



COMMONWEALTH OF VIRGINIA

DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
DIVISION OF MINERAL RESOURCES

ANALYSES OF CLAY, SHALE AND RELATED MATERIALS— SOUTHWESTERN COUNTIES

**Stanley S. Johnson, Marion V. Denny
and D. C. Le Van**

In Cooperation with U. S. Bureau of Mines

MINERAL RESOURCES REPORT 6

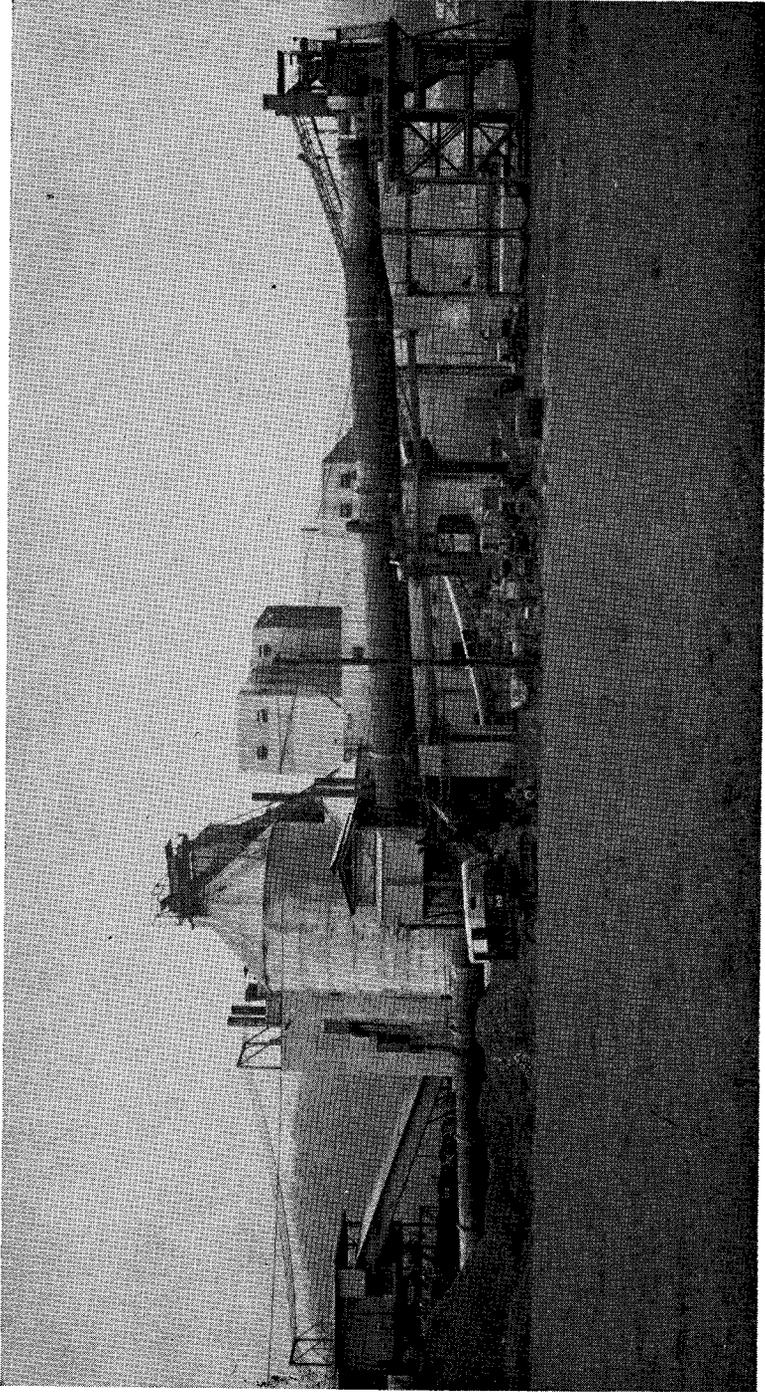
VIRGINIA DIVISION OF MINERAL RESOURCES

James L. Calver

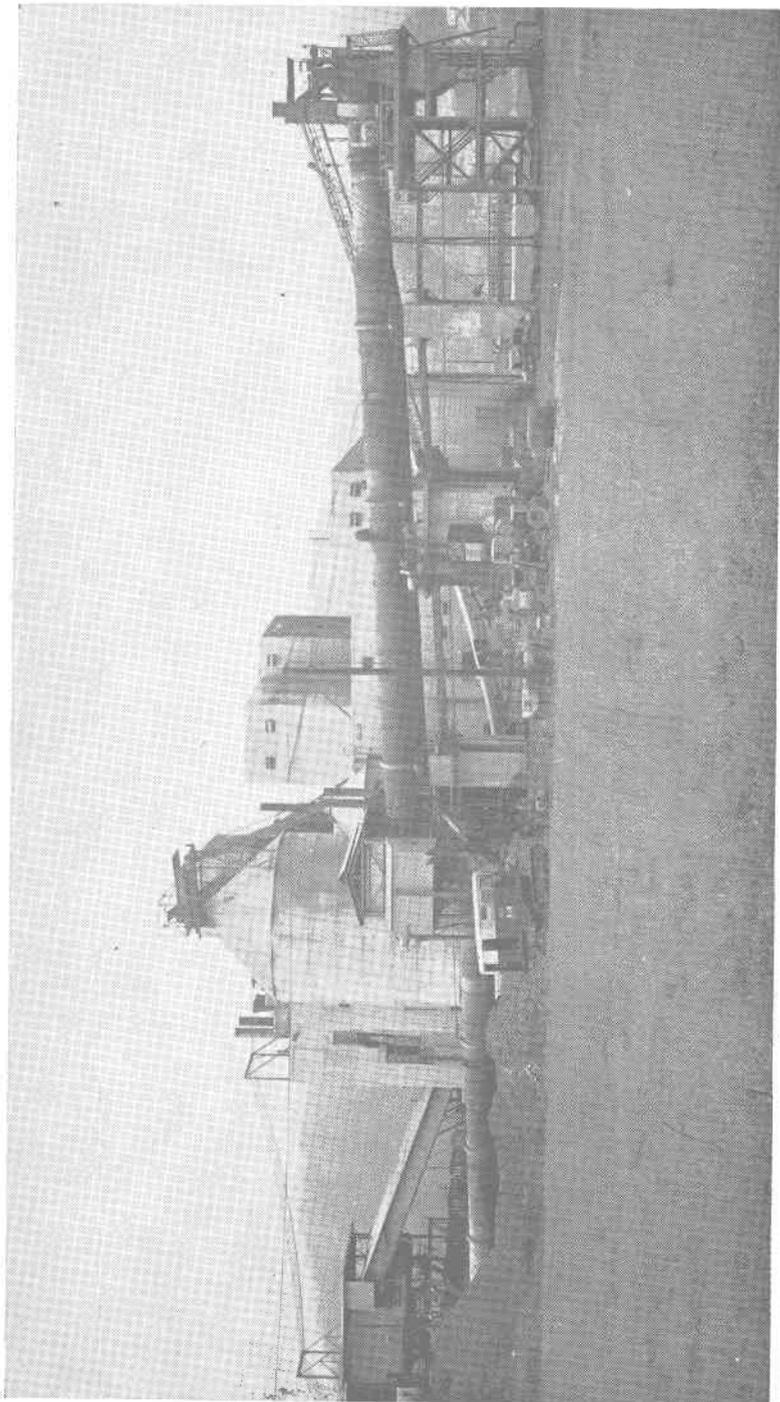
Commissioner of Mineral Resources and State Geologist

CHARLOTTESVILLE, VIRGINIA

1966



Plant of Clinchfield Coal Company, Lightweight Aggregate Division, near Clinchfield, Russell County. Shale from the company's coal mines is utilized as raw material in the manufacture of lightweight aggregate.



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COMMONWEALTH OF VIRGINIA
DEPARTMENT OF PURCHASES AND SUPPLY
RICHMOND
1965
Revised 1966

The original printing of Mineral Resources Report 6, dated 1965, was recalled because it contained errors in the laboratory determinations made by the United States Bureau of Mines. All copies of the original printing should be destroyed. This revised edition was printed at no cost to the Commonwealth of Virginia.

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ANALYSES OF CLAY, SHALE, AND RELATED MATERIALS—SOUTHWESTERN COUNTIES

By

STANLEY S. JOHNSON, MARION V. DENNY
AND D. C. LE VAN

ABSTRACT

This report contains results of tests and determinations of properties required to evaluate the potential ceramic and non-ceramic uses of 120 samples of clay, shale, and coal refuse from localities in southwestern Virginia. The counties sampled for this report are Bland, Buchanan, Dickenson, Giles, Lee, Pulaski, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe. Preliminary sample evaluations were conducted in a muffle furnace and continuous tests were made. The tests indicate that 66 samples are potentially suitable for some type of brick, 11 for tile, 2 for quarry tile, 5 for drain tile, 2 for flue lining, 1 for structural tile, 1 for pottery, 1 for artware, 2 for flower pots, 39 for lightweight aggregate, 1 for sewer pipe, and 1 for hot tops.

INTRODUCTION

In November 1957, the Virginia Division of Mineral Resources entered into a cooperative agreement with the U.S. Bureau of Mines to promote effective coordination of activities for exploration and evaluation of clays and similar non-metallic materials for ceramic and other uses. The responsibilities of the Virginia Division of Mineral Resources include the planning and conducting of field work, the correlation of field, geologic, and

laboratory data, and the sampling and delivery of clay samples to the Norris Metallurgy Research Laboratory, U. S. Bureau of Mines. Under the agreement the responsibility of the Bureau of Mines is to make appropriate tests and determinations of properties required to evaluate the potential ceramic and non-ceramic uses of the samples.

This publication contains the determinations for 120 samples collected in southwestern Virginia (Figure 1). The test data are arranged by county and the potential uses are summarized at the beginning of each county discussion. The reader should consult the data on individual samples for qualifying remarks pertaining to potential uses given in the county summaries. The specifications of the various ceramic materials and the criteria used in making the evaluations are listed in Appendices I-V. Information on testing procedures may be found in the "Syllabus of Clay Testing," Bulletin 565 of the U. S. Bureau of Mines, and in "Analyses of Clay, Shale and Related Materials—Northern Counties," Mineral Resources Report 2 of the Virginia Division of Mineral Resources.

The fired materials prepared from certain samples indicate that the raw materials are potentially suitable in all respects for the manufacture of brick or other structural clay products. Some of the sampled materials listed as having no potential use may become useful by blending with other clay materials or by the addition of substances to improve their raw or fired character-

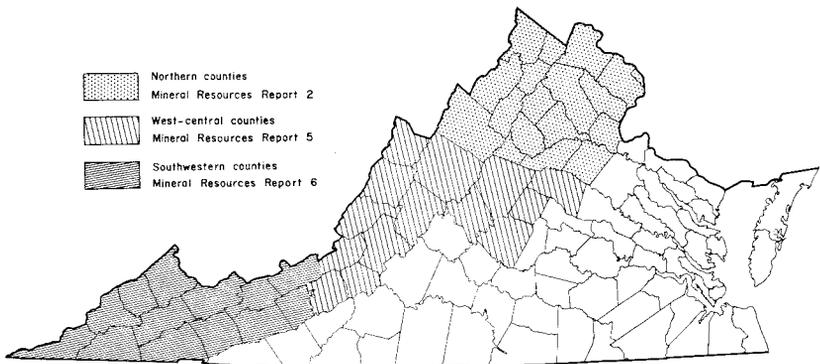


Figure 1. Areas of investigation.

istics. The addition of sandy clay may be helpful in reducing linear shrinkage to acceptable limits, and barium carbonate may be added to reduce or eliminate scumming of some individual samples.

No single criterion may be used to evaluate the quality of lightweight aggregate test samples. A combination of test data and visual inspection is necessary to evaluate a sample of lightweight aggregate. The drying and crushing characteristics and the dry strength of the unfired material, and the firing and bloating ranges, weight, expansion, absorption, color, and strength of the fired aggregate are all considered in evaluating the samples for potential use in lightweight aggregate.

Laboratory procedure used to test lightweight aggregate for this report employed a kiln retention time of 15 minutes. Particle size of raw material placed in the test kiln was $-1/2+1/4$ or $-3/4+1/2$ inch for almost all samples. Five samples were crushed to $-1+3/4$ inch before being placed in the kiln.

A word of caution: the evaluation remarks are based on test data determined on one or two samples from each locality. Detailed exploration, sampling, and tests should be carried out to prove any particular locality for commercial development. Likewise, test results of a single sample from an existing pit or stockpile may not be representative of all the material. Samples from other parts of the pit, stockpile, or other locations of the same formation may not have the same physical and chemical characteristics as determined for the sample that was tested.

ACKNOWLEDGEMENTS

The writers wish to thank the many persons who contributed information and assistance during the field investigation, the laboratory determinations, and the preparation of the manuscript. Carroll E. Smith collected samples from the localities in Bland and Pulaski counties. Robert S. Wood collected samples

from brick plants in Tazewell and Smyth counties. T. E. Shufflebarger, Jr. of Pennsylvania Glass Sand Corporation collected samples from Wise County while with the Southern Railway System. William B. Brent collected the samples near Hill, Scott County. Acknowledgement is made to Howard P. Hamlin (deceased) who provided technical interpretation and supervised the analysis of many samples, and to the other employees of the U. S. Bureau of Mines at Norris Metallurgy Research Laboratory who assisted in this project. Miles E. Tyrrell of the Tuscaloosa Metallurgy Research Center re-evaluated the test data for many of the samples. Special acknowledgement is made to James L. Calver, State Geologist, who contributed materially to the improvement of the manuscript.

SAMPLE DESCRIPTIONS
CHARACTERISTICS
AND EVALUATIONS

BLAND COUNTY

Samples were collected from seven localities in Bland County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-2054	Brallier Formation	Common brick
R-2055	Brallier Formation	Possible brick and lightweight aggregate
R-2056	Brallier Formation	Possible brick
R-2057	Romney (?) Shale	Possible brick, tile, and lightweight aggregate
R-2058	Residual clay	Brick and tile
R-2059	Romney Shale	Possible brick
R-2060	Brallier Formation	Possibly brick and lightweight aggregate

SAMPLE: R-2054

County: Bland

Locality: Roadcut, 1.2 miles northwest of Mechanicsburg, on the southeast side of State Road 608 approximately 3.0 miles by road north of the intersection with State Highway 42.

Description: The exposure, which extends for a distance of approximately 365 feet, consists of sub-fissile, stiff, olive-green shale and thin-bedded to thick-bedded, fine-grained, greenish sandstone. Shale is exposed for a distance of 40 feet and medium- to thick-bedded sandstone for 25 feet in the northern end of the exposure. The sampled shale and thin-bedded sandstone occur along the remainder of the outcrop. Bedding planes and weathered surfaces are stained by iron oxide. The rocks have a strike of N.40°E. and a dip of 38°SE. The shale has 3 to 5 feet of soil overburden.

Formation or age: Brallier Formation.

Sampled interval: Sample across 50 feet of shale.

Type: Shale

Unfired strength: Low

pH: 5.5

Raw Properties: Low plasticity, requires 22.0 percent water of plasticity, drying characteristics good, no defects, 2.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff	Soft, crumbly	2.5	17.7	1.83
1900	Buff	Soft, crumbly	2.5	16.4	1.86
2000	Buff-brown	Hard	3.5	12.6	1.96
2100	Brown	Steel hard	6.5	7.8	2.17
2200	Dk. brown	Steel hard	8.0	4.7	2.23
2300	—	—	(Expanded)		—

Remarks: Would require a clay additive to increase plasticity.

Bloating Test: Negative

Potential Use: Common brick

SAMPLE: R-2055

County: Bland

Locality: Roadcut, 0.5 mile east of Bastian, on the north side of U. S. Highway 21 and 52 approximately 0.8 mile by road east of the intersection with State Road 615.

Description: An exposure of olive-green, stiff, sandy, sub-fissile shale, with interbedded layers of fine-grained, thin-bedded, blocky-jointed greenish sandstone, extends along U. S. Highway 21 and 52 on Brushy Mountain. The shale weathers to form gray fragments; bedding and joint surfaces are stained by iron oxide. The rocks have a strike of N.65°E. and a dip of 12°SE., and are overlain by up to 2 feet of soil overburden.

Formation or age: Brallier Formation.

Sampled interval: Sample across 165 feet of shale near the bottom of the formation.

Type: Shale
pH: 7.15

Unfired strength: Very low

Raw Properties: Low plasticity, requires 18.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff-brown	Soft, crumbly	2.0	16.9	1.86
1900	Dk. buff-brown	Soft, crumbly	2.0	15.5	1.89
2000	Dk. buff-brown	Soft, crumbly	4.0	13.2	1.96
2100	Brown	Very hard	4.0	9.1	2.12
2200	Dk. brown	Steel hard	8.0	5.5	2.23
2300	—	(Melted)	(Expanded)	—	—

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
1900	2.19	136.4	2.6	No expansion
2000	1.85	115.2	3.3	No expansion
2100	1.61	100.3	3.1	Good expansion
2200	1.38	85.9	4.0	Good expansion, slightly sticky

Remarks: Fired weights are somewhat heavy, but the shale expands uniformly with low absorption and good strength, and may have aggregate possibilities.

Potential Use: Possible brick and lightweight aggregate.

SAMPLE: R-2056

County: Bland

Locality: Roadcut, 2.0 miles north of Bland, on the northeast side of U. S. Highway 21 approximately 2.6 miles by road north of the intersection with State Highway 42.

Description: An exposure of olive-green, stiff, sandy, sub-fissile shale, with interbedded layers of fine-grained, thin-bedded, blocky-jointed, greenish sandstone, extends along U. S. Highway 21 on Brushy Mountain. The shale weathers to form gray fragments; bedding and joint surfaces are stained by iron oxide. The rocks have a strike of N.67°E. and a dip of 14°SE., and are overlain by up to 15 feet of soil overburden.

Formation or age: Brallier Formation.

Sampled interval: Sample across 36 feet of shale near the top of the formation.

Type: Shale

Unfired strength: Very low

pH: 6.35

Raw Properties: Low plasticity, requires 18.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.	% Abs.	Bulk Dens.
1800	Dk. buff-brown	Soft, crumbly	1.0	20.5	1.72
1900	Dk. buff-brown	Soft, crumbly	1.0	20.4	1.73
2000	Dk. buff-brown	Soft, crumbly	3.0	18.3	1.79
2100	Brown	Very hard	3.0	15.6	1.87
2200	Dk. brown	Steel hard	5.0	11.5	1.97
2300	Near black	Steel hard	6.0	7.2	2.08

Bloating Test: Negative

Potential Use: Possible brick

SAMPLE: R-2057

County: Bland

Locality: Roadcut, 3.6 miles northwest of Bastian, along Wolf Creek, on the north side of State Road 614 approximately 3.8 miles by road west of the intersection with U.S. Highway 21.

Description: The exposure, which extends for a distance of 325 feet, consists of fissile, olive-green shale and a few layers of interbedded greenish sandstone. Bedding planes are stained red, orange, yellow, and brown by iron oxide. The rocks have a strike of N.47°E. and a dip of 25°SE. Four feet of soil overburden is present.

Formation or age: Romney (?) Shale

Sampled interval: Sample across 30 feet of shale near the middle of the exposure.

Type: Shale
pH: 6.5

Unfired strength: Very low

Raw Properties: Low plasticity, requires 20.0 percent water of plasticity, drying characteristics good, no defects, 2.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.	% Abs.	Bulk Dens.
1800	Dk. buff-brown	Soft, crumbly	4.0	15.9	1.88
1900	Dk. buff-brown	Soft, crumbly	4.0	15.2	1.90
2000	Dk. buff-brown	Soft, crumbly	4.0	12.7	1.98
2100	Brown	Very hard	5.0	8.7	2.13
2200	Dk. brown	Steel hard	7.5	8.1	2.09
2300	Near black	Steel hard	7.5	3.3	2.20

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1800	2.10	130.8	3.1	No expansion
1900	—	—	—	—
2000	1.79	111.5	2.2	No expansion
2100	1.53	95.3	3.1	Fair expansion
2200	1.17	72.8	2.9	Good expansion

Remarks: Fired weights are somewhat heavy, but the shale expands uniformly with low absorption and good strength, and may have aggregate possibilities.

Potential Use: Possible brick, tile, and lightweight aggregate.

SAMPLE: R-2058

County: Bland

Locality: Roadcut, 2.5 miles northwest of Bastian, along Wolf Creek, on the north side of State Road 614 approximately 1.3 miles by road west of the intersection with U. S. Highway 21.

Description: An exposure of light-gray and yellowish-orange clay extends for a distance of 75 feet. In the western end of the cut the exposure of clay is 18 feet in height with up to 25 feet of shale and soil overburden; in the eastern end of the cut the clay is 5 feet in height with 3 feet of soil overburden. The clay has been formed by the weathering of the Romney Shale.

Formation or age: Residual clay

Sampled interval: Composite of clay sampled for a distance of 75 feet.

Type: Clay
pH: 4.75

Unfired strength: Good

Raw Properties: Moderate plasticity, requires 34.0 percent water of plasticity, drying characteristics good, no defects, 6.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.	% Abs.	Bulk Dens.
1800	Buff-orange	Soft, crumbly	6.0	22.3	1.64
1900	Buff-orange	Soft, crumbly	7.5	19.6	1.71
2000	Buff-orange	Soft, crumbly	7.5	18.2	1.76
2100	Lt. orange	Very hard	10.0	14.1	1.89
2200	Brown	Steel hard	12.5	9.3	2.03
2300	Near black	Steel hard	15.0	0.2	2.29

Bloating Test: Negative

Potential Use: Brick and tile.

SAMPLE: R-2059

County: Bland

Locality: Roadcut, 2.5 miles northwest of Rocky Gap, on the north side of U. S. Highway 21 approximately 1.5 miles by road northwest of the intersection with State Road 613 in North Gap.

Description: An exposure of light- to dark-gray, fissile shale, 25 feet in height, with a few thin-bedded layers of sandstone, extends for a distance of 300 feet along the roadcut. Weathered surfaces and bedding planes are stained by iron oxide and some surfaces have black, carbonaceous stains. A small fold surrounded by distorted rocks occurs near the middle of the exposure. A few small faults are present. The rocks are overlain by 1 foot of soil.

Formation or age: Romney Shale

Sampled interval: Composite of shale sampled for a distance of 300 feet along the roadcut.

Type: Shale
pH: 4.8

Unfired strength: Very low

Raw Properties: Low plasticity, requires 21.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.	% Abs.	Bulk Dens.
1800	Sand-buff	Soft, crumbly	2.5	19.4	1.73
1900	Buff-brown	Soft, crumbly	4.0	15.4	1.83
2000	Buff-brown	Very hard	6.5	13.7	1.87
2100	Brown	Steel hard	6.5	10.5	1.99
2200	Gray-brown	Steel hard	6.5	6.4	2.00
2300	—	(Melted)	(Expanded)	—	—

Remarks: This shale will require a clay additive to increase plasticity.

Bloating Test: Negative

Potential Use: Possible brick

SAMPLE: R-2060

County: Bland

Locality: Roadcut and abandoned quarry, 2.5 miles southeast of Rocky Gap, on the north side of State Road 606 approximately 0.8 mile by road east of the intersection with U. S. Highway 21 at South Gap.

Description: An exposure of olive-green, stiff, fissile shale, with thin-bedded, fine-grained, green sandstone, extends for a distance of 450 feet along the roadcut and quarry. Bedding planes are stained by iron oxide and the rocks have an easterly strike and a dip of 25°S. No overburden is present.

Formation or age: Brallier Formation.

Sampled interval: Sample across 100 feet of shale in the eastern end of the exposure.

Type: Shale
pH: 5.8

Unfired strength: Low

Raw Properties: Low plasticity, requires 20.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-orange	Soft, crumbly	2.5	15.3	1.92
1900	Dk. buff-orange	Soft, crumbly	2.5	12.3	2.01
2000	Dk. buff-orange	Very hard	4.0	11.0	2.05
2100	Brown	Steel hard	5.0	7.8	2.18
2200	Dk. brown	Steel hard	7.5	4.9	2.22
2300	—	—	(Expanded)	—	—

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
1900	1.81	112.7	3.1	No expansion
2000	1.26	78.4	3.1	Fair expansion
2100	1.23	76.6	3.0	Good expansion
2200	1.00	62.3	—	Good expansion, slight sticking
2300	—	—	—	Melted

Remarks: Fired weights are somewhat heavy, but the shale expands uniformly with low absorption and good strength, and may have aggregate possibilities.

Potential Use: Possibly brick and lightweight aggregate.

BUCHANAN COUNTY

Samples were collected from three localities in Buchanan County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1930	Recent (?) clay	Brick, tile, and probably drain tile
R-2556	Wise Formation	Lightweight aggregate
R-2557	Wise Formation	Lightweight aggregate

SAMPLE: R-1930

County: Buchanan

Locality: Exposure on the J. H. Stinson Estate, about 1 mile south of Grundy, on Newhouse Branch, tributary of the Levisa River.

Formation or age: Recent (?) clay

Sampled interval: Sample believed to be representative of approximately 30 inches of clay.

Type: Clay (sandy)

Unfired strength: Low

pH: 5.35

Raw Properties: Moderate plasticity, thixotropic, finely gritty, requires 29.0 percent water of plasticity, drying characteristics good, no defects, 4.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff	Soft, crumbly	6.5	21.9	1.69
1900	—	—	—	—	—
2000	Lt. red-tan	Steel hard	9.0	12.3	2.30
2100	Brown-red	Steel hard	13.5	3.8	2.41
2200	Brown-gray	Steel hard	14.0	0.2	2.41
2300	—	—	(Expanded)	—	—

Bloating Test: Negative

Potential Use: Brick, tile, and probably drain tile.

SAMPLE: R-2556

County: Buchanan

Locality: Roadcut, 1.4 miles east of Prater, on the north side of State Highway 83 approximately 0.1 mile by road west of the intersection with State Road 673.

Description: An exposure of approximately 15 feet of dark-green, fissile shale, with thin siltstone layers, is present in a long roadcut. The shale weathers to form light gray-green, tan, and brown, fissile to sub-fissile, angular, and rectangular fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. The shale lies in a nearly horizontal position.

Formation or age: Wise Formation

Sampled interval: Sample across 11 feet of shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 6.90

Raw Properties: Moderate plasticity, requires 29.4 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	9.5	22.7	1.62
1900	Tan	Hard	9.5	18.5	1.75
2000	Tan	Very hard	12.0	13.5	1.90
2100	Lt. brown	Very hard	15.0	4.6	2.26
2200	Chocolate	Steel hard	15.0	1.6	2.36
2300	—	—	(Expanded)		—

Remarks: Short vitrification range, high shrinkage.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.54	96.1	5.9	Slight expansion
2100	1.34	83.7	3.1	Slight expansion
2200	1.08	67.4	5.0	Fair expansion

Remarks: Some promise for lightweight aggregate.

Potential Use: Lightweight aggregate

SAMPLE: R-2557

County: Buchanan

Locality: Roadcut, 0.8 mile east of Prater, on the north side of State Highway 83 approximately 1.0 mile by road northeast of the intersection with State Road 658.

Description: An exposure of approximately 40 feet of dark-gray, hard, fissile shale, with thin- to medium-bedded siltstone and sandstone layers, is present in a long roadcut. The shale weathers to form light-gray, gray, and tan fissile fragments. Some weathered cleavage and bedding surfaces are stained by iron oxide. The rock strata are nearly horizontal.

Formation or age: Wise Formation

Sampled interval: Sample across 12 feet of fresh and weathered shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 8.00

Raw Properties: Moderate plasticity, requires 25.2 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.	% Abs.	Bulk Dens.
1800	Tan	Fairly hard	10.0	19.6	1.70
1900	Tan	Fairly hard	10.0	16.7	1.80
2000	Lt. brown	Hard	13.5	10.4	2.01
2100	Chocolate	Steel hard	17.0	3.4	2.27
2200	—	—	(Expanded)	—	—

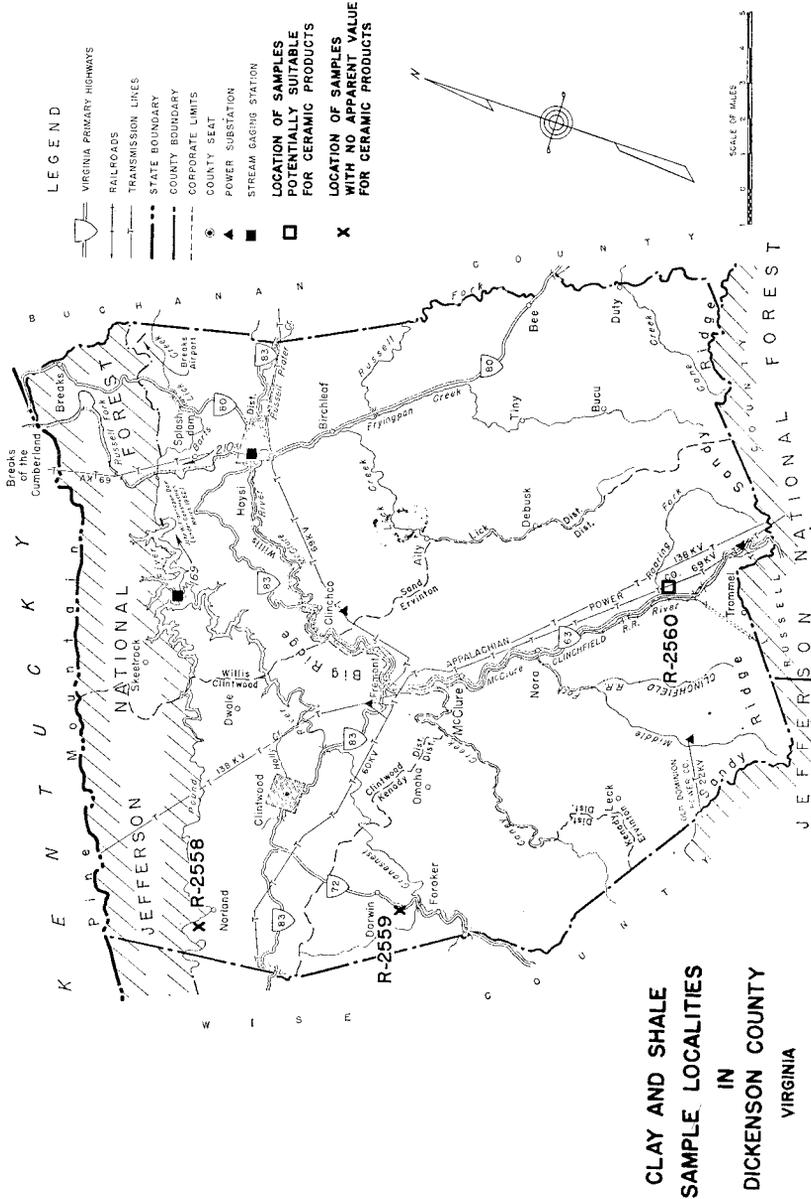
Remarks: Short vitrification range, high shrinkage.

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
2000	1.45	90.5	5.7	Slight expansion
2100	1.01	63.1	3.4	Good expansion
2200	0.87	54.3	14.1	Very good expansion

Remarks: Promising for lightweight aggregate.

Potential Use: Lightweight aggregate



Location Map of Dickenson County

DICKENSON COUNTY

Samples were collected from three localities in Dickenson County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-2558	Norton Formation	None (other than clay dummies)
R-2559	Norton Formation	None
R-2560	Norton Formation	Lightweight aggregate

SAMPLE: R-2558

County: Dickenson

Locality: Clay and shale pit of Combs Dummie Company, 0.6 mile northwest of Norland, on the north side of State Road 631 approximately 0.45 mile west of the intersection with State Road 624.

Description: Gray to gray-green and light-brown, micaceous shale, with minor coal seams and siltstone, is exposed in the shale and clay pit of the Combs Dummie Company. The shale weathers to form light- to medium-brown and light-gray, fissile fragments. Minor iron-oxide staining is present. The rock strata lie in a nearly horizontal position. The clay and shale from this pit were for many years used in the manufacture of bag-type clay dummies.

Formation or age: Norton Formation

Sampled interval: Sample across 8 feet of shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 7.05

Raw Properties: Moderate plasticity, requires 24.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.	% Abs.	Bulk Dens.
1800	Tan	Fairly hard	9.0	24.4	1.59
1900	Tan	Fairly hard	9.0	22.2	1.58
2000	Lt. brown	Hard	12.0	23.3	1.61
2100	Brown	Very hard	16.0	13.5	1.82
2200	Dk. brown	Steel hard	19.0	5.8	2.06
2300	—	—	(Expanded)	—	—

Remarks: Shrinkage too high.

Bloating Test: Negative

Potential Use: None (other than clay dummies).

SAMPLE: R-2559

County: Dickenson

Locality: Roadcut, 0.9 mile south of Darwin, on the northwest side of State Highway 72 approximately 1.0 mile by road south of the intersection with State Road 637.

Description: An exposure of approximately 30 feet of light-gray and tan, medium-grained, hard, slightly micaceous shale, 35 feet in height, with siltstone layers, is present in a long roadcut. The shale weathers to form fissile fragments that are stained by iron oxide. The shale-siltstone sequence is overlain by thick-bedded siltstone.

Formation or age: Norton Formation

Sampled interval: Sample across 15 feet of fresh and weathered shale and siltstone.

Type: Shale
pH: 7.30

Unfired strength: Good

Raw Properties: Moderate plasticity, requires 27.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	14.0	24.4	1.62
1900	Tan	Hard	14.0	20.0	1.71
2000	Lt. brown	Very hard	16.0	15.6	1.84
2100	Chocolate	Steel hard	20.0	10.2	2.01
2200	Dk. brown	Steel hard	25.5	5.0	2.19
2300	—	—	(Expanded)	—	—

Remarks: Shrinkage too high.

Bloating Test: Negative

Potential Use: None

SAMPLE: R-2560

County: Dickenson

Locality: Roadcut, 2.3 miles north of Trammel, on the northeast side of State Highway 63 approximately 0.1 mile by road southeast of the intersection with State Road 656.

Description: An exposure of approximately 25 feet of gray and black shale, 25 feet in height, is present in a long roadcut. The shale contains siltstone and sandstone layers, and weathers to form gray, brown, and tan, rough fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. A thick bed of sandstone overlies the shale.

Formation or age: Norton Formation

Sampled interval: Sample across 17 feet of shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 8.30

Raw Properties: Low plasticity, requires 21.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	0.0	19.2	1.70
1900	Tan	Fairly hard	0.0	15.9	1.77
2000	Brown	Hard	4.5	9.5	2.01
2100	Dk. brown	Very hard	10.0	1.9	2.30
2200	—	—	(Expanded)	—	—

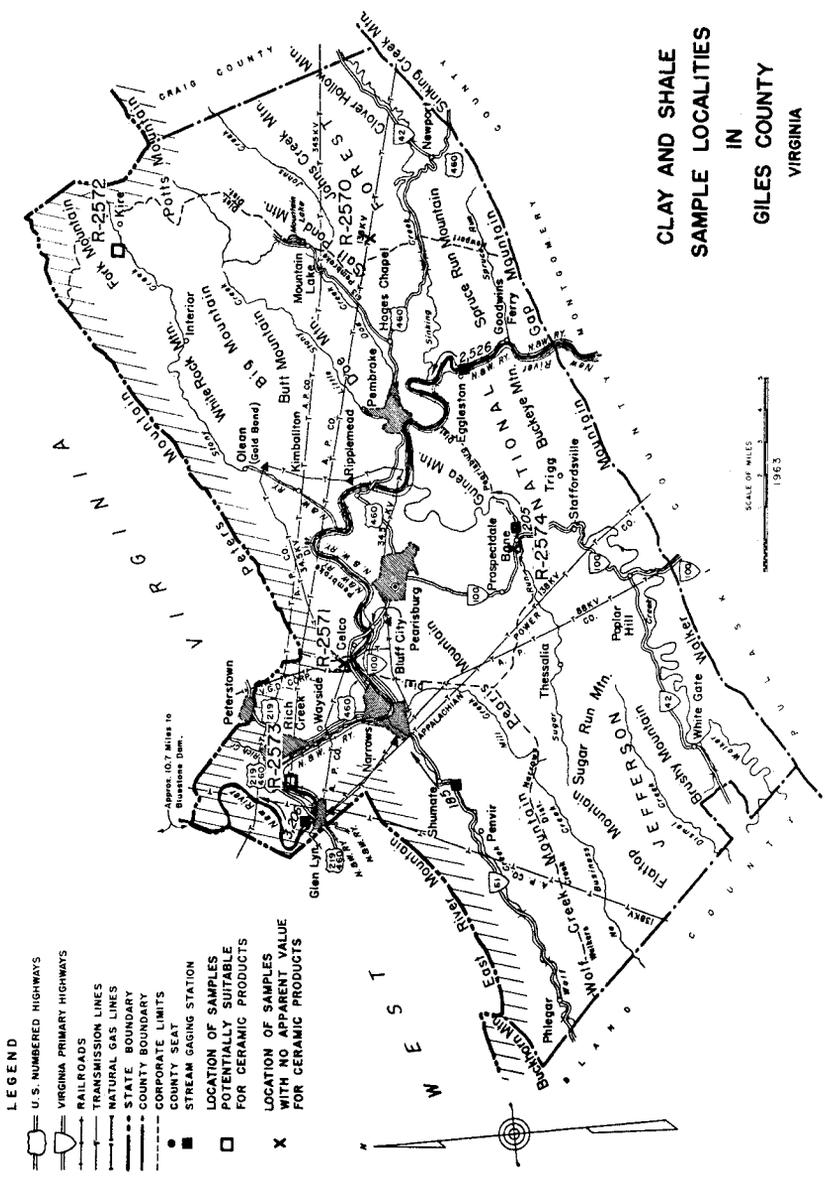
Remarks: Short vitrification range, scumming.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.30	81.2	6.5	Fair expansion
2100	0.89	55.6	7.6	Good expansion
2200	0.55	34.3	8.7	Very good expansion

Remarks: Promising for lightweight aggregate.

Potential Use: Lightweight aggregate



Location Map of Giles County

GILES COUNTY

Samples were collected from five localities in Giles County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-2570	Martinsburg Formation	None
R-2571	Shale of Devonian age	None
R-2572	Shale of Devonian age	Lightweight aggregate
R-2573	Shale and siltstone of Mississippian age	Lightweight aggregate and brick
R-2574	Rome Formation	None

SAMPLE: R-2570

County: Giles

Locality: Roadcut, 2.0 miles south of Mountain Lake, on the northeast side of State Road 700 approximately 0.7 mile by road northwest of the intersection with State Road 602.

Description: An exposure of light-gray and tan-yellow, soft, argillaceous shale, 13 feet in height, with thin interbeds of calcareous shale and limestone, is present in a long roadcut. The shale weathers to form light-gray and tan, fissile fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. Less than 3 feet of overburden is present.

Formation or age: Martinsburg Formation

Sampled interval: Sample across 15 feet of shale.

Type: Shale

Unfired strength: Good

pH: 5.70

Raw Properties: Moderate plasticity, requires 27.6 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	16.0	17.0	1.69
1900	Tan	Fairly hard	16.0	17.3	1.73
2000	Lt. brown	Hard	20.0	12.2	1.89
2100	Chocolate	Very hard	25.5	5.6	2.11
2200	—	—	(Expanded)	—	—

Remarks: Shrinkage too high.

Bloating Test: Negative

Potential Use: None

SAMPLE: R-2571

County: Giles

Locality: Roadcut, 2.0 miles northeast of Narrows, on the northwest side of U. S. Highway 460 approximately 1.7 miles by road northeast of the intersection with State Highway 61.

Description: An exposure of soft, friable, black, carbonaceous shale, 40 feet in height, is present in a long roadcut. The shale is stained orange to brown on cleavage and bedding surfaces and weathers to form small black and gray, fissile fragments. Slickensides occur on many surfaces. Some sandstone float is present in the exposure.

Formation or age: Devonian

Sampled interval: Sample across 5 feet of shale.

Type: Shale

Unfired strength: Good

pH: 5.50

Raw Properties: Moderate plasticity, requires 25.4 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.	% Abs.	Bulk Dens.
1800	Deep flesh	Fairly hard	11.0	27.0	1.45
1900	Tan	Hard	14.5	21.7	1.56
2000	Tan	Very hard	16.0	19.2	1.61
2100	Lt. brown	Very hard	20.0	13.3	1.80
2200	Brown	Steel hard	20.0(?)	4.2	1.99
2300	—	—	(Expanded)	—	—

Remarks: Shrinkage too high.

Bloating Test: Negative

Potential Use: None

SAMPLE: R-2572

County: Giles

Locality: Roadcut, 0.8 mile west of Kire, on the southeast side of State Road 635 at its intersection with State Road 755.

Description: An exposure of soft, black shale, 13 feet in height, is present in a long roadcut. The shale weathers to form tan, gray, and red-gray fragments. Some weathered cleavage and bedding surfaces are stained rusty red-brown by iron oxide. Less than 2 feet of overburden is present.

Formation or age: Devonian

Sampled interval: Sample across 10 feet of shale near the middle of the roadcut.

Type: Shale
pH: 8.00

Unfired strength: Fair

Raw Properties: Low plasticity, requires 19.1 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. tan	Fairly hard	0.0	18.5	1.77
1900	Tan	Hard	0.5	11.6	1.98
2000	Lt. brown	Hard	0.5	6.2	2.18
2100	Chocolate	Very hard	8.0	2.4	2.29
2200	Dk. brown	Very hard	5.0	3.2	2.06
2300	—	(Melted)	—	—	—

Remarks: Fair color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.22	76.2	13.9	Fair expansion, laminar
2100	1.12	69.9	14.3	Fair expansion, laminar
2200	0.93	58.1	14.7	Good expansion, laminar

Remarks: Promising for lightweight aggregate.

Potential Use: Lightweight aggregate

SAMPLE: R-2573

County: Giles

Locality: Roadcut, 1.3 miles northeast of Glen Lyn, on the east side of State Road 649 just north of its intersection with State Road 725.

Description: An exposure of interbedded black, green, and red-purple shale, 15 feet in height, extends for a distance of 750 feet along the roadcut. The shale is hard, and is fissile in places. Siltstone and thin sandstone layers are interbedded with the shale. The rocks weather to form fissile, blocky, and angular fragments. Some weathered cleavage and bedding surfaces are stained orange and rusty-red by iron oxide. The shale has a strike of N. 70° W. and a dip of 75° SW. Less than 4 feet of overburden is present.

Formation or age: Mississippian

Sampled interval: Composite of shale and siltstone sampled for a distance of 650 feet beginning at the intersection of State Roads 649 and 725.

Type: Shale

Unfired strength: Good

pH: 8.10

Raw Properties: Low plasticity, requires 16.4 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	0.0	13.5	1.96
1900	Lt. brown	Hard	4.0	9.9	2.09
2000	Brown	Very hard	5.5	5.8	2.26
2100	Dk. brown	Very hard	5.5	1.5	2.40
2200	—	—	(Expanded)		—

Remarks: Fair color

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
2000	1.45	90.5	6.6	Slight expansion
2100	1.00	62.4	4.3	Good expansion
2200	0.84	52.4	6.8	Good expansion, sticky

Remarks: Promising for lightweight aggregate.

Potential Use: Lightweight aggregate and brick.

SAMPLE: R-2574

County: Giles

Locality: Roadcut, 0.3 mile northwest of Bane, on the northeast side of State Highway 100 just northwest of its intersection with State Road 663.

Description: An exposure of light-green and red, moderately hard, fissile shale, 11 feet in height, is present in a long roadcut. The shale weathers to form fissile and angular fragments that are slightly stained by iron oxide. This exposure of Rome Shale occurs on the Bane anticline. The shale is overlain by the Honaker Dolomite, which is exposed on the flanks of the anticline in the same roadcut. Data from a well very close to this exposure have shown the Rome Shale to be approximately 325 feet thick. Less than 3 feet of overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 8 feet of fresh and weathered shale.

Type: Shale

Unfired strength: Poor

pH: 9.05

Raw Properties: Low plasticity, requires 19.4 percent water of plasticity, scumming.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Red-brown	Fairly hard	0.0	19.2	1.62
1900	Tan	Fairly hard	0.0	18.5	1.64
2000	Buff	Fairly hard	0.0	22.2	1.54
2100	Buff	Fairly hard	0.0	21.8	1.55
2200	Olive-gray	Hard	0.0	16.1	1.66
2300	—	(Melted)	—	—	—

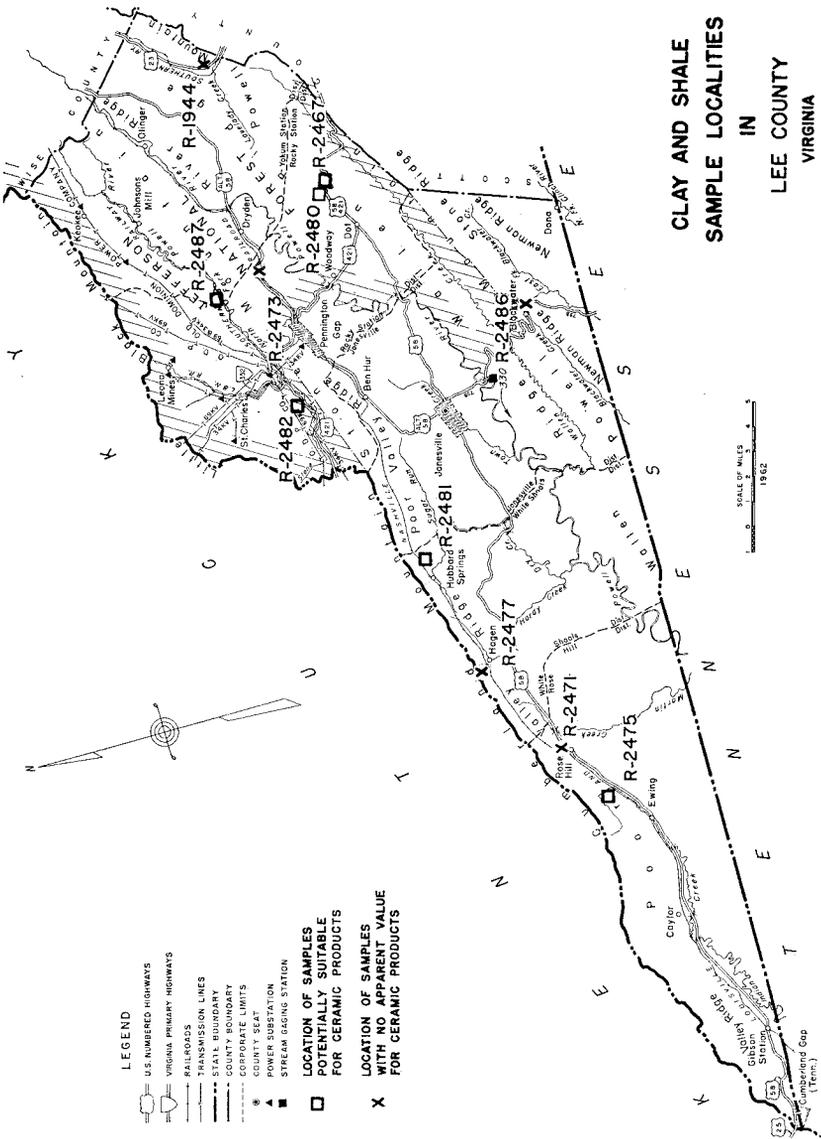
Remarks: Short vitrification range, scumming.

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
2000	1.96	122.4	16.7	No expansion
2100	1.75	109.3	14.1	Slight expansion
2200	1.45	90.5	9.2	Melting, sticky

Remarks: Not suitable for lightweight aggregate material
(heavy).

Potential Use: None



Location Map of Lee County

LEE COUNTY

Samples were collected from 11 localities in Lee County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1944	Big Stone Gap Shale	None
R-2467	Tuscarora Formation	Face brick
R-2471	Reedsville Shale	None
R-2473	Clinton Formation	None
R-2475	Residual Clay	Lightweight aggregate
R-2477	Brallier Formation	None
R-2480	Reedsville Shale	Common brick and drain tile
R-2481	Clinton (?) Formation	Face brick
R-2482	Wise Formation	Face brick
R-2486	Rogersville (?) Shale	None
R-2487	Wise Formation	Face brick

SAMPLE: R-1944

County: Lee

Locality: Roadcut, approximately 6.9 miles east of Dryden, along U. S. Highway 23, 4.75 miles north of the Southern Railway Station at Duffield.

Description: Dark-gray to black, crumpled, fissile to hackly-breaking shale is exposed in the roadcut. Some thin beds in the exposure have a lustrous coal-like sheen on fresh fracture surfaces due to the carbon content. Other beds have a sooty black appearance and may be low-grade coal. Pyrite, limonite, and siderite (?) are common in the rocks at this locality. The shale sampled is approximately 10 feet stratigraphically above limestone and sandstone of Devonian age.

Formation or age: Big Stone Gap Shale

Sampled interval: Representative of dark-gray to black shale exposed in the roadcut.

Type: Shale
pH: 9.2

Unfired strength: Very low

Raw Properties: Low plasticity, requires 17.0 percent water of plasticity, drying characteristics good, no defects, 0.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff-brown	Soft, crumbly	1.0	31.3	1.46
1900	Dk. buff-brown	Soft, crumbly	2.0	28.0	1.52
2000	Lt. brown	Fairly hard	6.0	24.6	1.59
2100	Brown-red	Hard	7.5	18.7	1.73
2200	—	—	(Expanded)	—	—

Potential Use: None

SAMPLE: R-2467

County: Lee

Locality: Roadcut, 3.8 miles east of Woodway, on the north side of U. S. Highway 58 and 421 approximately 2.1 miles by road northwest of the intersection with State Road 612 at Stickleyville (Figure 2).

Description: Approximately 70 feet of tan shale, with thin siltstone layers, is exposed for a distance of 190 feet along the roadcut. The shale weathers to form small, flat, light-tan chips. Some of the chips are stained by iron oxide. The shale is underlain by the lowermost sandstone of the Tuscarora Formation below which is the reddish-purple siltstone of the Sequatchie Formation. The rocks have a strike of N. 37° E. and a dip of 35° SE. The shale is overlain by less than 2 feet of soil.

Formation or age: Tuscarora Formation

Sampled interval: Sample across 70 feet of shale and siltstone.

Type: Shale

Unfired strength: Fair

pH: 7.00

Raw Properties: Low plasticity, requires 21.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.	% Abs.	Bulk Dens.
1800	Lt. brown	Fairly hard	2.5	15.2	1.84
1900	Brown	Hard	5.5	10.3	1.99
2000	Chocolate	Very hard	10.0	8.6	2.01
2100	Dk. brown	Steel hard	10.0	0.6	2.23
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	—	—	—

Remarks: Fair color, slight scumming.

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
2000	1.80	112.4	4.0	Laminar expansion
2100	1.45	90.5	4.3	Slight expansion
2200	1.19	74.3	3.4	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Face brick

SAMPLE: R-2471

County: Lee

Locality: Pit at abandoned brick plant, 0.4 mile north of Rose Hill, on the southeast side of the Louisville and Nashville Railroad approximately 1100 feet northwest of the intersection of State Roads 673 and 799 at Rose Hill School.

Description: An exposure of brown, silty, soft, micaceous shale, about 50 feet thick, is present in the shale pit. The shale weathers to form light- to dark-brown small, fissile chips. Bedding surfaces are stained dark brown by iron oxide. The shale has a strike of N. 48° E. and a dip of 64° NW.

Formation or age: Reedsville Shale

Sampled interval: Sample across 50 feet of shale.

Type: Shale

Unfired strength: Good

pH: 7.20

Raw Properties: Low plasticity, requires 20.2 percent water of plasticity, no drying defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.	% Abs.	Bulk Dens.
1800	Lt. brown	Fairly hard	4.0	17.2	1.78
1900	Lt. brown	Hard	4.0	15.3	1.82
2000	Chocolate	Very hard	10.0	6.0	2.15
2100	Dk. brown	Very hard	10.0	3.2	2.28
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	—	—	—

Remarks: Poor color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	2.12	132.4	7.4	No expansion
2100	1.99	124.2	4.2	Slight expansion
2200	1.68	104.9	4.4	Laminar expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: None

SAMPLE: R-2473

County: Lee

Locality: Railroad cut, 1.7 miles west of Dryden, on the southwest side of the Louisville and Nashville Railroad approximately 200 feet southwest of the intersection of U. S. Highway 58 Alternate and State Road 629 (Figure 3).

Description: An exposure of gray-red and gray, silty, hard, fissile shale, 45 feet in height, with thin siltstone layers, extends for a distance of 200 feet along the railroad cut. The shale weathers to form gray and red, fissile chips and rough, angular fragments. Some of the weathered cleavage and bedding surfaces are stained by iron oxide. The shale is overlain stratigraphically by thick beds of siltstone and sandstone. The rocks have a strike of N. 61° E. and a dip of 41° NW.

Formation or age: Clinton Formation

Sampled interval: Composite of fresh and weathered shale and siltstone sampled for a distance of 60 feet along the railroad cut.

Type: Shale

Unfired strength: Good

pH: 8.35

Raw Properties: Low plasticity, requires 19.2 percent water of plasticity, no drying defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Fairly hard	4.0	14.2	1.86
1900	Lt. brown	Hard	4.0	12.5	1.91
2000	Chocolate	Very hard	6.0	4.8	2.19
2100	Chocolate	Steel hard	9.5	1.9	2.21
2200	—	—	(Expanded)	—	—

Remarks: Poor color, scumming.

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
2000	2.32	144.8	4.9	No expansion
2100	1.98	123.6	4.5	Slight expansion
2200	1.19	74.6	5.1	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: None

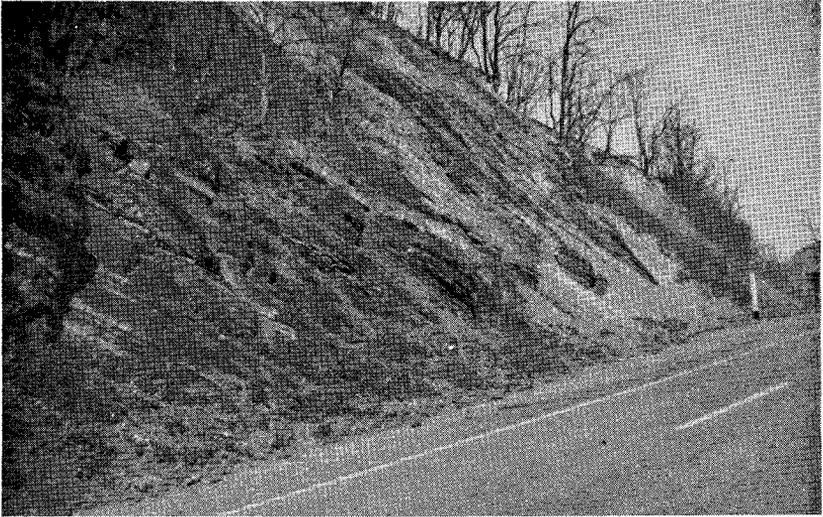


Figure 2. Exposure of the Tuscarora Formation (Sample R-2467) on the north side of U. S. Highway 58 and 421 approximately 2.1 miles by road northwest of the intersection with State Road 612 at Stickleyville.



Figure 3. Exposure of the Clinton Formation (Sample R-2473) on the southwest side of the Louisville and Nashville Railroad approximately 200 feet southwest of the intersection of U. S. Highway 58 Alternate and State Road 629.

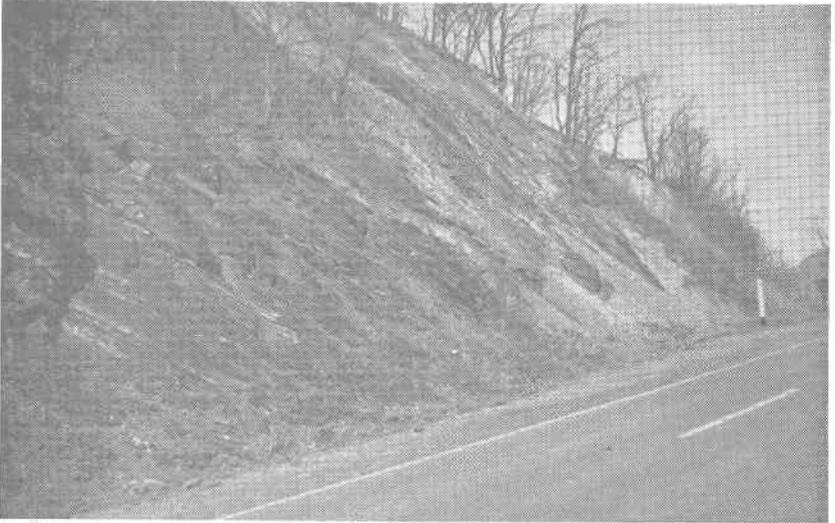


Figure 2. Exposure of the Tuscarora Formation (Sample R-2467) on the north side of U. S. Highway 58 and 421 approximately 2.1 miles by road northwest of the intersection with State Road 612 at Stickleyville.



Figure 3. Exposure of the Clinton Formation (Sample R-2473) on the southwest side of the Louisville and Nashville Railroad approximately 200 feet southwest of the intersection of U. S. Highway 58 Alternate and State Road 629.

SAMPLE: R-2475

County: Lee

Locality: Small pit, 1.7 miles northeast of Ewing, approximately 0.5 mile north of the intersection of U. S. Highway 58 and State Road 674 near Walker School, and on a tributary of Indian Creek.

Description: Approximately 3 feet of light greenish-gray clay, with a thin gray-brown and green gritty layer 1 foot above the base, is exposed in a prospect pit about 3 feet wide and 4 feet deep. The clay weathers to form cream-white, smooth, irregular lumps. Some of the weathered clay is stained by iron oxide. The clay is overlain by a light- to medium-gray limestone and is underlain by a medium-gray limestone. The clay bed has an easterly strike and a dip of 42° N.

Formation or age: Residual clay

Sampled interval: Grab sample of fresh and weathered clay.

Type: Clay

Unfired strength: Fair

pH: 6.40

Raw Properties: Moderate plasticity, requires 26.6 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Hard	15.0	3.4	2.33
1900	Lt. brown	Very hard	15.0	1.6	2.31
2000	—	—	(Expanded)		—
2100	—	—	—	—	—
2200	—	—	—	—	—
2300	—	(Melted)	—	—	—

Remarks: Fair color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.45	90.5	5.9	Slight expansion
2100	1.09	68.0	12.5	Fair expansion
2200	0.97	60.6	4.5	Good expansion

Remarks: Some promise for lightweight aggregate.

Potential Use: Lightweight aggregate

SAMPLE: R-2477

County: Lee

Locality: Railroad cut, on the west side of the Louisville and Nashville Railroad, leading to the portal tunnel at Hagen, approximately 600 feet north of the intersection of State Roads 789 and 621.

Description: An exposure of approximately 125 feet of dark-gray to black, brittle, fissile shale, with thin siltstone layers, extends for a distance of about 300 feet along the cut which is 440 feet long. The shale weathers to form light-gray, greenish-black, and brown platy fragments. Many of the cleavage and bedding surfaces are stained by iron oxide. The shale is underlain by a medium- to dark-gray dolomite. Some gossan, clay, and shaly coal are also present in the cut but were not sampled.

Formation or age: Brallier Formation

Sampled interval: Composite of weathered shale and siltstone sampled for a distance of 300 feet along the railroad cut.

Type: Shale

Unfired strength: Good

pH: 5.60

Raw Properties: Low plasticity, requires 25.1 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Fairly hard	0.0	27.1	1.43
1900	Lt. brown	Hard	2.5	25.6	1.42
2000	Chocolate	Steel hard	10.5	12.0	1.77
2100	Dk. brown	Steel hard	10.5	11.6	1.75
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	—	—	—

Remarks: Poor color, scumming.

Bloating Test: Negative

Potential Use: None

SAMPLE: R-2480

County: Lee

Locality: Roadcut on the north side of U. S. Highway 58 and 421 approximately 2.0 miles by road northeast of the bifurcation of U. S. Highway 58 and 421 at Dot.

Description: An exposure of yellowish-brown and light greenish-gray, soft shale, 35 feet in height, extends for a distance of 1270 feet along the roadcut. The shale weathers to form light yellow-tan, irregular fragments. Some of the weathered cleavage and bedding surfaces are stained dark brown by iron oxide. The shale has a northwesterly strike and a dip of 15° NE. Less than 1 foot of overburden is present.

Formation or age: Reedsville Shale

Sampled interval: Sample across 30 feet of shale.

Type: Shale

Unfired strength: Good

pH: 5.72

Raw Properties: Moderate plasticity, requires 28.0 percent water of plasticity, no drying defects, 2.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Fairly hard	5.0	23.8	1.59
1900	Lt. brown	Hard	10.0	17.0	1.75
2000	Red-brown	Very hard	15.0	8.6	2.03
2100	Chocolate	Steel hard	15.0	7.1	2.09
2200	Dk. chocolate	Steel hard	15.0	1.4	2.27
2300	—	—	(Expanded)	—	—

Remarks: Poor color

Bloating Test: Negative

Potential Use: Common brick and drain tile.

SAMPLE: R-2481

County: Lee

Locality: Roadcut, 0.8 mile east of Hubbard Springs, on the south side of State Road 621 approximately 0.5 mile by road northeast of the intersection with State Road 657.

Description: An exposure of light-tan, soft shale, 6 feet in height, with a few thin siltstone layers, extends for a distance of 80 feet along the roadcut. The shale weathers to form tan, small, fissile fragments. Some of the weathered cleavage and bedding surfaces are stained brown by iron oxide. The shale, which has a strike of N. 67° E. and a dip of 43° NW., is overlain and underlain by thick-bedded sandstone. Three feet of soil overburden is present.

Formation or age: Clinton (?) Formation

Sampled interval: Composite of shale and siltstone sampled for a distance of 60 feet along the roadcut.

Type: Shale

Unfired strength: Good

pH: 5.62

Raw Properties: Low plasticity, requires 22.2 percent water of plasticity, no drying defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	5.0	20.4	1.66
1900	Tan	Hard	6.0	15.6	1.78
2000	Lt. brown	Very hard	10.0	10.4	1.96
2100	Brown	Steel hard	10.0	4.6	2.16
2200	Dk. brown	Steel hard	11.3	1.9	2.26
2300	—	(Melted)	—	—	—

Remarks: Fair color

Bloating Test: Negative

Potential Use: Face brick

SAMPLE: R-2482

County: Lee

Locality: Roadcut, 2.8 miles west of Pennington Gap, on the north side of U. S. Highway 421 at its intersection with State Road 712.

Description: An exposure of light- to medium-gray, silty shale, 15 feet in height, with thin siltstone and sandstone layers, extends for a distance of 125 feet along the roadcut. The shale weathers to angular fragments. Some of the weathered bedding and cleavage surfaces are stained by iron oxide. The shale is overlain by thick-bedded sandstone. The rocks have an approximate strike of N.18°E. and a dip of about 5°NW.

Formation or age: Wise Formation

Sampled interval: Composite of weathered shale and siltstone sampled for a distance of 95 feet along the roadcut.

Type: Shale
pH: 6.25

Unfired strength: Good

Raw Properties: Low plasticity, requires 26.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	0.0	20.8	1.60
1900	Lt. brown	Fairly hard	0.0	18.2	1.67
2000	Red-brown	Very hard	10.0	12.8	1.87
2100	Dk. brown	Steel hard	10.0	3.6	2.18
2200	—	—	(Expanded)	—	—

Remarks: Fair color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.86	116.1	15.9	No expansion
2100	1.89	118.0	4.8	No expansion
2200	1.17	73.0	5.5	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Face brick

SAMPLE: R-2486

County: Lee

Locality: Roadcut, 0.3 mile east of Blackwater, on the north side of State Road 604 approximately 0.6 mile by road southwest of the intersection with State Road 603.

Description: An exposure of medium-brown, sandy, sub-fissile shale, 8 feet in height, extends for a distance of 190 feet along the roadcut. The shale weathers to form light-tan and cream-white, angular fragments. Some of the weathered fragments are stained by iron oxide and contain a small amount of a black material, probably carbonaceous matter. Less than 1 foot of overburden is present.

Formation or age: Rogersville (?) Shale

Sampled interval: Composite of fresh and weathered shale sampled for a distance of 160 feet along the roadcut.

Type: Shale

Unfired strength: Good

pH: 5.65

Raw Properties: Low plasticity, requires 23.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Flesh	Fairly hard	0.0	26.3	1.53
1900	Flesh	Hard	4.0	30.3	1.53
2000	Lt. brown	Very hard	10.0	13.0	1.94
2100	Chocolate	Steel hard	10.5	6.8	2.10
2200	Dk. brown	Steel hard	10.5	1.6	2.27
2300	—	—	(Expanded)	—	—

Remarks: Initial vitrification abrupt.

Bloating Test: Negative

Potential Use: None

SAMPLE: R-2487

County: Lee

Locality: Roadcut, 3.2 miles northwest of Dryden, on the south-east side of State Road 606 approximately 0.2 mile by road northeast of the intersection with State Road 628.

Description: An exposure of light gray-green and black, carbonaceous, sub-fissile shale, 13 feet in height, with thin siltstone layers, extends for a distance of 120 feet along the roadcut. The shale weathers to form tan, light gray-green, and light-gray, fissile and angular fragments. Some of the fragments are stained by iron oxide. The shale is underlain by thick-bedded sandstone. No overburden is present where sampled.

Formation or age: Wise Formation

Sampled interval: Composite of fresh and weathered shale and siltstone sampled for a distance of 90 feet along the roadcut.

Type: Shale
pH: 6.00

Unfired strength: Good

Raw Properties: Low plasticity, requires 26.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Flesh	Soft	0.0	26.3	1.57
1900	Tan	Fairly hard	4.0	22.7	1.64
2000	Lt. brown	Hard	5.5	19.2	1.82
2100	Brown	Very hard	5.5	12.4	1.92
2200	Dk. brown	Steel hard	10.0	7.6	2.04
2300	—	—	(Expanded)	—	—

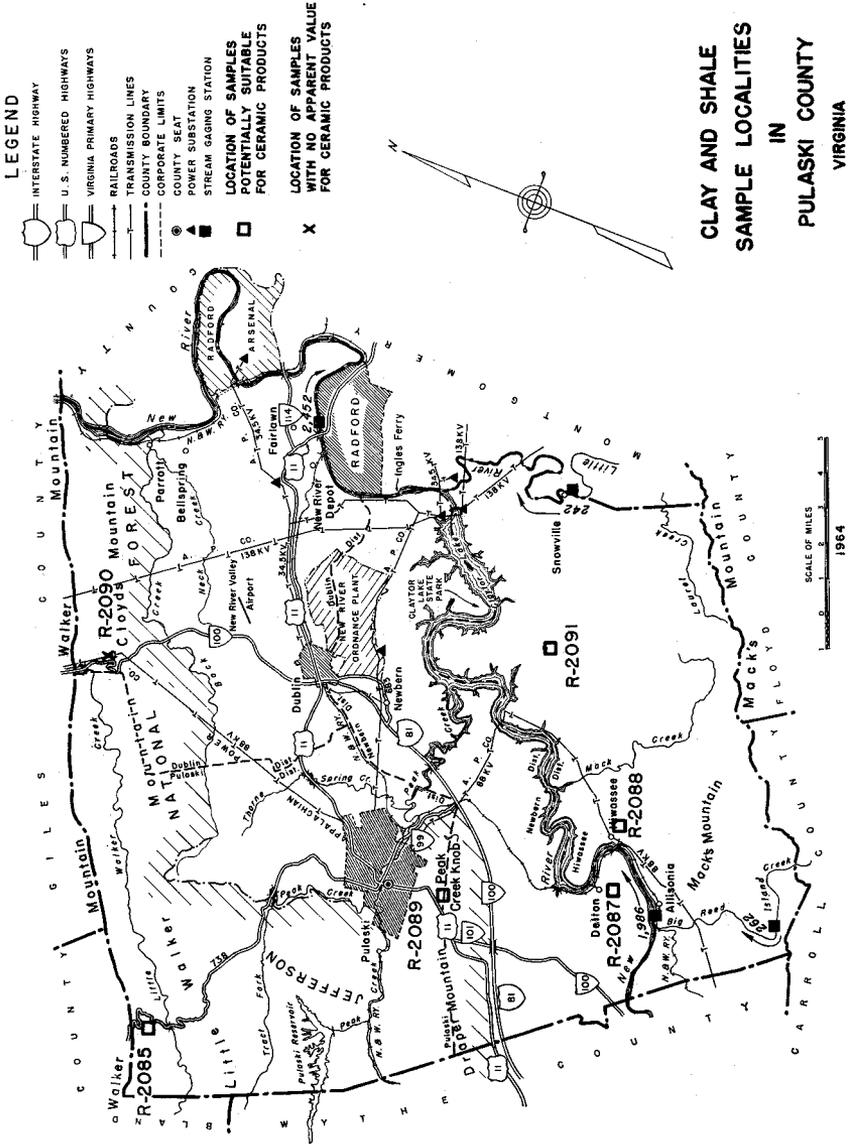
Remarks: Fair color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	2.44	152.3	1.2	No expansion
2100	2.08	129.9	1.4	Slight expansion
2200	1.80	112.4	1.5	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Face brick



Location Map of Pulaski County

PULASKI COUNTY

Samples were collected from six localities in Pulaski County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-2085	Brallier Formation	Common brick and possible light-weight aggregate
R-2087	Rome Formation	Brick and lightweight aggregate
R-2088	Residual clay	Brick
R-2089	Millboro Shale and Brallier Formation	Brick and tile
R-2090	Brallier Formation	None
R-2091	Rome Formation	Brick

SAMPLE: R-2085

County: Pulaski

Locality: Roadcut, 8.0 miles northwest of Pulaski, on the west side of State Road 738 approximately 0.5 mile by road north of the intersection with State Road 601.

Description: Interbedded dark olive-green and gray-green, sub-fissile shale and green, medium-bedded, blocky-jointed sandstone are exposed for a distance of approximately 320 feet along the roadcut. The rocks weather to form brown and gray fragments; bedding and joint surfaces are stained by iron oxide. The shale-sandstone sequence is overlain by thick-bedded, blocky-jointed, green sandstone in the southern part of the exposure. The rocks are nearly horizontal and are covered by 2 feet of soil overburden.

Formation or age: Brallier Formation

Sampled interval: Sample across 25 feet of shale in the northern end of the exposure.

Type: Shale
pH: 6.8

Unfired strength: Low

Raw Properties: Moderate plasticity, requires 21.0 percent water of plasticity, drying characteristics good, no defects, 4.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff	Soft, crumbly	5.0	15.9	1.85
1900	Buff-brown	Fairly hard	7.5	11.2	2.01
2000	Red-brown	Very hard	9.5	9.4	2.09
2100	Dk. brown	Steel hard	11.0	3.5	2.32
2200	V. dk. brown	Steel hard	11.0	2.2	2.32
2300	—	—	(Expanded)		—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1900	2.14	133.3	2.0	No expansion
2000	1.78	110.9	2.3	No expansion
2100	1.57	97.8	2.8	Fair expansion
2200	1.20	74.8	2.5	Good expansion, slightly sticky

Remarks: Fired weights are somewhat heavy, temperature is a little high for lightweight aggregate, material expands uniformly, has low absorption and exceptionally high strength; rotary kiln tests are necessary to determine suitability for lightweight aggregate.

Potential Use: Common brick and possible lightweight aggregate.

SAMPLE: R-2087

County: Pulaski

Locality: Roadcut, 0.5 mile south of Delton, on the south side of State Road 609 approximately 0.25 mile by road southeast of the intersection with State Road 657.

Description: Approximately 65 feet of interbedded red, yellow, and green shale and yellowish clay are exposed along the roadcut. The predominant material is hard, dark-red shale that is interbedded with thin layers of yellowish clay, crumbly soft red shale, soft yellow shale, and light-green shale. A small fault with a displacement of about 1 foot is present near the middle of the exposure. The rocks have a strike of N.40°W. and a dip of 25° to 30°SW. The shale is underlain in the eastern end of the roadcut by a deeply weathered shale that is exposed for a distance of 60 feet along the road; this material was not sampled.

Formation or age: Rome Formation

Sampled interval: Sample across 65 feet of shale and residual clay.

Type: Shale
pH: 6.7

Unfred strength: Low

Raw Properties: Moderate plasticity, requires 27.0 percent water of plasticity, drying characteristics good, no defects, 2.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.		Bulk Dens.
			% Abs.		
1800	Buff-brown	Soft, crumbly	5.0	18.0	1.70
1900	Brown	Fairly hard	5.0	13.0	1.85
2000	Brown	Very hard	7.0	10.5	1.95
2100	Dk. brown	Steel hard	11.5	1.5	2.23
2200	—	—	(Expanded)	—	—

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
1900	1.62	100.9	5.7	No expansion
2000	1.46	91.0	3.4	Slight expansion
2100	0.70	43.6	2.6	Excellent expansion
2200	1.09	67.9	1.8	Overexpansion, melted, slagged

Remarks: Rather short bloating range.

Potential Use: Brick and lightweight aggregate.

SAMPLE: R-2088

County: Pulaski

Locality: Roadcut, 0.1 mile east of Hiwassee, on the east side of State Road 605 approximately 0.3 mile by road northeast of the intersection with State Road 693 in Hiwassee.

Description: An exposure of very smooth deep red-brown, ochreous, residual clay, 18 feet in height, with occasional streaks of yellow clay, occurs along the roadcut. Some of this clay, which is derived from the Rome Formation, shows the original bedding of the shale. The clay is overlain by 4 feet of hard siliceous rocks in the northern end of the exposure and by 1 foot of soil in the remainder.

Formation or age: Residual clay

Sampled interval: Composite of clay sampled for a distance of 180 feet along the roadcut.

Type: Clay
pH: 5.5

Unfired strength: Average

Raw Properties: Moderate plasticity, requires 34.0 percent water of plasticity, drying characteristics good, no defects, 4.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-brown	Soft, crumbly	5.5	22.9	1.61
1900	Brown	Fairly hard	9.5	15.8	1.81
2000	Brown	Very hard	11.0	10.6	1.97
2100	Dk. brown	Steel hard	19.5	0.2	2.38
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Remarks: Very slight expansion at 2200 and 2300°F.

Bloating Test: Negative

Potential Use: Brick

SAMPLE: R-2089

County: Pulaski

Locality: Roadcut, 1.8 miles south of Pulaski, on the southeast side of U. S. Highway 11 approximately 2.7 miles by road west of the intersection with State Highway 99.

Description: At this locality 200 feet of black, fissile Millboro Shale lies above about 400 feet of interbedded pink to buff shale and siltstone of the Brallier Formation in an overturned sequence exposed along the highway. The rocks have a strike of about N. 60°E. and a general northwest dip. Two feet of soil overburden is present.

Formation or age: Millboro Shale and Brallier Formation

Sampled interval: Sample across 600 feet of shale and siltstone.

Type: Shale

Unfired strength: Low

pH: 5.8

Raw Properties: Low plasticity, requires 23.0 percent water of plasticity, drying characteristics good, no defects, 3.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin. Shk.	% Abs.	Bulk Dens.
1800	Lt. buff-brown	Soft, crumbly	4.0	20.2	1.68
1900	Lt. buff-brown	Fairly hard	5.5	16.0	1.82
2000	Lt. buff-brown	Hard	5.5	13.7	1.88
2100	Brown	Steel hard	9.0	6.7	2.11
2200	Dk. brown	Steel hard	14.0	2.3	2.25

Remarks: Fired colors fairly attractive.

Bloating Test: Negative

Potential Use: Brick and tile.

SAMPLE: R-2090

County: Pulaski

Locality: Roadcut, 8.7 miles north of Dublin, on the northeast side of State Highway 100 approximately 1.5 miles by road south of the intersection with State Road 601.

Description: Olive-green, fissile shale, and interbedded layers of medium-bedded, blocky-jointed dark-green sandstone are exposed for approximately 2 miles in roadcuts on the northern slope of Cloyds Mountain.

Formation or age: Brallier Formation

Sampled interval: Sample across 30 feet of shale in the lower part of the formation.

Type: Shale

Unfired strength: Good

pH: 6.40

Composition: Chemical Analysis

	<u>Weight %</u>		<u>Weight %</u>
SiO ₂	56.96	K ₂ O	4.25
Al ₂ O ₃	19.04	Na ₂ O	0.58
Fe ₂ O ₃	7.06	P ₂ O ₅	0.20
FeO	1.20	MnO	0.19
TiO ₂	0.96	Ign. loss (1 hr. at 1100°)	6.78
CaO	0.25	Total	99.78
MgO	2.31		

Raw Properties: Low plasticity, requires 22.1 percent water of plasticity, drying characteristics fair, some cracking, no drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Soft	1.0	18.1	1.78
1900	Lt. brown	Fairly hard	1.0	16.1	1.84
2000	Med. brown	Fairly hard	1.0	15.1	1.87
2100	Chocolate	Very hard	10.0	4.3	2.27
2200	Chocolate	Steel hard	9.0	3.3	2.31
2300	—	—	(Expanded)		—

Remarks: Fair color, abrupt vitrification about 2050°F.

Bloating Test: Negative (below 2300°F)

Potential Use: None

SAMPLE: R-2091

County: Pulaski

Locality: Roadcut, 4.5 miles west of Snowville, on the north side of State Road 605 approximately 0.9 mile by road west of the intersection with State Road 619.

Description: The exposure, which extends for a distance of 350 feet, consists predominantly of hard, dark-red shale with a few beds of yellow clayey shale. The red shale grades downward into a light-green shale. The shale weathers to form angular and blocky fragments. The rocks, which are distorted, have a general east-west strike and a dip of 55° to 60°S., and are overlain by 3 feet of deeply weathered shale.

Formation or age: Rome Formation

Sampled interval: Sample across 15 feet of shale.

Type: Shale

Unfired strength: Low

pH: 7.5

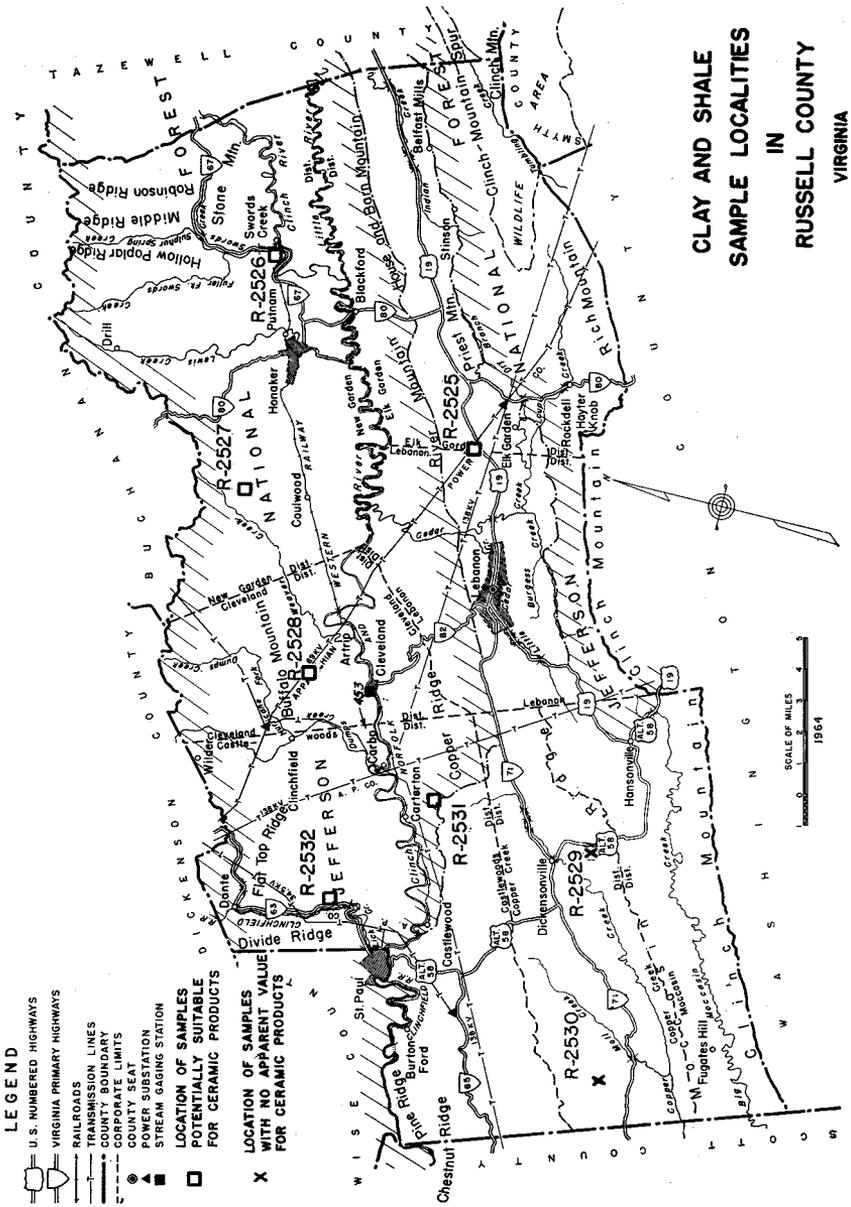
Raw Properties: Low plasticity, requires 20.0 percent water of plasticity, drying characteristics good, no defects, 2.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Soft, crumbly	2.5	17.2	1.77
1900	Lt. brown	Soft, crumbly	2.5	17.0	1.81
2000	Lt. brown	Fairly hard	5.0	14.7	1.89
2100	Rich brown	Very hard	7.5	8.3	2.11
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	(Expanded)	—	—

Bloating Test: Negative

Potential Use: Brick



**CLAY AND SHALE
SAMPLE LOCALITIES
IN
RUSSELL COUNTY
VIRGINIA**

Location Map of Russell County

RUSSELL COUNTY

Samples were collected from eight localities in Russell County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-2525	Shale and siltstone of Cambrian age	Flue lining
R-2526	Rome Formation	Brick
R-2527	Nolichucky Formation	Common brick
R-2528	Lee Formation	Face brick; possible sewer pipe and drain tile
R-2529	Rome Formation	None
R-2530	Nolichucky Formation	None
R-2531	Rome Formation	Lightweight aggregate
R-2532	Norton Formation	Face brick

SAMPLE: R-2525

County: Russell

Locality: Roadcut, approximately 4.6 miles east of Lebanon, on the west side of U. S. Highway 19 just northeast of the intersection with State Road 656.

Description: An exposure of gray-green, slightly calcareous, soft, fissile shale, 13 feet in height, with siltstone and limestone layers, is present in a long roadcut. The shale weathers to form light gray-green, fissile fragments. The weathered cleavage and bedding surfaces are stained dark-brown by iron oxide. The rocks have a strike of N.60°E. and a dip of 25°SE. Less than 3 feet of overburden is present.

Formation or age: Cambrian

Sampled interval: Sample across 10 feet of fresh and weathered shale and siltstone in the southern end of the roadcut.

Type: Shale
pH: 4.98

Unfired strength: Good

Raw Properties: Moderate plasticity, requires 25.0 percent water of plasticity, scumming.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	4.5	22.6	1.62
1900	Tan	Fairly hard	4.5	22.6	1.60
2000	Tan	Hard	4.5	23.8	1.56
2100	Buff-brown	Very hard	4.5	22.2	1.57
2200	Buff-brown	Very hard	5.0	21.3	1.56
2300	Buff-brown	Very hard	4.0	22.6	1.55

Remarks: Fair color, slight scumming.

Potential Use: Flue lining

SAMPLE: R-2526

County: Russell

Locality: Abandoned pit, 0.1 mile southwest of Swords Creek, on the west side of State Highway 67 approximately 0.1 mile by road south of the intersection with State Road 633 (Figure 4).

Description: An exposure of interbedded red and blue-gray, soft fissile shale, 35 feet in height, with thin siltstone layers, extends for a distance of over 150 feet along the face of the pit. The shale weathers to form light blue-gray, tan, gray, and red, small fissile chips. The weathered cleavage and bedding surfaces are stained brown by iron oxide. The shale has a strike of N.70°E. and a dip of 25°SE., and is underlain by a very calcareous shale or shaly limestone. Less than 1 foot of overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 40 feet of fresh and weathered shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 8.97

Raw Properties: Moderate plasticity, requires 24.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Red-tan	Fairly hard	4.5	15.9	1.81
1900	Red-tan	Hard	5.0	13.9	1.84
2000	Red-brown	Very hard	9.5	10.1	1.98
2100	Chocolate	Very hard	11.0	4.2	2.17
2200	Chocolate	Very hard	11.0	2.8	2.17
2300	—	—	(Expanded)	—	—

Bloating Test: Negative

Potential Use: Brick

SAMPLE: R-2527

County: Russell

Locality: Roadcut, 2.1 miles north of Coulwood, on the west side of State Road 620 approximately 1.8 miles by road north-east of the intersection with State Road 615.

Description: An exposure of gray-green, moderately hard shale, 13 feet in height, with thin siltstone layers, extends for a distance of approximately 225 feet along the roadcut. The shale weathers to form fissile, blocky, elongate fragments. The weathered cleavage and bedding surfaces are stained brown by iron oxide. The shale has a strike of N.65°E. and a dip of 5°SE. and is overlain and underlain by limestone and dolomite. Less than 3 feet of overburden is present where sampled.

Formation or age: Nolichucky Formation

Sampled interval: Composite of shale and siltstone sampled for a distance of 117 feet along the roadcut.

Type: Shale

Unfired strength: Good

pH: 5.62

Raw Properties: Low plasticity, requires 20.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1900	Red-tan	Fairly hard	4.5	11.9	1.91
2000	Red-tan	Hard	5.0	10.0	1.96
2100	Chocolate	Very hard	7.5	3.8	2.18
2200	—	—	(Expanded)	—	—

Remarks: Not suitable for vitreous clay products.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.68	104.9	1.5	Slight expansion
2100	1.34	83.7	15.5	Slight expansion
2200	1.26	78.7	13.7	Slight expansion
2300	—	—	—	Melted

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Common brick

SAMPLE: R-2528

County: Russell

Locality: Roadcut, 2.0 miles north of Cleveland, on the northwest side of State Road 615 approximately 0.5 mile by road southwest of the intersection with State Road 663.

Description: An exposure of tan, soft, fissile shale, 17 feet in height, with thin siltstone layers, is present in a long roadcut. The shale weathers to form light-gray and tan fissile chips and slabs. The cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.54°E. and a dip of 60°SE. Less than 2 feet of overburden is present.

Formation or age: Lee Formation

Sampled interval: Sample across 8 feet of weathered shale and siltstone.

Type: Shale
pH: 7.42

Unfired strength: Good

Raw Properties: Moderate plasticity, requires 27.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	4.5	22.2	1.48
1900	Tan	Fairly hard	4.5	22.8	1.53
2000	Tan	Fairly hard	4.5	19.6	1.57
2100	Lt. brown	Hard	7.5	14.8	1.72
2200	Dk. brown	Very hard	10.0	7.1	1.94
2300	Black-brown	Steel hard	11.0	2.3	2.03

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	2.23	139.2	1.9	No expansion
2100	1.76	109.9	5.5	Slight expansion
2200	1.79	111.7	3.9	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Face brick; might also be suitable for sewer pipe and drain tile.

SAMPLE: R-2529

County: Russell

Locality: Roadcut, 1.3 miles southeast of Dickensonville, on the west side of U. S. Highway 58 Alternate approximately 0.2 mile by road south of the intersection with State Road 671 (Figure 5).

Description: An exposure of more than 200 feet of red and light-green, soft, fissile shale, 55 feet in height, with a few siltstone layers, extends for a distance of 260 feet along the highway. The shale weathers to form gray-green and red, sub-fissile fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.50°E. and a dip of 43°SE. Less than 3 feet of overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 140 feet of fresh and weathered shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 5.12

Raw Properties: Low plasticity, requires 24.4 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Fairly hard	0.0	26.3	1.43
1900	Lt. brown	Fairly hard	0.0	20.0	1.54
2000	Brown	Hard	0.0	17.9	1.57
2100	Dk. brown	Very hard	10.0	3.9	2.06
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	—	—	—

Remarks: Short vitrification range.

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
2000	2.27	141.7	4.3	No expansion
2100	1.68	104.9	4.4	Slight expansion
2200	1.35	84.3	2.8	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: None



Figure 4. Exposure of the Rome Formation (Sample R-2526) on the west side of State Highway 67 approximately 0.1 mile by road south of the intersection with State Road 633.

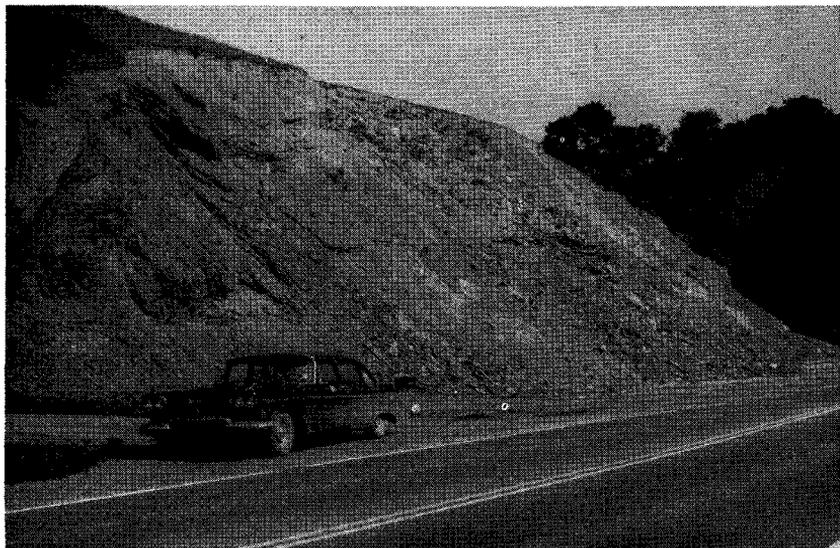


Figure 5. Exposure of the Rome Formation (Sample R-2529) on the west side of U. S. Highway 58 Alternate approximately 0.2 mile by road south of the intersection with State Road 671.



Figure 4. Exposure of the Rome Formation (Sample R-2526) on the west side of State Highway 67 approximately 0.1 mile by road south of the intersection with State Road 633.

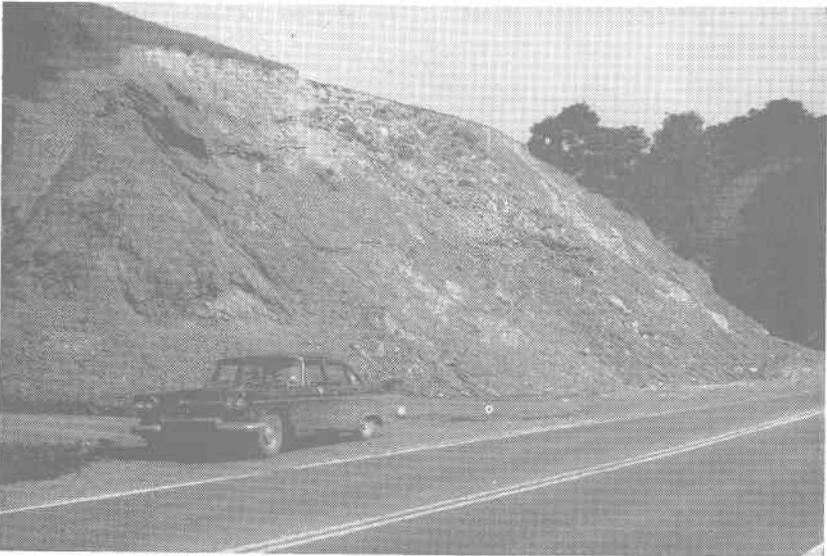


Figure 5. Exposure of the Rome Formation (Sample R-2529) on the west side of U. S. Highway 58 Alternate approximately 0.2 mile by road south of the intersection with State Road 671.

SAMPLE: R-2530

County: Russell

Locality: Roadcut, 7.1 miles west of Dickensonville, on the south-east side of State Road 609 at its intersection with State Road 611.

Description: An exposure of approximately 15 feet of gray-green, soft, fissile shale, 10 feet in height, with siltstone and limestone layers, is present in a long roadcut. The shale weathers to form gray-green, gray, and tan fissile chips and elongate fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of approximately N.60°E. and an approximate dip of 36°SE.

Formation or age: Nolichucky Formation

Sampled interval: Sample across 15 feet of shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 8.20

Raw Properties: Low plasticity, requires 21.8 percent water of plasticity, scumming.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Red-tan	Fairly hard	0.0	15.6	1.69
1900	Lt. brown	Hard	1.5	13.2	1.76
2000	Brown	Very hard	5.0	9.2	1.91
2100	Dk. brown	Very hard	10.0	1.3	2.16
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	—	—	—

Remarks: Poor color, scumming.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.54	96.1	8.3	Slight expansion
2100	1.02	63.7	9.6	Fair expansion
2200	1.23	76.8	2.5	Slight expansion

Remarks: Not suitable for lightweight aggregate (short range).

Potential Use: None

SAMPLE: R-2531

County: Russell

Locality: Roadcut, 1.0 mile southeast of Carterton, on the north-east side of State Road 614 approximately 1.0 mile by road southeast of the intersection with State Road 665.

Description: An exposure of approximately 25 feet of gray-green, moderately soft, fissile shale, 20 feet in height, with thin siltstone layers, is present in a long road cut. The shale weathers to form light gray-green and gray fissile chips and elongate fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.35°E. and a dip of 41°SE., and is overlain and underlain by massive limestone.

Formation or age: Rome Formation

Sampled interval: Sample across 18 feet of fresh and weathered shale and siltstone.

Type: Shale
pH: 8.29

Unfired strength: Good

Raw Properties: Low plasticity, requires 23.8 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	0.0	16.1	1.71
1900	Lt. brown	Fairly hard	2.5	11.5	1.85
2000	Brown	Hard	5.0	7.9	1.99
2100	Dk. brown	Very hard	10.0	0.7	2.29
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	—	—	—

Remarks: Poor color, scumming.

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
2000	1.83	114.2	5.9	No expansion
2100	1.39	86.8	5.1	Slight expansion
2200	1.03	64.3	5.4	Fair expansion

Remarks: Some promise for lightweight aggregate.

Potential Use: Lightweight aggregate

SAMPLE: R-2532

County: Russell

Locality: Excavated bank, 2.9 miles northeast of St. Paul, on the east side of State Highway 63 approximately 0.75 mile by road north of the intersection with State Road 615 at Hamlin.

Description: An exposure of approximately 40 feet of gray, soft, fissile shale and siltstone, 45 feet in height, extends for a distance of 140 feet along the highway. The shale weathers to form light-gray and tan, fissile chips and elongate fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. The rocks are in a nearly horizontal position.

Formation or age: Norton Formation

Sampled interval: Sample across 15 feet of fresh and weathered shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 7.60

Raw Properties: Low plasticity, requires 20.8 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. tan	Fairly hard	0.5	17.8	1.75
1900	Tan	Hard	5.0	11.1	1.96
2000	Lt. brown	Very hard	8.5	7.2	2.12
2100	Dk. brown	Steel hard	10.0	1.6	2.35
2200	Black-brown	Very hard	10.0	0.3	2.35
2300	—	(Melted)	—	—	—

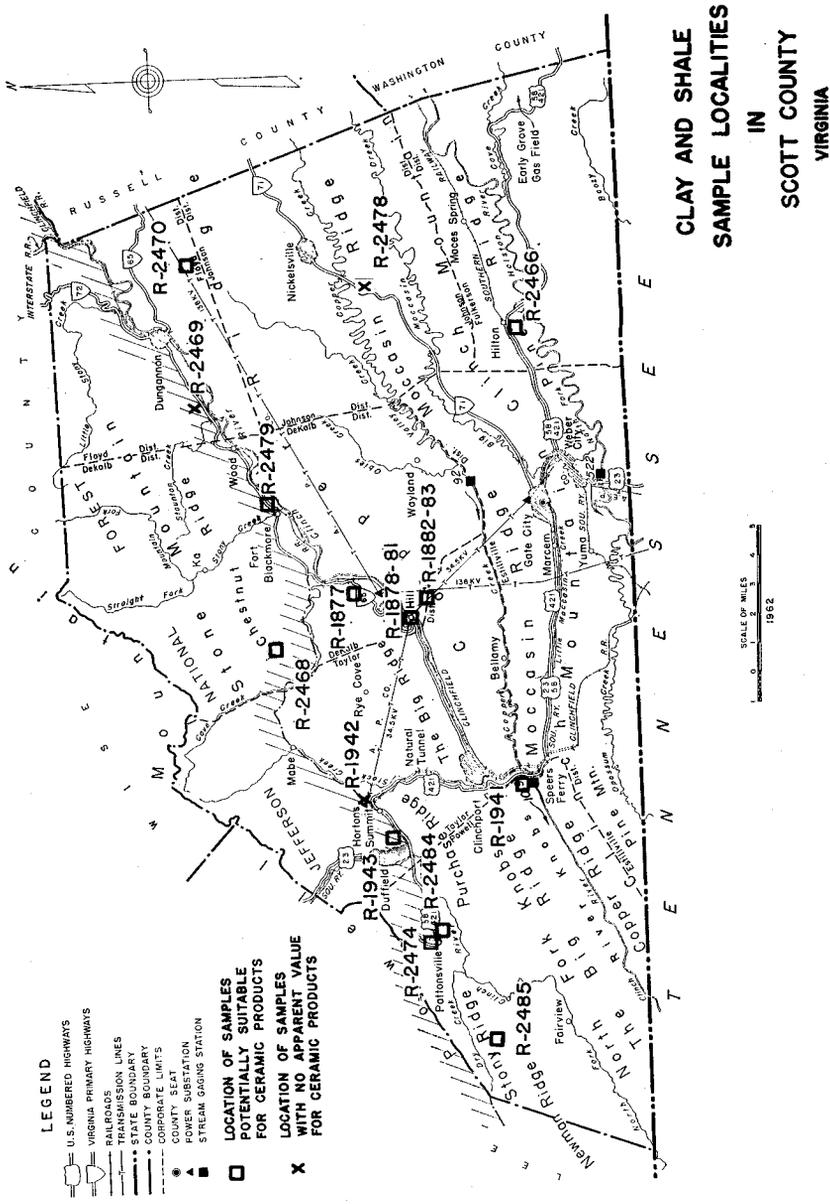
Remarks: Fair color

Blotting Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.70	106.1	5.7	Slight expansion
2100	1.11	69.3	13.6	Fair expansion
2200	1.24	77.4	2.3	Melting

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Face brick



Location Map of Scott County

SCOTT COUNTY

Samples were collected from 19 localities in Scott County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1877	Rome Formation	Possible sintered lightweight aggregate
R-1878	Rome Formation	Possible sintered lightweight aggregate
R-1879	Rome Formation	Possible sintered lightweight aggregate
R-1880	Rome Formation	Possible sintered lightweight aggregate
R-1881	Rogersville Shale	Lightweight aggregate
R-1882	Nolichucky Formation	Common brick (low grade) and lightweight aggregate
R-1883	Nolichucky Formation	Common brick (low grade) and possible sintered lightweight aggregate
R-1941	Rome Formation	Brick
R-1942	Big Stone Gap Shale	None
R-1943	Big Stone Gap Shale	Brick
R-2466	Brallier Formation	Face brick
R-2468	Nolichucky Formation	Common brick
R-2469	Rome Formation	None
R-2470	Rogersville (?) Shale	Lightweight aggregate
R-2474	Genesee Shale	Brick
R-2478	Nolichucky (?) Formation	None
R-2479	Rome Formation	Common brick
R-2484	Portage Shale	Face brick
R-2485	Genesee Shale	Lightweight aggregate

SAMPLE: R-1877

County: Scott

Locality: Roadcut, 1.85 miles northeast of Hill, on the north side of State Highway 65 approximately 0.4 mile by road southwest of the intersection with State Road 662.

Description: An exposure of red, green, and gray Pumpkin Valley (upper Rome) shale, 15 feet in height, occurs in the roadcut. This exposure of folded and contorted shale is located about 1 mile east of the Clinchport fault.

Formation or age: Rome Formation

Sampled interval: Sample across 100 feet of shale.

Type: Shale

Unfired strength: Very low

pH: 5.30

Raw Properties: Low plasticity, requires 20.0 percent water of plasticity, drying characteristics good, no defects, 2.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff-brown	Soft, crumbly	4.5	17.5	1.82
1900	Lt. brown	Fairly hard	5.0	15.9	1.87
2000	Brown-red	Hard	5.5	13.1	1.97
2100	Brown	Very hard	9.0	7.1	2.19
2200	Dkr. brown	Steel hard	9.0	2.6	2.32
2300	—	—	(Expanded)	—	—

Remarks: Fired colors are not attractive.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1800	2.59	161.3	3.3	No expansion
1900	1.77	110.3	3.9	No expansion
2000	1.93	120.2	3.1	No expansion
2100	1.41	87.8	3.8	Slight expansion, glazed, sticky
2200	1.74	108.4	2.2	Overfired, glazed, melted

Remarks: This material might be suitable for lightweight aggregate if the sintering process is employed.

Potential Use: Possible sintered lightweight aggregate.

SAMPLE: R-1878

County: Scott

Locality: Roadcut, 0.15 mile west of Hill, on the east side of State Road 645 approximately 0.2 mile by road northeast of the intersection with State Highway 65.

Description: An exposure of medium gray-green shale, 20 feet in height, extends for a distance of more than 300 feet along the road. The shale weathers to form green, yellow, and brown fragments. Some of the weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.25°E. and a dip of 30°SE. Less than 1 foot of soil overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 18 feet of shale.

Type: Shale
pH: 4.80

Unfired strength: Very low

Raw Properties: Low plasticity, requires 22.0 percent water of plasticity, drying characteristics good, no defects, 2.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff-brown	Soft, crumbly	4.5	18.8	1.75
1900	Lt. brown	Fairly hard	5.0	16.4	1.83
2000	Brown-red	Hard	6.0	14.1	1.91
2100	Brown	Very hard	10.0	7.2	2.17
2200	Dkr. brown	Steel hard	11.0	3.6	2.25
2300	—	—	(Expanded)		—

Remarks: Fired colors are not attractive and the maturing temperatures are too high for brick. This material might be suitable for lightweight aggregate if the sintering process is employed.

Bloating Test: Negative

Potential Use: Possible sintered lightweight aggregate.

SAMPLE: R-1879

County: Scott

Locality: Roadcut, 0.1 mile north of Hill, on the east side of State Road 645 approximately 0.4 mile by road northeast of the intersection with State Highway 65.

Description: An exposure of green and gray shale is present in a roadcut 15 to 20 feet in height. The shale weathers to form brown and red fragments. This exposure of Pumpkin Valley (upper Rome) shale contains 12 feet of interbedded limestone that was not sampled. The rocks have a dip to the south and are overlain by 1 foot of soil.

Formation or age: Rome Formation

Sampled interval: Sample across 125 feet of shale.

Type: Shale
pH: 6.25

Unfired strength: Very low

Raw Properties: Low plasticity, requires 23.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-brown	Soft, crumbly	4.5	12.5	1.94
1900	Lt. brown	Fairly hard	5.5	10.4	2.01
2000	Brown-red	Hard	8.5	6.7	2.15
2100	Brown	Steel hard	9.0	2.1	2.39
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Remarks: Fired colors are not attractive. This material might be suitable for lightweight aggregate if the sintering process is employed.

Bloating Test: Negative

Potential Use: Possible sintered lightweight aggregate.

SAMPLE: R-1880

County: Scott

Locality: Roadcut, 0.1 mile east of Hill, on the east side of State Road 645 approximately 0.2 mile by road north of the intersection with State Road 665.

Description: An exposure of gray and green shale, 20 feet in height, is present in a roadcut. The shale weathers to form brown and red fragments with some slight iron-oxide staining. The shale is interbedded with dolomite and siltstone. Less than 1 foot of soil overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 15 feet of shale.

Type: Shale

Unfired strength: Very low

pH: 6.52

Raw Properties: Low plasticity, requires 21.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-brown	Soft, crumbly	5.0	16.1	1.82
1900	Lt. brown	Hard	5.5	14.1	1.89
2000	Brown-red	Very hard	6.0	12.0	1.80
2100	Brown	Steel hard	8.5	4.9	2.08
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Remarks: Fired specimens show scumming. The raw material is slightly effervescent indicating calcareous material. Fired colors are not attractive. This material might be suitable for lightweight aggregate if the sintering process is employed.

Bloating Test: Negative

Potential Use: Possible sintered lightweight aggregate.

SAMPLE: R-1881

County: Scott

Locality: Roadcut, 0.2 mile south of Hill, on the east side of State Road 665 approximately 0.1 mile by road south of the intersection with State Road 645.

Description: An exposure of green and dark-gray shale, approximately 100 feet thick, is present in the roadcut. This shale is in a narrow belt of the Rogersville Shale, which lies between the Rutledge Limestone and the Maryville Limestone. The shale dips to the south and is overlain by 1 foot of soil.

Formation or age: Rogersville Shale

Sampled interval: Sample across 75 feet of shale.

Type: Shale
pH: 6.50

Unfired strength: Very low

Raw Properties: Low plasticity, requires 20.0 percent water of plasticity, drying characteristics good, no defects, 4.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff	Soft, crumbly	6.0	12.5	1.91
1900	Dk. buff	Hard	7.5	4.4	2.24
2000	Brown	Very hard	7.5	5.6	1.98
2100	—	—	(Expanded)	—	—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1800	1.13	70.3	6.3	Excellent expansion
1900	0.89	55.4	7.1	Excellent expansion
2000	0.55	24.3	4.5	Overfired, glazed, very sticky

Remarks: Bloating range is long; the product is very strong and the absorption is low. The shale shows excellent bloating at 1800°F. Rotary kiln tests are recommended.

Potential Use: Lightweight aggregate

SAMPLE: R-1882

County: Scott

Locality: Roadcut, 0.75 mile southeast of Hill, on the east side of State Road 665 approximately 1.0 mile by road southeast of the intersection with State Road 645.

Description: An exposure of gray and green shale, with layers of siltstone and limestone, is present in the roadcut. The shale weathers to form small gray fragments that are stained slightly by iron oxide. The rocks have a dip of 30°S. and are overlain by 1 foot of soil overburden.

Formation or age: Nolichucky Formation

Sampled interval: Sample across 50 feet of shale and siltstone.

Type: Shale

Unfired strength: Low

pH: 6.56

Raw Properties: Low plasticity, requires 25.0 percent water of plasticity, drying characteristics good, no defects, 4.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff	Hard	7.5	13.1	1.91
1900	Lt. brown	Very hard	10.0	9.5	1.99
2000	Med. brown	Steel hard	10.0	6.7	1.89
2100	Brown	Steel hard	(Expanded)	5.0	1.42
2200	—	(Melted)	—	—	—
2300	—	—	(Expanded)	—	—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1800	1.28	79.7	5.8	Slight expansion
1900	1.08	67.3	7.2	Fair expansion
2000	0.99	61.7	6.1	Good expansion
2100	0.99	61.7	4.2	Good expansion, particles glazed, very sticky
2200	—	—	—	Overfired, melted

Remarks: This material would probably make a satisfactory aggregate. A study of the crushing characteristics would likely improve the thickness of the particles.

Potential Use: Common brick (low grade) and lightweight aggregate.

SAMPLE: R-1883

County: Scott

Locality: Abandoned quarry, 0.8 mile southeast of Hill, on the east side of State Road 665 approximately 1.1 miles by road southeast of the intersection with State Road 645.

Description: An exposure of gray and green shale, 20 feet in height, with interlayers of siltstone, dolomite, and limestone, is present in a small abandoned quarry. The shale weathers to form yellow, brown, and gray fragments. The rocks have a dip of approximately 30°S. and are overlain by 1 foot of soil overburden.

Formation or age: Nolichucky Formation

Sampled interval: Sample across 100 feet of shale and siltstone.

Type: Shale
pH: 6.8

Unfired strength: Low

Raw Properties: Low plasticity, requires 24.0 percent water of plasticity, drying characteristics good, no defects, 5.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff	Fairly hard	6.0	11.6	1.96
1900	Dk. buff	Hard	9.0	9.1	2.03
2000	Brown	Steel hard	10.0	3.2	2.06
2100	—	—	(Expanded)	—	—
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1800	1.67	104	7.3	No expansion
1900	1.33	83	5.9	Slight expansion
2000	1.13	71	3.2	Expansion, very sticky
2100	1.05	66	2.2	Expansion, very sticky
2200	0.85	53	3.8	Expansion, sticky and melted
2300	—	—	—	Popped in kiln

Remarks: Bloating range too short for lightweight aggregate by rotary kiln method, could probably be sintered.

Potential Use: Common brick (low grade) and possible sintered lightweight aggregate.

SAMPLE: R-1941

County: Scott

Locality: Roadcut on the west side of U. S. Highway 23 and 58 approximately 1.3 miles by road south of the intersection with State Highway 65 in Clinchport.

Description: Reddish-purple and olive-green shale and siltstone of the Rome Formation are exposed along the roadcut. Sandstone, thin beds of sandy shale, and thick-bedded limestone or dolomitic limestone also occur with the shale. The rocks are crumpled and have a dip of approximately 55°SE.

Formation or age: Rome Formation

Sampled interval: Composite sample of weathered and unweathered reddish-purple and olive-green shale and siltstone in roadcut.

Type: Shale

Unfired strength: Average

pH: 5.75

Raw Properties: Low plasticity, requires 22.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff	Soft, crumbly	4.0	20.6	1.71
1900	Buff-orange	Soft, crumbly	4.5	18.1	1.78
2000	Lt. brown	Soft, crumbly	5.0	15.9	1.85
2100	Brown	Very hard	6.0	10.6	2.04
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Potential Use: Brick

SAMPLE: R-1942

County: Scott

Locality: Roadcut, 0.3 mile northeast of Hortons Summit, on the east side of State Road 653 about 0.1 mile by road north of its intersection with U. S. Highway 23, 58, and 421 at Sun-bright.

Description: An exposure of dark-gray, hard, fissile, shale, 12 feet in height, extends for a distance of 220 feet along the roadcut. The shale, which is crumpled and broken, contains a few thin siltstone layers and weathers to form yellow, light-red, and light gray-green fissile to hackly-breaking fragments. Some of the shale fragments are stained yellow-green by sulfur and light-brown by iron oxide.

Formation or age: Big Stone Gap Shale

Sampled interval: Representative sample of shale from exposure 12 feet in height.

Type: Shale (high silica)
pH: 4.0

Unfired strength: Very low

Raw Properties: Low plasticity, gritty, requires 19.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff-orange	Soft, crumbly	1.0	26.9	1.55
1900	Dk. buff-orange	Soft, crumbly	1.0	24.5	1.61
2000	Dk. buff-orange	Soft, crumbly	5.0	23.7	1.60
2100	Brown	Fairly hard	5.5	17.0	1.78
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Potential Use: None (but lightweight aggregate tests were not made).

SAMPLE: R-1943

County: Scott

Locality: Roadcut along U. S. Highway 23, 58, and 421 about 1.2 miles southeast of the Southern Railway Station at Duffield.

Description: Dark-gray to black, fissile shale is exposed along the roadcut. The shale weathers to form fissile chips that are stained yellow to orange by iron oxide. The shale is approximately 200 feet stratigraphically below a red sandstone.

Formation or age: Big Stone Gap Shale

Sampled interval: Representative sample of dark-gray to black shale exposed in the roadcut.

Type: Shale (high silica)
pH: 4.2

Unfired strength: Very low

Raw Properties: Low plasticity, gritty, requires 19.0 percent water of plasticity, drying characteristics good, no defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-orange	Soft, crumbly	4.5	25.0	1.59
1900	Buff-orange	Soft, crumbly	5.5	22.2	1.66
2000	Buff-orange	Soft, crumbly	7.5	17.9	1.78
2100	Brown (mottled)	Very hard	10.0	10.3	2.01
2200	Dkr. brown	Steel hard	10.0	8.5	2.02
2300	Gray-brown	Steel hard	10.0	4.9	2.02

Potential Use: Brick

SAMPLE: R-2466

County: Scott

Locality: Roadcut, 0.4 mile southwest of Hilton, on the southeast side of U. S. Highway 58 and 421 approximately 0.35 mile by road west of the intersection with State Road 709.

Description: An exposure of medium-gray and brownish-red shale, 35 feet in height, extends for a distance of 550 feet along the roadcut. The shale weathers to form light- to medium-brown, angular fragments. Some of the weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.70°W. and a dip of 30°NE. Less than 2 feet of overburden is present.

Formation or age: Brallier Formation

Sampled interval: Composite sample representing 45 feet of fresh and weathered shale near the middle of the roadcut.

Type: Shale
pH: 5.48

Unfired strength: Good

Raw Properties: Low plasticity, requires 21.8 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	5.0	17.6	1.73
1900	Tan	Hard	5.0	14.7	1.84
2000	Brown	Very hard	10.0	7.0	2.10
2100	Dk. brown	Steel hard	10.5	1.9	2.27
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	—	—	—

Remarks: Good color, slight scumming.

Bloating Test: Negative

Potential Use: Face brick

SAMPLE: R-2468

County: Scott

Locality: Roadcut, 3.5 miles east of Mabe, on the southeast side of State Road 653 approximately 1.35 miles by road east of the intersection with State Road 722 at Stanleytown.

Description: An exposure of greenish-tan, sandy shale, 8 feet in height, extends for a distance of 250 feet along the roadcut. The shale weathers to form small, light-green and light gray-green, fissile chips. Some of the weathered cleavage and bedding surfaces are stained dark brown by iron oxide. The shale has a strike of N.70°E. and a dip of 30°SE. Less than 2 feet of overburden is present.

Formation or age: Nolichucky Formation

Sampled interval: Composite of fresh and weathered shale sampled for a distance of 200 feet along the roadcut.

Type: Shale

Unfired strength: Good

pH: 6.20

Raw Properties: Low plasticity, requires 23.1 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Fairly hard	5.0	15.4	1.80
1900	Brown	Hard	5.5	12.1	1.88
2000	Chocolate	Very hard	14.0(?)	6.6	2.09
2100	Dk. brown	Steel hard	10.5	0.4	2.18
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	—	—	—

Remarks: Poor color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.72	107.4	7.9	Slight expansion
2100	1.49	93.0	4.5	Laminar expansion
2200	1.29	80.5	2.4	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Common brick

SAMPLE: R-2469

County: Scott

Locality: Roadcut, 1.7 miles northeast of Wood, on the northwest side of State Highway 65 approximately 1.5 miles by road northeast of the intersection with State Road 660.

Description: An exposure of brown and gray-green, micaceous shale, 25 feet in height, with thin siltstone layers, extends for a distance of 900 feet along the roadcut. The shale weathers to form light gray-green and cream-white, angular fragments. Some of the weathered cleavage and bedding surfaces are stained brown by iron oxide; the bedding surfaces of many fragments have a lustrous shine. Less than 1 foot of overburden is present.

Formation or age: Rome Formation

Sampled interval: Composite sample representing 135 feet of fresh and weathered shale and siltstone near the middle of the roadcut.

Type: Shale
pH: 6.80

Unfired strength: Fair

Raw Properties: Low plasticity, requires 20.4 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Brown	Fairly hard	0.5	17.3	1.70
1900	Brown	Hard	2.5	15.2	1.76
2000	Chocolate	Very hard	6.5	8.2	2.00
2100	Dk. brown	Very hard	10.0	1.4	2.29
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	—	—	—

Remarks: Poor color, scumming.

Bloating Test: Negative

Potential Use: None

SAMPLE: R-2470

County: Scott

Locality: Roadcut, 2.8 miles southeast of Dungannon, on the southwest side of State Road 774 approximately 2.6 miles by road southeast of the intersection with State Highway 65.

Description: An exposure of medium to dark gray-green shale, 15 feet in height, with thin siltstone layers, extends for a distance of 275 feet along the roadcut. The shale weathers to form light gray-green and yellow-brown, irregular chips. The shale is stratigraphically overlain by thick-bedded limestone. The rocks have a strike of N.71°E. and a dip of 25° SE.; the cleavage has an easterly strike and an approximate dip of 60°S. Less than 1 foot of overburden is present.

Formation or age: Rogersville (?) Shale

Sampled interval: Composite sample representing 35 feet of fresh and weathered shale and siltstone near the middle of the roadcut.

Type: Shale

Unfired strength: Good

pH: 9.20

Raw Properties: Low plasticity, requires 20.6 percent water of plasticity, no drying defects, 0.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Fairly hard	2.5	12.2	1.88
1900	Brown	Hard	5.0	8.3	1.99
2000	Chocolate	Very hard	9.5	1.9	2.16
2100	—	—	(Expanded)	—	—

Remarks: Fair color, slight scumming.

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
2000	1.58	98.6	6.0	Slight expansion
2100	1.27	79.3	4.1	Slight expansion
2200	1.03	64.3	3.8	Fair expansion

Remarks: Some promise for lightweight aggregate.

Potential Use: Lightweight aggregate

SAMPLE: R-2474

County: Scott

Locality: Roadcut on the east side of U. S. Highway 58 and 421 approximately 0.1 mile by road north of the intersection with State Road 604 at Pattonsville.

Description: An exposure of dark-gray to black, brittle, fissile shale, 10 feet in height, extends for a distance of 260 feet along the roadcut. The shale weathers to form light- to medium-gray, white, and light-green fissile chips. Some of the weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.30°E. and a dip of 8°SE. Less than 1 foot of overburden is present.

Formation or age: Genesee Shale

Sampled interval: Composite of weathered shale sampled for a distance of 220 feet along the roadcut.

Type: Shale

Unfired strength: Fair

pH: 5.85

Raw Properties: Low plasticity, requires 24.2 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	1.0	26.9	1.45
1900	Tan	Hard	1.0	24.0	1.51
2000	Brown	Very hard	10.0	9.9	1.92
2100	Chocolate	Steel hard	13.5	5.0	2.10
2200	Dk. brown	Steel hard	13.5	1.4	2.12
2300	—	(Melted)	—	—	—

Remarks: Fair color, initial vitrification abrupt.

Bloating Test: Negative

Potential Use: Brick

SAMPLE: R-2478

County: Scott

Locality: Roadcut on the east side of State Highway 71 approximately 2.9 miles by road southwest from the intersection with State Road 682 in Nickelsville.

Description: An exposure of light-brown shale, 8 feet in height, with thin siltstone and limestone layers, extends for a distance of 900 feet along the roadcut. The shale weathers to form tan, soft, fissile chips. Many of the weathered cleavage and bedding surfaces are stained dark-brown by iron oxide. The shale is overlain and underlain stratigraphically by thick-bedded siltstone and limestone. The rocks have a strike of N.73°E. and a dip of 30°SE. Less than 1 foot of overburden is present.

Formation or age: Nolichucky (?) Formation

Sampled interval: Sample across 20 feet of shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 5.95

Raw Properties: Low plasticity, requires 22.5 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Red-tan	Fairly hard	1.0	18.2	1.70
1900	Red-tan	Hard	1.0	17.9	1.71
2000	Chocolate	Very hard	9.5	8.3	2.00
2100	—	—	(Expanded)		—
2200	—	—	—	—	—
2300	—	(Melted)	—	—	—

Remarks: Poor color, short vitrification range.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.97	119.2	14.1	No expansion
2100	1.53	95.5	8.1	Slight expansion
2200	1.21	75.5	3.8	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: None

SAMPLE: R-2479

County: Scott

Locality: Roadcut, 0.2 mile northeast of Fort Blackmore, on the east side of State Road 619 at its intersection with State Highway 65.

Description: An exposure of light gray-green, poorly fissile shale, 9 feet in height, extends for a distance of 330 feet along the roadcut. The shale weathers to form light-red and light-gray, soft, angular fragments. Some of the weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.70°E. and a dip of 62°NW. Less than 1 foot of overburden is present.

Formation or age: Rome Formation

Sampled interval: Composite of fresh and weathered shale sampled for a distance of 330 feet along the roadcut.

Type: Shale
pH: 6.05

Unfired strength: Good

Raw Properties: Low plasticity, requires 22.2 percent water of plasticity, no drying defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	2.5	19.6	1.62
1900	Tan	Fairly hard	2.5	16.4	1.72
2000	Brown	Hard	7.5	12.4	1.85
2100	Chocolate	Very hard	10.0	7.0	2.05
2200	Dk. brown	Steel hard	12.5	1.7	2.29
2300	—	(Melted)	—	—	—

Remarks: Poor color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.82	113.6	8.8	No expansion
2100	2.05	128.0	10.1	Shrinkage
2200	1.24	77.4	4.1	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Common brick

SAMPLE: R-2484

County: Scott

Locality: Roadcut, 0.3 mile east of Pattonville, on the southeast side of U. S. Highway 58 and 421 approximately 0.2 mile by road east of the intersection with State Road 638.

Description: An exposure of medium- to dark-brown, sandy, soft, fissile shale, 9 feet in height, with thin siltstone layers, extends for a distance of 225 feet along the roadcut. The shale weathers to form light-gray and light greenish-gray, fissile fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. The rocks have a northeasterly strike and a dip of 58°SE. Less than 1 foot of overburden is present.

Formation or age: Portage Shale

Sampled interval: Composite of shale and siltstone sampled for a distance of 90 feet along the roadcut.

Type: Shale

Unfired strength: Good

pH: 5.72

Raw Properties: Low plasticity, requires 24.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Ivory	Fairly hard	0.5	19.6	1.64
1900	Ivory	Hard	4.0	17.2	1.71
2000	Tan	Hard	4.5	13.7	1.80
2100	Brown	Very hard	10.0	9.7	1.93
2200	Purple-gray	Steel hard	10.0	4.1	2.13
2300	—	(Melted)	—	—	—

Remarks: Good color

Bloating Test: Negative

Potential Use: Face brick

SAMPLE: R-2485

County: Scott

Locality: Roadcut, 4.0 miles southwest of Pattonville, on the north side of State Road 603 approximately 0.9 mile by road southwest of the intersection with State Road 623.

Description: An exposure of dark-gray to black, brittle, fissile shale, 5 feet in height, extends for a distance of 150 feet along the roadcut. The shale weathers to form light-gray to white, light-tan, and light-green, fissile fragments. Some of the weathered bedding surfaces are stained by iron oxide. Less than 1 foot of overburden is present.

Formation or age: Genesee Shale

Sampled interval: Composite of fresh and weathered shale sampled for a distance of 140 feet along the roadcut.

Type: Shale

Unfired strength: Good

pH: 6.05

Raw Properties: Low plasticity, requires 23.6 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	0.5	27.0	1.41
1900	Tan	Hard	3.5	23.8	1.49
2000	Brown	Very hard	10.0	14.7	1.72
2100	Chocolate	Steel hard	15.0	5.3	2.04
2200	Dk. brown	Steel hard	10.5	1.4	2.10
2300	—	—	(Expanded)	—	—

Remarks: Poor color

Bloating Test:

Temp. ° F	Bulk Dens.	Lib./ft. ³	% Abs.	Remarks
2000	2.16	134.8	3.8	No expansion
2100	1.46	91.1	6.7	Slight expansion
2200	1.00	62.4	7.7	Fair expansion

Remarks: Some promise for lightweight aggregate.

Potential Use: Lightweight aggregate

SMYTH COUNTY

Samples were collected from 14 localities in Smyth County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-46	Residual (?) clay	Pottery and artware
R-1889	Rome Formation	Brick, tile, and probably sintered lightweight aggregate
R-1890	Rome Formation	Brick, tile, and probably sintered lightweight aggregate
R-1908	Rome Formation	Brick, tile, and probably sintered lightweight aggregate
R-1904	Residual (?) clay	Drain tile and probably brick
R-2061	Brallier Formation	Possible brick and lightweight aggregate
R-2544	Price Formation	Common brick
R-2545	Nolichucky Formation	Lightweight aggregate
R-2546	Chemung Formation	None
R-2547	Maccrady (?) Formation	Lightweight aggregate
R-2548	Brallier Formation	Brick and flower pots
R-2549	Nolichucky Formation	None
R-2550	Shale of Cambrian age	None
R-2551	Rome Formation	None
R-2552	Chemung (?) Formation	None
R-2553	Rome Formation	None

SAMPLE: R-46

County: Smyth

Locality: Exposure, 2.9 miles north of Sugar Grove, on the north side of a forest access road leading east from State Highway 16 near elevation 2990' and near drain crossing Slemp Creek.

Formation or age: Residual (?) clay

Sampled interval: Sample believed to be representative of white clay in deposit.

Type: Clay (+ quartz)

Unfired strength: Good

pH: 5.3

Crude Material

Raw Properties: Moderate plasticity, smooth working, requires 30 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. ivory	Soft, crumbly	5.0	25.1	1.58
1900	Off-white	Soft, crumbly	6.0	21.6	1.67
2000	Off-white	Soft, crumbly	6.0	18.0	1.77
2100	Lt. pink	Fairly hard	9.0	14.3	1.88
2200	Lt. pink	Very hard	11.5	8.5	2.04
2300	Lt. pink	Very hard	11.5	7.5	2.08

Remarks: Unwashed clay has a mottled appearance.

Beneficiated Material

Beneficiation by water separation removed the coarser quartz from the quartz-clay mixture. In addition to bentonite (volcanic glass), kaolin, and montmorillonite, a minor quantity of iron oxide was determined in the beneficiated portion. Glassy rounded fragments with some alteration were found by microscopic examination. This material is typical of a volcanic ash and is between glass and bentonite.

Raw Properties: Smoother working than the unwashed material, 3.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. ivory	Soft, crumbly	4.0	23.6	1.63
1900	Off-white	Soft, crumbly	4.0	22.4	1.66
2000	Off-white	Soft, crumbly	9.5	10.2	2.00
2100	Lt. pink	Steel hard	12.0	3.4	2.22
2200	Lt. gray-pink	Steel hard	14.5	0.3	2.32
2300	Lt. gray-pink	Steel hard	14.5	0.1	2.20

Remarks: The iron content is probably associated with the clay because the washed specimens were uniform in color when fired.

Pottery Tests

Slip Composition:

	%
R-46	66.5
Nepheline syenite	10.5
Potter's flint	10.5
Ball clay	12.5
Total	100.0

0.07% Calgon (commercial) used as a deflocculating agent.

Slip Properties:

Water	35.0 %
Drying shrinkage	4.5 %
Firing shrinkage	10.5 %
Firing temperature	2120° F

Casting Properties:

The first test pieces were made with a slip composed entirely of the sample. This slip did not adhere to the mold and the resulting ware had very little green strength. Nepheline syenite was added to lower the maturing temperature, ball clay to increase strength, and potter's flint to open the body to allow faster casting. Casting time 15-20 minutes.

Potential Use: Satisfactory for pottery and artware.

SAMPLES: R-1889, R-1890, and R-1908 *County:* Smyth

Locality: Shale pit of Appalachian Shale Division of General Shale Products Corporation, located on the southeast side of U. S. Highway 11 approximately 1.6 miles southwest of Groseclose.

Formation or age: Rome Formation

SAMPLE R-1889

Sampled interval: Composite sample of yellowish-orange and moderate-red weathered shale from company stockpile believed to be representative of shale in pit.

Type: Shale (soft) *Unfired strength:* Good
pH: 5.45

Raw Properties: Moderate plasticity, smooth, requires 32.0 percent water of plasticity, drying characteristics good, no defects, 3.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff	Soft, crumbly	6.0	15.0	1.89
1900	Dk. buff	Fairly hard	6.0	12.1	2.01
2000	Red-brown	Steel hard	10.0	3.5	2.32
2100	—	(Vitreous)	(Expanded)	—	—
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1800	1.91	119.0	9.6	No expansion
1900	1.68	104.7	8.3	No expansion
2000	1.45	90.3	6.7	Slight expansion
2100	1.32	82.2	5.2	Fair expansion
2200	0.96	60.1	3.4	Overexpanded, glazed, very sticky

Remarks: The expanded material has excellent strength and low absorption. Although the weights are somewhat heavy, this shale could probably be used to make sintered lightweight aggregate.

Potential Use: Brick, tile, and probably sintered lightweight aggregate.

SAMPLE R-1890

Sampled interval: Composite sample of dark reddish-brown and pale-olive shale from company stockpile believed to be representative of shale in pit.

Type: Shale (soft)
pH: 6.5

Unfired strength: Low

Raw Properties: Low plasticity, gritty, requires 23.0 percent water of plasticity, drying characteristics good, no defects, 2.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff	Soft, crumbly	4.5	13.8	1.93
1900	Dk. buff	Hard	4.5	13.1	1.96
2000	Red-brown	Very hard	6.0	6.4	2.21
2100	—	—	(Expanded)	—	—
2200	—	(Melted)	—	—	—
2300	—	—	(Expanded)	—	—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1800	1.92	119.6	4.0	No expansion
1900	1.88	117.1	3.9	No expansion
2000	1.32	82.2	3.7	Fair expansion
2100	1.19	74.1	3.2	Fair expansion
2200	1.09	67.9	1.3	Overexpanded, glazed, very sticky

Remarks: The expanded material has excellent strength and low absorption. Although the weights are somewhat heavy, this shale could probably be used to make sintered lightweight aggregate.

Potential Use: Brick, tile, and probably sintered lightweight aggregate.

SAMPLE R-1908

Sampled interval: Sample is a blend of shale composed of 50 percent R-1889 and 50 percent R-1890 by weight.

Type: Shale
pH: 6.4

Unfired strength: Low

Raw Properties: Low plasticity, gritty, requires 22.0 percent water of plasticity, drying characteristics good, no defects, 3.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff	Soft, crumbly	4.0	16.5	1.91
1900	Dkr. buff	Hard	7.5	12.0	2.05
2000	Lt. brown	Very hard	8.5	9.3	2.18
2100	Med. brown	Steel hard	12.5	2.8	2.35
2200	—	(Melted)	—	—	—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1800	1.62	100.9	5.0	No expansion
1900	1.36	84.7	4.6	Slight expansion
2000	1.29	80.4	3.4	Fair expansion
2100	1.20	74.8	6.4	Fair expansion
2200	1.29	80.4	3.5	Overfired, glazed, very sticky

Remarks: The shale is not amenable to the rotary kiln method of processing.

Potential Use: Brick, tile, and probably sintered lightweight aggregate.

SAMPLE: R-1904

County: Smyth

Locality: Ditch, 2.9 miles northwest of Nebo, off the west side of State Road 621 approximately 0.9 mile by road north of the intersection with State Highway 42.

Description: Light-gray clay is exposed at a depth of about 3 feet in a small ditch approximately 200 feet in length.

Formation or age: Residual (?) clay

Sampled interval: Grab sample of light-gray clay in ditch.

Type: Clay

Unfired strength: Good

pH: 6.0

Raw Properties: Low plasticity, gritty, requires 22.0 percent water of plasticity, drying characteristics good, no defects, 5.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Med. buff	Soft, crumbly	5.0	14.8	1.84
1900	Med. buff	Fairly hard	5.0	13.7	1.87
2000	V. lt. brown	Very hard	7.5	10.6	1.97
2100	Lt. brown-red	Steel hard	10.0	7.0	2.09
2200	Lt. brown-gray	Steel hard	10.0	4.4	2.16
2300	Lt. gray-brown	Steel hard	10.0	4.8	1.98

Remarks: Fired colors are not very attractive for brick.

Bloating Test: Negative

Potential Use: Drain tile and probably brick.

SAMPLE: R-2061

County: Smyth

Locality: Outcrop, 3.5 miles east of Chatham Hill, on the east side of State Road 622 approximately 0.1 mile southeast of the intersection with State Highway 42.

Description: The outcrop, which is exposed for a distance of 400 feet, consists of fissile olive-green shale and thin-bedded, fine-grained, green sandstone. The rocks weather gray and are stained by iron oxide. Several small tight folds that crumple and distort the rocks are present in the northern end of the outcrop; an overturned fold is present in the southern end, and other folds and faults occur throughout the outcrop. The rocks have a strike of N.70° to 80°E. and have a dip that is generally to the south. Less than 1 foot of soil overburden is present.

Formation or age: Brallier Formation

Sampled interval: Sample across 75 feet of shale.

Type: Shale
pH: 6.7

Unfired strength: Very low

Raw Properties: Low plasticity, thixotropic, requires 20.0 percent water of plasticity, drying characteristics good, no defects, 2.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff-brown	Soft, crumbly	5.0	16.5	1.86
1900	Dk. buff-brown	Soft, crumbly	5.0	13.4	1.98
2000	Dk. buff-brown	Soft, crumbly	5.0	12.1	2.02
2100	Brown	Steel hard	5.0	8.2	2.19
2200	Dk. brown	Steel hard	7.0	5.5	2.27
2300	—	(Melted)	—	—	—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1900	1.97	122.7	3.5	No expansion
2000	1.64	102.1	3.8	No expansion
2100	1.40	87.2	3.5	Fair expansion
2200	1.21	75.3	3.9	Good expansion, very sticky

Remarks: Fired weights are somewhat heavy, but the shale expands uniformly with low absorption and good strength, and may have aggregate possibilities.

Potential Use: Possible brick and lightweight aggregate.

SAMPLE: R-2544

County: Smyth

Locality: Roadcut, 1.7 miles northeast of McCrady, on the northwest side of State Highway 91 approximately 0.25 mile by road northeast of the intersection with State Road 633 at North Holston (Figure 6).

Description: An exposure of medium gray-green, moderately soft shale, 15 feet in height, is present in a long roadcut. The shale is silty and micaceous, contains thin siltstone layers, and weathers to form light-gray and light gray-green, elongate fragments. Some of the weathered cleavage and bedding surfaces are stained red-brown to brown by iron oxide. Siderite concretions occur in the shale. The shale has a strike of N.3°W. and a dip of 45°SW., and is underlain by thick beds of siltstone.

Formation or age: Price Formation

Sampled interval: Sample across 4 feet of fresh and weathered shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 7.00

Raw Properties: Low plasticity, requires 19.1 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	10.0	17.9	1.70
1900	Tan	Fairly hard	10.0	15.4	1.78
2000	Lt. brown	Hard	11.0	11.5	1.91
2100	Chocolate	Very hard	14.0	6.1	2.10
2200	Gray-brown	Steel hard	15.5	4.1	2.17
2300	—	(Melted)	—	—	—

Remarks: Color marginal, slight scumming.

Bloating Test: Negative

Potential Use: Common brick

SAMPLE: R-2545

County: Smyth

Locality: Roadcut, 2.5 miles south of Broadford, on the west side of State Road 633 approximately 0.8 mile by road southeast of the intersection with State Road 723.

Description: An exposure of approximately 25 feet of gray-green, moderately hard, fissile shale, 40 feet in height, with thin siltstone layers, is present in a long roadcut. The shale weathers to form brown to light-tan and light gray-green, small, fissile chips. Some weathered cleavage and bedding surfaces are stained brown by iron oxide. The shale is underlain by limestone.

Formation or age: Nolichucky Formation

Sampled interval: Sample across 20 feet of fresh and weathered shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 8.80

Raw Properties: Moderate plasticity, requires 24.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	15.5	13.9	1.82
1900	Lt. brown	Hard	19.0	9.0	2.04
2000	Chocolate	Steel hard	20.0	4.0	2.21
2100	—	—	(Expanded)	—	—

Remarks: High shrinkage

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.48	92.4	2.7	Slight expansion
2100	1.17	73.0	4.2	Fair expansion
2200	1.00	62.4	2.7	Good expansion

Remarks: Some promise for lightweight aggregate.

Potential Use: Lightweight aggregate

SAMPLE: R-2546

County: Smyth

Locality: Roadcut, 1.7 miles west of Broadford, on the west side of State Highway 91 approximately 0.35 mile by road north of the intersection with State Road 633 (Figure 7).

Description: An exposure of medium-gray, gray-green, and black shale, 25 feet in height, is present in a long roadcut. The shale, which contains thin siltstone layers, is carbonaceous, moderately soft, and slightly micaceous, and weathers to form light-gray, small fissile chips and slabs. The weathered cleavage and bedding surfaces are stained orange and yellow-brown by iron oxide. The shale has a strike of N.4°E. and a dip of 35°SE. No overburden is present where sampled.

Formation or age: Chemung Formation

Sampled interval: Sample across 25 feet of shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 8.30

Raw Properties: Low plasticity, requires 20.6 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Gray-tan	Fairly hard	10.0	20.8	1.64
1900	Lt. brown	Hard	11.0	17.2	1.73
2000	Brown	Very hard	15.0	12.4	1.88
2100	Dk. brown	Steel hard	19.0	4.4	2.15
2200	Dk. brown	Steel hard	19.0	2.8	2.16
2300	—	—	(Expanded)	—	—

Remarks: Poor color, short vitrification range, scumming.

Potential Use: None

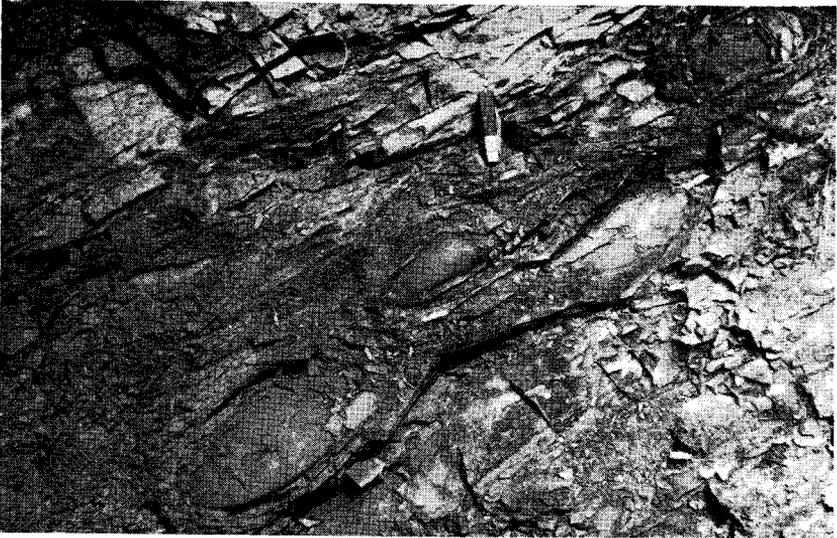


Figure 6. Exposure of the Price Formation (Sample R-2544) on the northwest side of State Highway 91 approximately 0.25 mile by road northeast of the intersection with State Road 633 at North Holston.

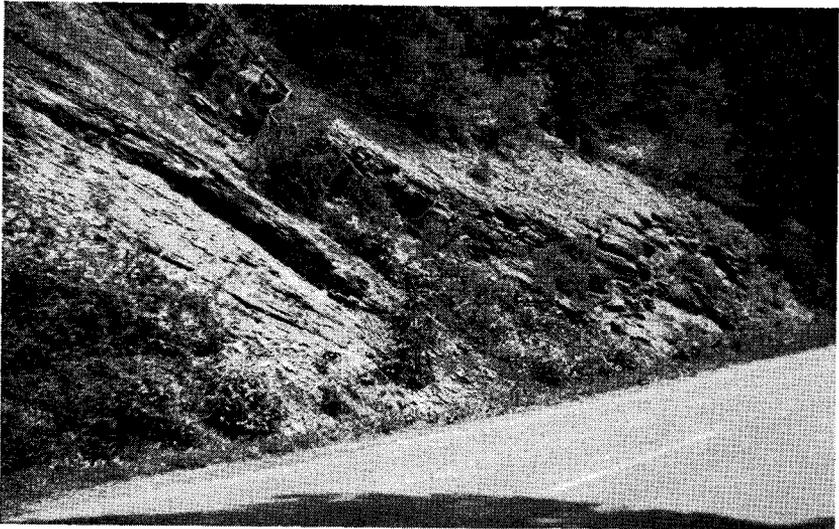


Figure 7. Exposure of the Chemung Formation (Sample R-2546) on the west side of State Highway 91 approximately 0.35 mile by road north of the intersection with State Road 633.



Figure 6. Exposure of the Price Formation (Sample R-2544) on the northwest side of State Highway 91 approximately 0.25 mile by road northeast of the intersection with State Road 633 at North Holston.



Figure 7. Exposure of the Chemung Formation (Sample R-2546) on the west side of State Highway 91 approximately 0.35 mile by road north of the intersection with State Road 633.

SAMPLE: R-2547

County: Smyth

Locality: Roadcut, 1.3 miles north of Chatham Hill, on the east side of State Highway 16 approximately 0.4 mile by road north of the intersection with State Highway 42 East.

Description: An exposure of green and gray-green shale and gray clay, 10 feet in height, with very thin siltstone layers, extends for a distance of 80 feet along the roadcut. The shale weathers to form red and light gray-green, blocky, angular, rough fragments with shiny surfaces. The weathered cleavage and bedding surfaces are stained brown by iron oxide. Less than 1 foot of overburden is present.

Formation or age: Maccrady (?) Formation

Sampled interval: Sample across 12 feet of fresh and weathered shale and clay.

Type: Shale and clay
pH: 6.00

Unfired strength: Good

Raw Properties: Moderate plasticity, requires 28.2 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	13.0	23.8	1.55
1900	Tan	Hard	14.5	21.3	1.65
2000	Tan	Very hard	17.5	17.6	1.73
2100	Brown	Steel hard	20.0	9.9	1.97
2200	Chocolate	Steel hard	25.0	6.1	2.11
2300	Black-brown	Very hard	25.0	3.4	2.16

Remarks: High shrinkage

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.49	93.0	11.8	Slight expansion
2100	1.38	86.2	11.5	Slight expansion
2200	0.80	49.9	35.7	Good expansion

Remarks: Some promise for lightweight aggregate.

Potential Use: Lightweight aggregate

SAMPLE: R-2548

County: Smyth

Locality: Roadcut, 3.2 miles east of Chatham Hill, on the north side of State Highway 42 approximately 0.15 mile by road east of the intersection with State Road 621.

Description: An exposure of green and light gray-green, hard, fissile shale, 20 feet in height, with thin siltstone layers, extends for a distance of approximately 700 feet along the roadcut. The shale weathers to form tan, gray, and gray-green, fissile fragments. The weathered cleavage and bedding surfaces are stained brown by iron oxide. The shale has a strike of N.66°E. and a dip of 55°SE. Less than 1 foot of overburden is present.

Formation or age: Brallier Formation

Sampled interval: Composite of fresh and weathered shale and siltstone sampled for a distance of 50 feet along the western end of the roadcut.

Type: Shale
pH: 6.70

Unfired strength: Good

Raw Properties: Moderate plasticity, requires 24.2 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	10.5	16.7	1.66
1900	Tan	Hard	15.5	—	1.78
2000	Tan	Very hard	18.5	13.2	1.88
2100	Chocolate	Steel hard	25.0	6.3	2.14
2200	Dk. brown	Steel hard	25.5	3.4	2.24
2300	—	—	(Expanded)	—	—

Potential Use: Brick and flower pots.

SAMPLE: R-2549

County: Smyth

Locality: Abandoned quarry, 1.0 mile northwest of Atkins, on the southwest side of State Road 622 approximately 1.5 miles by road north of the intersection with U. S. Highway 11.

Description: An exposure of gray-green, soft, fissile shale, 25 feet in height, with thin siltstone layers, extends for a distance of about 175 feet along the quarry face. The shale weathers to form light-gray, light-green, and brown, angular fragments. The weathered cleavage and bedding surfaces are stained brown by iron oxide. The shale has a strike of N.80°E. and a dip of 85°SE. Less than 2 feet of overburden is present.

Formation or age: Nolichucky Formation

Sampled interval: Sample across 40 feet of fresh and weathered shale and siltstone.

Type: Shale
pH: 7.15

Unfired strength: Fair

Raw Properties: Low plasticity, requires 21.6 percent water of plasticity, scumming, 12.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	14.5	21.3	1.62
1900	Tan	Hard	16.0	17.9	1.68
2000	Lt. brown	Hard	16.0	15.6	1.74
2100	Chocolate	Very hard	20.0	9.3	1.97
2200	Dk. brown	Steel hard	25.0	6.4	2.06
2300	Black-brown	Steel hard	25.0	4.3	2.11

Remarks: Shrinkage too high.

Bloating Test: Negative

Potential Use: None

SAMPLE: R-2550

County: Smyth

Locality: Roadcut, 1.5 miles south of Sugar Grove, on the east side of State Highway 16 approximately 0.9 mile by road south of the intersection with State Road 676.

Description: An exposure of gray-green, hard, sub-fissile shale, 12 feet in height, with thin siltstone layers, is present in a long roadcut. The shale weathers to form fissile elongate fragments. The weathered cleavage and bedding surfaces are stained by iron oxide.

Formation or age: Cambrian

Sampled interval: Sample across 10 feet of shale and siltstone in the southern end of the roadcut.

Type: Shale

Unfired strength: Good

pH: 6.80

Raw Properties: Moderate plasticity, requires 25.4 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	14.5	23.3	1.56
1900	Tan	Fairly hard	15.5	20.0	1.64
2000	Lt. brown	Hard	—	17.6	1.71
2100	Chocolate	Very hard	20.0	10.6	1.92
2200	Dk. brown	Steel hard	20.0	10.6	1.92
2300	Dk. brown	Steel hard	20.0	4.3	2.13

Remarks: High shrinkage

Bloating Test: Negative

Potential Use: None

SAMPLE: R-2551

County: Smyth

Locality: Roadcut, 2.5 miles northwest of Camp, on the north side of State Road 614 approximately 1.5 miles by road northeast of the intersection with State Road 612 at Summit.

Description: An exposure of interbedded red and gray-green, soft, silty shale, 15 feet in height, extends for a distance of approximately 800 feet along the roadcut. The shale weathers to form red and gray-green, fissile fragments. Some slight iron-oxide staining is present. The shale has a strike of N.78°E. and a dip of 45°SE. Less than 1 foot of overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 15 feet of shale.

Type: Shale

Unfired strength: Good

pH: 8.65

Raw Properties: Low plasticity, requires 22.6 percent water of plasticity, scumming.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Brown	Fairly hard	0.0	21.7	1.53
1900	Brown	Fairly hard	0.0	20.8	1.57
2000	Red-brown	Hard	0.0	18.9	1.64
2100	Dk. brown	Very hard	5.5	6.3	2.03
2200	—	—	(Expanded)	—	—
2300	—	(Melted)	—	—	—

Remarks: Short vitrification range, scumming.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	2.01	125.5	5.9	Slight expansion
2100	1.91	119.2	4.9	Slight expansion
2200	1.62	101.1	5.5	Melting, sticky

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: None

SAMPLE: R-2552

County: Smyth

Locality: Roadcut, 3.2 miles north of Seven Mile Ford, on the west side of State Road 659 approximately 0.2 mile by road south of the intersection with State Road 617.

Description: An exposure of gray and medium-green, soft, fissile shale, 10 feet in height, with thin siltstone layers, extends for a distance of 170 feet along the roadcut. The shale weathers to form light-gray, gray, brown, tan, and light-green, fissile chips. The weathered cleavage and bedding surfaces are stained by iron oxide. Less than 3 feet of overburden is present.

Formation or age: Chemung (?) Formation

Sampled interval: Sample across 30 feet of fresh and weathered shale and siltstone.

Type: Shale
pH: 6.30

Unfired strength: Good

Raw Properties: Low plasticity, requires 19.1 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	14.5	19.2	1.71
1900	Tan	Fairly hard	15.5	16.1	1.80
2000	Tan	Hard	18.5	13.9	1.86
2100	Brown	Very hard	20.0	9.0	2.02
2200	Dk. brown	Steel hard	20.0	6.5	2.10
2300	—	(Melted)	—	—	—

Remarks: Shrinkage too high.

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
2000	2.49	155.5	4.2	No expansion
2100	1.53	95.5	4.0	Slight expansion
2200	1.33	83.0	1.8	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: None

SAMPLE: R-2553

County: Smyth

Locality: Abandoned quarry, 4.5 miles south of Seven Mile Ford, on the west side of State Road 604 approximately 1.4 miles by road south of the intersection with State Road 648.

Description: An exposure of red, hard, partly mottled shale, 40 feet in height, with thin siltstone layers, is present in the quarry face. The shale weathers to form small, fissile or rough, elongate fragments, and has a strike of N.60°E. and a dip of 83°SE. Less than 2 feet of overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 30 feet of shale and siltstone.

Type: Shale

Unfired strength: Fair

pH: 9.00

Raw Properties: Low plasticity, requires 16.0 percent water of plasticity, no drying defects.

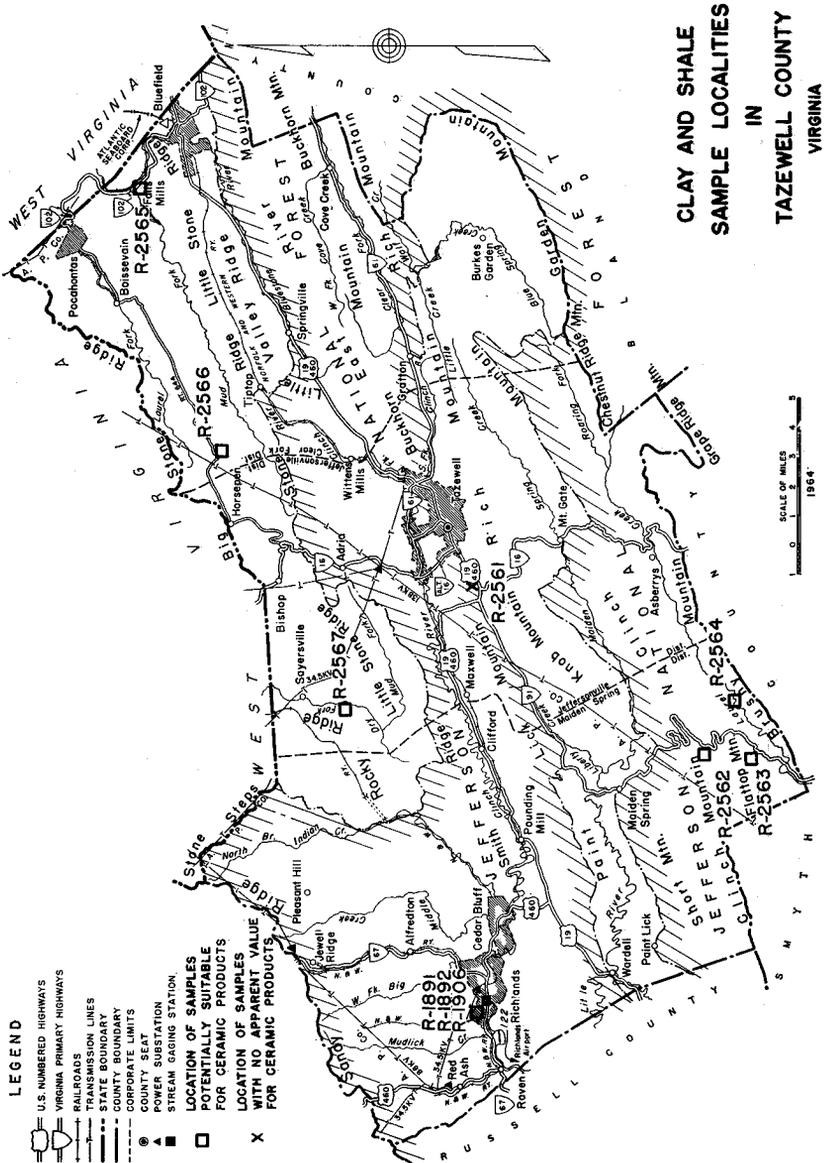
Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. red-brown	Hard	15.0	10.2	1.99
1900	Red-brown	Very hard	16.5	8.4	2.02
2000	Chocolate	Very hard	16.5	6.6	1.99
2100	—	—	(Expanded)	—	—

Remarks: Shrinkage too high.

Bloating Test: Negative

Potential Use: None



Location Map of Tazewell County

TAZEWELL COUNTY

Samples were collected from eight localities in Tazewell County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1891	Brallier Formation	Brick, tile, and lightweight aggregate
R-1892	Brallier Formation	Brick, tile, and lightweight aggregate
R-1906	Brallier Formation	Brick, tile, and lightweight aggregate
R-2561	Residual (?) clay	None (other than extruded clay dummies)
R-2562	Clinton (?) Formation	Face brick
R-2563	Portage (?) Shale	Face brick
R-2564	Clinton (?) Formation	Lightweight aggregate
R-2565	Bluestone Formation	Lightweight aggregate
R-2566	Hinton (?) Formation	Face brick (marginal)
R-2567	Shale and siltstone of Devonian age	Face brick (marginal)

SAMPLES: R-1891, R-1892, and R-1906 *County:* Tazewell

Locality: Shale pit of General Shale Products Corporation on the north side of U. S. Highway 460 in Richlands.

Formation or age: Brallier Formation

SAMPLE: R-1891

Sampled interval: Composite sample of greenish-gray, olive-gray, and grayish-orange weathered shale from company stock-pile believed to be representative of shale in pit.

Type: Shale
pH: 5.4

Unfired strength: Good

Raw Properties: Low plasticity, smooth, requires 24.0 percent water of plasticity, drying characteristics good, no defects, 3.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-orange	Soft, crumbly	6.0	15.9	1.90
1900	Buff-orange	Fairly hard	6.0	13.3	1.98
2000	Lt. red-brown	Steel hard	9.0	6.3	2.25
2100	Brown-red	Steel hard	12.0	2.8	2.34
2200	Med. brown	Steel hard	12.5	0.0	2.27
2300	—	—	(Expanded)		—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1800	1.91	119.0	3.6	No expansion
1900	1.63	105.5	7.8	Slight expansion
2000	1.16	72.3	6.7	Good expansion
2100	1.04	64.8	8.8	Good expansion, slightly sticky
2200	1.12	69.8	6.3	Overexpanded, slagged, sticky

Remarks: Good lightweight aggregate material; the unweathered shale would probably give better results.

Potential Use: Brick, tile, and lightweight aggregate.

SAMPLE: R-1892

Sampled interval: Composite sample of dark-gray unweathered shale from company stockpile believed to be representative of shale in pit.

Type: Shale (soft)
pH: 6.75

Unfired strength: Low

Raw Properties: Low plasticity, gritty, requires 18.0 percent water of plasticity, drying characteristics good, no defects, 3.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Dk. buff	Soft, crumbly	2.5	14.4	1.93
1900	Dk. buff	Soft, crumbly	2.5	12.8	1.96
2000	Red-brown	Very hard	5.0	9.0	2.11
2100	Brown	Steel hard	5.0	7.5	2.16
2200	—	(Melted)	—	—	—

Bloating Test:

Temp. ° F	Bulk		% Abs.	Remarks
	Dens.	Lb./ft. ³		
1800	1.58	98.4	8.8	Slight expansion
1900	1.28	79.7	11.2	Fair expansion
2000	0.82	51.1	15.2	Excellent expansion
2100	0.78	48.6	12.7	Excellent expansion, slightly sticky
2200	0.70	43.6	11.0	Overexpanded, very sticky, fragile

Remarks: Good lightweight aggregate material.

Potential Use: Brick, tile, and lightweight aggregate.

SAMPLE: R-1906

Sampled interval: Sample is a blend of shale composed of 60 percent R-1891 and 40 percent R-1892 by weight.

Type: Shale
pH: 5.85

Unfired strength: Good

Raw Properties: Low plasticity, smooth, requires 25.0 percent water of plasticity, drying characteristics good, no defects, 3.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Med. buff	Soft, crumbly	4.0	15.1	1.91
1900	Med. buff	Fairly hard	4.0	13.1	1.99
2000	Lt. red-brown	Steel hard	5.0	7.9	2.19
2100	Rich brown	Steel hard	7.5	5.6	2.25
2200	Dk. brown	Steel hard	7.5	2.4	2.31
2300	Near black	Steel hard	(Expanded)	4.9	2.10

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1800	1.70	105.9	8.5	No expansion
1900	1.22	76.0	10.3	Fair expansion
2000	1.09	67.9	10.4	Good expansion
2100	0.92	57.3	10.8	Good expansion
2200	1.02	63.5	9.1	Overexpanded, sticky

Remarks: The fired sample contains both bloated and unbloated material; will make a fairly good lightweight aggregate.

Potential Use: Brick, tile, and lightweight aggregate.

SAMPLE: R-2561

County: Tazewell

Locality: Clay pit of Tazewell Clay Products Company, 1.9 miles southwest of Tazewell, on the northwest side of U. S. Highway 19 and 460 approximately 1.0 mile by road northeast of the intersection with State Highway 16.

Description: An exposure of yellow-brown to brown-red clay is present in the clay pit of the Tazewell Clay Products Company. Limestone, dolomite, and shale are also present in the pit and surrounding area. The clay is used in the manufacture of extruded clay dummies.

Formation or age: Residual (?) clay

Sampled interval: Sample across 5 feet of clay.

Type: Clay
pH: 8.50

Unfired strength: Good

Raw Properties: High plasticity, requires 31.2 percent water of plasticity, no drying defects, 7.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Hard	10.0	14.7	1.94
1900	Brown	Very hard	22.0	1.2	2.32
2000	Chocolate	Steel hard	22.0	1.6	2.13
2100	—	—	(Expanded)	—	—

Remarks: Short vitrification range, shrinkage too high, scumming.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	2.32	144.8	4.9	No expansion
2100	2.22	138.6	3.8	No expansion
2200	1.97	123.0	3.7	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: None (other than current use as raw material for extruded clay dummies).

SAMPLE: R-2562

County: Tazewell

Locality: Roadcut, 3.2 miles southeast of Maiden Spring, on the west side of State Highway 91 approximately 0.75 mile by road northeast of the intersection with State Road 607.

Description: An exposure of gray-brown and brown-red shale, 6 feet in height, is present in a long roadcut. The shale is soft, argillaceous, and fissile. Medium-grained, gray to red sandstone float is present in the exposure. The shale weathers to form black, gray, and gray-green fissile chips. Some weathered cleavage and bedding surfaces are stained brown-red to black by iron oxide. The shale has an approximate strike of N.55-70°E. and an approximate dip of 45-60°SE.

Formation or age: Clinton (?) Formation

Sampled interval: Sample across 14 feet of shale.

Type: Shale
pH: 6.60

Unfired strength: Good

Raw Properties: Low plasticity, requires 26.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Flesh	Fairly hard	0.0	23.8	1.61
1900	Tan	Hard	1.0	18.9	1.72
2000	Tan	Very hard	5.5	11.1	1.97
2100	Lt. brown	Very hard	11.0	4.1	2.25
2200	Gray-brown	Steel hard	11.0	2.5	2.29
2300	—	—	(Expanded)	—	—

Remarks: Good color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.65	103.0	5.2	Slight expansion
2100	1.42	88.7	3.4	Slight expansion
2200	1.21	75.5	4.7	Fair expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Face brick

SAMPLE: R-2563

County: Tazewell

Locality: Roadcut, 5.0 miles south of Maiden Spring, on the northwest side of State Highway 91 approximately 0.15 mile by road northeast of the intersection with State Road 601.

Description: An exposure of gray and gray-green, moderately hard, slightly fossiliferous shale, 15 feet in height, is present in a long roadcut. The shale weathers to form black and light-gray fissile chips. The weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.68°E. and a dip of 38°SE. Less than 4 feet of overburden is present.

Formation or age: Portage (?) Shale

Sampled interval: Composite of shale sampled for a distance of 40 feet along the roadcut.

Type: Shale
pH: 6.80

Unfired strength: Good

Raw Properties: Low plasticity, requires 23.4 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Deep flesh	Fairly hard	0.0	22.2	1.66
1900	Lt. tan	Hard	1.0	19.6	1.74
2000	Tan	Very hard	6.0	11.4	1.99
2100	Brown	Very hard	10.0	7.5	2.11
2200	Dk. brown	Steel hard	12.0	2.0	2.38
2300	—	—	(Expanded)	—	—

Remarks: Good color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.73	108.0	4.8	Slight expansion
2100	1.43	89.3	4.2	Laminar expansion
2200	1.20	74.9	6.3	Fair expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Face brick

SAMPLE: R-2564

County: Tazewell

Locality: Roadcut, 4.9 miles southeast of Maiden Spring, on the north side of State Road 601 just southwest of the intersection with State Road 607 at Tannersville.

Description: An exposure of gray-green, fissile shale, 12 feet in height, extends for a distance of 75 feet along the roadcut. The shale contains thin siltstone layers and weathers to form small light gray-green and gray, fissile chips. Iron-oxide staining occurs on some of the weathered chips. The shale has a strike of N.45°E. and a dip of 26°SE. No overburden is present where sampled.

Formation or age: Clinton (?) Formation

Sampled interval: Sample across 16 feet of shale and siltstone.

Type: Shale

Unfired strength: Fair

pH: 9.00

Raw Properties: Low plasticity, requires 16.0 percent water of plasticity, scumming.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	0.0	14.9	1.90
1900	Lt. brown	Hard	0.0	9.8	2.09
2000	Red-brown	Very hard	5.0	6.4	2.21
2100	Dk. brown	Very hard	5.0	2.6	2.24
2200	—	—	(Expanded)	—	—

Remarks: Scumming

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.07	66.8	5.6	Fair expansion
2100	0.77	48.1	6.8	Good expansion
2200	0.58	36.2	6.6	Melting, sticky

Remarks: Promising for lightweight aggregate.

Potential Use: Lightweight aggregate

SAMPLE: R-2565

County: Tazewell

Locality: Roadcut, 0.2 mile south of Falls Mills, on the southwest side of State Highway 102 just southeast of the intersection with State Road 643.

Description: An exposure of approximately 50 feet of dark gray-green, moderately hard shale, 50 feet in height, extends for a distance of 225 feet along the roadcut. The shale contains thin siltstone layers, and weathers to form small fissile, elongate fragments. The cleavage and bedding surfaces are stained by iron oxide. Less than 3 feet of overburden is present.

Formation or age: Bluestone Formation

Sampled interval: Sample across 26 feet of shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 7.55

Raw Properties: Low plasticity, requires 17.4 percent water of plasticity, scumming.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Hard	0.0	17.0	1.83
1900	Tan	Very hard	4.0	12.8	1.97
2000	Lt. brown	Very hard	5.5	7.7	2.16
2100	Chocolate	Steel hard	5.5	4.1	2.29
2200	Dk. brown	Steel hard	5.5	1.6	2.32
2300	—	(Melted)	—	—	—

Remarks: Scumming

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.19	74.3	11.9	Fair expansion, laminar
2100	1.04	64.9	11.2	Fair expansion, laminar
2200	0.75	46.8	13.0	Good expansion, laminar

Remarks: Promising for lightweight aggregate.

Potential Use: Lightweight aggregate

SAMPLE: R-2566

County: Tazewell

Locality: Roadcut, 2.6 miles northwest of Tiptop, on the northwest side of State Road 655 approximately 0.45 mile by road southwest of the intersection with State Road 644.

Description: An exposure of approximately 20 feet of green shale, 8 feet in height, is present in a long roadcut. The shale weathers to form small light-green and tan, fissile fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. An impure, gray, medium-grained limestone overlies the shale. The shale has a strike of N.65°E. and a dip of 73°SE. Less than 2 feet of overburden is present.

Formation or age: Hinton (?) Formation

Sampled interval: Sample across 11 feet of shale.

Type: Shale

Unfired strength: Good

pH: 6.10

Raw Properties: Low plasticity, requires 22.8 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	0.0	19.6	1.73
1900	Tan	Hard	5.0	14.5	1.67
2000	Brown	Very hard	7.0	6.9	1.61
2100	Chocolate	Steel hard	10.0	2.1	2.35
2200	—	—	(Expanded)	—	—

Remarks: Fair color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.64	102.4	5.5	Slight expansion
2100	1.43	89.3	6.5	Laminar expansion
2200	1.38	86.2	5.3	Laminar expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Face brick (marginal).

SAMPLE: R-2567

County: Tazewell

Locality: Roadcut, 1.5 miles south of Sayersville, on the west side of State Road 637 approximately 1.85 miles by road south of the intersection with State Road 643.

Description: An exposure of approximately 20 feet of soft, dark, gray-green shale, 22 feet in height, with siltstone and sandstone layers, is present in a long roadcut. The shale weathers to form light gray-green, brown, and tan, fissile fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.35°E. and a dip of 25°SE. and is overlain by less than 2 feet of soil.

Formation or age: Devonian

Sampled interval: Sample across 18 feet of fresh and weathered shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 5.50

Raw Properties: Low plasticity, requires 20.1 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	0.0	17.5	1.77
1900	Tan	Hard	3.0	17.0	1.79
2000	Lt. brown	Very hard	5.0	13.2	1.91
2100	Chocolate	Very hard	5.0	10.6	1.97
2200	Dk. brown	Steel hard	5.0	6.3	2.07
2300	—	—	(Expanded)	—	—

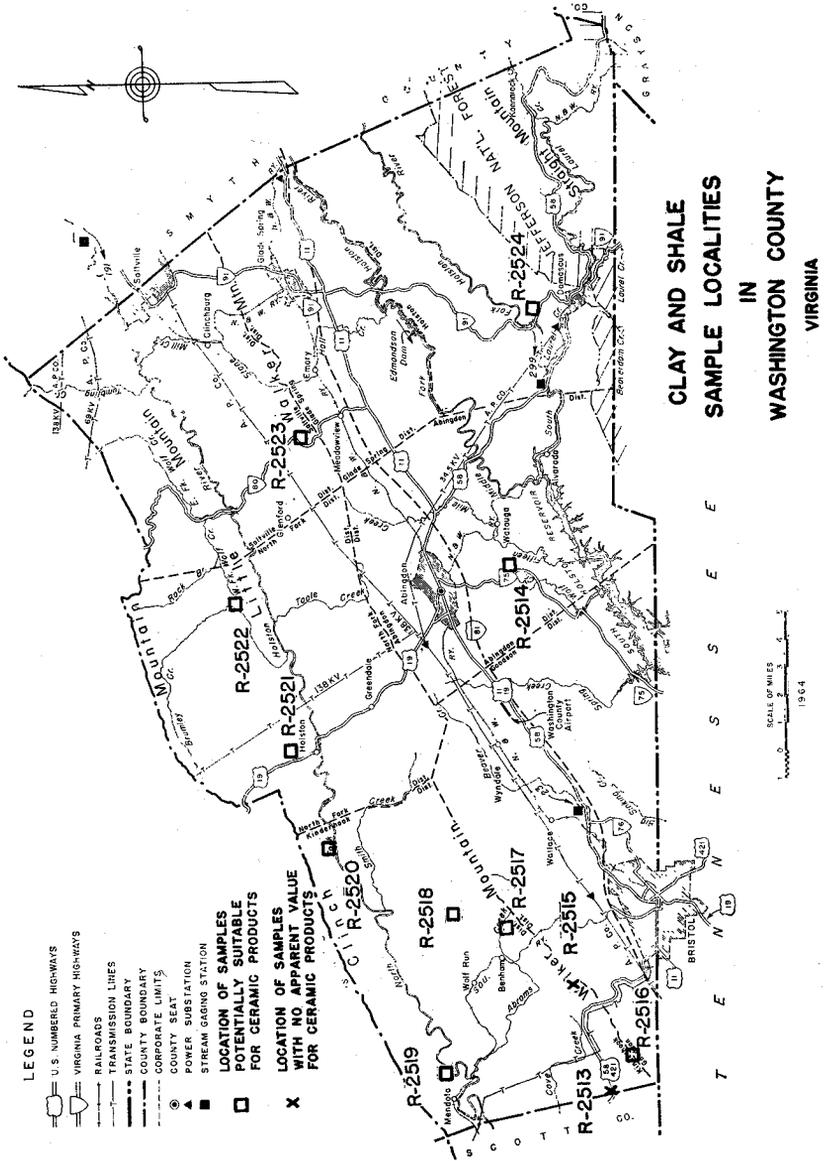
Remarks: Fair color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.70	106.1	6.5	Slight expansion
2100	1.59	99.3	5.8	Slight expansion
2200	1.14	71.2	8.5	Fair expansion.

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Face brick (marginal).



Location Map of Washington County

WASHINGTON COUNTY

Samples were collected from 12 localities in Washington County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-2513	Rome Formation	None
R-2514	Athens Formation	Lightweight aggregate
R-2515	Nolichucky Formation	None
R-2516	Residual (?) clay	Face brick and structural tile
R-2517	Nolichucky Formation	Common brick
R-2518	Shale and siltstone of Mississippian age	Common brick
R-2519	Brallier (?) Formation	Face brick
R-2520	Brallier (?) Formation	Common brick
R-2521	Brallier (?) Formation	Common brick and drain tile
R-2522	Portage (?) Shale	Common brick
R-2523	Athens Formation	Common brick and lightweight aggregate
R-2524	Residual clay	Flower pots

SAMPLE: R-2513

County: Washington

Locality: Excavated bank, 7.0 miles west of Bristol, on the north side of U. S. Highway 58 and 421 approximately 0.1 mile by road east of the intersection with State Road 618 at the Scott-Washington county line.

Description: An exposure of red and light gray-green, hard shale, 30 feet in height, with thin siltstone layers, extends for a distance of 90 feet along the face of the bank. The shale weathers to form light gray-green and red, sub-fissile to semi-angular blocks and chips. Some of the cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.65°E. and a dip of 73°SE. Less than 3 feet of overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 45 feet of fresh and weathered shale and siltstone.

Type: Shale (soft)

Unfired strength: Good

pH: 8.46

Raw Properties: Low plasticity, requires 22.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Fairly hard	0.5	17.2	1.67
1900	Lt. brown	Fairly hard	0.5	16.4	1.69
2000	Lt. brown	Hard	0.5	16.1	1.70
2100	Brown	Hard	5.0	13.0	1.76
2200	Dk. brown	Very hard	7.5	2.8	1.89
2300	—	(Melted)	—	—	—

Remarks: Short vitrification range, highly effervescent with HCl.

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
1900	2.24	139.8	5.9	No expansion
2000	1.98	123.6	5.5	Slight expansion
2100	1.94	121.1	5.0	Slight expansion
2200	1.50	93.6	4.4	Laminar expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: None

SAMPLE: R-2514

County: Washington

Locality: Abandoned pit, 2.75 miles south of Abingdon, on the northeast side of State Highway 75 approximately 0.4 mile by road northwest of the intersection with State Road 677 (Figure 8).

Description: An exposure of light-brown and light- to dark-gray, soft shale, 70 feet in height, with a few thin siltstone layers, is present in an abandoned pit. The shale weathers to form light-brown and light gray-green, fissile chips; many of the light gray-green chips are slightly calcareous and contain a white coating on some of the weathered surfaces. Some of the cleavage and bedding surfaces are stained by iron oxide. The rocks have a strike of N.30°E. and a dip of 41°NW. Less than 3 feet of overburden is present.

Formation or age: Athens Formation

Sampled interval: Sample across 40 feet of fresh and weathered shale and siltstone.

Type: Shale
pH: 8.40

Unfired strength: Fair

Raw Properties: Low plasticity, requires 20.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Fairly hard	5.0	17.2	1.75
1900	Red-brown	Fairly hard	5.5	15.6	1.80
2000	Chocolate	Very hard	5.5	14.9	1.82
2100	Chocolate	Very hard	6.0	10.5	1.94
2200	Dk. brown	Very hard	6.0	0.8	2.01
2300	—	(Melted)	—	—	—

Remarks: Short vitrification range, highly effervescent with HCl.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1900	2.40	149.8	6.1	No expansion
2000	1.66	103.6	6.2	Slight expansion
2100	1.10	68.7	4.6	Fair expansion
2200	0.76	47.4	14.6	Good expansion

Remarks: Some promise for lightweight aggregate.

Potential Use: Lightweight aggregate

SAMPLE: R-2515

County: Washington

Locality: Roadcut, 2.7 miles southwest of Benham, on the north-east side of State Road 617 approximately 0.5 mile by road southeast of the intersection with State Road 700.

Description: An exposure of green, fissile shale, 15 feet in height, with thin siltstone layers, extends for a distance of 130 feet along the roadcut. The shale weathers to form light gray-green, fissile chips and small blocky fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.40°E. and a dip of 32°SE. and is overlain and underlain by limestone. Less than 1 foot of overburden is present.

Formation or age: Nolichucky Formation

Sampled interval: Sample across 20 feet of shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 8.83

Raw Properties: Low plasticity, requires 18.8 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	0.0	20.0	1.64
1900	Tan	Fairly hard	0.0	20.0	1.63
2000	Buff-tan	Fairly hard	0.0	19.6	1.63
2100	Buff-gray	Hard	0.0	16.7	1.64
2200	Black-brown	Very hard	5.0	2.1	1.87
2300	—	(Melted)	—	—	—

Remarks: Short vitrification range, highly effervescent with HCl.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.87	116.7	12.7	No expansion
2100	1.57	98.0	8.1	Slight expansion
2200	1.23	76.8	3.4	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: None

SAMPLE: R-2516

County: Washington

Locality: Roadcut, 6.0 miles west of Bristol, on the west side of State Road 630 approximately 0.9 mile by road south of the intersection with U. S. Highway 58 and 421 at Mary Chapel.

Description: An exposure of light-gray clay, 7 feet in height, extends for a distance of approximately 250 feet along the roadcut. The clay contains some orange streaks throughout the exposure. Less than 2 feet of overburden is present.

Formation or age: Residual (?) clay

Sampled interval: Composite of clay sampled for a distance of 175 feet along the roadcut.

Type: Clay

Unfired strength: Good

pH: 4.69

Raw Properties: Moderate plasticity, requires 28.1 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Pale flesh	Fairly hard	5.5	20.4	1.71
1900	Pale flesh	Fairly hard	5.5	17.9	1.77
2000	Pale flesh	Hard	7.5	14.9	1.84
2100	Mottled tan	Very hard	10.0	11.2	1.99
2200	Buff-gray	Steel hard	15.0	3.7	2.23
2300	Gray	Steel hard	15.0	1.9	2.27

Remarks: Fair color, good vitrification range.

Bloating Test: Negative

Potential Use: Face brick and structural tile.

SAMPLE: R-2517

County: Washington

Locality: Roadcut, 1.0 mile east of Benham, on the south side of State Road 640 approximately 0.4 mile by road west of the intersection with State Road 622.

Description: An exposure of green, soft, fissile shale, 20 feet in height, extends for a distance of 150 feet along the roadcut. The shale weathers to form light-green, light gray-green, and light-tan fissile fragments. The weathered cleavage and bedding surfaces are stained by iron oxide. The shale is overlain and underlain by dolomite and limestone. Less than 1 foot of overburden is present.

Formation or age: Nolichucky Formation

Sampled interval: Sample across 12 feet of weathered shale.

Type: Shale

Unfired strength: Good

pH: 6.98

Raw Properties: Low plasticity, requires 23.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Fairly hard	1.0	17.0	1.69
1900	Lt. brown	Fairly hard	1.0	14.5	1.77
2000	Red-brown	Hard	5.0	13.5	1.81
2100	Brown	Very hard	5.0	8.7	1.96
2200	Dk. brown	Very hard	9.5	1.2	1.98
2300	—	(Melted)	—	—	—

Remarks: Poor color

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	2.24	139.8	5.3	No expansion
2100	1.86	116.1	5.5	Slight expansion
2200	2.11	131.7	5.9	No expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Common brick

SAMPLE: R-2518

County: Washington

Locality: Roadcut, 2.3 miles northeast of Benham, on the northwest side of State Road 700 approximately 0.3 mile by road northeast of the intersection with State Road 622.

Description: An exposure of red, soft, fissile shale, 12 feet in height, with thin siltstone layers, extends for a distance of 100 feet along the roadcut. The shale weathers to form red, fissile fragments that are stained slightly by iron oxide. Less than 2 feet of overburden is present.

Formation or age: Mississippian

Sampled interval: Composite of fresh and weathered shale and siltstone sampled for a distance of 85 feet along the roadcut.

Type: Shale
pH: 5.35

Unfired strength: Good

Raw Properties: Low plasticity, requires 31.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Red-tan	Soft	0.0	25.6	1.50
1900	Red-tan	Soft	0.5	23.3	1.56
2000	Red-tan	Soft	2.5	21.3	1.61
2100	Brown	Fairly hard	5.0	16.7	1.73
2200	Dk. brown	Hard	12.0	4.8	2.14
2300	Gray-black	Steel hard	12.0	0.8	2.29

Remarks: Poor color

Bloating Test: Negative

Potential Use: Common brick

SAMPLE: R-2519

County: Washington

Locality: Roadcut, 0.7 mile northeast of Mendota, on the northwest side of State Road 802 approximately 0.65 mile by road northeast of the intersection with State Road 614.

Description: An exposure of dark-gray to black, soft, fissile shale, 9 feet in height, extends for a distance of 110 feet along the roadcut. The shale weathers to form gray and tan, fissile chips. The weathered cleavage and bedding surfaces are stained by iron oxide. Less than 1 foot of overburden is present.

Formation or age: Brallier (?) Formation

Sampled interval: Composite of fresh and weathered shale sampled for a distance of 70 feet along the roadcut.

Type: Shale

Unfired strength: Good

pH: 5.80

Raw Properties: Low plasticity, requires 26.6 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Flesh	Soft	0.0	26.3	1.39
1900	Tan	Fairly hard	4.5	21.3	1.46
2000	Tan	Fairly hard	4.5	18.2	1.53
2100	Brown	Hard	10.0	10.3	1.78
2200	Dk. brown	Steel hard	10.5	3.0	2.02
2300	Dk. brown	Steel hard	10.5	2.8	2.06

Remarks: Light color

Bloating Test: Negative

Potential Use: Face brick

SAMPLE: R-2520

County: Washington

Locality: Excavated bank, 3.4 miles west of Holston, on the north side of State Road 802 approximately 2.7 miles by road northeast of the intersection with State Road 624 at Alum Wells.

Description: An exposure of green, soft, fissile shale, 30 feet in height, is present in the bank. The shale weathers to form orange-yellow and tan, fissile and rectangular fragments. The cleavage and bedding surfaces are stained brown by iron oxide. Less than 3 feet of overburden is present.

Formation or age: Brallier (?) Formation

Sampled interval: Sample across 20 feet of shale.

Type: Shale

Unfired strength: Good

pH: 6.90

Raw Properties: Low plasticity, requires 20.1 percent water of plasticity, no drying defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	4.5	22.2	1.62
1900	Red-tan	Fairly hard	5.5	16.4	1.79
2000	Red-tan	Hard	5.5	12.5	1.91
2100	Chocolate	Very hard	10.0	2.0	2.32
2200	Dk. brown	Very hard	10.0	2.0	2.25
2300	—	—	(Expanded)	—	—

Remarks: Short vitrification range.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.34	83.7	1.8	Slight expansion
2100	1.37	85.5	1.6	Slight expansion
2200	1.43	89.3	1.3	Slight expansion
2300	—	—	—	Melted

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Common brick

SAMPLE: R-2521

County: Washington

Locality: Roadcut, 0.9 mile north of Holston, on the north side of State Road 689 approximately 0.3 mile by road east of the intersection with U. S. Highway 19 and 58 at Kregers Store.

Description: Gray shale and underlying soft, black, fissile shale occur along the roadcut in an exposure 7 feet in height. The shale weathers to form light gray-green, gray, and tan, fissile fragments. Slight iron-oxide staining is present on cleavage and bedding surfaces. Less than 3 feet of overburden is present.

Formation or age: Brallier (?) Formation

Sampled interval: Sample across 60 feet of shale.

Type: Shale

Unfired strength: Good

pH: 6.52

Raw Properties: Low plasticity, requires 25.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	0.5	19.6	1.72
1900	Tan	Hard	5.0	12.8	1.91
2000	Lt. brown	Very hard	10.0	9.1	2.04
2100	Chocolate	Steel hard	15.0	2.2	2.33
2200	—	—	(Expanded)	—	—

Remarks: Fair color, slight scumming.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.71	106.8	1.3	Slight expansion
2100	1.37	85.5	0.7	Slight expansion
2200	1.14	71.2	1.9	Fair expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Common brick and drain tile.

SAMPLE: R-2522

County: Washington

Locality: Roadcut, 5.9 miles northeast of Holston, on the north side of State Road 689 approximately 3.0 miles by road west of the intersection with State Highway 80.

Description: An exposure of dark-gray to black, hard, brittle, fissile shale, 6 feet in height, extends for a distance of 250 feet along the roadcut. The shale weathers to form gray, fissile chips. The weathered cleavage and bedding surfaces are stained by iron oxide. The shale has a strike of N.75°E. and a dip of 25°SE. Less than 2 feet of overburden is present.

Formation or age: Portage (?) Shale

Sampled interval: Composite of fresh and weathered shale sampled for a distance of 175 feet along the roadcut.

Type: Shale

Unfired strength: Good

pH: 5.20

Raw Properties: Low plasticity, requires 26.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Pink-tan	Fairly hard	5.0	23.3	1.60
1900	Tan	Fairly hard	6.0	19.1	1.69
2000	Tan	Hard	6.0	15.4	1.79
2100	Brown	Very hard	14.0	5.9	2.12
2200	Dk. brown	Very hard	14.0	2.0	2.26
2300	Dk. brown	Very hard	14.0	1.5	2.27

Remarks: Fair color

Bloating Test:

<u>Temp.</u> <u>° F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb./ft.³</u>	<u>% Abs.</u>	<u>Remarks</u>
2000	1.88	117.4	3.2	No expansion
2100	1.54	96.1	4.5	Slight expansion
2200	1.27	79.3	7.8	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Common brick

SAMPLE: R-2523

County: Washington

Locality: Roadcut, 1.9 miles northwest of Meadowview, on the southeast side of State Highway 80 approximately 0.4 mile by road north of the intersection with State Road 740.

Description: An exposure of brown, soft, fissile shale, 10 feet in height, extends for a distance of 150 feet along the roadcut. The shale weathers to form light-gray, fissile, rectangular and platy fragments that are stained by iron oxide. Less than 2 feet of overburden is present.

Formation or age: Athens Formation

Sampled interval: Sample across 9 feet of fresh and weathered shale.

Type: Shale

Unfired strength: Good

pH: 8.30

Raw Properties: Moderate plasticity, requires 28.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Red-tan	Hard	3.5	23.2	1.60
1900	Red-tan	Hard	5.0	21.3	1.62
2000	Red-tan	Very hard	5.5	16.4	1.75
2100	Chocolate	Steel hard	10.5	12.5	1.78
2200	Dk. brown	Very hard	9.5	2.2	1.37
2300	—	—	(Expanded)	—	—

Remarks: Good color, slight scumming.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.65	103.0	5.1	Slight expansion
2100	1.03	64.3	2.9	Fair expansion
2200	0.92	57.4	3.4	Good expansion

Remarks: Some promise for lightweight aggregate.

Potential Use: Common brick and lightweight aggregate.

SAMPLE: R-2524

County: Washington

Locality: Roadcut, 1.0 mile north of Damascus, on the northeast side of State Highway 91 approximately 0.1 mile by road north of the intersection with State Road 605 at Ketron Corner (Figure 9).

Description: An exposure of interbedded orange and red-brown, silty, friable, ocherous clay, 20 feet in height, with a few thin shaly layers, extends for a distance of 125 feet along the roadcut. Some of the clay contains manganese staining on what are probably relict-bedding and cleavage structures. Less than 6 feet of soil and coarse gravel overburden is present.

Formation or age: Residual clay

Sampled interval: Sample across 50 feet of clay.

Type: Clay

Unfired strength: Good

pH: 5.00

Raw Properties: Moderate plasticity, requires 33.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Red-tan	Fairly hard	4.0	27.0	1.48
1900	Red-tan	Fairly hard	5.5	25.6	1.51
2000	Red-tan	Hard	10.0	21.8	1.60
2100	Chocolate	Steel hard	17.5	6.3	2.11
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Remarks: Good color, short vitrification range.

Bloating Test: Negative

Potential Use: Flower pots

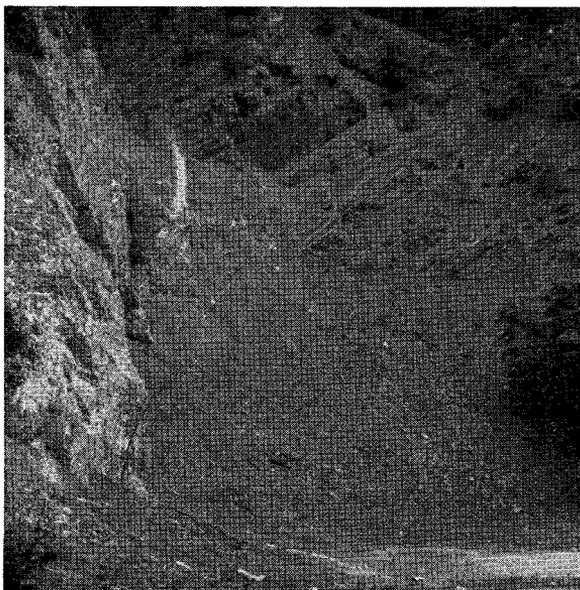


Figure 8. Exposure of the Athens Formation (Sample R-2514) on the northeast side of State Highway 75 approximately 0.4 mile by road northwest of the intersection with State Road 677.



Figure 9. Exposure of residual clay (Sample R-2524) on the northeast side of State Highway 91 approximately 0.1 mile by road north of the intersection with State Road 605 at Ketrion Corner.



Figure 8. Exposure of the Athens Formation (Sample R-2514) on the northeast side of State Highway 75 approximately 0.4 mile by road northwest of the intersection with State Road 677.



Figure 9. Exposure of residual clay (Sample R-2524) on the northeast side of State Highway 91 approximately 0.1 mile by road north of the intersection with State Road 605 at Ketron Corner.

WISE COUNTY

Samples were collected from 14 localities in Wise County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1945	Clinton Formation	Brick and tile (if color acceptable)
R-1946	Big Stone Gap Shale	None
R-1947	Big Stone Gap Shale	None
R-1948	Norton Formation	Common brick
R-1949	Lee Formation	None
R-1950	Wise Formation	Common brick
R-1951	Coal-mine refuse	Could be used in the manufacture of sintered lightweight aggregate
R-1952	Coal-mine refuse	Common brick
R-1953	Wise Formation	Could be used in the manufacture of sintered lightweight aggregate
R-1954	Norton Formation	Brick, quarry tile, and lightweight aggregate
R-1955	Norton Formation	Brick and lightweight aggregate
R-1956	Norton Formation	Brick and quarry tile
R-1957	Norton Formation	Common brick
R-1958	Coal-mine refuse	Could be used in the manufacture of sintered lightweight aggregate

SAMPLE: R-1945

County: Wise

Locality: Roadcut, 3.0 miles south of Big Stone Gap, on the northwest side of U. S. Highway 23 about 0.6 mile by road southwest of the intersection with State Road 668 and 1.4 miles northeast of Oreton.

Description: Green and buff to red shale, thin-bedded siltstone, and fine-grained sandstone are exposed in the roadcut. A 15-foot thickness of these rocks is exposed in a borrow-pit at this locality.

Formation or age: Clinton Formation

Sampled interval: Representative sample of shale, siltstone, and sandstone exposed in the roadcut.

Type: Shale

Unfired strength: Good

pH: 6.5

Raw Properties: Low plasticity, smooth, requires 20.0 percent water of plasticity, drying characteristics good, no defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-orange	Soft, crumbly	6.0	16.5	1.85
1900	Buff-orange	Hard	10.0	13.0	1.97
2000	Lt. brown	Steel hard	10.0	7.4	2.21
2100	—	—	(Expanded)	—	—

Remarks: Fired color not attractive, but properties are ideal for brick and tile.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1900	1.91	119.0	2.5	No expansion
2000	1.82	113.3	3.0	No expansion
2100	1.47	91.6	3.4	Slight expansion
2200	1.30	81.0	3.4	Slight expansion

Remarks: Expansion is not adequate for lightweight aggregate.

Potential Use: Brick and tile (if colors are acceptable).

SAMPLE: R-1946

County: Wise

Locality: Roadcut, 2 miles south of Big Stone Gap, along State Road 609 approximately 0.3 mile northeast of the intersection with State Road 668.

Description: Dark-gray to black, crumpled, fissile to hackly-breaking shale is exposed in the roadcut. Some thin beds in the exposure have a lustrous coal-like sheen on fresh fracture surfaces due to the carbon content. Other beds have a sooty black appearance and may be low-grade coal. Pyrite, limonite, and siderite (?) are common in the rocks at this locality. The shale sampled is approximately 10 feet stratigraphically above limestone and sandstone of Devonian age.

Formation or age: Big Stone Gap Shale

Sampled interval: Representative of dark-gray to black shale exposed in the roadcut.

Type: Shale

Unfired strength: Very low

pH: 4.3

Raw Properties: Low plasticity, gritty, requires 20.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff orange-brown	Soft, crumbly	1.5	26.0	1.52
1900	Buff orange-brown	Soft, crumbly	5.0	23.2	1.60
2000	Brown	Soft, crumbly	5.5	17.8	1.71
2100	Dk. brown	Hard	7.0	16.8	1.74
2200	—	—	(Expanded)	—	—

Potential Use: None

SAMPLE: R-1947

County: Wise

Locality: Roadcut, 3 miles southwest of Norton, along State Road 610 approximately 0.4 mile east of the intersection with State Road 717 and about 1.5 miles south of Josephine.

Description: Dark-gray to black, crumpled, fissile to hackly-breaking shale is exposed to the roadcut. Some thin beds in the exposure have a lustrous coal-like sheen on fresh fracture surfaces due to the carbon content. Other beds have a sooty black appearance and may be low-grade coal. Pyrite, limonite, and siderite (?) are common in the rocks at this locality. The shale sampled is about 10 feet stratigraphically above limestone and sandstone of Devonian age.

Formation or age: Big Stone Gap Shale

Sampled interval: Representative of dark-gray to black shale exposed in the roadcut.

Type: Shale

Unfired strength: Very low

pH: 4.0

Raw Properties: Low plasticity, sandy, requires 19.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-brown	Soft, crumbly	2.5	27.2	1.48
1900	Buff-orange	Soft, crumbly	3.0	24.2	1.55
2000	Lt. brown	Fairly hard	5.0	20.5	1.66
2100	Brown	Hard	7.0	15.9	1.79
2200	—	—	(Expanded)	—	—

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1948

County: Wise

Locality: Roadcut, about 2 miles west of Norton, along U. S. Highway 23 at Josephine.

Description: Tan and black to dark-gray shale, with interlayered thin-bedded sandstone and micaceous siltstone, is exposed in the roadcut. A coal seam about 3 inches thick is also present.

Formation or age: Norton Formation

Sampled interval: Representative sample of 50 feet of unweathered to slightly weathered shale, siltstone, and sandstone.

Type: Shale

Unfired strength: Very low

pH: 6.4

Raw Properties: Low plasticity, gritty, requires 18.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff	Soft, crumbly	2.0	17.2	1.78
1900	Lt. brown-buff	Soft, crumbly	4.5	15.3	1.86
2000	Lt. brown	Very hard	5.0	14.0	1.89
2100	Brown	Steel hard	7.5	7.5	2.16
2200	—	—	(Expanded)		—

Remarks: Calcium salts are indicated by scumming on specimens fired at 2000°F and 2100°F. The scumming would have to be controlled if material is to be used in brick manufacture.

Potential Use: Common brick

SAMPLE: R-1949

County: Wise

Locality: Roadcut along U. S. Highway 23 about 0.2 mile east of Blackwood.

Description: Steeply dipping, dark-gray to black and tan, calcareous shale, interlayered with thin-bedded siltstone and sandstone, is exposed in a fault zone along the roadcut. Four coal seams, ranging from 3 inches to 3 feet in thickness, are also present.

Formation or age: Lee Formation

Sampled interval: Sample representative of 75 feet of unweathered shale, siltstone, and sandstone.

Type: Shale
pH: 8.3

Unfired strength: Very low

Raw Properties: Low plasticity, requires 20.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-brown	Soft, crumbly	5.0	43.6	1.17
1900	Buff-brown	Soft, crumbly	5.5	38.4	1.25
2000	Lt. brown	Soft, crumbly	8.5	29.8	1.22
2100	Brown	Steel hard	13.5	35.0	1.30
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Potential Use: None

SAMPLE: R-1950

County: Wise

Locality: Roadcut, 6 miles west of Norton, on the north side of U. S. Highway 23 about 0.6 mile west of the intersection with State Road 603 at Kent Junction.

Description: The exposure consists predominantly of olive-tan to dark-gray, evenly bedded shale and siltstone. Some inter-bedded sandstone is also present.

Formation or age: Wise Formation

Sampled interval: Representative sample of 75 feet of unweathered shale, siltstone, and sandstone.

Type: Shale

Unfired strength: Very low

pH: 7.5

Raw Properties: Low plasticity, requires 16.0 percent water of plasticity, drying characteristics good, no defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-brown	Soft, crumbly	2.5	14.9	1.87
1900	Buff-brown	Soft, crumbly	2.5	13.3	1.93
2000	Lt. brown	Very hard	5.0	9.3	2.08
2100	Brown	Steel hard	9.5	4.9	2.25
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Remarks: Specimens at 2000°F and 2100°F show scumming, indicating CaSO₄.

Potential Use: Common brick (if BaCO₃ eliminates scumming).

SAMPLE: R-1951

County: Wise

Locality: Waste pile from a coal mine along State Road 600 about 4.4 miles north of Andover.

Formation or age: Pennsylvanian

Sampled interval: Selected sample of sandy shale, rasy coal, and draw-slate from waste pile.

Type: Coal refuse

Unfired strength: Very low

pH: 9.0

Raw Properties: Low plasticity, requires 15.0 percent water of plasticity, drying characteristics good, no defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	—	Too crumbly for properties	—	—	—
1900	—	Too crumbly for properties	—	—	—
2000	—	Too crumbly for properties	—	—	—
2100	Dk. brown	Hard, crumbly	—	—	—
2200	Dk. brown	Hard	8.0	23.6	1.42
2300	Dk. brown	Hard	9.0	33.6	1.27

Bloating Test: Negative

Potential Use: Could be used in the manufacture of sintered lightweight aggregate.

SAMPLE: R-1952

County: Wise

Locality: Waste pile from a coal mine along State Road 600 at Andover.

Formation or age: Pennsylvanian

Sampled interval: Selected sample of draw-slate, rasy coal, and coal from waste pile.

Type: Shale

Unfired strength: Very low

pH: 9.0

Raw Properties: Low plasticity, requires 15.0 percent water of plasticity, drying characteristics good, no defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff	Soft, crumbly	2.5	14.5	1.83
1900	Buff	Fairly hard	3.5	13.7	1.84
2000	Lt. buff-brown	Very hard	5.0	10.6	1.92
2100	Brown	Steel hard	7.5	7.1	2.02
2200	Dk. brown	Steel hard	6.0	5.5	2.04
2300	—	—	(Expanded)	—	—

Bloating Test: Negative

Potential Use: Common brick

SAMPLE: R-1953

County: Wise

Locality: Roadcut, about 7 miles northwest of Norton, along State Road 603 near Dunbar and approximately 4.7 miles north of the intersection with U. S. Highway 23 and 58.

Description: Dark-gray to black shale and sandy shale, interlayered with thin beds of hard, black sandstone and rasy coal, are exposed in the roadcut.

Formation or age: Wise Formation

Sampled interval: Representative sample of 15 feet of weathered shale, sandy shale, sandstone, and rasy coal.

Type: Shale (carbonaceous)
pH: 8.0

Unfired strength: Very low

Raw Properties: Low plasticity, requires 21.0 percent water of plasticity, drying characteristics fair, 1.0 percent drying shrinkage.

Slow Firing Test:

Too crumbly for properties.

Bloating Test: Negative

Potential Use: Could be used in the manufacture of sintered lightweight aggregate.

SAMPLE: R-1954

County: Wise

Locality: Roadcut along U. S. Highway 58 about 0.6 mile west of Tacoma.

Description: Forty feet of medium-gray to black, carbonaceous, thin-bedded sandy shale and shale are exposed in the roadcut.

Formation or age: Norton Formation

Sampled interval: Representative of 40 feet of shale and sandy shale.

Type: Shale
pH: 8.0

Unfired strength: Very low

Raw Properties: Low plasticity, requires 20.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-brown	Soft, crumbly	5.0	17.9	1.74
1900	Lt. brown	Fairly hard	5.0	16.0	1.80
2000	Lt. brown	Very hard	6.0	12.5	1.92
2100	Rich brown	Steel hard	10.0	5.5	2.18
2200	Dk. brown	Steel hard	10.0	2.1	2.17
2300	—	—	(Expanded)	—	—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1900	1.73	107.8	2.9	No expansion
2000	1.24	77.3	10.4	Good expansion
2100	0.91	56.7	10.3	Excellent expansion
2200	0.57	35.5	6.4	Overexpanded, slightly sticky

Remarks: Excellent lightweight aggregate material; expansion uniform and aggregate has good strength and low absorption.

Potential Use: Brick, quarry tile, and lightweight aggregate.

SAMPLE: R-1955

County: Wise

Locality: Roadcut along State Road 646 about 1.0 mile west of Coeburn.

Description: Dark- to olive-gray, evenly bedded shale and siltstone that weather tan are exposed in the roadcut.

Formation or age: Norton Formation

Sampled interval: Sample representative of 40 feet of weathered shale and siltstone.

Type: Shale

Unfired strength: Low

pH: 7.9

Raw Properties: Low plasticity, requires 21.0 percent water of plasticity, drying characteristics good, no defects, 1.0 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-orange	Soft, crumbly	3.0	17.5	1.76
1900	Buff-orange	Fairly hard	5.5	14.2	1.86
2000	Buff-orange	Very hard	7.0	9.4	2.03
2100	Brown	Steel hard	12.0	2.3	2.36
2200	—	—	(Expanded)	—	—
2300	—	—	(Expanded)	—	—

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
1900	1.52	94.7	4.3	No expansion
2000	1.16	72.3	4.9	Slight expansion
2100	0.83	51.7	5.8	Excellent expansion
2200	0.53	33.0	5.2	Overexpanded, slightly sticky

Remarks: Good lightweight aggregate possibility.

Potential Use: Brick and lightweight aggregate.

SAMPLE: R-1956

County: Wise

Locality: Roadcut along State Road 706 about 0.2 mile northwest of the intersection with U. S. Highway 58 at Tacoma.

Description: Seventy-five feet of dark-gray shale are exposed in the roadcut. The shale is fissile to hackly-breaking and weathers to olive-tan.

Formation or age: Norton Formation

Sampled interval: Sample representative of 75 feet of weathered shale.

Type: Shale
pH: 6.7

Unfired strength: Low

Raw Properties: Low plasticity, requires 23.0 percent water of plasticity, drying characteristics good, no defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-orange	Soft, crumbly	5.5	19.4	1.71
1900	Buff-orange	Fairly hard	7.5	15.9	1.82
2000	Dk. buff-orange	Very hard	10.0	9.3	2.05
2100	Dk. brown	Steel hard	14.5	1.3	2.39
2200	Dkr. brown	Steel hard	14.5	0.0	2.43
2300	—	—	(Expanded)	—	—

Potential Use: Brick and quarry tile.

SAMPLE: R-1957

County: Wise

Locality: Roadcut along State Highway 72 about 0.8 mile south of Coeburn and 300 feet south of the grade crossing of the Interstate Railroad.

Description: Hard black shale, with some interbedded carbonaceous shale, is exposed in the roadcut. The black shale weathers tan and gray. The carbonaceous shale has a lustrous sheen on the fresh fractures, and has iron-stained, sooty, weathered surfaces. The unit sampled is about 50 feet stratigraphically above a massive sandstone.

Formation or age: Norton Formation

Sampled interval: Representative of about 50 feet of shale exposed in the roadcut.

Type: Shale
pH: 6.60

Unfired strength: Very low

Raw Properties: Low plasticity, requires 18.0 percent water of plasticity, drying characteristics good, no defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Buff-yellow	Soft, crumbly	4.0	17.2	1.76
1900	Buff-yellow	Fairly hard	5.0	15.8	1.80
2000	Buff-orange	Very hard	6.0	11.9	1.92
2100	Brown	Steel hard	10.0	7.6	2.05
2200	Brown-gray	Steel hard	10.0	5.3	2.09
2300	—	—	(Expanded)	—	—

Potential Use: Common brick

SAMPLE: R-1958

County: Wise

Locality: Waste pile at Dorchester, about 1 mile north of Norton, from the coal mines of Wise Coal and Coke Company.

Formation or age: Pennsylvanian

Sampled interval: Selected sample of shale, sandy shale, draw-slate, and rasy coal from waste pile.

Type: Coal refuse

Unfired strength: Very low

pH: 6.1

Raw Properties: Low plasticity, requires 18.0 percent water of plasticity, drying characteristics good, no defects, 1.5 percent drying shrinkage.

Slow Firing Test:

Too crumbly to determine properties after firing.

Potential Use: Could be used in the manufacture of sintered lightweight aggregate.

WYTHE COUNTY

Samples were collected from six localities in Wythe County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-2538	Brallier (?) Formation	Face brick (marginal)
R-2539	Martinsburg (?) Formation	Common brick
R-2540	Rome Formation	None
R-2541	Rome Formation	Common brick
R-2542	Rome Formation	Common brick
R-2543	Residual clay	Flue lining and hot tops

SAMPLE: R-2538

County: Wythe

Locality: Roadcut, 7.1 miles northwest of Wytheville, on the west side of U. S. Highway 21 and 52 approximately 0.3 mile by road south of the intersection with State Road 717.

Description: An exposure of green, moderately hard shale, 8 feet in height, with thin siltstone layers, extends for a distance of 130 feet along the roadcut. The shale weathers to form light-green and light gray-green, elongate fragments. Some cleavage and bedding surfaces are stained orange-brown and black by iron oxide. Less than 1 foot of overburden is present.

Formation or age: Brallier (?) Formation

Sampled interval: Sample across 9 feet of fresh and weathered shale and siltstone.

Type: Shale
pH: 8.55

Unfired strength: Fair

Raw Properties: Low plasticity, requires 15.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	6.5	12.2	1.98
1900	Tan	Fairly hard	8.5	10.2	2.05
2000	Lt. brown	Hard	10.0	9.7	2.05
2100	Brown	Very hard	12.5	4.0	2.26
2200	—	—	(Expanded)	—	—

Remarks: Fair color

Potential Use: Face brick (marginal).

SAMPLE: R-2539

County: Wythe

Locality: Roadcut, 3.5 miles north of Wytheville, on the east side of State Road 603 approximately 0.9 mile by road south of the intersection with State Road 600.

Description: An exposure of brown-gray, soft, fissile, fossiliferous shale, 12 feet in height, extends for a distance of approximately 300 feet along the roadcut. The shale weathers to form light gray-green, fissile fragments. Some cleavage and bedding surfaces are stained dark-brown to black by iron oxide. Fossil molds of brachiopods are present in the exposure.

Formation or age: Martinsburg (?) Formation

Sampled interval: Sample across 10 feet of shale.

Type: Shale

Unfired strength: Good

pH: 6.00

Raw Properties: Moderate plasticity, requires 24.6 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	11.0	17.2	1.75
1900	Lt. brown	Hard	13.5	13.9	1.85
2000	Brown	Very hard	16.5	5.6	2.13
2100	Dk. brown	Steel hard	16.5	0.8	2.13
2200	—	—	(Expanded)	—	—

Remarks: Not suitable for vitreous clay products.

Bloating Test: Negative

Potential Use: Common brick

SAMPLE: R-2540

County: Wythe

Locality: Roadcut and abandoned quarry on the east side of State Highway 121 approximately 0.3 mile by road north of the intersection with U. S. Highway 11 at Fort Chiswell (Figure 10).

Description: An exposure of red and green shale, 35 feet in height, extends for a distance of 116 feet along the quarry face and roadcut. The shale, which contains thin hard siltstone layers and a few soft, yellow, friable, silty layers, weathers to form red, rough blocky fragments. The rocks have a strike of N.75°E. and a dip of 50°NW. Less than 3 feet of overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 225 feet of shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 7.50

Raw Properties: Low plasticity, requires 17.6 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Brown	Fairly hard	0.0	14.7	1.78
1900	Brown	Fairly hard	0.0	14.3	1.78
2000	Red-brown	Hard	0.0	12.7	1.84
2100	Dk. brown	Very hard	0.5	5.5	2.07
2200	Black-brown	Very hard	0.5	1.1	2.07
2300	—	(Melted)	—	—	—

Remarks: Scumming

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	1.87	116.7	3.8	Slight expansion
2100	1.68	104.9	3.8	Laminar expansion
2200	1.43	89.3	3.3	Melting, sticky

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: None

SAMPLE: R-2541

County: Wythe

Locality: Roadcut, 3.3 miles north of Ivanhoe, on the east side of State Highway 94 approximately 0.3 mile by road south of the intersection with State Road 640.

Description: An exposure of red, moderately hard, semi-fissile shale, 7 feet in height, with a few siltstone layers, extends for a distance of 200 feet along the roadcut. Some interbeds of light gray-green shale also occur. The shale weathers to form rough, red fragments. Less than 2 feet of overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 8 feet of fresh and weathered shale and siltstone.

Type: Shale

Unfired strength: Good

pH: 5.80

Raw Properties: Low plasticity, requires 21.4 percent water of plasticity, no drying defects, 0.5 percent drying shrinkage.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Brown	Fairly hard	1.5	18.9	1.66
1900	Brown	Fairly hard	4.5	18.9	1.65
2000	Brown	Hard	4.5	12.8	1.85
2100	Dk. brown	Steel hard	8.5	9.2	1.94
2200	Dk. brown	Very hard	11.5	2.5	2.23
2300	—	—	(Expanded)		—

Remarks: Marginal color, short vitrification range.

Bloating Test: Negative

Potential Use: Common brick

SAMPLE: R-2542

County: Wythe

Locality: Roadcut, 3.5 miles south of Rural Retreat, on the east side of State Road 749 just north of the intersection with State Road 670.

Description: An exposure of red, soft shale, 7 feet in height, extends for a distance of 250 feet along the roadcut. The shale weathers to form rough, red fragments. Some yellow to dark-brown iron-oxide staining occurs on cleavage and bedding surfaces. Yellow and red interbedded clay occurs in the southern end of the cut. Less than 2 feet of overburden is present.

Formation or age: Rome Formation

Sampled interval: Sample across 8 feet of shale in northern end of the roadcut.

Type: Shale
pH: 6.60

Unfired strength: Good

Raw Properties: Low plasticity, requires 22.0 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Lt. brown	Fairly hard	8.5	15.4	1.81
1900	Lt. brown	Hard	10.0	13.0	1.89
2000	Brown	Very hard	13.5	8.3	2.07
2100	Dk. brown	Very hard	—	2.8	2.25
2200	—	—	(Expanded)	—	—

Remarks: Fair color, short vitrification range.

Bloating Test:

Temp. ° F	Bulk Dens.	Lb./ft. ³	% Abs.	Remarks
2000	2.03	126.7	2.7	No expansion
2100	1.44	89.9	1.8	Slight expansion
2200	1.30	81.2	1.0	Slight expansion

Remarks: Not suitable for lightweight aggregate (heavy).

Potential Use: Common brick

SAMPLE: R-2543

County: Wythe

Locality: Clay pit, 6.5 miles east of Wytheville, on the west side of State Road 634 at its intersection with State Road 631 (Figure 11).

Description: Light-gray clay, mixed with fine- to coarse-grained sand and some large quartz gravel and boulders, is exposed in two abandoned clay pits. The clay and sand are stained orange by iron oxide.

Formation or age: Residual clay from the Shady Formation.

Sampled interval: Representative of clay and sand along 20 feet of exposure in the northern wall of the southern pit.

Type: Clay and sand
pH: 5.20

Unfired strength: Fair

Raw Properties: Low plasticity, requires 20.8 percent water of plasticity, no drying defects.

Slow Firing Test:

Temp. ° F	Color	Hardness	% Total Lin.		Bulk Dens.
			Shk.	% Abs.	
1800	Tan	Fairly hard	8.0	21.3	1.68
1900	Tan	Fairly hard	8.0	21.3	1.68
2000	Tan	Fairly hard	8.0	19.6	1.73
2100	Lt. brown	Hard	10.0	16.7	1.80
2200	Gray-brown	Hard	10.0	15.4	1.83

Remarks: Too refractory for use in structural clay products.

Bloating Test: Negative

Potential Use: Flue lining and hot tops.

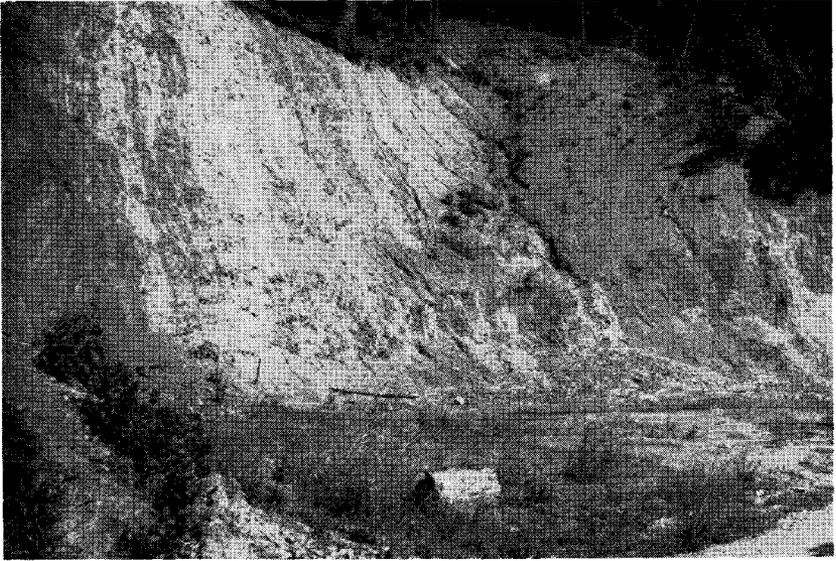


Figure 10. Exposure of the Rome Formation (Sample R-2540) on the east side of State Highway 121 approximately 0.3 mile by road north of the intersection with U. S. Highway 11 at Fort Chiswell.



Figure 11. Exposure of residual clay (Sample R-2543) on the west side of State Road 634 at its intersection with State Road 631.

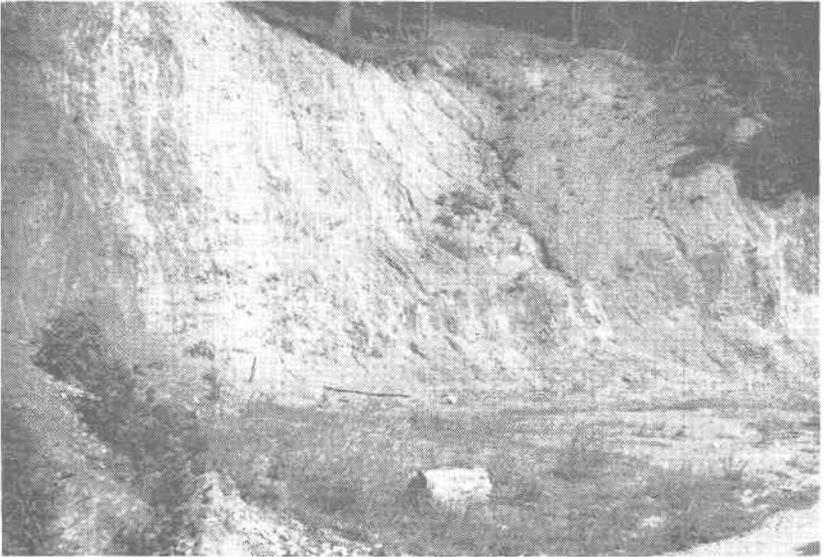


Figure 10. Exposure of the Rome Formation (Sample R-2540) on the east side of State Highway 121 approximately 0.3 mile by road north of the intersection with U. S. Highway 11 at Fort Chiswell.



Figure 11. Exposure of residual clay (Sample R-2543) on the west side of State Road 634 at its intersection with State Road 631.

APPENDIX I
STRUCTURAL CLAY PRODUCTS

Product Raw material	Fired color	Description of product	Uses
Common brick clays and shales	Reds to red-brown	Under fired or off-color brick	Backing up masonry walls
Face brick clays and shales	Creams, buffs, reds, browns (various scored, glazed, etc., finishes)	Uniform attractive colors, textured finishes	Facing walls
Decorative brick clays and shales	Unusual colors, pinks, buffs, grays, etc.	Mottled and spotted	Facing walls and special appli- cations, such as interior and exterior decorations
Hollow tile clays and shales	Not critical, usually reds, buffs, brown-reds	Rectangular, four holes	Back up for hollow wall con- struction
Wall tile clays and shales, talcs, etc.	White, buffs, etc., glazed to any color	Flat squares	Interior wall (facings, etc.)
Drain tile clays and shales	Buffs to red-brown	Porous, circular shapes	Septic fields and water drain- age around suburban housing developments
Roofing tile clays and shales	Buffs, reds, browns	Corrugated or channeled	Roofs
Floor tile clays and shales (can be synthetic mixes)	Various colors	Vitrified, dense	Floors and patios
Chimney flue tile clays and shales, low grade fire clays	Buffs, reds, and red-brown	Hollow cross sections, refractory	Lining of chimneys
Terra cotta clays and shales, buff burning, 25-50% calcined material	Various	Variety of shapes and colors, hollow construction, glazed and unglazed	Facing walls, interior and ex- terior decoration
Electrical conduit clay and shales	Buffs, reds, and brown	Square sectional, vitrified	Conduit for underground electrical wiring
Sewer pipe clays and shales	Reds, red-brown	Usually salt glazed, circular with flanged end	Sewer drainage
Lightweight aggregate clays and shales	Light to dark colors	Expanded or bloated particles	Lightweight concretes, blocks, etc., for back up

APPENDIX II

CRITERIA USED IN EVALUATING STRUCTURAL CLAYS

	Common brick 1	Face brick 2	Decorative brick 2A	Hollow tile 3	Wall tile 4	Drain tile 5	Roofing tile 6
<i>Unfired properties</i>							
Workability	Fairly plastic to plastic	Fairly plastic to plastic	Fairly plastic to plastic	Plastic to very plastic and smooth	Plastic to very plastic and smooth	Plastic to very plastic and smooth	Plastic to very plastic and smooth
Water of plasticity %	15—40.0	15—40.0	15—40.0	Up to 35.0	Up to 35.0	15—40.0	Up to 35.0
<i>Green strength</i>							
Wet and dry	Low to high	Low to high	Low to high	Average to high	Average to high	Average to high	Average to high
Drying characteristics	No warping or cracking	No warping or cracking	No warping or cracking	No warping or cracking	No warping or cracking	No warping or cracking	No warping or cracking
Drying shrinkage %	0—12	0—12	0—12	0—8	0—8	0—8	0—8
<i>Fired properties</i>							
Maturing temp. °F	1800—2000	1800—2200	1800—2200	1800—2100	1800—2100	1800—2000	1800—2200
Hardness	Very hard to steel hard	Steel hard	Steel hard	Steel hard	Steel hard	Very hard	Steel hard
Absorption %	Up to 20	Up to 15	Up to 15	Up to 15	0—10	0—12	0—10
Shrinkage %	0—10	0—10	0—10	0—10	0—10	0—8	0—8
Color	Reds to browns	Reds, browns, buffs, creams	Unusual colors, pinks, grays, etc.	Not too critical, usually red, brown-red, buff	White, buffs, reds, creams	Buff, reds, browns	Buff, reds, browns
Scumming*	Slight	None	None	Slight	None	Slight	None

APPENDIX II—Continued

	Floor tile 7	Chimney tile 8	Terra cotta 9	Conduit 10	Sewer pipe 11	Lightweight aggregate 12
<i>Unfired properties</i>						
Workability	Plastic to very plastic and smooth	Plastic to very plastic and smooth	Very plastic and smooth	Very plastic and smooth	Plastic to very plastic and smooth	
Water of plasticity %	Up to 85.0	15—40.0	18—35	15—40.0	Up to 85.0	
<i>Green strength</i>						
Wet and dry	Average to high	Average to high	Average to high	Average to high	Average to high	See Appendix V
Drying characteristics	No warping or cracking	No warping or cracking	No warping or cracking	No warping or cracking	No warping or cracking	
Drying shrinkage %	0—8	0—8	Up to 8.0	0—4	0—8	
<i>Fired properties</i>						
Maturing temp. °F	1800—2200	1800—2400	2000—2200	1800—2200	1800—2100	
Hardness	Steel hard	Very hard	Steel hard	Steel hard	Steel hard	
Absorption %	0—20	0—20	8—25	0—4	0—8	
Shrinkage %	0—8	0—8	0—8	0—10	0—10	
Color	Reds, buffs, dark browns	Not critical, buffs, reds and red-brown	Reds, buffs, gray-buffs, off-whites	Not critical	Reds, red-brown	
Scumming*	None	None	None	None	None	

*Scumming indicates soluble salts, slight scumming can usually be corrected by adding BaCl₂ or BaCO₃.

APPENDIX III

PRINCIPAL TYPES OF POTTERY

	Fired Colors	Uses
<i>Whiteware</i>		
Mixes of white burning clays, feldspars, flint, etc.	White (colors obtained by glazes, body pigments, etc.)	Table ware, sanitary ware, porcelain, etc.
<i>Stoneware</i>		
Gray to buff clays	Variety of colors, glazed and decorated	Kitchen ware, chemical stoneware, etc.
<i>Earthenware</i>		
Red-buff burning clays	Red to buff, glazed and unglazed	Kitchenware, gardenware, etc.
<i>Artware</i>		
Various clays	Variety of colors, glazes and decorations	Decoration

APPENDIX IV

CRITERIA FOR EVALUATING POTTERY CLAYS

	Whiteware 1	Stoneware 2	Earthenware 3	Artware 4
<i>Unfired properties</i>				
Workability	Highly plastic and smooth working Not critical	Highly plastic and smooth working Not critical	Very plastic and smooth working Not critical	Very plastic and smooth working Not critical
Water of plasticity	Not critical	Not critical	Not critical	Not critical
<i>Green strength</i>				
Wet and dry	Average	Above average	Average	Above average
Drying characteristics	Dry free from defects under controlled drying	Dry free from defects at normal drying rates	Dry free from defects at normal drying rates	Dry free from defects at normal drying rates
% Drying shrinkage*	3-12	3-8	2-10	0-15
<i>Fired properties</i>				
Maturing temp. °F.	1800-2500	2100-2300	1800-2200	1800-2100
% Shrinkage*	0-8	1-8	1-8	0-20
% Absorption (un-glazed)	0-2	0-2	0-5	Not critical
Colors	Whites, blues, yellows, etc.	Whites, blues, yellows, buff and grays	Reds, browns, and buffs	Variety

* Total shrinkage of both green and fired properties should not exceed 12 percent except for artware.

APPENDIX V

CRITERIA USED IN EVALUATING LIGHTWEIGHT AGGREGATE CLAYS

	Rotary kiln process	Sintering process
<i>Unfired properties</i>		
Drying characteristics	Dry readily and show only slight disintegration	Not critical, water used to pelletize before firing
Dry strength	Strength must be sufficient for proper sizing when crushed for kiln feed	Not critical
Crushing characteristics	-8 mesh material should not exceed 20%	Not critical except where particles tend to be thin and platy
<i>Fired properties</i>		
Firing range	1800-2200°F	Vitreous and glazes between 2200-2300°F
Bloating range	Minimum 100°F, 200° preferred	Not critical
Weight	75-45 lb/ft ³	75-45 lb/ft ³
Expansion	Gradual weight decrease thru bloating range	Slight
% Absorption	0-18.0 at best bloating temp.	0-6.0
Color	Light reds to light grays preferred, although color not too critical	Light red-grays preferred although color not too critical
Strength	Determined by concrete performance test	Determined by concrete performance test

GLOSSARY

- Absorption**—the relationship of the weight of the water absorbed to the weight of the dry specimen, expressed in a percent.
- Apparent porosity**—the ratio of the volume of open pores in a specimen to the bulk volume. It is usually expressed in percent.
- Ball clay**—a secondary clay, commonly characterized by the presence of organic matter, high plasticity, high dry strength, long vitrification range, and a light color when fired.
- Beneficiate**—to improve a raw material by the removal of undesirable constituents.
- Bloating**—swelling naturally or by gas-forming additives upon the application of heat.
- Bulk density**—the dry weight of a specimen divided by the bulk volume, where the latter is equal to the sum of the volume of the solid material, plus the volume of the open and closed pores (reported in grams per cubic centimeter).
- Casting**—forming ceramic ware by introducing a body slip into a porous mold which absorbs sufficient water from the slip to produce a semi-rigid article.
- Drying**—removal of uncombined water or other volatile substance from a ceramic raw material or product, usually expedited by low-temperature heating.
- Dummy (bag- or extruded-type clay product)**—rod-shaped clay, commonly 1 to 1.5 inches in diameter and 12 inches in length, utilized to backfill holes in which explosive charges have been set.
- Expansion**—swelling of a clay material when in the thermoplastic state.
- Expansion range**—temperature range in which a clay material will expand.
- Extrusion**—the forcing of clay material through an opening or die of suitable shape and size to form a continuous ribbon.
- Firing**—the controlled heat treatment of ceramic ware in a kiln or furnace, during the process of manufacture, to develop the desired properties.
- Firing range**—the range of firing temperature within which a ceramic composition develops properties which render it commercially useful.
- Flocculation**—the technical term for the gathering of suspended particles into aggregations.
- Fusion**—the process of melting, usually the result of interaction of two or more materials.
- Glaze**—a ceramic coating matured to the glassy state on a formed ceramic article, or the material or mixture from which the coating is made.

- Green strength (dry)**—the strength of dry ceramic material before it is fired.
- Green strength (wet)**—the strength of moistened ceramic material before it is fired.
- Hot top**—a refractory feedhead for an ingot mold.
- Kiln**—a furnace for firing ceramic products such as brick or porcelain.
- Maturing range**—the time-temperature range within which a ceramic body, glaze, or other composition may be fired to yield specified properties.
- pH values**—measure of relative alkalinity and acidity.
- Plasticity**—the property of a moistened material to be deformed under pressure, with the deformed shape being retained when the deforming pressure is removed.
- psi**—pounds per square inch.
- Rotary kiln**—an inclined tubular furnace which revolves on its axis.
- Scumming**—the formation of an undesirable residue on the surface of a ceramic product.
- Shrinkage**—the reduction in dimensions of a ceramic material from loss of water or through coalescence upon heat treatment.
- Sinter**—a ceramic material or mixture fired to less than complete fusion, resulting in a coherent mass, or the process involved.
- Slip**—a suspension of ceramic material in a liquid.
- Soluble salts**—compounds formed by the combining of acids and bases. Common water-soluble salts found in clay materials include chlorides, sulfates, and carbonates of alkalies, alkaline earths, aluminum, and iron.
- Thixotropic**—tending to change reversibly from gel to sol under mechanical action such as shaking.
- Vitrification**—the condition of being vitrified.
- Vitrify**—to produce (in a ceramic ware) enough glassy phase or close crystallization by high firing to make nonporous.
- Water of plasticity**—percent of water required to plasticize a clay material.
- Workability**—the consistency and moldability of plastic ceramic materials.