft (24 m) of shore. Basal sandstone overlain by shale of Hagan Shale Member of Clinch, just north of crest of Big Ridge.	
Andersonville Dock.	12	Big Ridge	Big Ridge Park, Tenn.	Rose Hill Formation and Clinch Sandstone (Poor Valley Ridge Member and Hagan Shale Member).	Fair	Section along county road through water gap in Lone Mountain. Several hundred feet (about 160 m) of greenish-gray shale containing platy beds of fine-grained sandstone; hematitic "iron ore" bed near base (Rose Hill). Sandstone, very fine grained, resistant—25 ft (8 m) (Poor Valley Ridge Member of Clinch). Shale, greenish-gray, containing basal bed of very fine-grained hard sandstone—50 ft (17 m) (Hagan Shale Member of Clinch).	

TABLE 2.—*Silurian clastic formations at selected localities in southwest Virginia and northeast Tennessee*—Continued

Name of section	No. in fig. 1	Name of outcrop belt	Quadrangle (1:24,000)	Silurian clastic formation present and exposed	Number and Quality of outcrops	Description	Reference
Indian Gap Church.	13	Big Ridge	Norris, Tenn.	Rose Hill Formation and Clinch Sandstone (Poor Valley Ridge Member and Hagan Shale Member).	Fair	Section along county road over Lone Mountain at Indian Gap Church. Rose Hill Formation: shale and fossiliferous platy-bedded siltstone, several hundred feet (about 100 m) thick. Clinch Sandstone: Poor Valley Ridge Member—sandstone, white, fine-grained, quartzose; thickness uncertain, perhaps 20–40 ft (6–12 m). Hagan Shale Member—shale, containing platy beds of siltstone, poorly exposed; thickness uncertain.	
U.S. Hwy. 441	14	Big Ridge	Norris, Tenn.	None	Very poor	Conspicuous gap, but no exposures at road level.	
U.S. Hwy. I–75	15	Big Ridge	Norris, Tenn.	Rockwood Formation	Excellent	Approximately 80 ft (24 m) of Silurian beds exposed above complete section of Sequatchie Formation (Ordovician). Fault cuts out higher beds in roadcut. Predominantly shale, containing a sandstone bed 2 ft (0.6 m) thick at base, and thin beds of fine-grained sandstone and siltstone interbedded with shale. A 6-ft-thick (2 m) sandstone 8 ft (2.5 m) below fault at top of section is wedge-edge equivalent of Poor Valley Ridge Member of Clinch. Underlying beds equivalent to Hagan Shale Member of Clinch. Upper part of Rockwood Formation, overlying beds described above, is absent because of fault.	
Pilot Knob	16	Big Ridge	Clinton, Tenn.	Rockwood Formation	Good	Massive sandstone 9 ft (3 m) thick 3 ft (1 m) above base. Remainder of section gray shale containing thin platy beds of siltstone and very fine grained sandstone.	

Little Tunnel.	17	Poor Valley Ridge.	Middlesboro South, Tenn., Va., Ky.	Rose Hill Formation and Clinch Sandstone (Poor Valley Ridge Member and Hagan Shale Member).	Good	New roadcut on U.S. 25 E through Poor Valley Ridge and old cut along L. & N. Railroad at north portal of "Little Tunnel" through Poor Valley Ridge. A few outcrops of Rose Hill Formation at NW. end of railroad cut. Resistant sandstone, exposed in railroad cut and at top of highway cut, apparently not more than 15 ft (4.6 m) thick (Poor Valley Ridge Member of Clinch). Shale exposed in highway cut—about 60 ft (18 m) thick (Hagan Shale Member of Clinch).	Miller and Fuller (1954); Butts (1940 p. 232).
Carr Chapel.	18	Poor Valley Ridge.	Ausmus, Tenn.	Rose Hill Formation and Clinch Sandstone (Poor Valley Ridge Member and Hagan Shale Member).	Poor (mostly float).	Traverse up and along spur 0.4 mile (0.7 km) northwest of Meyer Cemetery. Few exposures, but Hagan Shale Member of Clinch on southeast upper slope of southeast knob, Poor Valley Ridge Member of Clinch at crest, and Rose Hill Formation in saddle and on northwest knob are recognizable and mappable.	
La Follette	19	Poor Valley Ridge.	Jacksboro, Tenn.	Rose Hill Formation and Clinch Sandstone (Poor Valley Ridge Member and Hagan Shale Member).	Poor (mostly float).	Traverse along elongate spur directly southwest of Roger Cemetery. Sandstone beds of Poor Valley Ridge Member of Clinch hold up 1430-ft (436-m) knob. Thin Hagan Shale Member of Clinch could be present southeast of crest. Float of Rose Hill Formation northwest of crest and in saddle.	
Dutch Valley.	20	Dutch Valley.	Lake City, Tenn.	Rockwood Formation	Very poor	A few exposures of shale of Rockwood Formation in this relatively flat valley. Rome Formation (Cambrian) thrust over Rockwood along southeast side of valley.	
Emory Gap	21	Rockwood	Harriman, Tenn.	Rockwood Formation	Good	Reference section for Rockwood Formation measured and described by R. C. Milici. Predominantly gray shale; contains thin interbedded sandstone units, and hematitic iron beds as much as 4.2 ft (1.3 m) thick. Transition zone 24 ft (7.4 m) thick into overlying Chattanooga Shale.	R. C. Milici and Helmuth Wedow, Jr. (unpub. data, 1974).

Norris Reservoir, but most of the outcrops of the formation are beneath the water except at times of low lake level. Southwest along the Big Ridge belt, fair exposures at Indian Gap Church (fig. 1, No. 13) also show both members of the Clinch as well as the Rose Hill Formation, the ridge-forming beds of the Poor Valley Ridge Member of the Clinch being 20 to 40 feet (6 to 12 m) thick.

Still farther southwest in the Big Ridge belt, excellent exposures along U.S. Interstate Highway 75 (fig. 1, No. 15) reveal beds approximately 70 feet (20 m) thick, consisting predominantly of shales that are the equivalent of the Hagan Shale Member to the northeast. One sandstone unit 6 feet (2 m) thick is present that could represent the wedge edge of the Poor Valley Ridge Member. At Pilot Knob (fig. 1, No. 16) there is no sandstone of the Poor Valley Ridge Member; thus beds equivalent to the Hagan Shale Member give way upward to beds equivalent to the Rose Hill Formation, and no criterion exists for separating the two. This sequence has been designated the Rockwood Formation (R. C. Milici, oral commun., 1973); it matches very well the sequence at the type locality (fig. 1, No. 21) of the Rockwood (R. C. Milici and Helmuth Wedow, Jr., unpub. data).

Figure 3 is a restored section along the line *B–B′* (fig. 1) near the Wallen Ridge and Big Ridge belts. It shows the tonguing out of the Poor Valley Ridge Member of the Clinch Sandstone, as described above, and the merging of the underlying Hagan Shale Member and overlying Rose Hill Formation into the Rockwood Formation close to the position of Highway I–75. Thus, it seems appropriate in the Big Ridge belt to map Clinch Sandstone, with its two members, and Rose Hill Formation

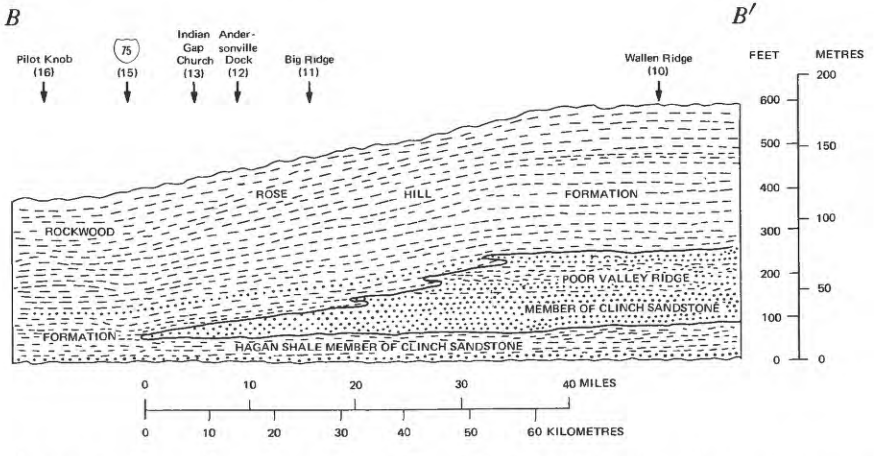

FIGURE 3.—Restored section along the line *B–B′* (fig. 1) showing the tonguing out southwestward of the Poor Valley Ridge Member of the Clinch Sandstone and the resultant changes in nomenclature. The numbers beneath the localities at the top of the section correspond to the locality numbers in figure 1.

north of U.S. Highway I–75 and to restrict the usage of the name Rockwood Formation to the area from I–75 southwestward.

DUTCH VALLEY BELT

Dutch Valley is a narrow flat-floored intermontane valley just southeast of the Cumberland Plateau front (fig. 1, No. 20). Cambrian rocks are thrust northwestward on Silurian clastic rocks along the southeast wall of the valley. When this valley was traversed, a very few exposures of shale of Silurian age were found in several places. As no resistant sandstone beds seem to be present, such as those that form the Poor Valley Ridge Member of the Clinch, these beds are properly referable to the Rockwood Formation. In a report on the Lake City quadrangle, which includes the Dutch Valley area, Swingle (1960a) dated the Rockwood Formation as being of Early and Middle Silurian age. The author agrees with this age, on the basis of the lateral equivalency of the Rockwood to the Lower Silurian Clinch and Middle Silurian Rose Hill.

POOR VALLEY RIDGE BELT

In southwest Virginia, Poor Valley Ridge is a low ridge held up by the Poor Valley Ridge Member of the Clinch Sandstone. The Hagan Shale Member crops out on the uppermost slopes just southeast of the ridge crest, and the Rose Hill Formation is on the low northwest slopes and beneath adjacent Poor Valley.

Poor Valley Ridge extends southwestward into Tennessee as a separate and distinct ridge for 12 miles (19 km). Beyond this, however, a series of roughly alined knobs in many places reveal the presence of a more resistant unit, although in other places these rocks are overwhelmed and buried by debris from the high steep Cumberland Plateau escarpment close by on the west.

Traverses were made across the Poor Valley Ridge belt of Silurian clastic rocks at three localities. At Cumberland Gap, just south of the Tennessee-Virginia State line (fig. 1, No. 17, and table 2), the Hagan Shale and Poor Valley Ridge Members of the Clinch were described by Butts (1940) and Miller and Fuller (1954), as mentioned previously. A new highway cut on U.S. 25E now exposes the Hagan and basal beds of the Poor Valley Ridge perfectly, but the Rose Hill Formation has few exposures.

Southwest from Cumberland Gap, a traverse was made along a prominent pair of knobs near Carr Chapel in the Ausmus quadrangle (fig. 1, No. 18, and table 2). The Hagan Shale Member continues beneath the sandstone that holds up the eastern of the two knobs. The sandstone consists of hard fine-grained and very fine grained crossbedded sandstone in beds as much as 18 inches (46 cm) thick.

These beds are referable to the Poor Valley Ridge Member of the Clinch. A few scattered outcrops and float of fossilferous beds overlying the Clinch are clearly the Rose Hill Formation.

A third traverse was made across the Poor Valley Ridge on the outskirts of La Follette (fig. 1, No. 19, and table 2). Here the presence of the Poor Valley Ridge Member of the Clinch, again holding up a knob, and shale of the overlying Rose Hill Formation was established by outcrops and float. The Hagan Shale Member is probably also present in its normal position but is covered. No resistant sandstone assignable to the Poor Valley Ridge Member was seen where I–75 crosses the Silurian belt. Thus, the lower shale, equivalent to the Hagan, grades upward into the shale containing sandstone beds, and this sequence at the southwest tip of the Poor Valley Ridge belt is more appropriately named Rockwood Formation.

The evidence along the Poor Valley Ridge belt indicates that the Clinch Sandstone and the Rose Hill Formation are identifiable and mappable for almost the full length of the belt in Tennessee. Furthermore, the two members of the Clinch also are identifiable throughout the northeastern part of the belt in Tennessee, at least as far southwest as La Follette (fig. 1).

ELK VALLEY BELT

The northwesternmost belt of Silurian outcrop in Tennessee is in Elk Valley (fig. 1) where the Rockwood Formation is brought to the surface by the Pine Mountain overthrust for a distance of nearly 5 miles (8 km) (Englund, 1968). Englund stated that the formation here consists largely of gray shale; it has very fine grained sandstone and siltstone at the base and thin beds of fine-grained sandstone and siltstone throughout. The pinchout of the Poor Valley Ridge Member of the Clinch takes place in the subsurface between the Poor Valley Ridge belt and the Elk Valley belt, probably closer to the former than the latter, as suggested by the dotted line in figure 1. A very small and rather enigmatic brachiopod collection from the basal beds of the Rockwood was provisionally assigned by Boucot (Englund, 1968, p. 8) to the Middle Silurian. This age designation, if substantiated by additional paleontologic evidence, would indicate that the Rockwood was laid down in a sea lapping westward onto the craton and that the Lower Silurian part of the Rockwood between the Poor Valley Ridge belt and the Elk Valley belt was never deposited.

REGIONAL APPLICATION OF SILURIAN FORMATION NAMES

The evidence has shown (1) that the Clinch Sandstone, locally overlain by the Rose Hill Formation, is essentially a lithologic unit in

Clinch Mountain; (2) that to the northwest, in Lee and Wise Counties, Va., and Hancock and Claiborne Counties, Tenn., the Clinch is divisible into a lower shale member, the Hagan, and a resistant sandstone member, the Poor Valley Ridge, and that these are overlain by a much thicker predominantly shale formation, the Rose Hill; and (3) that in Tennessee the Poor Valley Ridge Member of the Clinch tongues out in a southwest direction, and the Hagan Shale Member of the Clinch and the overlying Rose Hill Formation come together to form the Rockwood Formation. The areas to which each relationship pertains have been shown in figure 1.

SUMMARY

1. The name Clinton, from New York State where it is a group, should not be used in Virginia and Tennessee. The name Rose Hill Formation, from Maryland, is preferable.
2. A reference section for the Clinch Sandstone has been established at Little Moccasin Gap, Washington County, Va.
3. In most of the Clinch Mountain belt, the Clinch is the only Silurian formation present, but at Little Moccasin Gap and Big War Gap, more than 88 feet (27 m) and 2 feet (0.6 m), respectively, of Rose Hill Formation overlie the Clinch.
4. Two members of the Clinch, the Hagan Shale Member and the Poor Valley Ridge Member, and an overlying clastic formation, the Rose Hill Formation, are identifiable in Lee County, Va., and in the Powell Mountain, Wallen Ridge, and Poor Valley Ridge belts, and in the northern part of the Big Ridge belt in Tennessee.
5. The Clinch in Clinch Mountain is of Early Silurian and perhaps early Middle Silurian age. West of Clinch Mountain, however, all the Clinch is of Early Silurian age.
6. Where the Poor Valley Ridge Member of the Clinch thins to extinction southwest of the above areas, the name Rockwood Formation is applicable to the entire section of clastic Silurian rocks.

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