



COMMONWEALTH OF VIRGINIA

DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT

DIVISION OF MINERAL RESOURCES

ANALYSES OF CLAY, SHALE
AND RELATED MATERIALS—
WEST-CENTRAL COUNTIES

James L. Calver, C. E. Smith, and
D. C. Le Van

In Cooperation with U.S. Bureau of Mines

MINERAL RESOURCES REPORT 5

VIRGINIA DIVISION OF MINERAL RESOURCES

James L. Calver
Commissioner of Mineral Resources and State Geologist

CHARLOTTESVILLE, VIRGINIA

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DEPARTMENT OF PURCHASES AND SUPPLY
RICHMOND
1964

DEPARTMENT OF CONSERVATION AND
ECONOMIC DEVELOPMENT

Richmond, Virginia

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DEDICATION

This report is dedicated to the memory and in appreciation of the excellent analytical work performed by Howard Phillip Hamlin. His untiring enthusiasm to evaluate ceramic materials, particularly those found in the Southeastern United States, has led not only to the commercial use of these ceramic materials but also the establishment of a number of plants.

Howard Phillip Hamlin was born in Smoky, Tennessee, May 7, 1913. He received a B. S. degree from Milligan College and had advanced work at the University of Tennessee and University of Alabama graduate schools. He entered Federal Service in 1942 with the Tennessee Valley Authority, then transferred to the U. S. Bureau of Mines at Norris, Tennessee, as a chemist. In 1946 he was transferred to the Metallurgical Branch, U. S. Bureau of Mines, Tuscaloosa, Alabama, working mainly in ceramics. In early 1952 he was transferred to the U. S. Bureau of Mines Station at Raleigh, North Carolina, and a few months later assigned to the U. S. Bureau of Mines Station at Norris, Tennessee, where he was involved in ceramic work until his death from a heart attack August 24, 1963. He was author or co-author of several papers in Federal, State and journal publications.

CONTENTS

	PAGE
Abstract	1
Introduction	1
Acknowledgements	3
Sample descriptions, characteristics, and evaluations	5
Albemarle County	6
Alleghany County	16
Augusta County	36
Bath County	80
Botetourt County	88
Buckingham County	110
Craig County	126
Fluvanna County	136
Highland County	154
Louisa County	166
Montgomery County	172
Nelson County	186
Roanoke County	196
Rockbridge County	206

ILLUSTRATIONS

FIGURE	PAGE
1. Areas of investigation	2
2. Exposure of the Romney shale	48
3. Exposure of the Catskill formation	48

ANALYSES OF CLAY, SHALE, AND RELATED MATERIALS—WEST-CENTRAL COUNTIES

By

JAMES L. CALVER, C. E. SMITH,
AND D. C. LE VAN

ABSTRACT

This report contains results of tests and determinations of properties required to evaluate the potential ceramic and nonceramic uses of 151 samples of clay, shale, mudstone, slate, phyllite, and schist. A total of 131 localities in Albemarle, Alleghany, Augusta, Bath, Botetourt, Buckingham, Craig, Fluvanna, Highland, Louisa, Montgomery, Nelson, Roanoke and Rockbridge counties, Virginia are represented.

INTRODUCTION

In November 1957, the Virginia Division of Mineral Resources entered into a cooperative agreement with the United States 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 151 samples collected from 131 localities in the west-central part of Virginia (Figure 1). Of the 151 samples tested, 71 were found to be potentially suitable for brick manufacture, 12 for decorative brick, 35 for tile, 10 for other structural clay products, 28 for lightweight aggregate, 8 for pottery, 8 for ceramic ware, 6 for refractory brick, 7 for quarry tile, and 9 for mineral filler and other miscellaneous uses. The test data are arranged by county and the evaluation remarks are summarized at the beginning of each county discussion. The specifications of the various ceramic materials and the criteria used in making the evaluations are printed in Virginia Division of Mineral Resources Mineral Resources Report 2.

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 stock pile may not be representative of all the material. Samples from other parts of the pit, stock pile, or other locations of the same formation may not have the same physical and chemical characteristics as determined for the sample that was tested.

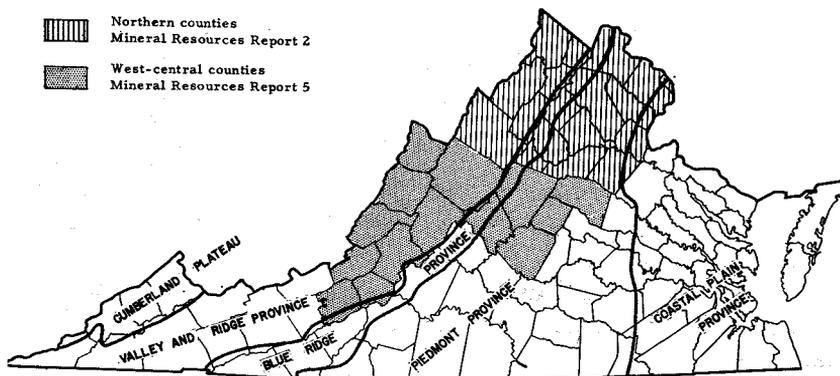
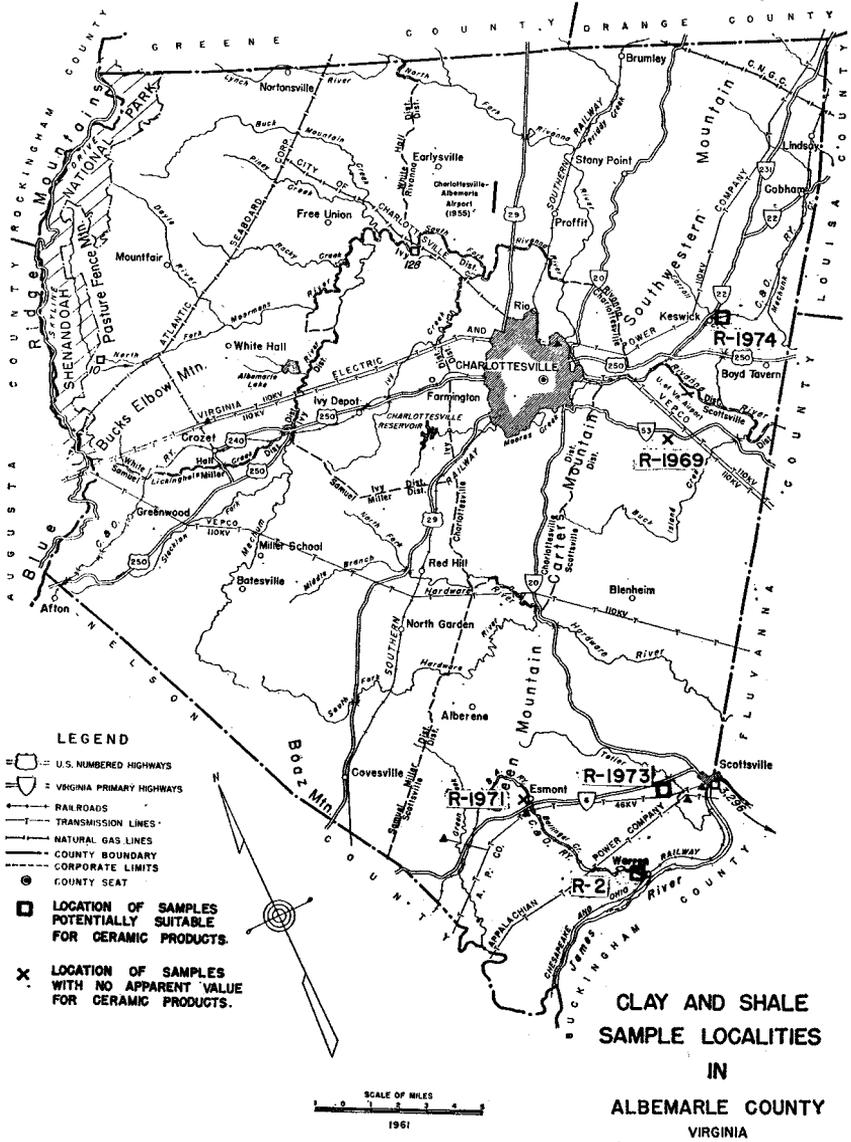


Figure 1. Areas of investigation.

ACKNOWLEDGMENTS

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. Robert S. Wood of Texaco, Inc. collected samples from most of the localities while on the staff of the Virginia Division of Mineral Resources. Acknowledgment is made to the employees of the U. S. Bureau of Mines, and in particular to Howard P. Hamlin (deceased), U. S. Bureau of Mines station at Norris, Tennessee, who provided technical interpretations and supervised the analysis of the samples.

SAMPLE DESCRIPTIONS
CHARACTERISTICS
AND EVALUATIONS



Location Map of Albemarle County

ALBEMARLE COUNTY

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

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-2	Triassic shale	Brick, tile, and quarry tile
R-1969	Precambrian or early Paleozoic phyllite	None
R-1971	Arvonian slate	None
R-1973	Triassic shale and mudstone	Brick and quarry tile
R-1974	Precambrian or early Paleozoic phyllite	Color additive

SAMPLE: R-2

County: Albemarle

Locality: Exposure of shale in cut along right-of-way of the Nelson and Albemarle Railway just northwest of Warren.

Formation or age: Triassic

Type: Shale

pH: 6.12

Raw Properties: Fairly plastic and smooth working, requires 28 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Orange red	Soft crumbly	2.0	21.7	2.78
2050	Med. red brown	Hard	9.0	9.6	2.68
2100	Dk. red brown	Very hard	11.0	4.7	2.58
2200	Dk. brown	Vitreous	Expanded	22.6	2.13

Bloating Test: Negative

Potential Use: Dark red-brown brick and tile, and quarry tile.

Pressed Specimen 2" by 1" by 1/2"

Temp. °F	Hardness	% Lin.		Approx.
		Shk.	% Abs.	Sp. Gr.
1900	Very hard	5.5	10.0	2.74
2000	Steel hard	7.1	7.8	2.69
2050	Steel hard	7.9	5.5	2.68

SAMPLE: R-1969

County: Albemarle

Locality: Roadcut, 5.0 miles southeast of Charlottesville, on the west side of State Highway 53 approximately 1.3 miles west of junction with State Road 729.

Description: Approximately 45 feet of dark-gray phyllite with small lenses of milky quartz are exposed. The phyllite weathers to form light-gray and reddish-gray angular fragments. The cleavage of the phyllite has a strike of N. 60° E.

Formation or age: Precambrian or early Paleozoic

Sampled interval: Sample across 45 feet of phyllite

Type: Phyllite

Unfired strength: Very low

pH: 7.1

Composition:

*X-ray and Petrographic Analysis*¹

Spectrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	30 - 40	K ₂ O	3.30
Mica	25 - 30	TiO ₂	1.10
Feldspar	15 - 20	Cr ₂ O ₃	.02
Kaolin	8 - 10	Fe ₂ O ₃	4 - 8
Fe (OH) ₂	2	Sr	Trace
Montmorillonite	2 - 3	Zr	Trace
Heavy minerals		Rb	Trace
Zircon			
Tourmaline	0.5 - 1.0		

¹ (Particles very angular)

Raw Properties: Not very plastic, short working, requires 25.0 percent water of plasticity, no drying defects, 1.0 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u> <u>Shk.</u>	<u>% Abs.</u>	<u>Approx.</u> <u>Sp. Gr.</u>
1800	Lt. red	Soft crumbly	2.0	23.4	2.67
2000	Lt. red	Soft crumbly	5.0	17.9	2.69
2100	Brown	Fairly hard	7.0	11.3	2.67
2200	Near black	Very hard	8.5	6.8	2.55
2300	Black	Steel hard	8.5	6.8	2.42
2400	Black	Steel hard, vitreous	8.5	3.7	2.42

Bloating Test: Negative*Potential Use:* None

SAMPLE: R-1971

County: Albemarle

Locality: Abandoned slate quarry on the north side of State Highway 6 at Esmont.

Formation or age: Arvonian slate

Sampled interval: Composite of unweathered slate from dump believed to be representative of slate in quarry.

Type: Slate

Unfired strength: Very low

pH: 9.0

Raw Properties: Not plastic, short working, thixotropic, requires 23 percent water of plasticity, no drying defects, 3.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Sand brown	Soft crumbly	2.0	20.6	2.69
1900	Sand brown	Soft crumbly	2.0	18.3	2.71
2000	Lt. brown	Fairly hard	5.0	14.0	2.67
2100	Brown (olive)	Hard	5.0	9.0	2.68
2200	(Expanded and cracked when removed from kiln)				

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1973

County: Albemarle

Locality: Roadcut, 1.8 miles west of Scottsville, on the south side of State Highway 6 approximately 0.6 mile east of the junction with State Road 737.

Description: Reddish-brown mudstone and shale containing a few interbedded medium-grained, reddish-brown sandstones occur in a roadcut.

Formation or age: Triassic

Sampled interval: Representative of exposure of shale and mudstone, 10 feet in height, sampled for a distance of 190 feet.

Type: Shale and mudstone *Unfired Strength:* Very low
pH: 6.0

Raw Properties: Not plastic, short working, thixotropic, requires 22 percent water of plasticity, no drying defects. 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800	Dk. buff orange	Soft crumbly	5.0	21.3	2.73
1900	Dk. buff orange	Soft crumbly	5.0	19.6	2.72
2000	Lt. brown	Fairly hard	7.5	13.5	2.67
2100	Rich brown	Very hard	12.0	9.6	2.65
2200	Dk. brown	Steel hard	12.0	6.7	2.56
2300	Very dk. brown	Steel hard	12.0	2.9	2.37

Bloating Test: Negative

Potential Use: Brick and quarry tile

SAMPLE: R-1974 County: Albemarle

Locality: Exposure, 0.5 mile east of Keswick, on the north-east side of State Road 616 about 0.2 mile southeast of the intersection with State Road 685.

Description: Dark-gray phyllite that weathers light gray and greenish gray is exposed. Joints occur in the rocks but no well-defined sets are present. Some of the joint planes are stained rusty brown by iron oxide. The cleavage has a strike of N. 63° E. and a dip of 55° SE.

Formation or age: Precambrian or early Paleozoic

Sampled interval: Representative of exposure of phyllite, 10 feet in height, sampled for a distance of 95 feet.

Type: Phyllite *Unfired strength:* Very low
pH: 7.5

Composition:

X-ray and Petrographic Analysis

Spectrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	30 - 40	K ₂ O	3.5
Mica	25 - 30	CaO	.10
Feldspar	8 - 10	TiO ₂	1.15
Kaolin	15 - 30	Mn.	.08
Fe (OH) ₃	1±	Fe ₂ O ₃	4 - 8
Montmorillonite	3 - 5	Zn	Trace
Heavy Minerals		Zr	Trace
Zircon		Rb.	Trace
Tourmaline			
Carbonates	0 - 5±		

Raw Properties: Fairly plastic, short working, requires 17.0 percent water of plasticity, no drying defects, 0.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. purple	Soft crumbly	0.5	16.1	2.70
1900	Lt. purple	Soft crumbly	1.0	14.1	2.70
2000	Purple	Fairly hard	1.0	12.9	2.71
2100	Dk. purple	Very hard	4.5	8.2	2.67
2200	Near black	Steel hard	5.0	5.4	2.58

Bloating Test: Negative

Potential Use: Might be used as a color additive in ceramic bodies. Fired colors suggest manganese.

ALLEGHANY COUNTY

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

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1818	Residual clay above Romney shale	Brick, tile, and possibly sewer pipe
R-1819	Residual clay above Romney shale	Decorative brick and tile, drain tile, and terra cotta
R-1820	Residual clay above Romney shale	Decorative brick and tile, drain tile, terra cotta, and pottery
R-1828	Residual clay above Romney shale	Decorative brick and tile, drain tile, terra cotta, and pottery
R-1829	Residual clay above Romney shale	After beneficiation might be used as fluxing agent in ceramic whiteware
R-1849	Residual clay	Low-grade common brick
R-1976	Brallier shale	Brick, tile, and possibly sintered aggregate
R-1977	Brallier shale	Brick and tile
R-1978	Maccrady shale	Low-grade brick, sintered aggregate, and possibly rotary kiln aggregate
R-1980	Romney shale	None
R-1981	Chemung (?) shale	Brick (?)
R-1982	Romney shale	None
R-1986	Brallier shale	Brick
R-1987	Brallier shale	Brick (?)

SAMPLES: R-1818, R-1819, and R-1820

County: Alleghany

Locality: Exposure along the southeastern face of an open cut of the Double Ridge mine, on the northwest flank of Potts Mountain, about 3.3 miles south of Jordan Mines.

Description: Dark yellowish-orange, light-gray, grayish-red, and grayish-orange clay occur in an exposure up to 12 feet in height along the southeastern face of the pit. The clay has been derived from the weathering of fissile, black Romney shale and some partially weathered black shale occurs near the base of the exposure. The clay is underlain by ferruginous Ridgeley sandstone which has been gently folded.

Formation or age: Residual clay above Romney shale

SAMPLE R-1818

Sampled interval: Representative of dark yellowish-orange, light-gray, and grayish-red clay sampled at intervals for a distance of 250 feet.

Type: Clay

Unfired strength: Above average

pH: 4.4

Raw Properties: Plastic, smooth and slightly fatty working, requires 34.0 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff	Soft crumbly	9.0	16.6	2.56
1900	Dk. buff	Steel hard	15.0	5.5	2.50
2000	Dk. buff	Steel hard	16.0	3.9	2.47
2100	Brown	Steel hard	16.5	0.2	2.42
2200	Dk. brown	Steel hard	17.5	.0	2.38
2300	Dk. brown-gray	Steel hard	Expanded	2.3	1.89

Bloating Test: Negative

Potential Use: Brick and tile; possibly sewer pipe

SAMPLE R-1819

Sampled interval: Representative of light-gray, grayish-red, and grayish-orange clay sampled for a distance of 40 feet.

Type: Clay
pH: 4.5

Unfired strength: Average

Raw Properties: Very plastic and smooth working, requires 31.0 percent water of plasticity, no drying defects, 5.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. buff	Soft crumbly	5.5	20.3	2.57
1900	Lt. buff	Very hard	8.5	13.9	2.57
2000	Dk. buff	Steel hard	11.5	6.7	2.41
2100	Lt. brown	Steel hard	15.0	1.1	2.27
2200	Brown	Steel hard	15.5	0.3	2.27
2300	Gray brown	Steel hard	Expanded	0.4	2.05

Bloating Test: Negative

Potential Use: Decorative brick and tile, drain tile, and terra cotta

SAMPLE R-1820

Sampled interval: Sample of light-gray clay

Type: Clay
pH: 4.4

Unfired strength: Average

Raw Properties: Plastic, smooth and fatty working, requires 34 percent water of plasticity, no drying defects, 6.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. buff	Soft crumbly	6	18.4	2.40
1900	Lt. buff orange	Very hard	10	14.1	2.40
2000	Buff orange	Steel hard	15	9.5	2.40
2100	Lt. brown	Steel hard	17.5	0.8	2.30
2200	Med brown	Steel hard	19.5	0.7	2.23
2300	Brown gray	Steel hard	Expanded	2.3	1.74

Blotting Test: Negative

Potential Use: Decorative brick and tile, drain tile, terra cotta, and pottery

SAMPLES: R-1828 and 1829

County: Alleghany

Locality: Exposure in the northwestern face of the largest open cut of Rich Patch mine located between Horse Mountain and Porter Mountain about 3.0 miles southwest of Low Moor.

Description: Approximately 13 feet of light-gray, medium-gray, and grayish-orange clays are exposed for a distance of 75 feet. Grayish orange clay with mottled zones of light-gray clay occurs in the upper part of the exposure and the remaining portion consists predominantly of light- and medium-gray clay. The clay has been derived from the weathering of Romney shale and some of the grayish-orange clay shows the original structure of the shale. The clay is underlain by massive beds of ferruginous Ridgeley sandstone which have a strike of N. 20° E. and a dip of 35° NW.

Formation or age: Residual clay from Romney shale

SAMPLE R-1828

Sampled interval: Sample is representative of light- and medium-gray clay, of which 13 feet are exposed for a distance of 75 feet.

Type: Clay
pH: 4.9

Unfired strength: Average

Raw Properties: Very plastic, smooth working, requires 34.0 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. cream	Fairly hard	5.0	18.3	2.61
1900	Lt. cream	Hard	8.5	15.0	2.63
2000	Darker cream	Very hard	10.5	10.6	2.54
2100	Lt. tan	Steel hard	11.0	0.6	2.40
2200	Dk. tan	Steel hard	11.0	0.0	2.40
2300	Gray tan	Steel hard	Expanded	0.0	2.15

Bloating Test: Negative

Potential Use: Decorative brick and tile, drain tile, terra cotta, and pottery (thermal shock resistance low).

SAMPLE R-1829

Sampled interval: Sample representative of all clay in exposure, 13 feet in height, that extends for a distance of 75 feet.

Type: Clay
pH: 4.0

Unfired strength: High

Composition: X-ray and Petrographic Analysis

	<u>Unwashed</u> Approx. %	<u>Beneficiated</u> Approx. %
Quartz	60 - 65	50 - 60
Montmorillonite	-	-
Kaolin	20 - 25	30
Sericite	10 - 15	15
FeO	Less than 1.0	Less than 1.0

Crude Material

Raw Properties: Plastic, smooth and fine gritty working, requires 34.0 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. buff	Fairly hard	7.5	17.7	2.56
1900	Lt. tan	Very hard	13.0	5.5	2.51
2000	Lt. tan	Steel hard	14.5	3.7	2.47
2100	Tan	Steel hard	17.5	0.4	2.41
2200	Dk. tan	Steel hard	17.5	0.2	2.40
2300	Tan gray	Steel hard	Expanded	-	1.94

Bloating Test: Negative

Beneficiated

Washed clay	61.1%
Residue	36.9%

Type: Clay*Unfired strength:* Average

Raw Properties: Plastic and smooth working, requires 34.0 percent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Off-white	Soft crumbly	5.0	24.0	2.59
2000	Off-white	Fairly hard	10.0	13.2	2.53
2100	Lt. gray	Steel hard	15.0	2.7	2.41
2200	Lt. gray	Steel hard	16.0	0.0	2.27
2300	Lt. gray	Steel hard	16.0	0.2	2.28
2400	Lt. gray	Steel hard	Expanded	5.7	1.78

Potential Use: In ceramic whiteware mixes has good possibilities as a fluxing agent to replace part of the feldspar.

SAMPLE: R-1849

County: Alleghany

Locality: Exposure, 4.0 miles northeast of Covington, in a small open cut of the Iron Mountain mine on the northwest flank of Fore Mountain and about 0.25 mile southeast of Forest Service Road 125.

Description: Pale-purple, white, and grayish-orange clay occurs along the eastern face of a small open cut. Fragments of fine-grained sandstone and medium-gray chert occur in the clay. Some of the clay shows the original structure of the rock from which it was derived. An overburden of gravel and reddish-brown clay, up to 2 feet in thickness, is present. Structurally the area is on the overturned southeast-dipping limb of a syncline.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, 12 feet in height, sampled for a distance of eight feet.

Type: Clay

Unfired strength: Average

pH: 5.3

Raw Properties: Plastic and smooth working, requires 28.0 percent water of plasticity, no drying defects, 6.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. tan	Steel hard	7.5	15.7	2.54
1900	Lt. tan	Steel hard	7.5	13.5	2.53
2000	Tan olive	Steel hard	10.0	9.0	2.48
2100	Brown olive	Steel hard	11.0	3.1	2.40
2200	Brown gray	Steel hard	Expanded	—	—
2300	Brown gray	Glazed	Expanded	—	—

Bloating Test: Negative

Potential Use: Low-grade common brick? (if color acceptable by trade; material fires steel hard at 1800° F but the fired colors are very unattractive).

SAMPLE: R-1976

County: Alleghany

Locality: Exposure, 7.2 miles north of Callaghan, on the east side of State Road 661 just south of the intersection with State Road 781.

Description: Approximately 30 feet of olive-gray micaceous shale with a few interbedded layers of fine-grained, olive-gray sandstone are exposed. The shale weathers to form light olive-gray angular fragments. Joints occur but no well-defined sets are present. The joint planes are stained rusty brown by iron oxide. The shale is covered by 2 feet of soil.

Formation or age: Brallier shale.

Sampled interval: Sample across 30 feet of shale

Type: Shale

Unfired strength: Very low

pH: 7.3

Raw Properties: Not very plastic, short and slightly fatty working, requires 16.0 percent water of plasticity, no drying defects, 1.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk. buff orange	Soft crumbly	3.0	13.9	2.66
1900	Dk. buff orange	Soft crumbly	5.0	11.2	2.65
2000	Lt. brown buff	Fairly hard	5.0	9.4	2.65
2100	Rich brown	Steel hard	7.5	5.9	2.59
2200	Dk. brown	Steel hard	7.5	3.3	2.45
2300	—	(Melted)	Expanded	-	-

Bloating Test: Negative

Potential Use: Brick, tile, and possibly sintered aggregate.

SAMPLE: R-1977

County: Alleghany

Locality: Roadcut, 5.9 miles west of Callaghan, on the north-west side of U. S. Highway 60 approximately 4.3 miles northeast of the intersection of U. S. Highway 60 and State Highway 311, and 3.6 miles northeast of the Virginia-West Virginia State line.

Description: Exposed in the roadcut are 25 feet of olive-gray micaceous shale with interbedded thin layers of laminated siltstone. The shale weathers to form light olive-gray angular fragments. Joints occur in the rocks but no well-defined sets are present. The joint planes are stained rusty brown by iron oxide. The rocks have a strike of N. 50° E. and a dip of 65° NW.

Formation or age: Brallier shale

Sampled interval: Sample across 25 feet of shale

Type: Shale
pH: 7.9

Unfired strength: Very low

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	50 - 60	Kaolin	10 - 15
Mica	20 - 25	Fe (OH) _x	1±
Feldspar	5 - 8	Montmorillonite	5 - 8

Raw Properties: Not plastic, short and mealy working, thixotropic, requires 17.0 percent water of plasticity, no drying defects, 3.0 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> °F	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u> <u>Shk.</u>	<u>% Abs.</u>	<u>Approx.</u> <u>Sp. Gr.</u>
1800	Dk. buff orange	Soft crumbly	3.5	14.1	2.67
1900	Dk. buff orange	Soft crumbly	3.5	12.3	2.66
2000	Lt. brown	Fairly hard	7.5	10.4	2.65
2100	Brown	Very hard	7.5	7.5	2.61

Potential Use: Brick and tile

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1900	2.33	145.1	2.6	No bloating
2000	1.88	117.1	3.4	Slight bloating
2100	1.60	99.7	5.2	Fair bloating
2200	1.46	90.9	1.8	Fair bloating

Firing Characteristics: This sample appears to be mostly weathered material. Expansion is not uniform.

SAMPLE: R-1978

County: Alleghany

Locality: Roadcut on the west side of State Highway 311 approximately 1.5 miles southeast of the intersection with State Road 602 at Alleghany.

Description: Eight feet of dark-red shale that weathers to form small angular fragments is exposed along the roadcut. The shale is overlain and underlain by thick-bedded, medium-grained, greenish sandstone. The rocks have a strike of N. 10° E. and a dip of 50° NW.

Formation or age: Maccrady shale

Sampled interval: Sample across 8 feet of shale

Type: Shale

Unfired strength: Very low

pH: 8.0

Raw Properties: Not plastic, short working, requires 20.0 percent water of plasticity, no drying defects, 6.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dk. buff brown	Soft crumbly	6.5	13.8	2.68
1900	Dk. buff brown	Soft crumbly	6.5	11.0	2.67
2000	Brown	Hard	9.0	7.7	2.65
2100	Darker brown	Very hard	9.0	4.1	2.56
2200	—	(Melted)	Expanded	-	-

Potential Use: Low-grade brick; lightweight aggregate

Bloating Test:

Temp. °F	Bulk Dens.	Lb/ft ³	% Abs.	Remarks
1900	2.30	143.3	2.7	No bloating
2000	2.01	125.2	2.2	No bloating
2100	1.51	94.0	3.0	Slight bloating
2200	1.33	82.8	3.4	Fair bloating and sticky

Firing Characteristics: Would make good sintered aggregate and possibly good rotary kiln aggregate.

SAMPLE: R-1980

County: Alleghany

Locality: Exposure, 4.7 miles north of Callaghan, on the west side of State Road 600 just north of the intersection with State Road 641.

Description: About 45 feet of dark-gray fissile shale are exposed. The shale weathers to form grayish-orange angular fragments and bedding planes are stained rusty brown by iron oxide. The rocks have a strike of N. 30° to 45° E. and a dip of 20° to 35° NW.

Formation or age: Romney shale

Sampled interval: Sample across 45 feet of shale

Type: Shale

Unfired strength: Very low

pH: 6.1

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	50 - 60	Kaolin	8 - 10
Mica	20 - 25	Fe (OH) _x	1 - 2
Feldspar	3 - 5	Montmorillonite	3 - 5

Raw Properties: Not plastic, short and mealy working, requires 18.0 percent water of plasticity, no drying defects, 3.0 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u>		<u>Approx.</u> <u>Sp. Gr.</u>
			<u>Shk.</u>	<u>% Abs.</u>	
1800	Buff orange	Soft crumbly	1.5	24.3	2.69
1900	Buff orange	Soft crumbly	3.0	19.8	2.64
2000	Dk. orange buff	Soft crumbly	5.0	15.0	2.57
2100	Brown mottled	Fairly hard	7.5	11.2	2.53
2200	Gray mottled brown	Hard	7.5	6.9	2.28
2300	--	(Melted)	Expanded	-	-

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1981

County: Alleghany

Locality: Roadcut, 3.7 miles north of Covington, on the east side of U. S. Highway 220 approximately 0.1 mile north of the intersection with State Road 684.

Description: Exposed in the roadcut is 50 feet of olive-gray fissile shale that weathers to form light olive-gray angular fragments. Joints occur in the shale but no well-defined sets are present. The sampled rocks lie on the eastern limb of a northwest-trending anticline and have a strike of N. 25° W. and a dip of 32° to 52° NE.

Formation or age: Chemung (?) formation

Sampled interval: Sample across 50 feet of shale

Type: Shale
pH: 7.4

Unfired strength: Very low

Raw Properties: Not plastic, short and mealy working, requires 18.0 percent water of plasticity, no drying defects, 3.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dk. orange buff	Soft crumbly	4.0	17.5	2.72
1900	Dk. orange buff	Soft crumbly	4.0	14.2	2.69
2000	Lt. brown	Fairly hard	5.0	9.8	2.66
2100	Brown	Very hard	7.5	7.4	2.62
2200	Dk. brown	Steel hard	7.5	4.4	2.47
2300	Near black	Steel hard	7.5	3.3	2.21

Potential Use: Brick (?) and lightweight aggregate.

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	2.24	139.6	5.8	No bloating
1900	1.88	117.1	5.2	No bloating
2000	1.58	98.4	4.6	Slight bloating
2100	1.24	77.2	4.8	Excellent bloating
2200	1.25	77.9	4.0	Excellent bloating, slight sticking

Firing Characteristics: The material was too fine for proper testing. This shale has a good bloating range and the expanded material is good quality.

SAMPLE: R-1982

County: Alleghany

Locality: Exposure, 0.6 mile east of Longdale, on the south-east side of State Road 632 just south of the intersection with U. S. Highway 60.

Description: Approximately 55 feet of dark-gray and light olive-gray fissile shale with interbedded dark-gray siltstone are exposed. The shale weathers to form grayish-orange and light-gray angular fragments. The rocks are fractured and have a strike of N. 30° E. and a dip of 25° to 35° SE.

Formation or age: Romney shale

Sampled interval: Composite sample across 55 feet of shale

Type: Shale
pH: 7.8

Unfired strength: Very low

Raw Properties: Not plastic, short and mealy working, requires 18.0 percent of water plasticity, no drying defects, 1.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff	Soft crumbly	1.0	18.6	2.61
1900	Buff	Soft crumbly	1.0	16.0	2.58
2000	Buff	Soft crumbly	1.5	15.7	2.45
2100	Brown	Hard	1.5	15.8	2.28
2200	—	(Melted)	Expanded	-	-

Bloating Test: Negative

Potential Use: None (effervescence, indicating calcium carbonate)

SAMPLE: R-1986

County: Alleghany

Locality: Exposure, 4.1 miles south of Covington, on the north side of State Road 657 at the intersection with State Highway 18.

Description: Approximately 50 feet of dark-gray micaceous shale and interbedded layers of dark-gray laminated siltstone are exposed. Joints occur but no well-defined sets are present. Some joint planes are stained rusty brown by iron oxide. The rocks have a strike of N. 45° E. and a dip of 45° SE., and are overlain by 2 feet of soil.

Formation or age: Brallier shale

Sampled interval: Composite sample across 50 feet of shale and siltstone.

Type: Shale

Unfired strength: Very low

pH: 5.8

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	40 - 50	Fe (OH) _x	2±
Mica	15 - 20	Carbonates	2±
Feldspar	5 - 8		
Kaolin	10 - 15 ¹		

¹ Poorly crystallized

Raw Properties: Not plastic, short and mealy working, requires 18.0 percent water of plasticity, no drying defects, 1.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff	Soft crumbly	1.5	21.0	2.68
1900	Buff	Soft crumbly	1.5	17.8	2.63
2000	Lt. brown	Hard	4.0	14.8	2.63
2100	Dk. brown	Steel hard	6.0	8.1	2.44
2200	Dk. brown	Steel hard	Expanded	6.6	2.06

Potential Use: Brick

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1900	1.66	105.4	8.5	No bloating
2000	1.48	99.2	8.6	Slight bloating
2100	1.05	65.4	10.1	Good bloating, slightly sticky
2200	0.83	51.7	11.7	Overbloated and very sticky

Firing Characteristics: Sample appears to be a mixture of weathered and unweathered shale.

SAMPLE: R-1987

County: Alleghany

Locality: Roadcut, 3.3 miles northeast of Longdale, on the east side of State Highway 42 approximately 0.6 mile northeast of the intersection with State Road 635.

Description: Exposed in the roadcut is 30 feet of dark-gray micaceous shale that weathers to form light-gray angular fragments. Bedding planes have been stained rusty brown by iron oxide. Joints occur but no well-defined sets are present. The shale has a strike of N. 30° E. and a dip of 57° SE.

Formation or age: Brallier shale

Sampled interval: Sample across 30 feet of shale

Type: Shale

Unfired strength: Very low

pH: 4.8

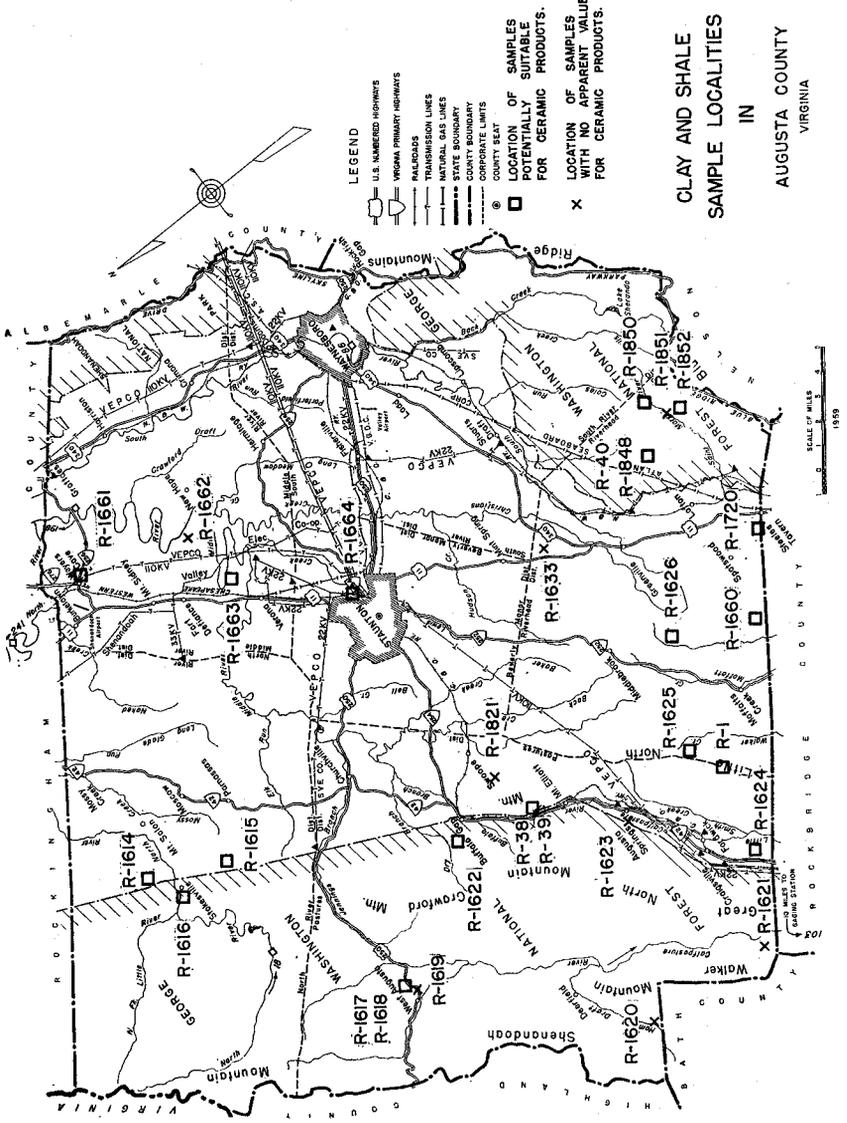
Raw Properties: Not very plastic, short working, thixotropic, requires 20.0 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff yellow	Soft crumbly	3.5	21.1	2.71
1900	Buff yellow	Soft crumbly	5.0	17.9	2.69
2000	Buff brown	Fairly hard	5.0	13.6	2.64
2100	Brown	Very hard	7.5	9.7	2.62
2200	Dk. brown	Steel hard	10.0	5.4	2.51
2300	Dk. gray brown	Steel hard	10.0	3.0	2.29

Bloating Test: Negative

Potential Use: Brick (?)



Location Map of Augusta County

AUGUSTA COUNTY

Samples were collected from 25 localities in Augusta County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1	Saprolitic clay	Decorative brick and tile
R-38	Weathered Romney shale	Common brick, tile, and sintered aggregate
R-39	Unweathered Romney shale	Brick, tile, and sintered aggregate
R-40 (See R-1848)	Residual clay	With additional preparation, in ceramic whiteware, as a substitute for potter's flint and as a mineral filler in plastics, asphalts, tile, etc.
R-1614	Brallier shale	Brick, quarry tile, and lightweight aggregate
R-1615	Romney shale	Lightweight aggregate
R-1616	Catskill formation	Common brick
R-1617	Weathered and unweathered Romney shale	Common brick
R-1618	Unweathered Romney shale	Low-grade common brick, and lightweight aggregate
R-1619	Brallier shale	None
R-1620	Romney (?) shale	None
R-1621	Romney (?) shale	None
R-1622	Devonian shale	Common brick and tile
R-1623	Romney shale	None
R-1624	Romney shale	Common brick
R-1625	Romney (?) shale	Common brick and tile
R-1626	Residual clay	Super-heat-duty refractories and colored ceramic ware
R-1633	Martinsburg shale	None
R-1660	Residual clay	Super-heat-duty refractories and colored ceramic ware
R-1661	Martinsburg shale	Sintered aggregate
R-1662	Martinsburg shale	None
R-1663	Martinsburg shale	Brick, tile, and lightweight aggregate
R-1664	Edinburg shale	Common brick, and lightweight aggregate
R-1720	Edinburg shale	Low-grade common brick
R-1821	Martinsburg shale	None
R-1848 (See R-40)	Residual clay	None

R-1850	Residual clay	Brick and tile
R-1851	Residual clay	None
R-1852	Residual clay	Brick and tile

SAMPLE: R-1

County: Augusta

Locality: Exposure, approximately 7 miles west of Middlebrook, located east of the crest of Little North Mountain and south of State Road 682.

Description: An exposure of white, tan, and gray clay, 2 feet in height, extends for a distance of 95 feet. An auger hole showed that the clay extends to a depth of 2 feet and is underlain by yellowish-brown sand. The deposit appears to be a saprolitic clay derived from the weathering of the Clinton formation.

Formation or age: Saprolitic clay

Sampled interval: Composite sample from 4 feet of clay in outcrop and auger hole.

Type: Clay

Raw Properties: Very plastic, smooth working, requires 34 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Ivory	Fairly hard	4.5	19.2	2.51
1900	Buff	Very hard	6.0	4.8	2.46
2000	Red buff	Very hard	12.5	2.0	2.42
2100	Red	Steel hard	15.0	0	2.39
2200	Red brown	Steel hard	14.5	0	2.36
2300	Gray brown	Steel hard	Expanded	2.3	2.07
2400	Medium gray	Steel hard	Expanded	1.3	2.01

Potential Use: Decorative brick and tile

SAMPLE: R-38 and R-39

County: Augusta

Locality: Inactive quarry of the North Mountain Brick Company located on the east side of State Highway 42 about 3.0 miles southwest of the intersection with State Highway 254 near Buffalo Gap.

Description: In the southeastern part of the quarry 130 feet of unweathered thin-bedded grayish-olive shale and micaceous siltstone occur. The shale and siltstone weather to form light-brown, light-red, and grayish-orange angular fragments. Some of the bedding planes contain slickensides and are stained rusty brown by iron. The rocks have a strike of N. 30° E. and a dip of 60° to 80° SE., and are weathered to an average depth of 25 feet. A prominent joint set has a strike of N. 50° W. and is vertical.

Formation or age: Romney shale

SAMPLE R-38

Sampled interval: Representative of 25 feet of weathered shale.

Type: Weathered shale
pH: 5.3

Unfired strength: Low

Raw Properties: Not very plastic, short and gritty working, requires 26 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dk. buff	Soft crumbly	3.0	21.7	2.73
2000	Dk. buff	Hard	5.5	15.2	2.69
2100	Red brown	Very hard	9.5	10.2	2.65
2200	Red brown	Steel hard	9.5	7.6	2.60
2300	Dk. brown	Steel hard	11.5	4.0	2.50
2400	Black brown	—	Expanded	7.2	2.24

Blotting Test: Negative

Potential Use: Common brick, tile, and probably sintered aggregate.

SAMPLE R-39

Sampled interval: Sample across 130 feet of unweathered shale and siltstone.

Type: Shale
pH: 5.60

Unfired strength: Very low

Raw Properties: Not plastic, short and gritty working, requires 22 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.	% Abs.	Approx.
			Shk.		Sp. Gr.
1800	Dk. buff	Soft crumbly	21.3	2.5	2.73
2000	Dk. buff	Fairly hard	15.7	4.5	2.68
2100	Red brown	Hard	12.4	9.5	2.64
2200	Dk. brown red	Very hard	9.3	9.5	2.58
2300	Dk. brown	Very hard	6.8	9.5	2.46
2400	Black brown	—	Expanded	—	—

Bloating Test: Negative

Potential Use: Brick, tile, and probably sintered aggregate

SAMPLES: R-40 and R-1848

County: Augusta

Locality: Abandoned clay pit on the west flank of the Blue Ridge Mountains approximately 2.7 miles east of Lofton and 2.0 miles south of Cold Springs.

Description: An exposure of white clay, 30 feet in height, occurs in the southeastern face of a large open cut. Mottled zones of pink and yellowish clay also are present in the exposure. Most of the clay is partially consolidated, dense, and waxy. The clay contains fragments of quartzite, chert, and dolomite, and some zones contain well-rounded quartz grains up to 2 mm in size. Portions of the clay show laminations which may represent original bedding. The clay is overlain by up to 30 feet of slumped material consisting of limonite boulders, clay, and gravel.

Formation or age: Residual clay

SAMPLE R-40

Sampled interval: Sample collected from exposure of pink clay, 12 feet in height.

Type: Fine silica (small amount of clay)

Unfired strength: Very low

pH: 4.90

Raw Properties: Not plastic, short and fine gritty working, requires 24 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Ivory	Soft crumbly	4.0	22.1	2.66
2000	Off-white	Soft crumbly	4.0	21.8	2.65
2100	Off-white	Soft crumbly	4.0	21.3	2.65
2200	Off-white	Soft crumbly	4.0	21.7	2.66
2300	Off-white	Soft crumbly	4.5	20.3	2.64
2400	Off-white	Soft crumbly	4.5	20.5	2.58

Pyrometric cone equivalent — Cone 29, which indicates that this sample is mostly silica.

Potential Use: With additional preparation, this material could be used in ceramic whiteware as a substitute for potter's flint, and as a mineral filler in plastics, asphalts, tile, etc.

SAMPLE R-1848

Sampled interval: Representative of exposure of white clay, 30 feet in height, sampled for a distance of 130 feet.

Type: Clay
pH: 6.1

Unfired strength: Low

Raw Properties: Plastic, smooth and gritty working, requires 27 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Off-white	Soft crumbly	2.5	24.0	2.58
2000	Off-white	Soft crumbly	2.5	21.8	2.60
2100	Very light gray	Hard	7.5	15.2	2.57
2200	Light gray	Very hard	9.0	11.7	2.55
2300	Light gray	Steel hard	12.5	6.0	2.48
2400	Light gray	Steel hard	12.5	3.8	2.45

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1614

County: Augusta

Locality: Roadcut, 1.5 miles northeast of Stokesville, on the northwest side of State Road 764 approximately 0.1 mile west of the intersection with State Road 758.

Description: About 130 feet of light olive-gray shale and interbedded thin to medium layers of fine-grained, light olive-gray sandstone are exposed in the roadcut. The shale and sandstone weather to form grayish-orange and pale yellowish-brown angular fragments. The rocks have been folded to form a minor northeast-trending anticline. The beds on the southeastern limb are overturned to the northwest in places. The gently dipping beds on the northwestern limb appear to be cut by a minor southeastward-dipping fault. Northwest of the fault the beds have a steep southeasterly dip. The rocks have a strike of N. 5° E., and are overlain by 1 foot of soil.

Formation or age: Brallier shale

Sampled interval: Sample across 120 feet of shale

Type: Shale

Unfired strength: Low

pH: 7.5

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	40 - 50	Sericite	15 - 20
Montmorillonite	5 - 8	Iron (oxides)	2 - 3
Kaolin	20 - 25		

Raw Properties: Fairly plastic, short working, requires 20 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Orange buff	Soft crumbly	5.0	18.7	2.70
1900	Orange buff	Soft crumbly	6.0	16.1	2.66
2000	Light brown	Hard	6.0	11.1	2.65
2100	Brown red	Steel hard	10.0	6.4	2.58
2200	Dark brown	Steel hard	10.0	4.8	2.48
2300	Near black	Steel hard	Expanded	-	1.94

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

Bloating Test:

Temp. °F	Bulk Dens.	Lb/ft ³	% Abs.	Remarks
1800	1.79	111.5	3.4	No bloating
1900	1.78	110.9	2.3	No bloating
2000	1.17	72.9	5.6	Fair bloating
2100	1.10	68.5	6.7	Good bloating and slightly sticky
2200	1.04	64.8	4.9	Overbloomed and very sticky

Firing Characteristics: Fired material is on the heavy side, but percent absorption is low and aggregate is very strong. Good aggregate material.

SAMPLE: R-1615

County: Augusta

Locality: Roadcut, 2.7 miles northwest of Parnassus, just southwest of the intersection of State Roads 730 and 761 (Figure 2).

Description: About 50 feet of dark-gray shale that weathers to form yellowish-orange angular fragments is exposed in the roadcut. Some of the bedding planes contain mud cracks and are stained rusty brown. A few lenticular zones of dark-gray siltstone, less than 1 foot in thickness, are present. The rocks have a strike of N. 27° to 35° E. and a dip of 40° to 57° SE., and are overlain by 1 foot of soil.

Formation or age: Romney shale

Sampled interval: Sample across 50 feet of shale.

Type: Shale

Unfired strength: Low

pH: 5.90

Raw Properties: Not too plastic, short and fairly smooth working, requires 20 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff	Soft crumbly	4.5	18.7	2.71
2000	Reddish buff	Fairly Hard	6.0	13.2	2.65
2100	Dull dk. red	Hard	9.0	7.8	2.51
2200	Dark brown	—	10.0	6.3	2.14
2300	Gray brown	—	Expanded	23.6	1.71
2400	—	(Melted)	—	—	—

Potential Use: Lightweight aggregate, provided material can be handled in rotary kiln. (Firing range is rather short).

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	1.92	119.6	7.2	No bloating
1900	1.92	119.6	9.2	No bloating
2000	1.55	96.6	9.6	Slight bloating
2100	1.17	72.9	11.6	Fair bloating and slightly sticky
2200	0.81	50.5	11.3	Overfired and very sticky

Firing Characteristics: Firing range is rather short, but might be used for lightweight aggregate, provided it can be handled in a rotary kiln.



Figure 2. Exposure of the Romney shale (Sample R-1615), 2.7 miles northwest of Parnassus, just southwest of the intersection of State Roads 730 and 761.

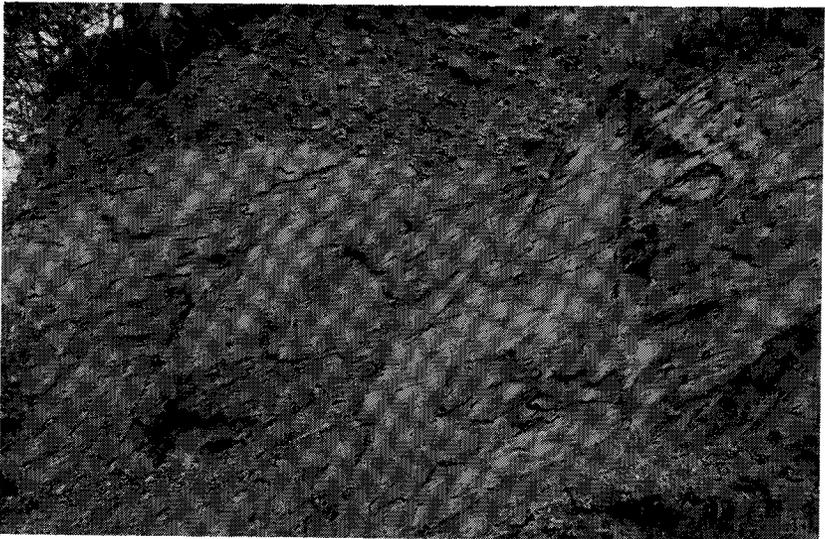


Figure 3. Exposure of the Catskill formation (Sample R-1616) on the southwest side of State Road 730 approximately 0.1 mile west of the intersection with State Road 763 in Stokesville.

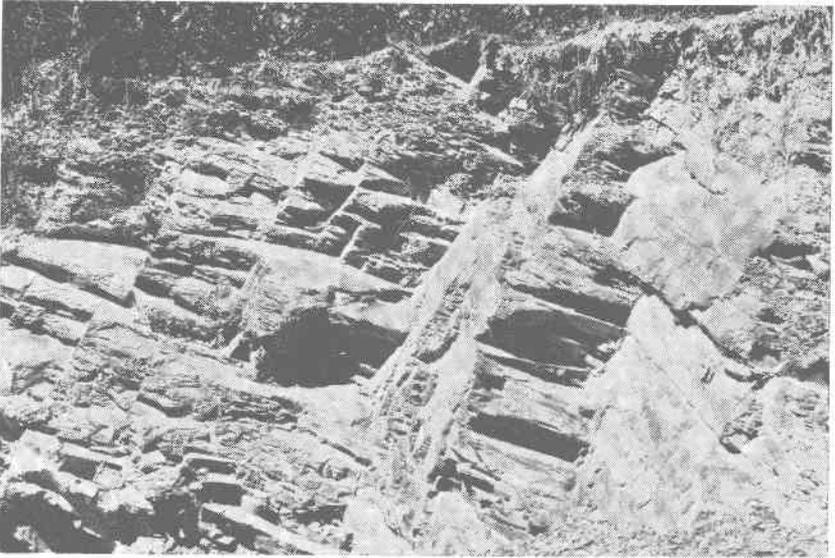


Figure 2. Exposure of the Romney shale (Sample R-1615), 2.7 miles northwest of Parnassus, just southwest of the intersection of State Roads 730 and 761.



Figure 3. Exposure of the Catskill formation (Sample R-1616) on the southwest side of State Road 730 approximately 0.1 mile west of the intersection with State Road 763 in Stokesville.

SAMPLE: R-1616

County: Augusta

Locality: Roadcut on the southwest side of State Road 730 approximately 0.1 mile west of the intersection with State Road 763 in Stokesville (Figure 3).

Description: About 120 feet of light olive-gray and grayish-red micaceous shale and interbedded thin to medium layers of fine-grained, grayish-red sandstone are exposed in the roadcut. The light olive-gray shale weathers to form yellowish-orange angular fragments and the grayish-red shale weathers to form light grayish-red angular fragments. The sandstone is cross bedded and contains fragments of shale. The rocks have a strike of N. 30° E. and a dip of 45° SE., and are overlain by 6 feet of sand and gravel.

Formation or age: Catskill formation

Sampled interval: Sample across 114 feet of shale

Type: Shale

Unfired strength: Low

pH: 5.70

Raw Properties: Not too plastic, short and smooth working, requires 20 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. reddish buff	Soft crumbly	3.5	15.4	2.69
2000	Dull red	Fairly hard	4.5	11.4	2.66
2100	Dull dk. red	Hard	5.5	8.1	2.61
2200	Dk. red brown	Very hard	6.5	5.0	2.50
2300	Dk. brown	Slightly glazed	6.5	4.6	2.33
2400	Dk. brown	Glazed	—	5.6	2.25

Bloating Test: Negative

Potential Use: Common brick

SAMPLES: R-1617 and R-1618 *County:* Augusta

Locality: Roadcut on the north side of U. S. Highway 250 about 0.6 mile east of the intersection with State Road 716 in West Augusta.

Description: Approximately 105 feet of grayish-orange weathered shale and dark-gray unweathered shale are exposed in the roadcut. The rocks have a general strike of N. 25° E. and a dip of 45° to 65° SE., and are overlain by 1 foot of soil. The rocks near the center of the exposure are tightly folded into a minor northeastward-trending anticline and syncline.

Formation or age: Romney shale

SAMPLE R-1617

Sampled interval: Sample across 105 feet of weathered and unweathered shale.

Type: Shale

Unfired strength: Very low

pH: 8.1

Raw Properties: Not plastic, short working, requires 18 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff red	Soft crumbly	5.0	17.2	2.61
1900	Lt. red brown	Fairly hard	5.0	15.9	2.59
2000	Lt. red brown	Very hard	6.0	12.0	2.52
2100	Dk. brown	Steel hard	Expanded	5.6	2.04
2200	Dk. brown	Highly glazed	Expanded	—	—
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: Common brick. (Highly effervescent, indicating calcareous material.)

SAMPLE R-1618

Sampled interval: Sample across 25 feet of unweathered shale.

Type: Shale
pH: 7.51

Unfired strength: Low

Raw Properties: Not too plastic, short and fairly smooth working, requires 17 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dark buff	Soft crumbly	1.5	14.9	2.65
2000	Dull red	Hard	4.0	9.4	2.56
2100	Dk. red brown	Very hard	4.0	7.3	2.36
2200	Dk. brown	—	Expanded	11.5	1.67
2300	—	(Melted)	—	—	—

Potential Use: Low-grade common brick and possibly light-weight aggregate.

Bloating Test:

Temp. °F	Bulk Dens.	Lb/ft ³	% Abs.	Remarks
1800	1.97	122.7	6.2	No bloating
1900	1.58	98.4	9.4	Slight bloating
2000	1.50	93.5	9.3	Slight bloating
2100	0.94	58.6	11.0	Good bloating and slightly sticky
2200	0.55	34.3	19.1	Overfired and very sticky

SAMPLE: R-1619

County: Augusta

Locality: Roadcut on the north side of U. S. Highway 250 about 0.4 mile east of the intersection with State Road 716 in West Augusta.

Description: Approximately 95 feet of thin-bedded, grayish-olive shale and interbedded thin to medium layers of fine-grained, olive-green sandstone are exposed in the roadcut. The shale weathers to form grayish-orange and reddish-brown angular fragments. The rocks have a strike of N. 30° E., and a dip of 35° to 45° SE., and are overlain by 1 foot of soil. The shale was sampled to the base of thick-bedded sandstone near the southeastern end of the roadcut.

Formation or age: Brallier shale

Sampled interval: Sample across 90 feet of shale.

Type: Shale

Unfired strength: Low

pH: 5.50

Raw Properties: Not too plastic, short, and fatty working, requires 21 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. reddish buff	Soft crumbly	4.5	17.0	2.65
2000	Lt. red	Fairly hard	7.5	10.3	2.57
2100	Dull red	Hard	9.5	6.5	2.53
2200	Dk. red brown	Very hard	10.5	3.4	2.45
2300	Very dk. red brown	Steel hard	10.5	1.7	2.34
2400	Very dk. brown	Glazed	6.5	2.1	1.97

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1620

County: Augusta

Locality: Roadcut, 3.7 miles southwest of Deerfield, on the west side of State Road 629 approximately 0.2 mile north-east of the Augusta-Bath county line.

Description: Exposed in the roadcut are 25 feet of thin-bedded, olive-gray shale which weathers to form grayish-orange fragments. The shale forms peg-shaped fragments where it is highly fractured. Bedding planes are stained reddish brown by iron oxide. Two prominent joint sets are present. One set has a north strike and a west dip, the other a northwest strike and a northeast dip. The rocks have a strike of N. 20° to 30° E. and a dip of 40° to 80° SE., and are overlain by 1 foot of soil. The shale was sampled to the base of medium-bedded, fine-grained, olive-gray sandstone.

Formation or age: Romney (?) shale

Sampled interval: Sample across 25 feet of shale.

Type: Shale
pH: 4.40

Unfired strength: Very low

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>
Quartz	50
Montmorillonite	2 - 4
Kaolin	20 - 25
Sericite	10 - 12
FeO	3

Raw Properties: Not too plastic, short and smooth working, requires 21 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Pinkish buff	Soft crumbly	5.0	17.7	2.59
2000	Red buff	Soft crumbly	5.5	10.4	2.52
2100	Dull red	Hard	9.5	6.3	2.47
2200	Dk. red brown	Steel hard	9.5	3.0	2.36
2300	Dk. red gray	Steel hard	9.5	1.8	2.05
2400	Gray brown	—	Expanded	2.5	1.68

Potential Use: None (bloating data show that material is not uniform in composition)

Bloating Test:

Temp. °F	Bulk Dens.	Lb/ft ³	% Abs.	Remarks
1800	2.06	128.3	5.6	No bloating
1900	1.71	106.5	8.0	No bloating
2000	1.40	87.2	7.0	Slight bloating
2100	1.09	67.9	7.9	Fair bloating, spotty
2200	0.89	55.4	8.2	Good bloating, very sticky

Firing Characteristics: Bloating data show material is not uniform in composition.

SAMPLE: R-1621

County: Augusta

Locality: Exposure, 4.4 miles west of Craigsville, on the west side of State Road 600 just north of the intersection with State Road 687.

Description: Approximately 100 feet of dark-gray, fissile shale is exposed. The shale weathers to form pale yellowish-brown and moderate-brown angular fragments. The bedding and fracture planes are stained rusty brown by iron. Closely spaced jointing imparts a blocky appearance to portions of the exposure. The rocks have a strike of N. 57° E. and a dip of 35° to 60° NW. The shale was sampled from the top of a highly weathered shale at the southwestern end of the exposure to a zone of yellowish-brown clay at the northwestern end.

Formation or age: Romney (?) shale

Sampled interval: Sample across 100 feet of shale.

Type: Shale

Unfired strength: Low

pH: 5.50

Raw Properties: Not too plastic, short and smooth working, requires 22 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff	Soft crumbly	5.0	16.8	2.59
2000	Reddish buff	Hard crumbly	7.5	10.6	2.49
2100	Dull red	Hard	7.5	7.2	2.45
2200	Dark red brown	Steel hard	9.0	4.5	2.34
2300	Dark red gray	Steel hard	9.0	1.9	2.03
2400	Mottled gray	—	Expanded	3.5	1.59

Potential Use: None

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	1.99	124.0	9.6	No bloating
1900	1.73	107.8	5.9	No bloating
2000	1.39	86.6	8.9	Slight bloating
2100	1.12	69.8	10.4	Fair bloating and sticky
2200	0.87	54.2	9.7	Overfired and very sticky

SAMPLE: R-1622

County: Augusta

Locality: Roadcut on the north side of State Road 688 about 0.6 mile northwest of the intersection with State Highway 42 at Buffalo Gap.

Description: About 85 feet of grayish-olive micaceous shale and interbedded thin to medium layers of fine-grained, grayish-olive sandstone are exposed in the roadcut. The shale and sandstone weather to form dark yellowish-brown and grayish-orange angular fragments. Some of the sandstone is laminated and cross bedded and the shale is cut by fractures filled with iron oxide. The rocks have a strike of N. 22° E. and a dip that ranges from 85° NW. to 85° SE. across the exposure. Clay derived from the weathering of the shale forms on overburden as much as 7 feet thick. The shale was sampled from the top of a thick-bedded grayish-olive sandstone at the southeastern end of the roadcut to the base of a thick-bedded sandstone at the northwestern end.

Formation or age: Devonian

Sampled interval: Sample across 75 feet of shale.

Type: Shale

Unfired strength: Low

pH: 5.7

Raw Properties: Not too plastic, short and smooth working, requires 23 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Reddish buff	Soft crumbly	4.5	15.2	2.58
2000	Light red	Hard crumbly	5.5	10.2	2.57
2100	Dull red	Hard	9.0	7.3	2.53
2200	Dk. red brown	Steel hard	10.0	3.8	2.45
2300	Very dk. red brown	Steel hard	10.0	1.5	2.33
2400	Dk. brown	—	Expanded	2.3	1.79

Potential Use: Common brick and tile

Blotting Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	2.55	158.9	3.8	No bloating
1900	2.36	147.0	2.5	No bloating
2000	1.89	117.7	4.8	No bloating
2100	1.94	108.4	4.8	No bloating
2200	1.07	66.7	40.7	Poor bloating

SAMPLE: R-1623

County: Augusta

Locality: Outcrop and roadcut on the northeast side of National Forest Road 82 about 0.4 mile northwest of the intersection with State Highway 42 at Augusta Springs.

Description: Approximately 265 feet of dark-gray fissile shale and a few interbedded layers of olive-green shale are exposed. The shale weathers to form grayish-orange angular fragments and is stained rusty brown by iron. A few concretions and thin layers of siltstone occur in the shale. The rocks have a strike of N. 40° E. and a dip of 25° to 65° SE., and are overlain by up to 2 feet of soil.

Formation or age: Romney shale

Sampled interval: Sample across 265 feet of shale.

Type: Shale

Unfired strength: Low

pH: 6.1

Raw Properties: Not too plastic, short and smooth working, requires 23 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Light buff	Soft crumbly	3.0	19.3	2.69
2000	Light brown	Fairly hard	5.0	14.5	2.61
2100	Dull red brown	Hard	6.5	8.5	2.55
2200	Dk. red brown	Very hard	8.5	6.0	2.30
2300	Dk. red gray	Steel hard	8.5	4.9	2.16
2400	Mottled gray	—	Expanded	11.1	1.84

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1624

County: Augusta

Locality: Roadcut, 2.0 miles southwest of Fordwick, on the north side of State Road 683 approximately 0.5 mile northwest of the intersection with State Road 684.

Description: Exposed in the roadcut are approximately 110 feet of grayish-olive shale containing a few interbedded thin layers of grayish-olive siltstone. The shale and siltstone weather to form grayish-orange angular fragments. A few small concretions of siltstone occur in the shale. One prominent joint set, which has an east strike and a north dip, is present. The bedding planes and joint surfaces have been stained rusty brown by iron. The rocks have a strike of N. 45° E. and a dip of 45° SE., and are overlain by up to 3 feet of soil. Medium to thick-bedded, coarse-grained, dark-gray calcareous sandstone of the underlying Oriskany formation crops out at the northwestern end of the roadcut.

Formation or age: Romney shale

Sampled interval: Sample across 110 feet of shale and siltstone

Type: Shale

Unfired strength: Low

pH: 6.90

Raw Properties: Not too plastic, short, fatty, and smooth working, requires 20 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. red	Hard crumbly	6.0	19.9	2.69
2000	Red	Fairly hard	7.5	12.7	2.59
2100	Very dk. red	Very hard	9.0	6.6	2.49
2200	Dk. brown	Slightly glazed	8.0	5.2	2.28
2300	Dk. brown	—	Expanded	7.4	2.15
2400	Black brown	—	Expanded	12.9	2.06

Potential Use: Common brick

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	1.95	121.5	5.7	No bloating
1900	1.40	87.2	4.3	Slight bloating
2000	1.55	96.6	6.6	Slight bloating
2100	1.13	70.4	1.8	Fair bloating and sticky
2200	1.02	63.5	3.1	Fair bloating and very sticky

SAMPLE: R-1625

County: Augusta

Locality: Roadcut, 5.6 miles west of Middlebrook, on the northwest side of State Road 682 about 1.1 miles west of the intersection with State Road 602.

Description: About 35 feet of light olive-gray shale and thin-bedded light olive-gray micaceous siltstone are exposed in the roadcut. The shale and siltstone weather to form dark yellowish-brown angular fragments. Joint planes and bedding planes are stained rusty brown by iron. One prominent joint set, which has a strike of N. 45° W. and a dip of 75° NE., is present. The rocks have a strike of N. 55° E. and a dip of 35° to 45° NW., and are overlain by 2 feet of soil containing sandstone float.

Formation or age: Romney (?) shale

Sampled interval: Sample across 35 feet of shale and siltstone.

Type: Shale

Unfired strength: Low

pH: 5.90

Raw Properties: Not too plastic, short, fatty, and smooth working, requires 21 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Reddish buff	Soft crumbly	3.5	16.7	2.72
2000	Dull red	Fairly hard	5.0	11.5	2.66
2100	Dull dk. red	Very hard	9.0	5.5	2.58
2200	Dk. red brown	Very hard	9.0	4.0	2.50
2300	Dk. red brown	Steel hard	9.0	2.9	2.33
2400	Black brown	—	Expanded	19.4	1.96

Bloating Test: Negative

Potential Use: Common brick and tile

SAMPLE: R-1626

County: Augusta

Locality: Abandoned clay pit, 2.6 miles south of Middlebrook, on the west side of State Road 670 about 0.2 mile south of the intersection with State Road 674.

Description: Grayish-red, white, and reddish-brown clay occurs along the northeastern and southeastern faces of an abandoned clay pit. An exposure of clay, 14 feet in height, extends for a distance of 160 feet along the northeastern face. This clay is overlain by 3 feet of sandy soil which contains fragments of dolomite and chert. An exposure, 20 feet in height, consisting predominantly of white clay with a few mottled areas of reddish-brown and grayish-red clay, extends for a distance of 170 feet along the southeastern face.

Formation or age: Residual clay

Sampled interval: Composite sample representing all clays exposed in pit.

Type: Clay

Unfired strength: Above average

pH: 4.90

Raw Properties: Plastic, long, fatty, and smooth working, requires 41 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Off-white	Soft crumbly	6.5	33.3	2.72
2000	Off-white	Soft crumbly	7.5	32.4	2.75
2100	Off-white	Fairly hard	10.0	25.0	2.75
2200	Off-white	Hard	12.0	19.3	2.74
2300	Lt. gray white	Very hard	17.5	11.1	2.69
2400	Ivory	Steel hard	20.0	6.1	2.64

Pyrometric cone equivalent: Cone 34

Bloating Test: Negative

Potential Use: Super-duty refractories and colored ceramic ware.

SAMPLE: R-1633

County: Augusta

Locality: Exposure, 4.2 miles northeast of Greenville, on the southwest side of State Road 655 about 1.1 miles northwest of the intersection with U. S. Highway 340.

Description: The portion of the exposure that was sampled consists of about 80 feet of dark-gray, calcareous shale which weathers to form grayish-orange angular fragments. The rocks have a strike of N. 50° to 64° E. and a dip of 86° NW. to 77° SE., and are covered by up to 3 feet of soil. The exposure was sampled from the base of a highly weathered shale at the southeastern end to a zone of yellowish-brown clay at the northwestern end.

Formation or age: Martinsburg shale

Sampled interval: Sample across 80 feet of shale

Type: Shale

Unfired strength: Low

pH: 7.50

Raw Properties: Fairly plastic, fairly long, fatty, and smooth working, requires 26 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. red buff	Soft crumbly	4.0	25.1	2.62
2000	Dull lt. red	Hard crumbly	4.0	19.1	2.63
2100	Dk. red brown	Hard	5.5	10.5	2.57
2200	Very dk. brown	—	Expanded	4.4	2.04
2300	—	(Melted)	—	—	—

Potential Use: None

Bloating Test:

Temp. °F	Bulk Dens.	Lb/ft ³	% Abs.	Remarks
1800	1.79	111.5	13.9	No bloating
1900	1.72	107.2	10.2	No bloating
2000	1.57	97.8	7.4	Slight bloating
2100	1.47	91.6	7.5	Slight bloating
2200	1.10	68.5	5.2	Fair bloating

SAMPLE: R-1660

County: Augusta

Locality: Abandoned bauxite mine, 2.6 miles west of Spotswood, on the northwest side of State Road 604 just north of the intersection with State Road 838.

Description: Ten feet of white clay containing some mottled zones of yellowish-brown and moderate-red clay is exposed in the pit which is about 175 feet long, 90 feet wide, and 14 feet deep. A series of auger holes drilled in the pit at the base of each face revealed that the clay extends to a depth of at least 10 feet. The clay is generally covered by slumped material except in the northwestern face, and fractures in the clay are stained rusty brown by iron oxide. Along the northwestern face the clay is covered by about 4 feet of soil. The clay apparently has been derived from the weathering of calcareous rocks.

Formation or age: Residual clay

Sampled interval: Representative of 20 feet of clay in exposure and auger hole.

Type: Clay
pH: 7.00

Unfired strength: High

Raw Properties: Plastic, long, fatty, and smooth working, requires 38 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Ivory white	Soft crumbly	8.5	27.4	2.60
2000	Off-white	Soft crumbly	8.5	27.7	2.61
2100	Off-white	Soft crumbly	9.0	25.0	2.65
2200	Off-white	Hard crumbly	12.0	22.6	2.66
2300	Off-white	Fairly hard	15.5	14.8	2.67
2400	Off-white	Hard	16.0	11.1	2.70

Pyrometric cone equivalent: Cone 34 - 1760° C

Bloating Test: Negative

Potential Use: Super-duty refractories and colored ceramic ware

SAMPLE: R-1661

County: Augusta

Locality: Roadcut on the northeast side of State Highway 256 approximately 0.5 mile southeast of the intersection with State Highway 276 at Weyers Cave.

Description: About 80 feet of dark-gray shale and interbedded thin to medium layers of medium-grained cross-bedded sandstone are exposed in the roadcut. Some of the sandstone layers thicken and thin and pinch out laterally within a short distance. A closely spaced joint set, which has an east strike and a dip of 83° north, causes the shale to break up into small angular fragments. The rocks have a strike of N. 55° E. and a dip of 25° SE., and are overlain by 1 foot of soil.

Formation or age: Martinsburg shale

Sampled interval: Sample across 65 feet of shale

Type: Shale

Unfired strength: Very low

pH: 8.20

Raw Properties: Not too plastic, short and slightly fatty working, requires 19 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk. buff	Soft crumbly	3.5	24.0	2.78
2000	Lt. tan	Hard crumbly	3.5	23.1	2.73
2100	Mottled dk. brown	Hard	9.0	7.8	2.57
2200	—	(Melted)	—	—	—

Potential Use: Bloating range too short for aggregate by rotary kiln method; might be sintered.

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>% Abs.</u>	<u>Bulk</u> <u>Sp. Gr.</u>	<u>Lb/ft³</u>	<u>Remarks</u>
1800	12.4	1.94	120.9	No bloating
1900	10.5	1.84	114.6	No bloating
2000	8.4	1.53	95.3	Slight bloating
2100	13.7	0.67	41.7	Overfired and very sticky
2200	8.8	0.81	50.0	Overfired and very sticky

SAMPLE: R-1662

County: Augusta

Locality: Roadcut, 1.6 miles northwest of New Hope, on the southwest side of State Road 616 approximately 0.2 mile northwest of the southwest intersection with State Road 781.

Description: About 60 feet of olive-gray shale and interbedded thin to medium layers of cross-bedded, medium-grained, dark-brown, weathered sandstone are exposed in the roadcut. The shale weathers to form grayish-orange angular fragments. Some of the sandstone layers thicken and thin and pinch out laterally within a short distance. A closely spaced joint set, which has a strike of N. 65° W. and a dip of 55° to 60° NE., causes the shale to break up into small angular fragments. The joint planes are stained rusty brown by iron oxide. The rocks have a strike of N. 70° to 85° E. and a general dip of 20° SE., and are overlain by 3 feet of soil. The rocks have been folded to form a minor anticline and syncline at the southeastern end of the exposure. The shale was sampled to the base of a yellowish-brown clay at the southeastern end of the roadcut.

Formation or age: Martinsburg shale

Sampled interval: Sample across about 50 feet of shale.

Type: Shale

Unfired strength: Low

pH: 8.10

Raw Properties: Not too plastic, short and smooth working, requires 26 percent water of plasticity, no drying defects, 6.0 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u> <u>Shk.</u>	<u>% Abs.</u>	<u>Approx.</u> <u>Sp. Gr.</u>
1800	Light red buff	Soft crumbly	6.0	20.9	2.66
2000	Dull medium red	Hard	10.5	10.7	2.61
2100	Dark red brown	Steel hard	13.5	2.9	2.50
2200	Dark brown	Steel hard	15.0	0.6	2.37
2300	Black brown	—	Expanded	10.3	2.18
2400	—	(Melted)	—	—	—

Bloating Test: Negative*Potential Use:* None

SAMPLE: R-1663

County: Augusta

Locality: Roadcut, 1.4 miles northeast of Verona, on the southeast side of State Road 780 approximately 1.1 miles east of the intersection with U. S. Highway 11.

Description: About 40 feet of dark-gray and olive-gray shale and a few interbedded thin layers of fine- to medium-grained yellowish-brown weathered sandstone are exposed in the roadcut. The shale weathers to form grayish-orange angular fragments. One prominent joint set, which has an east strike and a dip of 65° north, is present. Joint planes are stained rusty brown by iron oxide. A north-eastward-striking, bedding-plane fault, which has a south-east dip, is present near the bottom of the roadcut. The trace of this fault is marked by a zone of brecciated shale cemented by white calcite. The rocks have a strike of N. 55° to 70° E. and a dip of 15° to 20° SE. above the fault and a dip of 60° SE. below the fault. An overburden of soil 2 feet in thickness is present.

Formation or age: Martinsburg shale

Sampled interval: Sample across about 35 feet of shale.

Type: Shale

Unfired strength: Low

pH: 7.20

Raw Properties: Not too plastic, slightly fatty, fairly smooth, and short working, requires 24 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. red buff	Soft crumbly	4.0	21.0	2.68
2000	Dull red (scummed)	Hard	8.5	11.3	2.61
2100	Dk. red brown	Steel hard	10.0	3.4	2.50
2200	Dk. brown	Glazed	15.0	1.4	2.13
2300	Black brown	—	Expanded	13.7	1.98

Potential Use: Brick, tile, and excellent lightweight aggregate (high strength, low percent absorption).

*Bloating Test:**Quick Fire*

15 Minute Retention Time

<u>Temp.</u> <u>°F</u>	<u>% Abs.</u>	<u>Bulk</u> <u>Sp. Gr.</u>	<u>Lb/ft³</u>	<u>Remarks</u>
1800	10.6	2.07	129.0	No bloating
1900	12.0	1.77	110.3	No bloating
2000	6.5	1.44	89.7	Slight bloating
2100	6.2	0.94	58.6	Good bloating and slightly sticky
2200	7.6	0.73	45.5	Overfired and very sticky

SAMPLE: R-1664

County: Augusta

Locality: Roadcut, on the eastern city limits of Saunton, on the northwest side of U. S. Highway 11 about 0.7 mile northeast of the intersection of U. S. Highways 11 and 250.

Description: About 105 feet of dark-gray fissile shale is exposed in the roadcut. The shale weathers to form grayish-orange and yellowish-gray angular fragments. Bedding and fracture planes are stained rusty brown by iron oxide. The rocks have a strike of N. 73° to 85° W. and a dip of 41° to 48° NE., and are covered by up to 1 foot of soil.

Formation or age: Edinburg formation

Sampled interval: Sample across 105 feet of shale

Type: Shale

Unfired strength: Low

pH: 9.0

Raw Properties: Fair plasticity, short, slightly fatty, requires 23.0 percent water of plasticity, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff	Soft crumbly	2.5	23.8	2.68
1900	Lt. red buff	Soft crumbly	2.5	20.3	2.62
2000	Lt. red	Very hard	3.0	17.1	2.57
2100	Dk. brown	Steel hard	10.0	8.6	2.39
2200	Dk. brown	(Melting)	Expanded	—	—

Potential Use: Common red brick, and lightweight aggregate

Bloating Test:

Temp. °F	% Abs.	Bulk Sp. Gr.	Lb/ft ³	Remarks
1800	8.7	1.90	118.4	No bloating
1900	6.8	1.51	94.0	Slight bloating
2000	8.9	1.05	65.0	Good bloating
2100	5.0	0.91	56.7	Overbloomed and very sticky
2200	9.0	0.62	38.6	Overbloomed, melting and very sticky

Rotary Kiln Test:

Screen Analyses of Shale Crushed for Rotary Kiln Feed

Sieve Size	Percent Retained
— $\frac{3}{4}$ " + $\frac{1}{2}$ "	16.6
— $\frac{1}{2}$ " + $\frac{1}{4}$ "	56.1
— $\frac{1}{4}$ " + 8 mesh	17.0
—8 mesh	10.3
Total	100.0
Container	
Weight Lb/ft.	75.0
Maximum Temp. °F.	2030
Minimum Temp. °F.	2000
Optimum Temp. °F.	2030
Sticking Temp. °F.	2040
Retention Time (min.)	17.0
Quenching effect	None
Container Weight	
Fired Lb/ft ³	45.0

Properties of Aggregate by Laboratory Method

Size	— $\frac{3}{4}$ " + $\frac{1}{2}$ "
Bulk Sp. Gr.	1.31
Lb/ft ³	81.6
% Abs.	4.6
Size	— $\frac{1}{2}$ " + $\frac{1}{4}$ "
Bulk Sp. Gr.	1.40
Lb/ft ³	87.2
% Abs.	7.9
Size	— $\frac{1}{4}$ " + 8 mesh
Bulk Sp. Gr.	1.40
Lb/ft ³	87.2
% Abs.	7.9

Screen Analyses of Fired Aggregate Crushed to $\frac{3}{8}$ "

<u>Sieve Size</u>	<u>Percent Retained</u>
— $\frac{3}{8}$ "	13.4
— $\frac{3}{8}$ " + $\frac{1}{4}$ "	60.7
— $\frac{1}{4}$ " + 8 mesh	19.1
— 8 + 20 mesh	4.5
—20 + 65 mesh	1.1
—65	1.1
	<hr/>
Total	100.0

Properties of Lightweight Concrete
2" cubes cured 6 hours (autoclave)

Cement/yard	5 sacks
Fine aggregate %	50.0
Coarse aggregate %	50.0
Bulk Sp. Gr.	1.53
Lb/ft ³	95.3
% Abs.	15.3
Compression (p. s. i.)	6100

The firing range of this material is very short. Logging and sticking occurred at 2040° F, which is only 15° above the minimum bloating temperature. During the kiln run the 8 mesh material tended to segregate, and as a result, was overfired causing sticking and logging. The material will make a good lightweight aggregate by the rotary kiln process if a close control of the kiln feed sizes is maintained. The aggregate makes satisfactory lightweight concrete. The percent absorption is very low and the compressive strength compares favorably with commercial materials.

SAMPLE: R-1720

County: Augusta

Locality: Roadcut on the south side of State Road 606 approximately 0.5 mile west of the intersection with U. S. Highway 11 at Steeles Tavern.

Description: Exposed in the cut are about 65 feet of dark-gray shale which weathers to form yellowish-orange and tan angular fragments. One prominent joint set, which has a strike of N. 45° W. and a dip of 85° NE., is present. A few additional poorly developed joints occur in the shale. The rocks have a strike of N. 50° E. and a dip of 50° SE. to vertical, and are overlain by up to 1 foot of soil.

Formation or age: Edinburg formation

Sampled interval: Sample across 65 feet of shale.

Type: Shale
pH: 6.8

Unfired strength: Very low

Raw Properties: Not plastic, short working, requires 23 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Salmon buff	Soft crumbly	5.0	22.8	2.68
2000	Buff	Soft crumbly	5.5	16.6	2.61
2100	Red brown	Hard	7.5	9.6	2.45
2200	Dk. red gray	Very hard	7.5	5.6	2.31
2300	Dk. gray	Very hard	Expanded	—	1.98
2400	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: Might make a very low-grade common brick.

SAMPLE: R-1821

County: Augusta

Locality: Exposure, 2.3 miles south of Buffalo Gap, on the north side of State Road 706 just west of the intersection with State Road 703.

Description: Exposed along the roadcut are dark-gray and grayish-olive shale and siltstone that weather to form grayish-orange angular fragments. Some of the bedding and fracture planes are stained rusty brown by iron oxide. The shale and siltstone contain a few small concretions that are cut by veins of white calcite. One prominent joint set, which has an east strike and a steep south dip is present. The rocks have been folded and are covered by 3 feet of clay derived from the weathering of the shale and siltstone.

Formation or age: Martinsburg shale

Sampled interval: Representative of exposure of shale and siltstone, 6 feet in height, sampled for a distance of 370 feet.

Type: Shale
pH: 7.8

Unfired strength: Very low

Raw Properties: Not too plastic, short working, requires 20.0 per cent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. buff tan	Soft crumbly	5.0	25.7	2.66
1900	Lt. buff tan	Soft crumbly	5.0	25.0	2.66
2000	Lt. buff tan	Soft crumbly	5.0	24.8	2.66
2100	Lt. buff tan	Soft crumbly	5.0	24.6	2.65
2200	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: None (Highly effervescent indicating calcium carbonate; the leaching effect of CaCO₃ on shale very apparent; high silica indicated by low shrinkage.)

SAMPLE: R-1850

County: Augusta

Locality: Small open cut of the Red Mountain mine on the northwest flank of Knob of Rocks approximately 4.75 miles east of Lofton and 1.5 miles northwest of the Bald Mountain lookout.

Description: Dark yellow-orange residual clay is exposed in the southwestern face of a small open cut. Mottled zones of white and reddish-brown clay also occur in the exposure. The clay, which is derived from impure limestone, is partially consolidated and has a waxy appearance. Some of the clay shows a bedded structure.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, 7 feet in height, sampled for a distance of 30 feet.

Type: Clay
pH: 5.4

Unfired strength: Above average

Raw Properties: Plastic and smooth working, requires 43.0 percent water of plasticity, no drying defects, 7.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800	Buff orange	Very hard	9.0	12.8	2.65
1900	Buff orange	Very hard	9.0	12.0	2.67
2000	Red brown	Steel hard	11.0	4.1	2.55
2100	Dk. brown	—	—	0.1	2.54
2200	Dk. brown	—	—	1.5	2.42
2300	Dk. brown	Glazed	Expanded	—	—

Bloating Test: Negative

Potential Use: Brick and tile (without blending, the fired shrinkage is too high for brick; the clay is highly plastic and would be ideal for mixing with less-plastic brick clays).

SAMPLE: R-1851

County: Augusta

Locality: Small open cut of the Minebank mine located on the northwest flank of Minebank Mountain, approximately 3.5 miles southeast of Lofton, and just southwest of the dam for a large settling basin.

Description: Four feet of dark yellowish-orange clay that contains mottled zones of reddish-brown and white clay is exposed in the cut. Some of the clay is bedded and contains angular grains of quartz up to 1 mm in size. An overburden of sand and gravel 5 feet in thickness is present.

Formation or age: Residual clay

Sampled interval: Composite sample representative of 4 feet of clay.

Type: Silica and clay
pH: 5.5

Unfired strength: Very low

Raw Properties: Not plastic, sandy working, requires 30.0 percent water of plasticity, no drying defects, 2.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. buff orange	Soft crumbly	2.5	23.3	2.73
1900	Lt. buff orange	Soft crumbly	2.5	22.2	2.73
2000	Lt. buff orange	Soft crumbly	3.0	22.1	2.73
2100	Darker buff orange	Soft crumbly	6.0	20.0	2.74
2200	Buff	Soft crumbly	7.5	19.2	2.74
2300	Gray	Soft crumbly	7.5	18.4	2.71

Bloating Test: Negative

Potential Use: None (mostly silica, 10-15% clay)

SAMPLE: R-1852

County: Augusta

Locality: The main pit of the Minebank mine located on the northwest flank of Minebank Mountain approximately 3.7 miles southeast of Lofton.

Description: Dark yellowish-orange clay containing a few mottled zones of white and reddish-brown clay occurs along the eastern face of the second level in a large open cut. The clay is partially consolidated and has a waxy appearance. Dark-gray manganese stains are scattered throughout the clay.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, 12 feet in height, sampled for a distance of 30 feet.

Type: Clay

Unfired strength: Above average

pH: 5.2

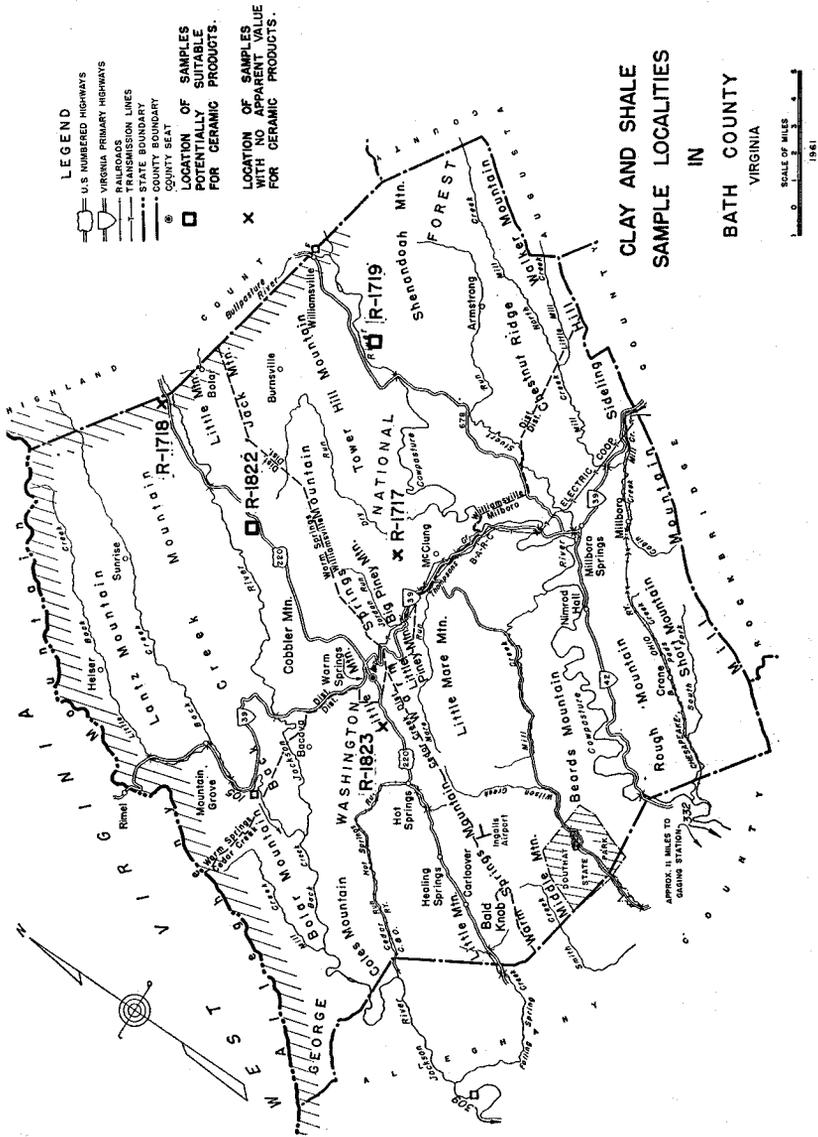
Raw Properties: Very plastic, smooth and fatty working, requires 41.0 percent water of plasticity, no drying defects.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. buff	Hard	9.0	21.0	2.68
1900	Lt. buff	Very hard	11.0	20.8	2.67
2000	Buff	Steel hard	11.0	16.0	2.67
2100	Red	Steel hard	15.0	8.7	2.57
2200	Gray brown	Steel hard	16.0	5.4	2.51
2300	Med. gray	Steel hard	17.0	2.2	2.44

Bloating Test: Positive

Potential Use: Brick and tile (without blending, the fired shrinkage is too high for brick; the clay is highly plastic and would be ideal for mixing with less plastic brick clays).



Location Map of Bath County

BATH COUNTY

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

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1717	Millboro shale	None
R-1718	Millboro shale	None
R-1719	Brallier shale	Brick and tile
R-1822	Residual clay	Brick, tile, pottery (red-burning), and possibly quarry tile
R-1823	Romney (?) shale	None

SAMPLE: R-1717

County: Bath

Locality: Small quarry, 1.4 miles north of McClung, on the southeast side of State Road 609 approximately 2.1 miles northeast of the intersection with State Highway 39.

Description: About 90 feet of dark-gray fissile shale is exposed in the quarry. The shale contains concretions of siltstone up to about 1 foot in length and weathers to form yellowish-gray angular fragments. Joints are present in the shale but are poorly developed. Bedding and joint planes have been stained rusty brown by iron oxide. The rocks have a strike of N. 45° to 50° E. and a dip that ranges from 72° NW. to 55° SE. Minor faulting has occurred in the northeastern part of the quarry, which is about 50 by 155 feet in area with a face about 20 feet high. An overburden of yellowish-brown clay 2 feet in height is present.

Formation or age: Millboro shale

Sampled interval: Sample across 90 feet of shale.

Type: Shale

pH: 6.5

Raw Properties: Not plastic, short working, requires 21 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. buff	Soft crumbly	1.5	21.4	2.62
2000	Lt. brown buff	Fairly hard	3.5	15.8	2.52
2100	Mottled lt. red brown	Fairly hard	4.5	11.9	2.41
2200	Mottled gray	—	Expanded		1.92
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1718

County: Bath

Locality: Small quarry, about 1.8 miles west of Bolar, on the northwest side of U. S. Highway 220 at the Bath-Highland County line.

Description: Approximately 40 feet of dark-gray fissile shale is exposed in the quarry. The shale contains concretions of faintly laminated dark-gray siltstone and weathers to form grayish-orange angular and rectangular fragments. Two prominent joint sets are present. One set has a strike of N. 25° E., and a dip of 85° SE. to 80° NW.; the other has a strike of N. 45° W. and is vertical. Some of the joint and bedding planes are stained rusty brown by iron oxide. The rocks have a strike of N. 35° to 40° E. and a dip of 16° to 20° SE., and are overlain by 1 foot of sand and gravel.

Formation or age: Millboro shale

Sampled interval: Sample across 40 feet of shale.

Type: Shale

Unfired strength: Very low

pH: 6.10

Raw Properties: Not plastic, short working, requires 20 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Salmon buff	Soft crumbly	2.5	15.1	2.59
2000	Lt. red brown	Fairly hard	5.5	20.6	2.25
2100	Dk. brown	Hard	7.0	10.5	2.10
2200	Dk. gray	—	Expanded	—	1.79
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1719

County: Bath

Locality: Roadcut, 4.0 miles south of Williamsville, on the southwest side of State Road 627 approximately 1.1 miles southeast of the intersection with State Road 678.

Description: About 35 feet of olive-gray shale and a few interbedded thin layers of olive-gray siltstone are exposed in the roadcut. The shale weathers to form light-gray and grayish-orange angular fragments. Some fracture and bedding planes are stained reddish brown by iron oxide. Joints are present in the rocks but are poorly developed. The rocks have a strike of N. 10° W. and a dip of 15° SW., and are overlain by 1 foot of soil.

Formation or age: Brallier shale

Sampled interval: Sample across 35 feet of shale and siltstone.

Type: Shale
pH: 6.5

Unfired strength: Average

Raw Properties: Fairly plastic, smooth working, requires 22 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Orange buff	Soft crumbly	4.0	19.6	2.77
2000	Dk. buff	Hard	8.5	11.5	2.68
2100	Red brown	Steel hard	11.5	5.9	2.61
2200	Dk. brown	Steel hard	11.5	3.7	2.46
2300	Black	Steel hard	Expanded	—	2.09
2400	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: Brick and tile

SAMPLE: R-1822

County: Bath

Locality: Roadcut, 7.3 miles north of Warm Springs, on the west side of U. S. Highway 220 approximately 3.6 miles north of the intersection with State Road 614.

Description: Dark yellowish-orange clay with mottled zones of light-gray clay is exposed in the roadcut. Angular grains of quartz up to 8 mm in size and coral fragments occur in the clay. Some zones of carbonaceous material occur near the lower part of the exposure.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, 20 feet in height, sampled for a distance of 240 feet.

Type: Clay

Unfired strength: Above average

pH: 5.95

Raw Properties: Plastic, smooth and slightly gritty working, requires 34.0 percent water of plasticity, no drying defects, 5.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff	Very hard	10.0	16.2	2.50
1900	Lt. red brown	Steel hard	14.0	7.4	2.45
2000	Lt. red brown	Steel hard	15.0	6.2	2.41
2100	Brown red	Steel hard	17.5	3.6	2.36
2200	Dk. brown	Steel hard	17.5	2.4	2.30
2300	Near black	Steel hard	Expanded	3.3	2.07

Bloating Test: Negative

Potential Use: Brick and tile, pottery (red-burning), and possibly quarry tile.

SAMPLE: R-1823

County: Bath

Locality: Small quarry, 2.3 miles north of Hot Springs, on the northeast side of State Road 618 about 2.4 miles northwest of the intersection with U. S. Highway 220.

Description: Exposed in the quarry are 60 feet of dark-gray shale and siltstone both of which weather to light olive-gray and grayish-orange angular fragments. Joints are well developed in the rocks but there are no well-defined sets. Joint and bedding planes have been stained rusty brown by iron oxide. The rocks have a strike of N. 30° E. and a dip of 46° NW., and are covered by 6 inches of soil. Olive-gray shale is exposed in the southeastern face of the quarry but was not sampled.

Formation or age: Romney (?) shale

Sampled interval: Sample across 60 feet of shale and siltstone.

Type: Shale

Unfired strength: Very low

pH: 6.01

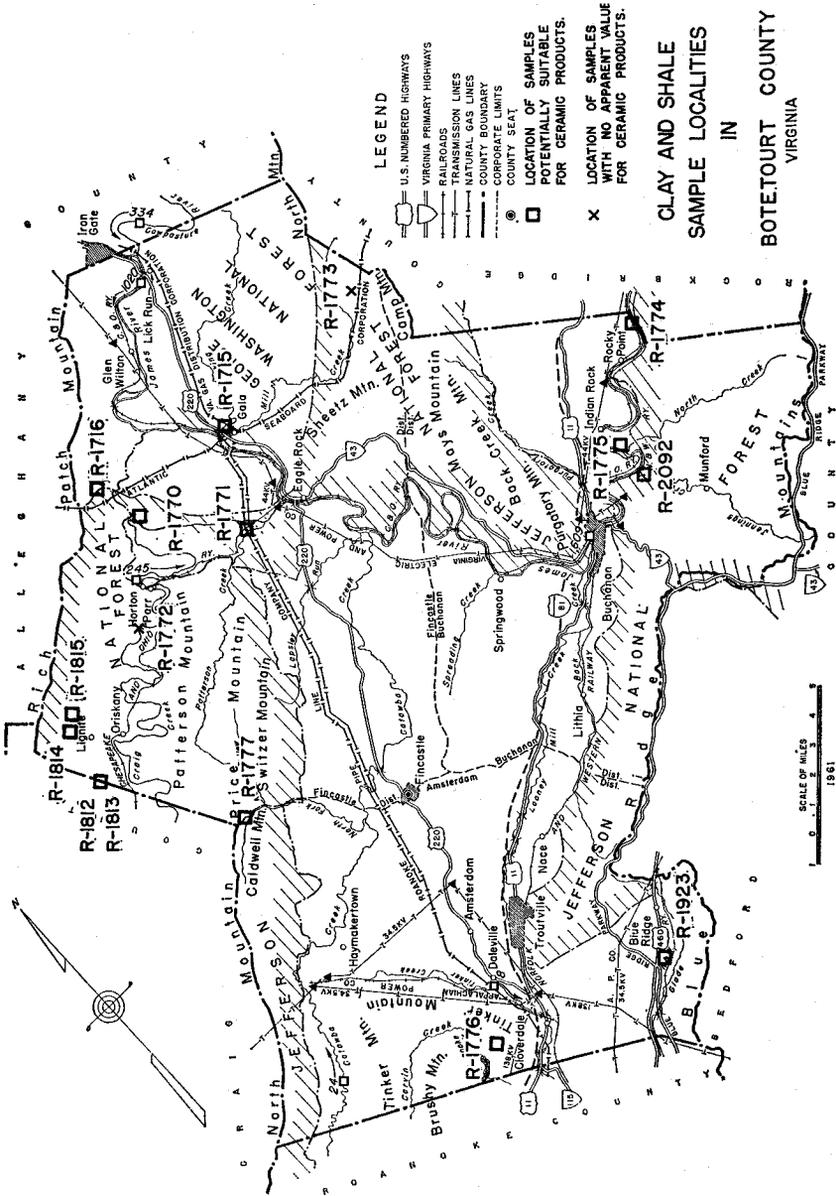
Raw Properties: Not plastic, short working, requires 24.0 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff	Soft crumbly	5.0	18.3	2.50
1900	Buff	Soft crumbly	5.0	—	2.47
2000	Buff	Soft crumbly	5.0	—	2.41
2100	Lt. brown	Fairly hard	6.0	—	2.36
2200	Red brown	Very hard	6.0	—	2.11
2300	Dk. brown, gray	Very hard	7.5	—	2.02

Bloating Test: Negative

Potential Use: None (high silica indicated by low firing shrinkage).



Location Map of Botetourt County

BOTETOURT COUNTY

Samples were collected from 15 localities in Botetourt County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1715	Romney (?) shale	Low-grade common brick
R-1716	Romney shale	Low-grade common brick
R-1770	Romney shale	Lightweight aggregate
R-1771	Brallier shale	Common brick, and sintered aggregate
R-1772	Brallier (?) shale	None
R-1773	Romney shale	None
R-1774	Rome shale	Low-grade common brick, and sintered aggregate
R-1775	Rome shale	Low-grade common brick, and sintered aggregate
R-1776	Romney (?) shale	Decorative brick (mottled color attractive)
R-1777	Chemung shale	Common brick and quarry tile
R-1812	Residual clay	Excellent buff brick, tile, terra cotta, and pottery
R-1813	Residual clay	Decorative brick and tile, drain tile, and pottery
R-1814	Residual clay	Could be mixed with R-1812 to improve thermal shock resistance.
R-1815	Residual clay	Decorative brick and tile, and quarry tile
R-1923	Rome shale	Brick and tile
R-2092	Residual clay	Brick and tile

SAMPLE: R-1715

County: Botetourt

Locality: Exposure, just north of Gala, on the east side of U. S. Highway 220 just southeast of the intersection with State Road 622.

Description: Approximately 95 feet of dark-gray fissile shale which weathers to form small grayish-orange angular fragments is exposed. Two prominent joint sets are present. One set has a strike of N. 40° E. and a dip of 62° NW; the other has a strike of N. 30° W. and a dip of 87° SW. The rocks have a strike of N. 50° to 68° E. and a dip of 25° to 40° SE. A normal fault, which strikes northeast and dips to the southeast, occurs near the northern end of the exposure. This fault splits into two segments near the base of the exposure.

Formation or age: Romney (?) shale

Sampled interval: Sample across 95 feet of shale.

Type: Shale
pH: 6.6

Unfired strength: Very low

Raw Properties: Not plastic, short and mealy working, requires 27 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff	Soft crumbly	4.5	17.9	2.67
2000	Red brown	Hard	8.0	9.4	2.56
2100	Dk. brown	Very hard	8.0	6.6	2.43
2200	Dk. gray	—	Expanded	—	2.04
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: Might make low-grade common brick

SAMPLE: R-1716

County: Botetourt

Locality: Roadcut, 3.6 miles north of Horton, on the north side of State Road 621 approximately 1.7 miles north of the intersection with State Road 615.

Description: Dark-gray shale containing a few concretions of dark-gray siltstone is exposed along the roadcut. The shale weathers to form grayish-orange plate-shaped fragments. One prominent joint set, which has a strike of N. 60° W. and a dip of 70° SW., is present. Some joint and bedding planes have been stained rusty brown by iron oxide. The rocks have a strike of N. 25° to 35° E. and a general south-east dip, and are overlain by up to 3 feet of soil. Some minor folding and possibly faulting has occurred.

Formation or age: Romney shale

Sampled interval: Representative of exposure of shale, 7 feet in height, sampled for a distance of 120 feet.

Type: Shale

Unfired strength: Very low

pH: 6.7

Raw Properties: Not plastic, short and mealy working, requires 21 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Mottled buff	Soft crumbly	3.5	17.2	2.66
2000	Mottled red brown	Hard	8.5	9.0	2.59
2100	Mottled brown	Very hard	8.5	6.9	2.50
2200	Mottled dk. gray	Very hard	—	—	2.11

Bloating Test: Negative

Potential Use: Might make low-grade common brick

SAMPLE: R-1770

County: Botetourt

Locality: Exposure, 5.5 miles northwest of Eagle Rock, on the northeast side of State Road 615 just southeast of the intersection with State Road 621.

Description: Dark-gray fissile shale which weathers to form light olive-gray and grayish-orange angular fragments is exposed. A few concretions of dark-gray siltstone up to 7 feet in length are present in the shale. Joints occur but are poorly developed. Bedding and jointing planes have been stained rusty brown by iron oxide. The rocks have a strike of N. 63° E. and a dip of 35° SE. Near the northern end of the exposure the rocks appear to be gently folded. An overburden of soil up to 2 feet thick is present.

Formation or age: Romney shale

Sampled interval: Sample across 50 feet of shale

Type: Shale

Unfired strength: Low

pH: 7.3

Raw Properties: Not plastic, very short working, requires 18.0 percent water of plasticity, no drying defects, 1.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff brown	Soft crumbly	1.0	17.8	2.74
1900	Buff brown	Soft crumbly	3.5	14.9	2.71
2000	Buff brown	Fairly hard	5.0	14.3	2.66
2100	Brown red	Hard	3.5	11.3	2.65
2200	Dk. brown	Very hard	5.5	9.1	2.55
2300	—	(Melted)	Expanded	—	—

Potential Use: Possibly lightweight aggregate.

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	2.31	143.9	1.3	No bloating
1900	2.33	145.2	3.0	No bloating
2000	1.41	87.8	8.6	Slight expansion
2100	0.79	49.2	6.1	Good expansion
2200	0.77	48.0	8.8	Good expansion and slightly sticky
2300	Overfired	—	—	—

Firing Characteristics: The sample is a mixture of weathered and unweathered shale. The unweathered shale expands and would make very good aggregate.

SAMPLE: R-1771

County: Botetourt

Locality: Exposure, 2.1 miles west of Eagle Rock, along the inactive right-of-way of the Chesapeake and Ohio Railway just west of the crossing of State Road 685.

Description: An estimated 25 feet of light olive-gray shale with interbedded medium to thick layers of fine-grained, light olive-gray laminated sandstone are exposed. The shale weathers to form grayish-orange and yellowish-brown angular fragments. A prominent joint set, which has a strike of N. 50° W. and a dip of 73° NE., is present. Other joints occur but are poorly developed. Closely spaced jointing imparts a blocky appearance to the sandstone. The strike of the rocks ranges from N. 50° E. to N. 5° W. and in the western part of the exposure the dip ranges from 20 to 25° SW. An overburden of soil up to 2 feet thick is present. The shale was sampled to the base of a thick-bedded sandstone located near the western end of the exposure.

Formation or age: Brallier shale

Sampled interval: Sample across an estimated 25 feet of shale.

Type: Shale

Unfired strength: Low

pH: 6.7

Raw Properties: Slightly plastic, short working, requires 21 percent water of plasticity, no drying defects, 2.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Orange buff	Soft crumbly	1.5	20.5	2.76
1900	Orange buff	Soft crumbly	3.0	17.4	2.72
2000	Lt. brown	Very hard	6.5	12.2	2.70
2100	Red brown	Steel hard	8.5	9.0	2.66
2200	Dk. brown	Steel hard	9.5	5.6	2.59
2300	Near black	Steel hard	9.5	3.2	2.44

Bloating Test: Slight expansion

Potential Use: Common brick (fired color not too good) and probably sintered aggregate.

SAMPLE: R-1772

County: Botetourt

Locality: Roadcut, 1.4 miles southwest of Parr, on the north side of State Road 615 approximately 1.1 miles east of the intersection with State Road 683.

Description: Exposed in the roadcut are about 60 feet of medium-gray and light olive-gray fissile shale with a few interbedded thin layers of medium-grained, yellowish-orange laminated sandstone. One prominent joint set, which has a strike of N. 25° W. and a dip of 80° SW., is present. Fractures in the shale have been cemented with iron oxide. The rocks have a strike of N. 40° to 50° E. and a dip of 49° SE., and are overlain by 1 foot of soil.

Formation or age: Brallier (?) shale

Sampled interval: Sample across about 60 feet of shale.

Type: Shale
pH: 6.8

Unfired strength: Very low

Raw Properties: Not plastic, short working, requires 20 percent water of plasticity, no drying defects, 2.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff brown	Soft crumbly	1.0	20.1	2.70
1900	Buff brown	Soft crumbly	3.5	17.3	2.68
2000	Lt. brown	Fairly hard	5.0	12.5	2.64
2100	Brown	Very hard	6.5	9.5	2.58
2200	Dk. brown	Steel hard	8.0	5.8	2.52
2300	Dk. gray	Steel hard	8.0	4.5	2.34

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1773

County: Botetourt

Locality: Roadcut, 7.5 miles northeast of Eagle Rock, on the northwest side of State Road 612 approximately 1.2 miles southwest of the Botetourt-Rockbridge county line.

Description: Dark-gray shale that weathers to form grayish-orange and light-gray angular fragments is exposed along the roadcut. A few lenticular zones of dark-gray siltstone, up to 2 feet in length, occur in the exposure. The rocks have been highly fractured by folding and some faulting, and the fractures have been cemented by rusty-brown iron oxide. Joints are present but are poorly developed. The rocks have about 1 foot of soil overburden.

Formation or age: Romney shale

Sampled interval: Representative of exposure of shale, up to 14 feet in height, sampled for a distance of 295 feet.

Type: Shale

Unfired strength: Very low

pH: 6.6

Raw Properties: Not plastic, short working, requires 21.0 percent water of plasticity, no drying defects, 0.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff brown	Soft crumbly	1.5	21.9	2.66
1900	Buff brown	Soft crumbly	2.5	17.9	2.58
2000	Buff brown	Fairly hard	4.5	15.2	2.57
2100	Brown	Very hard	6.5	10.1	2.51
2200	Dk. brown	Steel hard	7.5	4.3	2.45
2300	Gray black	Steel hard	6.5	5.7	2.12

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1774

County: Botetourt

Locality: Exposure, 1.5 miles northeast of Rocky Point, on the east side of State Road 609 approximately 0.8 mile north of the intersection with State Road 608.

Description: About 70 feet of dusky-red and light olive-gray shale and interbedded thin layers of laminated siltstone are exposed. The shale weathers to form grayish-red and yellowish-gray peg-shaped fragments. The rocks, which are gently folded, have a strike of N. 60° E. and a dip which ranges from 70° SE. to vertical.

Formation or age: Rome formation

Sampled interval: Composite sample across 70 feet of shale and siltstone.

Type: Shale
pH: 7.4

Unfired strength: Very low

Raw Properties: Not plastic, short and gritty working, requires 17.0 percent water of plasticity, no drying defects, 0.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. brown	Soft crumbly	3.0	12.3	2.66
1900	Brown red	Hard	4.0	9.1	2.59
2000	Brown red	Very hard	4.0	8.2	2.58
2100	Brown	Steel hard	4.0	4.6	2.25
2200	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: Low-grade common brick (fired color not attractive) and probably sintered aggregate.

SAMPLE: R-1775

County: Botetourt

Locality: Roadcut, 3.0 miles northeast of Buchanan, on the north side of State Road 614 about 0.2 mile northeast of the crossing over the Chesapeake and Ohio Railway.

Description: Exposed in the roadcut are 70 feet of dusky-red and light olive-gray shale and interbedded laminated fine-grained sandstone. The shale weathers to form grayish-red, dark yellowish-orange, and yellowish-gray peg-shaped fragments. Joints are present in the rocks but are poorly developed. The rocks have a strike of N. 35° E. and a dip of 55° to 80° SE., and are overlain by up to 2 feet of sand and gravel. The lower portion of the exposure is partially covered by alluvium from the James River. The shale was sampled from the base of a medium-bedded, fine-grained red sandstone in the southeastern part of the exposure to the top of a weathered fine-grained yellowish-orange sandstone in the northwestern part.

Formation or age: Rome formation

Sampled interval: Sample across 65 feet of shale.

Type: Shale

Unfired strength: Low

pH: 6.9

Raw Properties: Fair plasticity, slightly short working, requires 22.0 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff orange	Soft crumbly	4.0	18.0	2.65
1900	Buff orange	Hard	5.0	15.1	2.65
2000	Lt. brown	Very hard	6.5	10.6	2.62
2100	Brown	Steel hard	9.5	7.8	2.55
2200	Dk. brown	Steel hard	6.5	4.6	2.08

Bloating Test: Negative

Potential Use: Low-grade common brick (fired color not attractive) and probably sintered aggregate.

SAMPLE: R-1776

County: Botetourt

Locality: Roadcut, 2.0 miles west of Cloverdale, on the east side of State Road 648 about 2.1 miles north of the intersection with U. S. Highway 11.

Description: Dark-gray shale is exposed along the roadcut. The shale weathers to form light olive-gray and grayish-orange angular and peg-shaped fragments. Joints are present in the shale but are poorly developed. Joint and bedding planes are stained rusty brown by iron oxide. The rocks have a northeast strike and a general southeast dip. Tight folding and associated faulting have occurred in the shale. An overburden of soil, up to 5 feet in thickness, is present.

Formation or age: Romney (?) shale

Sampled interval: Representative of exposure of shale, 8 feet in height, sampled for a distance of 125 feet.

Type: Shale

Unfired strength: Very low

pH: 6.3

Raw Properties: Not plastic, short working, requires 22.0 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Salmon buff	Soft crumbly	2.5	22.4	2.72
1900	Salmon buff	Soft crumbly	3.5	19.1	2.70
2000	Lt. brown	Fair hard	6.5	12.2	2.64
2100	Brown mottled	Steel hard	8.5	9.7	2.61
2200	Dk. brown	Steel hard	9.0	10.1	2.54
2300	Dk. gray	Steel hard	9.0	—	2.35

Bloating Test: Negative

Potential Use: Might be used for decorative brick (mottled color attractive).

SAMPLE: R-1777

County: Botetourt

Locality: Roadcut, 5.8 miles northwest of Fincastle, on the north side of State Road 606 approximately 0.3 mile east of the Botetourt-Craig county line and 2.0 miles west of the intersection with State Road 666.

Description: Light olive-gray shale and interbedded thin to medium layers of fine-grained, olive-gray micaceous sandstone are exposed along the roadcut. The shale weathers to form grayish-orange angular and peg-shaped fragments. A few lenticular zones of fine-grained light olive-gray laminated sandstone are present. The rocks are gently folded and fractured and have a strike of N. 20° to 35° E. and a dip of 65° to 82° SE. Fracture and bedding planes are stained rusty brown by iron oxide. The rocks are overlain by up to 2 feet of soil. The shale was sampled from the base of a medium-bedded, fine-grained, light-brown sandstone at the eastern end of the roadcut to the top of a thin- to medium-bedded, olive-gray sandstone at the western end.

Formation or age: Chemung formation

Sampled interval: Sample across 45 feet of shale.

Type: Shale

Unfired strength: Very low

pH: 6.4

Raw Properties: Not plastic, short and gritty working, requires 20.0 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff	Soft crumbly	1.5	19.7	2.73
1900	Buff orange	Soft crumbly	3.5	16.2	2.72
2000	Buff orange	Fairly hard	3.5	14.4	2.69
2100	Brown	Very hard	6.5	8.6	2.64
2200	Dark brown	Steel hard	6.5	9.9	2.73
2300	Black brown	Steel hard	6.5	4.1	2.52

Bloating Test: Negative

Potential Use: Might make common brick or quarry tile
(firing temperature high).

SAMPLE: R-1812 and 1813

County: Botetourt

Locality: Exposure in the southeastern face of the largest open cut of the Lignite mine, on the southeast slope of Bald Mountain, approximately 1.7 miles southwest of Lignite.

Description: Approximately 35 feet of white clay, containing mottled zones of dark yellowish-orange and moderate-red clay, is exposed in the cut. The clay has been derived from the weathering of thin-bedded, fissile, black Romney shale. The original structure of the shale has been retained in some of the dark yellowish-orange and moderate-red clays. The clay is in sharp contact with underlying Ridgeley sandstone that has a strike of N. 45° E. and a dip of 55° to 75° SE. Structurally this area is on the southeastern limb of the Bald Mountain anticline. An overburden of sand and gravel, up to 20 feet in thickness, is present.

Formation or age: Residual clay from Romney shale

SAMPLE R-1812

Sampled interval: Sample across 35 feet of white clay.

Type: Clay

Unfired strength: Average

pH: 5.95

Raw Properties: Very plastic and smooth working, requires 31 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Pale ivory	Soft crumbly	4.0	21.9	2.54
1900	Lt. cream	Hard	6.0	10.8	2.52
2000	Lt. cream	Steel hard	14.5	4.7	2.49
2100	Lt. tan	Steel hard	18.5	0.7	2.44
2200	Lt. tan	Steel hard	18.0	0.4	2.36
2300	Tan gray	Steel hard	Expanded	1.0	1.88

Bloating Test: Negative

Potential Use: Excellent buff brick, tile, terra cotta, and pottery (Thermal shock resistance low).

SAMPLE R-1813

Sampled interval: Composite sample across 35 feet of white, dark yellowish-orange, and moderate-red clay

Type: Clay
pH: 5.7

Unfired strength: Average

Raw Properties: Very plastic and smooth working, requires 34.0 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u> <u>Shk.</u>	<u>% Abs.</u>	<u>Approx.</u> <u>Sp. Gr.</u>
1800	Lt. buff (orange tint)	Soft crumbly	5.5	19.9	2.52
1900	Lt. buff (orange tint)	Fairly hard	10.0	16.0	2.54
2000	Very lt. tan	Very hard	13.5	9.7	2.53
2100	Tan	Steel hard	15.0	3.8	2.45
2200	Brown	Steel hard	17.0	0.7	2.41
2300	Gray brown	Steel hard	17.0	0.6	2.21

Bloating Test: Negative

Potential Use: Decorative brick and tile, drain tile, and pottery.

SAMPLE: R-1814

County: Botetourt

Locality: Exposure in the southwestern corner of an open cut of the Farrow Bank mine on the east slope of Bald Mountain, just north of Lignite.

Description: White, dark reddish-brown, and dark yellowish-orange clay occurs in the southwestern corner of a large open cut. The clay contains rounded grains of quartz up to 0.25 mm in size. Some of the clay may have resulted from weathering of the Romney shale. Similar clay, which is underlain by ferruginous Ridgeley sandstone, is exposed in the northern end of the pit.

Formation or age: Residual clay from Romney shale

Sampled interval: Representative of exposure of clay, up to 15 feet in height, that extends for a distance of 32 feet.

Type: Clay
pH: 5.3

Unfired strength: Average

Raw Properties: Plastic, smooth and gritty working, requires 40.0 percent water of plasticity, no drying defects, 7.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800	Lt. orange buff	Soft crumbly	9.0	29.2	2.66
1900	Lt. orange buff	Soft crumbly	10.0	29.6	2.64
2000	Lt. pink	Soft crumbly	10.0	28.2	2.66
2100	Med. pink	Fairly hard	11.0	25.0	2.67
2200	Med. pink	Very hard	15.0	18.0	2.65
2300	Lt. gray pink	Steel hard	16.5	13.8	2.64

Potential Use: Could be mixed with Sample R-1812 to improve the thermal shock resistance of that sample.

SAMPLE: R-1815

County: Botetourt

Locality: Exposure on a logging road on the east slope of Bald Mountain approximately 0.8 mile north of Lignite.

Description: Reddish-orange and light-gray clay that contains a few rounded quartz grains up to 0.5 mm in size occurs along the logging road. The clay appears to have been derived from the weathering of a shale and some of the clay shows the original structure of the shale.

Formation or age: Residual clay and weathered shale

Sampled interval: Representative of exposure of clay, up to 2 feet in height, that extends for a distance of 65 feet.

Type: Clay
pH: 4.5

Unfired strength: Average

Raw Properties: Very plastic, smooth and gritty working, requires 34 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. orange buff	Soft crumbly	5.5	19.5	2.58
1900	Lt. orange buff	Hard	6.5	16.2	2.50
2000	Dk. orange buff	Steel hard	11.0	9.4	2.48
2100	Lt. brown	Steel hard	15.0	4.8	2.42
2200	Med. brown	Steel hard	15.5	1.8	2.39
2300	Dk. brown gray	Steel hard	15.5	1.2	2.34

Bloating Test: Negative

Potential Use: Decorative brick and tile, and quarry tile.

SAMPLE: R-1923

County: Botetourt

Locality: Quarry of Webster Brick Company, Inc., located on the northwest side of State Road 738 at Webster, about 2 miles southwest of Blue Ridge.

Formation or age: Rome formation

Sampled interval: Composite sample of shale from company stockpile believed to be representative of shale in quarry.

Type: Shale

Unfired strength: Low

pH: 5.4

Raw Properties: Fairly plastic, smooth, sticky, gritty, slightly fatty working, requires 25.0 percent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dk. buff orange	Soft crumbly	5.0	19.1	2.70
1900	Dk. buff orange	Soft crumbly	7.0	16.7	2.69
2000	Med. red brown	Very hard	8.5	12.6	2.64
2100	Brown	Steel hard	10.5	7.7	2.36
2200	Brown	Steel hard	Expanded	7.0	1.97

Bloating Test: Negative

Potential Use: Brick and tile

SAMPLE: R-2092

County: Botetourt

Locality: Limestone quarry of the James River Hydrate and Supply Company, Inc., on company's service road 2.0 miles northeast of intersection with State Highway 43, and 2.5 miles east of Buchanan.

Description: An exposure of residual clay up to 35 feet high and 100 feet wide occurs on the first bench of the north face of the quarry. The clay, which is predominantly yellow with a few scattered streaks of gray to white clay, is underlain by the Shady dolomite and has no overburden.

Formation or age: Residual clay

Sampled interval: Sample of clay representative of a 35 foot thickness of material.

Type: Clay

Unfired strength: Average

pH: 4.7

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	50 - 55	Montmorillonite	5 - 8
Sericite, illite	15 - 18	Iron (oxides)	5 - 8
Kaolin	15 - 20	Chlorite	1 - 2

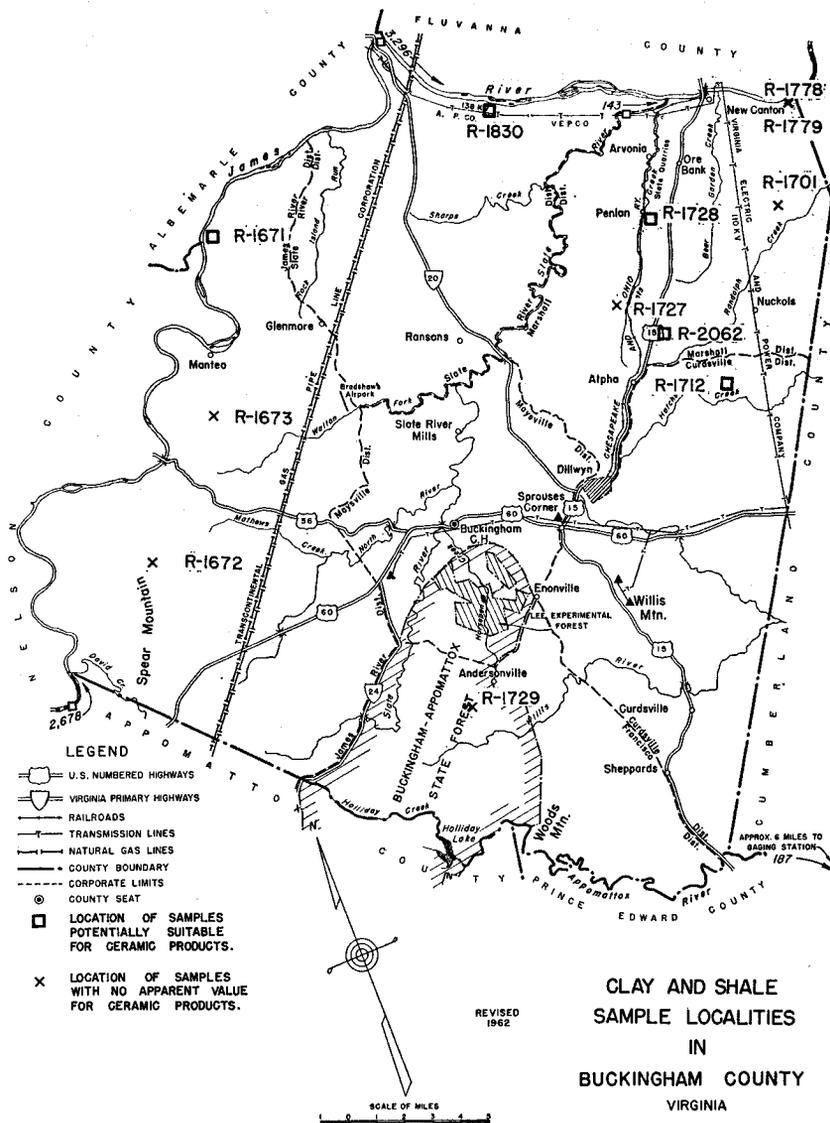
Raw Properties: Very plastic and smooth, requires 39.0 percent water of plasticity, no drying defects, 3.0 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u> <u>Shk.</u>	<u>% Abs.</u>	<u>Approx.</u> <u>Sp. Gr.</u>
1800	Buff orange	Soft crumbly	5.0	24.4	2.59
1900	Buff orange	Fairly hard	5.0	23.5	2.62
2000	Buff orange	Hard	10.0	20.3	2.60
2100	Rich brown	Steel hard	16.5	7.1	2.52
2200	Dk. brown	Steel hard	20.0	1.7	2.43
2300	Very dk. brown	Steel hard	Expanded	11.8	2.27

Bloating Test: Negative

Potential Use: Brick and tile (the total shrinkage of this clay is a little high for structural clay products, but with the addition of fine sand it would be ideal for brick and tile).



Location Map of Buckingham County

BUCKINGHAM COUNTY

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

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1671	Triassic shale and mudstone	Could be mixed with other clay or shale to improve plasticity.
R-1672	Precambrian or early Paleozoic phyllite	None
R-1673	Precambrian or early Paleozoic phyllite	None
R-1701	Flood-plain clay	None
R-1712	Residual clay	Could be mixed with other clay or shale to improve plasticity.
R-1727	Recent (?) clay	None
R-1728	Arvonian slate	Lightweight aggregate
R-1729	Residual clay	None
R-1778	Flood-plain sandy clay	None
R-1779	Flood-plain sandy clay	None
R-1830	Flood-plain clay	Pigmenting clay
R-2062	Mica-sand-clay mixture	Mineral filler (?)

SAMPLE: R-1671

County: Buckingham

Locality: Roadcut, 4.8 miles northwest of Glenmore, on the north side of State Road 602 approximately 0.5 mile west of intersection with State Road 653.

Description: Moderate reddish-brown shale and mudstone are exposed along the roadcut. The shale and mudstone weather to form angular fragments. Joints are present in the rocks but are poorly developed. Some of the bedding and joint planes have been stained black by manganese oxide. The rocks are overlain by up to 3 feet of sand and gravel.

Formation or age: Triassic

Sampled interval: Representative of exposure of shale and mudstone, 6 feet in height, that extends for a distance of 255 feet.

Type: Shale
pH: 6.90

Unfired strength: Above average

Raw Properties: Fairly plastic, short, fatty, smooth, requires 25 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. red	Soft crumbly	5.0	21.5	2.75
2000	Red	Fairly hard	5.5	11.6	2.64
2100	Dk. red brown	Steel hard	13.0	3.5	2.59
2200	Very dk. brown	Steel hard	13.0	1.6	2.48
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: If blended with other shale or clay to increase the plasticity, might be used in the manufacture of brick.

SAMPLE: R-1672

County: Buckingham

Locality: Roadcut, 10.9 miles west of Buckingham, on the north side of State Road 606 about 2.3 miles northwest of the intersection with State Road 604.

Description: Greenish-gray phyllite which weathers to form silvery-white angular fragments is exposed along the roadcut. Some lenticular zones of quartz occur in the phyllite. Two prominent joint sets are present. One set has a strike of N. 40° E. and a dip of 62° SE; the other set has a strike of N. 45° W. and a dip of 75° SW. The schistosity has a strike of N. 26° to 40° W. and a dip of 20° to 25° NE. An overburden of soil 3 feet in thickness is present.

Formation or age: Precambrian or early Paleozoic

Sampled interval: Representative of exposure of phyllite, 7 feet in height, that extends for a distance of 325 feet.

Type: Phyllite
pH: 7.70

Unfired strength: Very low

Raw Properties: Not too plastic, short and smooth working, requires 25 percent water of plasticity, no drying defects, 1.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800	Lt. brown	Soft crumbly	0.5	26.6	2.75
2000	Medium brown	Soft crumbly	2.5	20.2	2.71
2100	Brown	Soft crumbly	2.5	13.9	2.70
2200	Dk. gray	Fairly hard	5.0	9.9	2.60
2300	Dk. gray	Hard	7.5	8.6	2.35
2400	Black brown	—	Expanded	—	—

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1673

County: Buckingham

Locality: Roadcut, 2.4 miles south of Manteo, on the east side of State Road 664 about 0.5 mile southeast of the intersection with State Road 604.

Description: Greenish-gray phyllite is exposed along the roadcut. The phyllite contains a few lenticular zones of quartz and weathers to form a fairly plastic yellowish-brown clay.

Formation or age: Precambrian or early Paleozoic

Sampled interval: Representative of exposure of phyllite, 5 feet in height, that extends for a distance of 210 feet.

Type: Phyllite
pH: 7.50

Unfired strength: Very low

Raw Properties: Not too plastic, short and smooth working, requires 22 percent water of plasticity, no drying defects, 1.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk. buff	Soft crumbly	3.0	21.9	2.68
2000	Lt. red brown	Hard crumbly	5.5	19.2	2.84
2100	Dk. red brown	Hard	10.0	10.2	2.69
2200	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1701

County: Buckingham

Locality: Stream cut, 4.7 miles south of New Canton, 0.3 mile southeast of State Road 717 about 1.0 mile southeast of its intersection with State Road 610.

Description: A thickness of 2.5 feet of clay is exposed in a stream cut in the flood plain of a small stream.

Formation or age: Flood-plain clay

Sampled interval: Representative of 2.5 feet of clay

Type: Clay

Unfired strength: Very low

pH: 5.75

Raw Properties: Not too plastic, short working, gritty, slightly fatty, requires 19 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800	Dk. buff	Soft crumbly	2.5	13.2	2.53
2000	Dull red	Hard crumbly	5.0	10.8	2.48
2100	Red brown	Fairly hard	5.5	11.1	2.49
2200	Dk. red gray	Very hard	7.5	3.7	2.31
2300	Brownish gray	—	3.5	2.7	2.00

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1712

County: Buckingham

Locality: Roadcut, 3.5 miles east of Alpha, on the south side of State Road 617 approximately 0.2 mile west of the intersection with State Road 667.

Description: Reddish-brown clay is exposed along the roadcut. The clay contains angular grains of quartz up to about 1.0 mm in size and fragments of white and reddish-brown quartzite.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, up to 5 feet in height, sampled for a distance of 310 feet.

Type: Clay

Unfired strength: Above average

pH: 7.3

Raw Properties: Fairly plastic and smooth working, requires 37 percent water of plasticity, no drying defects, 9 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Red brown	Soft crumbly	11.0	25.8	2.98
2000	Red brown	Soft crumbly	16.0	13.6	2.96
2100	Red brown	Fairly hard	17.0	13.9	2.93
2200	Dk. red brown	Fairly hard	17.0	12.1	2.94
2300	Dk. red brown	Fairly hard	17.0	10.7	2.93

Bloating Test: Negative

Potential Use: Could be mixed with other red-burning clay or shale to increase plasticity.

SAMPLE: R-1727

County: Buckingham

Locality: Roadcut, 2.8 miles north of Alpha, on the southwest side of State Road 622 approximately 0.1 mile east of the intersection with State Road 676.

Description: Moderate reddish-orange micaceous clay is exposed in a roadcut. The clay contains angular grains of quartz up to about 1.5 mm in size. Some fracture planes in the clay have been stained rusty brown by iron oxide. The clay is covered by up to 6 inches of soil.

Formation or age: Recent (?)

Sampled interval: Representative of exposure of clay, up to 4 feet in height, sampled for a distance of 215 feet.

Type: Clay
pH: 5.85

Unfired strength: Very low

Raw Properties: Not plastic, short and gritty working, requires 33 percent water of plasticity, no drying defects, 6.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Red buff	Soft crumbly	8.5	26.7	2.80
2000	Red buff	Soft crumbly	9.0	20.6	2.80
2100	Dull red brown	Soft crumbly	14.0	17.1	2.80
2200	Medium brown	Soft crumbly	14.0	16.5	2.79
2300	Dk. brown	Soft crumbly	15.0	15.4	2.76
2400	Dk. gray brown	Fairly hard	15.0	14.0	2.76

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1728

County: Buckingham

Locality: Abandoned quarry on the southwest side of State Road 671 just southeast of Penlan.

Description: An estimated 75 feet of medium-gray slate is exposed in the quarry. Some of the slate contains lenticular zones of quartz. One prominent joint set has a strike of N. 65° W. and is vertical. The cleavage has a strike of N. 25° E. and a dip of 84° NW. to 83° SE. Some of the cleavage and joint planes are stained rusty brown by iron oxide. The quarry is about 200 feet long and 70 feet wide.

Formation or age: Arvonian slate

Sampled interval: Sample across an estimated 75 feet of slate.

Type: Slate

Unfired strength: Very low

pH: 6.4

Raw Properties: Not plastic, short, and gritty working, requires 23 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk orange buff	Soft crumbly	3.5	21.9	2.79
2000	Lt. red	Soft crumbly	4.5	17.8	2.75
2100	Red brown	Hard	4.5	13.2	2.67
2200	Dk. brown	Very hard	5.0	11.8	2.05
2300	Near black	—	Expanded	—	1.78
2400	—	(Melted)	—	—	—

Potential Use: Lightweight aggregate by rotary kiln method.

Bloating Tests:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	2.43	151.4	3.2	No bloating
1900	2.10	130.4	6.0	No bloating
2000	1.57	97.8	8.6	Very slight bloating
2100	0.98	61.1	9.2	Good expansion
2200	0.62	38.6	15.0	Overbloated and sticky

Firing Characteristics: Bloating range is somewhat short, expansion is uniform, and the aggregate is very strong with low absorption.

SAMPLE: R-1729

County: Buckingham

Locality: Roadcut, 1.3 miles southwest of Andersonville, on the southeast side of State Road 640 just east of the intersection with State Road 612.

Description: Moderate reddish-orange and grayish-orange clay is exposed in a roadcut. The clay contains angular fragments of quartz and appears to have been derived from the weathering of a schist. One foot of sandy soil overlies the clay.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, up to 5 feet in height, sampled for a distance of 245 feet.

Type: Clay
pH: 6.3

Unfired strength: Average

Raw Properties: Fairly plastic and smooth working, requires 43 percent water of plasticity, slow drying necessary to prevent cracking.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. red buff	Soft crumbly	12.5	28.0	2.88
2000	Lt. red buff	Soft crumbly	12.5	24.0	2.88
2100	Lt. brown	Soft crumbly	15.0	18.4	2.90
2200	Med. brown	Soft crumbly	18.5	15.6	2.91
2300	Dk. brown	Fairly hard	19.0	13.9	2.88
2400	Near black	Fairly hard	20.0	11.0	2.86

Bloating Test: Negative

Potential Use: None

SAMPLES: R-1778 and R-1779 *County:* Buckingham

Locality: Flood plain of the James River, 2.8 miles southeast of New Canton, about 0.5 mile northeast of State Road 734 near its northern end.

Description: Vertical auger holes were drilled in a 200 by 275 foot tract located along a private road. Holes drilled to a depth of 7 feet in the eastern part of the tract encountered pale-olive, grayish-olive, and yellowish-brown clay. This clay contains angular grains of quartz up to 5 mm in size. Holes drilled to a depth of 7 feet in the western portion of the tract encountered 4 feet of yellowish-brown clay underlain by 3 feet of light- and medium-gray clay. These clays also contain varying percentages of angular quartz up to 5 mm in size.

Formation or age: Flood-plain clay

SAMPLE R-1778

Sampled interval: Composite sample of 7 feet of clay from auger holes in the eastern part of tract.

Type: Sandy clay *Unfired strength:* Very low
pH: 7.0

Raw Properties: Not plastic, short and gritty working, requires 20 percent water of plasticity, dry strength very low, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Light buff	Soft crumbly	5.5	14.2	2.61
1900	Light buff	Soft crumbly	5.5	15.9	2.66
2000	Buff	Soft crumbly	6.0	14.1	2.60
2100	Brown buff	Soft crumbly	5.5	13.4	2.59
2200	Red gray	Soft crumbly	5.5	14.6	2.62
2300	Gray red	Soft crumbly	5.0	14.2	2.62

Bloating Test: Negative

Potential Use: None

SAMPLE R-1779

Sampled interval: Composite sample of 7 feet of clay from
auger holes in western part of tract.

Type: Sandy clay
pH: 8.0

Unfired strength: Very low

Raw Properties: Fairly plastic, smooth and gritty working,
requires 21.0 percent water of plasticity, dry strength very
low, 4.5 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u> <u>Shk.</u>	<u>% Abs.</u>	<u>Approx.</u> <u>Sp. Gr.</u>
1800	Orange buff	Soft crumbly	5.5	14.6	2.54
1900	Orange buff	Soft crumbly	5.5	13.3	2.52
2000	Orange buff	Soft crumbly	6.0	13.0	2.51
2100	Lt. brown	Soft crumbly	7.5	10.7	2.47
2200	Brown	Fairly hard	7.5	10.3	2.44
2300	Gray brown	Hard	Expanded	10.6	2.47

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1830

County: Buckingham

Locality: The flood plain of the James River, 6.2 miles northwest of Arvonnia, approximately 0.4 mile northeast of the north end of State Road 611.

Description: Moderate yellowish-brown clay was obtained from vertical auger holes drilled to a depth of 4 feet in the flood plain of the James River. The clay contains angular grains of quartz up to 1.0 mm in size. Sand was encountered in one hole at a depth of 4.5 feet.

Formation or age: Flood-plain clay

Sampled interval: Composite sample from vertical auger holes drilled to a depth of 4.5 feet.

Type: Clay

Unfired strength: Low

pH: 5.50

Raw Properties: Not plastic, short and gritty working, requires 26.0 percent water of plasticity, no drying defects, 5.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. red brown	Soft crumbly	5.5	17.3	2.52
1900	Lt. red brown	Soft crumbly	5.5	16.2	2.52
2000	Red brown	Soft crumbly	5.5	14.6	2.48
2100	Rich brown	Fairly hard	7.5	11.8	2.52
2200	Dk. brown	Very hard	9.0	6.8	2.41
2300	Very dk. brown	Steel hard	10.0	3.7	2.30

Bloating Test: Negative

Potential Use: Pigmenting clay to obtain darker fired colors.

SAMPLE: R-2062

County: Buckingham

Locality: Davidson's Orchard, about 2 miles northeast of Alpha, on the east side of U. S. Highway 15 near the junction of State Road 692.

Description: The sample is from a drill hole. The interval from which the sample was taken is not known.

Formation or age: Not known

Sampled interval: Not known

Type: Mica-sand-clay mixture

pH: 4.5

Crude Material

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	30 - 40	Kaolin	10 - 15
Mica	40 - 50	Feldspar	3 - 5

Raw Properties: Not plastic and sandy working, requires 25.0 percent water of plasticity, 0.0 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> °F	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u> Shk.	<u>Approx.</u> % Abs.	<u>Sp. Gr.</u>
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Too crumbly and soft to determine properties.

Wet Screen Analysis

<u>Size</u>	<u>% Retained</u>	<u>Size</u>	<u>% Retained</u>
+20	1.1	—100 + 200	35.5
—20 + 60	7.6	—200 + 325	16.2
—60 + 100	18.3	—325	21.2

Microscopic examination of screen fractions to determine % quartz

<u>Size</u>	<u>Approx. %</u>	<u>Size</u>	<u>Approx. %</u>
+60 mesh	90+	-200 325 mesh	5 - 8±
-60 100 mesh	60±	-325	2 - 3±
-100 200 mesh	40±		

Heavy minerals in the material 3-5%

Beneficiated (-325 mesh)

Type: Mica and clay

Color: Dark ivory

Raw Properties: Not plastic, smooth and short working, requires 38.0 percent water of plasticity with 1.0 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u>		<u>Approx.</u>
			<u>Shk.</u>	<u>% Abs.</u>	<u>Sp. Gr.</u>
1800	Buff cream	Soft crumbly	2.5	41.8	2.52
2000	Buff cream	Soft crumbly	4.0	35.1	2.52
2100	Buff	Fairly hard	5.0	26.3	2.52
2200	Tan gray	Steel hard	10.0	15.8	2.44
2300	Gray tan	Steel hard	12.5	9.8	2.36
2400	(Cracked when removed from kiln - no properties.)				

X-Ray Analysis: (Approximate percent) of beneficiated material

Quartz	2 - 3	Kaolin	20±
Mica	75±	Feldspar	0.0

Potential Use: Fine mica is used as a filler in paints, rubber, insecticides, etc., but clay content may render this material unsuitable for these purposes. Fine mica is also used as a flux in the ceramic industry but the fired color of this material is too dark for this use.

CRAIG COUNTY

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

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1816	Residual clay from Romney shale	Decorative brick and tile, and pottery
R-1817	Residual clay from Romney shale	Drain tile and brick
R-1968	Brallier shale	Brick and tile; lightweight aggregate
R-1972	Brallier shale	Brick
R-1979	Romney shale	Decorative brick (?)
R-1984	Devonian shale	Brick (?) and lightweight aggregate

SAMPLES: R-1816 and R-1817

County: Craig

Locality: Exposure, 1.7 miles north of Barbours Creek village, in the southwestern face of a large open cut of the Fenwick mine, located approximately 0.3 mile northwest of Mill Creek on the southeast slope of Bald Mountain.

Description: Medium-gray, yellowish-gray, pale-red and light-gray clay is exposed along the southwestern face of the abandoned iron-ore mine. The clay has been derived from the weathering of thin-bedded, fissile, black Romney shale. Zones of partially weathered black shale are exposed in all faces of the open cut. The clay is underlain by ferruginous Ridgeley sandstone which has been folded into a syncline and anticline.

Formation or age: Residual clay from Romney shale

SAMPLE R-1816

Sampled interval: Representative of light-gray clay in exposure, 13 feet in height, that extends for a distance of 110 feet.

Type: Clay
pH: 4.9

Unfired strength: Average

Raw Properties: Very plastic and smooth working, requires 45.0 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Pale ivory	Soft crumbly	5.0	21.9	2.53
1900	Pale ivory	Hard	6.0	18.3	2.51
2000	Pale ivory	Very hard	9.5	16.8	2.51
2100	Lt. cream tan	Steel hard	15.0	3.8	2.44
2200	Lt. tan	Steel hard	16.5	0.5	2.39
2300	Lt. gray tan	Steel hard	16.5	0.7	2.20

Bloating Test: Negative

Potential Use: Decorative brick and tile, and pottery.

SAMPLE R-1817

Sampled interval: Composite sample of all clays in exposure, 13 feet in height, that extends for a distance of 110 feet.

Type: Clay

Unfired strength: Average

Raw Properties: Fairly plastic, smooth and gritty working, requires 32 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Off-buff	Hard	5.5	16.7	2.49
1900	Tan	Steel hard	12.0	6.4	2.45
2000	Tan	Steel hard	15.0	4.6	2.45
2100	Lt. brown	Steel hard	15.5	0.8	2.38
2200	Dk. brown	Steel hard	15.5	0.1	2.37
2300	Gray brown	Steel hard	Expanded	2.2	1.82

Bloating Test: Negative

Potential Use: Drain tile; might be used for brick between 1800-1900° F.

SAMPLE: R-1968

County: Craig

Locality: Roadcut on the southeast side of State Highway 18 approximately 3.8 miles northeast of the intersection with State Highway 311 in Paint Bank and 1.6 miles southwest of the Craig-Alleghany county line.

Description: Exposed in the roadcut are 17 feet of dark-gray shale with a few interbedded layers of dark-gray siltstone. The shale weathers to form light-gray peg-shaped fragments. Joints occur in the rocks but no well-defined sets are present. The rocks have a strike of N. 40° E. and a dip of 20° to 25° NW. and are overlain by 3 feet of soil.

Formation or age: Brallier shale

Sampled interval: Sample across 17 feet of shale

Type: Shale
pH: 6.7

Unfired strength: Low

Raw Properties: Fair plasticity, smooth, slightly short working, requires 25.0 percent water of plasticity, no drying defects, 6.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dk. buff	Soft crumbly	6.0	20.6	2.72
2000	Dk. buff brown	Hard crumbly	7.5	14.2	2.68
2100	Brown	Very hard	10.0	4.3	2.57
2200	Dk. brown	Steel hard	10.0	2.4	2.44
2300	Dk. brown	Steel hard	Expanded	5.9	2.06
2400	—	(Melted)	—	—	—

Potential Use: Brick and tile, and lightweight aggregate.

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	1.81	112.8	5.0	No bloating
1900	1.40	87.2	4.3	Slight bloating
2000	0.86	63.6	4.7	Excellent bloating
2100	0.79	49.2	10.1	Overbloated and sticky
2200	0.86	53.6	8.3	Overbloated, melting and very sticky

Firing Characteristics: Excellent lightweight aggregate material. Strong product with low absorption.

SAMPLE: R-1972

County: Craig

Locality: Exposure, 4.8 miles west of New Castle, on the northeast side of State Highway 311 just north of the intersection with State Road 658.

Description: Approximately 30 feet of olive-gray shale is exposed. The shale weathers to form light olive-gray and grayish-orange angular fragments. Joints occur in the outcrop but no well-defined sets are present. The joint planes are stained rusty brown by iron oxide. The rocks have a strike of N. 60° E. and a dip of 30° to 35° SE.

Formation or age: Brallier shale

Sampled interval: Sample across 30 feet of shale

Type: Shale

Unfired strength: Very low

pH: 6.9

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	60 - 70	Fe (OH) _x	0.5
Mica	12 - 15	Montmorillonite	8 - 10
Feldspar	5 - 8	Carbonates	0.5±
Kaolin	3 - 5		

Raw Properties: Not plastic, short working, thixotropic, requires 16.0 percent water of plasticity, no drying defects, 0.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Orange buff	Soft crumbly	5.0	16.1	2.73
1900	Orange buff	Soft crumbly	5.0	14.1	2.70
2000	Dk. orange buff	Fairly hard	5.0	9.9	2.66
2100	Rich brown	Steel hard	7.5	6.1	2.63
2200	Dk. brown	Steel hard	7.5	3.9	2.52

Bloating Test: Slight expansion

Potential Use: Brick

SAMPLE: R-1979

County: Craig

Locality: Roadcut, on the north side of State Highway 42 approximately 0.8 mile southwest of the intersection with State Highway 311 in New Castle.

Description: Dark-gray shale that weathers to form light-gray and grayish-orange angular fragments is exposed in the roadcut. Some bedding planes are stained rusty brown by iron oxide.

Formation or age: Romney shale

Sampled interval: Representative of exposure of shale, up to 25 feet in height, sampled for a distance of 125 feet.

Type: Shale

Unfired strength: Very low

pH: 5.3

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff yellow	Soft crumbly	4.0	18.8	2.66
1900	Buff yellow	Soft crumbly	4.0	15.3	2.62
2000	Buff	Fairly hard	7.5	10.5	2.58
2100	Lt. mottled brown	Steel hard	10.0	7.4	2.54
2200	Dk. mottled brown	Steel hard	10.0	4.5	2.46
2300	Dk. mottled brown	Steel hard	10.0	3.9	2.26

Bloating Test: Negative

Potential Use: Decorative brick (?) (mottled effect very attractive).

SAMPLE: R-1984

County: Craig

Locality: Roadcut on the northwest side of State Road 658 approximately 3 miles northeast of the intersection with State Road 636 at Maggie.

Description: Exposed in the roadcut is 6 feet of olive-gray shale that weathers grayish orange. Joints occur but no well-defined sets are present. Bedding and joint planes are stained rusty brown by iron oxide. The rocks have a strike of N. 40° E. and a dip of 40° SE.

Formation or age: Devonian

Sampled interval: Sample across 6 feet of shale

Type: Shale

Unfired strength: Very low

pH: 6.6

Raw Propertieess Not plastic, short and mealy working, requires 21.0 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

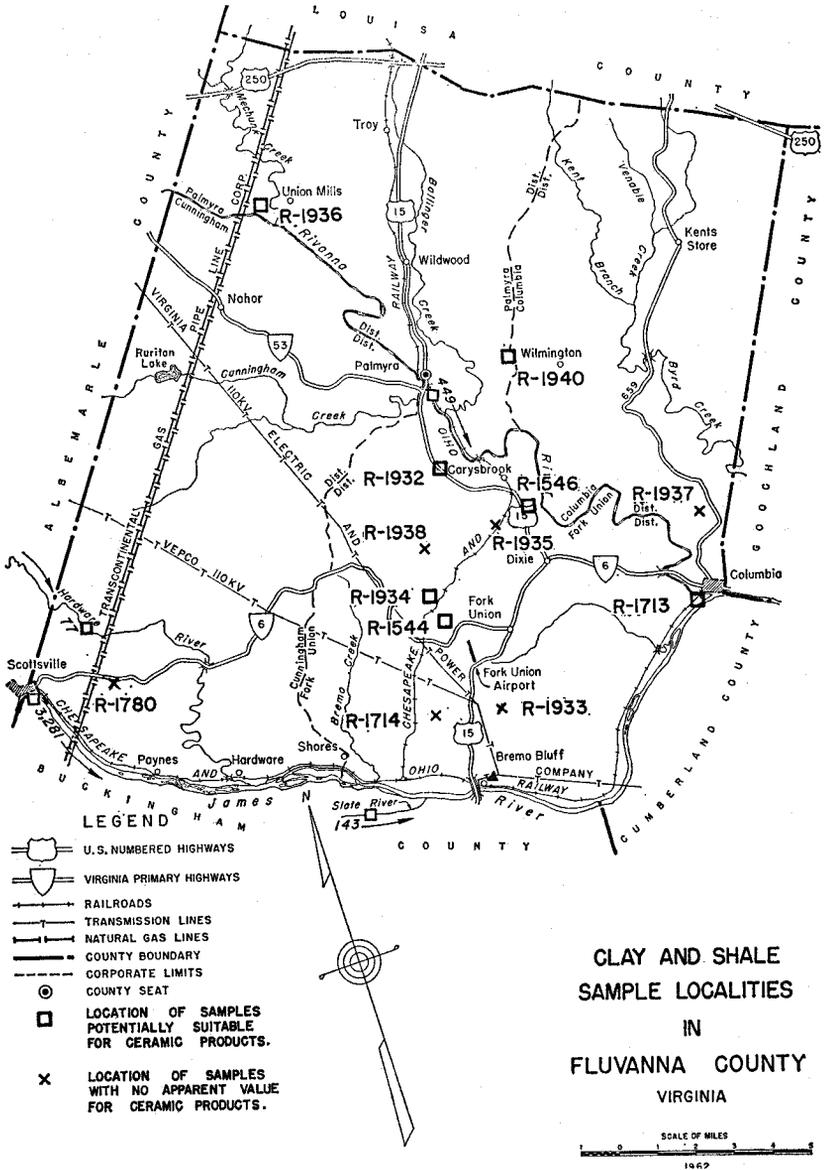
Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff orange	Soft crumbly	5.0	16.9	2.69
1900	Buff orange	Soft crumbly	5.0	14.0	2.67
2000	Lt. brown	Soft crumbly	7.5	10.2	2.65
2100	Brown	Very hard	7.5	6.6	2.62
2200	Dk. brown	Steel hard	10.0	3.4	2.50
2300	—	(Melted)	Expanded	—	—

Potential Use: Brick (?) and lightweight aggregate

Bloating Test: Positive

Temp. °F	Bulk Dens.	Lb/ft ³	% Abs.	Remarks
1900	2.21	137.7	4.7	No bloating
2000	1.85	115.3	4.7	No bloating
2100	1.39	86.6	4.1	Good bloating
2200	1.32	82.2	4.0	Good bloating

Firing Characteristics: Aggregate a little heavy, expanding characteristics similar to weathered Martinsburg shale.



Location Map of Fluvanna County

FLUVANNA COUNTY

Samples were collected from 13 localities in Fluvanna County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1544	Arvonian slate	Common brick
R-1546	Flood-plain clay	Brick and tile (with proper processing)
R-1713	Flood-plain clay	Brick and tile
R-1714	Arvonian slate	None
R-1780	Recent (?) clay	None
R-1932	Arvonian slate	Common brick and quarry tile; lightweight aggregate
R-1933	Residual clay	None
R-1934	Residual clay	Common brick (?)
R-1935	Arvonian (?) slate	None
R-1936	Paleozoic (?) phyllite	Common brick
R-1937	Arvonian (?) schist	None
R-1938	Arvonian slate	None
R-1940	Arvonian slate	Common brick

SAMPLE: R-1544

County: Fluvanna

Locality: Exposure, 1.7 miles northwest of Fork Union, on the east side of State Road 671 about 0.8 mile north of the eastern junction with State Highway 6.

Description: Greenish-gray slate that has a strike of N. 20° E. and a dip of 80° SE. is exposed. The slate extends for approximately 1 mile along the strike and has an exposed width of approximately 300 feet. From 3 to 5 feet of overburden are present.

Formation or age: Arvonian slate

Sampled interval: Sample across 300 feet of slate.

Type: Slate

Unfired strength: Low

pH: 4.96

Raw Properties: Short, smooth and mealy working, requires 59 percent water of plasticity, no drying defects, 2.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. reddish buff	Soft crumbly	2.5	32.1	2.62
2000	Lt. reddish buff	Soft crumbly	2.5	26.8	2.57
2100	Lt. red	Fairly hard	5.0	19.3	2.53
2200	Dk. red brown	Hard	10.0	9.6	2.43
2300	Dk. brown	—	9.5	7.0	1.86
2400	Very dk. brown	—	Expanded	18.4	1.60

Bloating Test: Negative

Potential Use: Probably common brick (Sample does not vitrify steel hard at 2100° F, but a longer firing and soaking period may increase the degree of vitrification sufficiently for brick).

SAMPLE: R-1546

County: Fluvanna

Locality: Exposure along Carys Creek on the east side of U. S. Highway 15 about 0.9 mile south of Carysbrook.

Description: Material was collected from the flood plain of Carys Creek. The clay unit sampled is about 300 feet wide and 4 to 5 feet thick.

Formation or age: Flood-plain clay

Sampled interval: Sample representative of clay 4 to 5 feet thick.

Type: Clay

pH: 5.09

Raw Properties: Fairly plastic, gritty working, requires 31 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800	Buff	Soft crumbly	6.0	22.9	2.64
2000	Very lt. reddish buff	Soft crumbly	7.0	16.7	2.59
2100	Red	Fairly hard	10.0	14.1	2.56
2200	Dk. red brown	Hard	11.5	11.0	2.52
2300	Dk. red gray	Very hard	13.5	4.9	2.39
2400	Dk. brown	Very hard	11.5	7.9	2.31

Potential Use: Brick and tile

Miniature brick: (The sample was ground to —20 mesh and pressed at 5000 psi. with approximately 10 percent moisture with four hours soak at specified temperatures.)

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
2000	Lt. brown	Fairly hard	2.6	11.0	2.64
2100	Red brown	Very hard	5.0	8.9	2.62
2200	Med. brown	Steel hard	6.5	6.0	2.59

Firing Characteristics: The sample is probably suitable for brick and tile with proper processing. The vitrification range is rather short and the specimen did not become steel hard in the normal temperature range used for most brick and tile (1800-2100° F). With the longer firing and soaking periods employed by commercial plants a vitrification temperature 50-100° F lower than the temperature of the laboratory tests is indicated.

SAMPLE: R-1713

County: Fluvanna

Locality: Cut, 0.8 mile west of Columbia, along the south side of the Chesapeake and Ohio Railway about 0.1 mile west of the railroad bridge over the Rivanna River.

Description: Grayish-orange and light-gray clay is exposed in the cut. Subangular grains of quartz, up to 1.0 mm in size, occur in the clay, which weathers to form small light yellowish-orange angular fragments.

Formation or age: Recent

Sampled interval: Representative of exposure of clay, up to 8 feet in height, sampled for a distance of 360 feet.

Type: Clay

Unfired strength: Above average

pH: 6.3

Raw Properties: Very plastic and smooth working, requires 29 percent water of plasticity, no drying defects, 6.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff orange	Fairly hard	8.5	19.2	2.68
2000	Lt. red	Hard	13.5	9.0	2.56
2100	Dk. red	Very hard	15.0	5.1	2.47
2200	Dk. gray	Steel hard	15.5	3.2	2.43
2300	Lt. brown	Steel hard	14.5	5.3	2.21

Bloating Test: Negative

Potential Use: Brick and tile (shrinkage rather high but the clay has good fired colors and good working properties).

SAMPLE: R-1714

County: Fluvanna

Locality: Abandoned slate quarry, 2.9 miles southwest of Fork Union, approximately 0.8 mile northwest of the south end of State Road 614 and about 0.5 mile east of the Chesapeake and Ohio Railway.

Description: Exposed in the quarry is an estimated 40 feet of dark-gray slate which weathers to form grayish-orange angular fragments. Joint planes in the slate are stained rusty brown by iron oxide. The cleavage has a strike of N. 15° to 20° E. and a dip of 87° SE. The slate is overlain by up to 3 feet of soil and grayish-orange clay derived from the weathering of the slate. The quarry is about 45 by 35 feet in area.

Formation or age: Arvonian slate

Sampled interval: Sample across an estimated 40 feet of slate.

Type: Slate

Unfired strength: Very low

pH: 6.6

Raw Properties: Not plastic, short working thixotropic, requires 27 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff	Soft crumbly	1.5	27.3	2.70
2000	Red brown	Soft crumbly	4.5	18.4	2.67
2100	Dk. brown red	Hard	7.5	11.9	2.53
2200	Dk. brown	Very hard	Expanded	—	1.91
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1780

County: Fluvanna

Locality: Roadcut, 2.2 miles east of Scottsville, on the south side of State Highway 6 just east of the intersection with State Road 645.

Description: Two feet of dark yellowish-orange and light-gray clay are exposed for a distance of 620 feet along the roadcut. A series of vertical auger holes revealed that the clay extends to a depth of at least 3 feet. The clay contains subangular grains of quartz, and weathers to form small angular fragments. The clay is overlain by up to 2 feet of sandy soil with intermixed pebbles.

Formation or age: Recent (?)

Sampled interval: Representative of 5 feet of clay sampled for a distance of 620 feet.

Type: Clay
pH: 6.8

Unfired strength: High

Raw Properties: Very plastic, smooth and slightly gritty working, requires 28.0 percent water of plasticity, dry strength high, 8.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff orange	Soft crumbly	8.0	17.8	2.65
1900	Buff orange	Fairly hard	12.5	15.9	2.62
2000	Buff orange	Hard	13.0	11.0	2.58
2100	Lt. red brown	Very hard	14.0	8.6	2.54
2200	Brown	Steel hard	15.0	5.9	2.47
2300	Dk. brown	Steel hard	15.0	4.4	2.48

Bloating Test: Negative

Potential Use: None (unless blended with other clay).

SAMPLE: R-1932

County: Fluvanna

Locality: Roadcut, 2.7 miles south of Palmyra, on the north-east side of U. S. Highway 15 about 0.4 mile east of intersection with State Road 649.

Description: Dark-gray slate is exposed in the roadcut. The cleavage has a strike of N. 40 to 47° E. and a dip of 83° SE. to 80° NW. Interbedded sandy zones occur in the exposure. The slate weathers to form a yellowish-orange clay.

Formation or age: Arvonian slate

Sampled interval: Representative of exposure of slate, 18 feet in height, sampled for distance of 54 feet.

Type: Slate
pH: 7.5

Unfired strength: Low

Raw Properties: Fairly plastic, short and smooth working, requires 27.0 percent water of plasticity, no drying defects, 0.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. brown	Soft crumbly	0.5	31.1	2.74
1900	Lt. brown	Soft crumbly	1.5	30.2	2.73
2000	Lt. brown	Soft crumbly	1.5	27.6	2.72
2100	Brown red	Hard	7.5	20.1	2.69
2200	Dk. brown	Steel hard	11.5	7.5	2.52
2300	Dk. brown	Steel hard	11.5	4.2	2.19

Potential Use: Common brick and possibly quarry tile; probably lightweight aggregate.

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	2.17	136.1	4.9	No bloating
1900	2.07	129.0	7.2	No bloating
2000	2.06	128.3	10.5	No bloating
2100	1.82	113.4	6.4	Slight expansion
2200	1.40	87.2	5.0	Slightly sticky fair bloating

Firing Characteristics: This sample appears to be a mixture of weathered and unweathered material. If the unweathered material will expand as indicated by some of the particles from the preliminary bloating test, this material would probably make a fairly good aggregate.

SAMPLE: R-1933

County: Fluvanna

Locality: Outcrop in a creek located east of U. S. Highway 15 approximately 2.1 miles northeast of Bremono Bluff.

Description: Dark-gray and yellowish-orange clay is exposed along the creek. The clay has been derived from the weathering of slate.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, 10 feet in height, sampled for a distance of 60 feet.

Type: Clay (sandy)

Unfired strength: Very low

pH: 6.2

Raw Properties: Not plastic, short and gritty working, requires 23.0 percent water of plasticity, no drying defects, 1.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk. buff brown	Soft crumbly	1.5	34.4	2.71
1900	Dk. buff brown	Soft crumbly	2.5	34.5	2.72
2000	Dk. buff brown	Soft crumbly	4.0	32.3	2.73
2100	Lt. brown	Soft crumbly	5.0	28.3	2.71
2200	Brown	Soft crumbly	6.5	23.4	2.67
2300	Brown	Hard	10.0	17.6	2.66

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1934

County: Fluvanna

Locality: Roadcut, 2.2 miles northwest of Fork Union, on the west side of State Road 671 about 0.3 mile south of the intersection with State Road 672.

Description: Grayish-orange and light-gray clay is exposed in a roadcut. The clay was derived from the weathering of amphibolite.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, up to 4 feet in height, sampled for a distance of 122 feet.

Type: Clay

Unfired strength: Very low

pH: 6.8

Raw Properties: Not very plastic, short and slightly gritty working, requires 23 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk. buff orange	Soft crumbly	5.0	23.1	2.71
1900	Dk. buff orange	Soft crumbly	6.0	23.0	2.72
2000	Dk. buff orange	Soft crumbly	6.0	19.6	2.66
2100	Brown	Hard	9.0	16.8	2.65
2200	Darker brown	Very hard	10.0	11.9	2.59
2300	Dk. brown	Steel hard	11.5	8.7	2.52

Bloating Test: Negative

Potential Use: Common brick (?) (percent absorption at 2300° F rather high, but material might make common brick with the longer firing cycle used in commercial production).

SAMPLE: R-1935

County: Fluvanna

Locality: Railroad cut, 1.5 miles northwest of Dixie, on the northwest side of the Chesapeake and Ohio Railway about 0.25 mile northeast of the crossing of State Road 672 over the railroad.

Description: Olive-gray and moderate-red slate is exposed along the railroad. The slate is stained rusty brown by iron oxide. The cleavage has a strike of N. 40° E. and a dip of 52° SE. An overburden of yellowish-brown clay derived from the weathering of the slate is present.

Formation or age: Paleozoic (?)

Sampled interval: Representative of exposure of slate, 8 feet in height, that extends for a distance of 220 feet.

Type: Slate
pH: 6.8

Unfired strength: Very low

Raw Properties: Not plastic, short and gritty working, requires 27.0 percent water of plasticity, no drying defects, 1.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. brown	Soft crumbly	1.0	34.9	2.70
1900	Lt. brown	Soft crumbly	2.0	34.6	2.68
2000	Lt. brown	Soft crumbly	2.5	31.2	2.74
2100	Lt. brown	Soft crumbly	2.5	31.2	2.74
2200	Brown	Fairly hard	5.0	26.4	2.71
2300	Darker brown	Very hard	9.0	15.2	2.66

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1936

County: Fluvanna

Locality: Roadcut, 0.6 mile west of Union Mills, on the north side of State Road 616 approximately 1.4 miles west of the intersection with State Road 600.

Description: Exposed in the roadcut are 135 feet of dark-gray phyllite that contains lenses of quartz. The cleavage of the phyllite has a strike of N. 35° E. and a dip of 60° to 70° SE. The phyllite weathers reddish brown and grayish orange, and forms a silty soil.

Formation or age: Paleozoic (?)

Sampled interval: Sample across 135 feet of phyllite.

Type: Phyllite

Unfired strength: Very low

pH: 5.8

Raw Properties: Slightly plastic and short working, requires 26.0 percent water of plasticity, no drying defects, 0.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff brown	Soft crumbly	2.0	24.4	2.78
1900	Buff brown	Soft crumbly	2.0	22.3	2.79
2000	Buff brown	Fairly hard	2.0	21.9	2.78
2100	Lt. brown	Hard	4.0	17.1	2.77
2200	Brown	Very hard	7.5	14.5	2.72
2300	Dk. brown	Steel hard	10.0	8.0	2.68

Bloating Test: Negative

Potential Use: Common brick if longer firing will produce adequate vitrification between 2000-2150° F.

SAMPLE: R-1937

County: Fluvanna

Locality: Roadcut, 2.1 miles north of Columbia, on the north side of State Road 606 about 0.4 mile west of the intersection with State Road 659.

Description: Light-gray and reddish-brown weathered schist is exposed in a roadcut. Lenses of quartz occur in the schist. The schistosity has a strike of N. 5° E. and a dip of 50° SE.

Formation or age: Paleozoic (?)

Sampled interval: Representative of exposure of schist, 2 feet in height, sampled for a distance of 140 feet.

Type: Mica schist
pH: 6.0

Unfired strength: Very low

Raw Properties: Not plastic, short and gritty working, requires 22.0 percent water of plasticity, no drying defects, 1.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800		(Specimen too crumbly to determine properties)			
1900		(Specimen too crumbly to determine properties)			
2000		(Specimen too crumbly to determine properties)			
2100	Red brown	Soft crumbly	1.5	31.1	2.69
2200	Dk. brown	Soft crumbly	2.5	30.5	2.71
2300	Dk. gray brown	Soft crumbly	6.0	28.8	2.78

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1938

County: Fluvanna

Locality: Inactive quarry, 3.1 miles northwest of Dixie, located north of State Road 672 approximately 1.0 mile north-east of the intersection of State Roads 671 and 672.

Description: Fifty feet of dark-gray slate is exposed in the abandoned quarry. The slate weathers light greenish gray and rusty brown. Joints are present in the slate. The cleavage has a strike of N. 30° E. and a dip of 80° to 85° SE.

Formation or age: Arvonnia slate

Sampled interval: Sample across 50 feet of slate.

Type: Slate

Unfired strength: Very low

pH: 7.0

Raw Properties: Not plastic, short working, requires 23.0 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800		(Specimen too crumbly for properties)			
1900		(Specimen too crumbly for properties)			
2000		(Specimen too crumbly for properties)			
2100	Brown	Fairly hard	5.0	21.5	2.76
2200	Darker brown	Very hard	5.5	14.7	2.70
2300	Dark brown	Steel hard	8.0	9.6	2.65

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1940

County: Fluvanna

Locality: Outcrop in a creek, 2.2 miles east of Palmyra, located east of State Road 678 approximately 0.4 mile northeast of the intersection of State Roads 625 and 678.

Description: About 32 feet of dark-gray slate that weathers light gray is exposed along the creek. The cleavage has a strike of N. 60° E. and a dip of 70° to 75° SE. The slate is overlain by up to 2 feet of alluvial clay.

Formation or age: Arvonian slate

Sampled interval: Sample across 32 feet of slate.

Type: Slate

Unfired strength: Very low

pH: 6.7

Raw Properties: Not plastic, very short working, requires 22.0 percent water of plasticity, no drying defects, 1.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. brown	Soft crumbly	1.5	22.5	2.76
1900	Lt. brown	Soft crumbly	1.5	22.1	2.76
2000	Lt. brown	Soft crumbly	1.5	20.6	2.76
2100	Brown	Hard	5.0	16.6	2.75
2200	Dk. brown	Very hard	8.5	10.1	2.69
2300	Dk. brown	Steel hard	8.5	8.4	2.66

Bloating Test: Negative

Potential Use: Common brick if longer firing will produce adequate vitrification between 2000-2150° F.

HIGHLAND COUNTY

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

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1824	Catskill shale	Common brick
R-1825	Romney shale	Common brick
R-1826	Romney shale	Decorative brick and tile
R-1827	Romney shale	None
R-1859	Brallier shale	Brick and tile; lightweight aggregate
R-1860	Romney shale	None
R-1861	Clinton (?) shale	Common brick

SAMPLE: R-1824

County: Highland

Locality: Roadcut, 5.4 miles northwest of Monterey, on the northeast side of U. S. Highway 250 approximately 1.2 miles northwest of the intersection with State Road 600.

Description: Approximately 60 feet of olive-gray and grayish-red shale and interbedded thin to medium layers of fine- to medium-grained, olive-gray laminated sandstone are exposed. The shale weathers to form grayish-orange, dull-red, and light olive-gray angular fragments. Some of the shale and sandstone are stained rusty brown by iron oxide. Joints are present but there are no well-defined sets. Closely spaced jointing imparts a blocky appearance to some of the sandstone. The rocks have a strike of N. 25° to 37° E. and a dip of 15° NW., and are covered by 2 feet of soil. The shale was sampled from the top of a medium-grained, medium-bedded, olive-gray sandstone in the eastern portion of the exposure to the base of a medium-bedded, olive-gray laminated sandstone at the northwestern end.

Formation or age: Catskill formation

Sampled interval: Sample across 55 feet of shale.

Type: Shale

Unfired strength: Low

pH: 5.70

Raw Properties: Not too plastic, short working, requires 19.0 percent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. buff brown	Soft crumbly	4.0	14.7	2.51
1900	Lt. buff brown	Fairly hard	5.0	12.8	2.49
2000	Lt. buff brown	Hard	6.0	9.1	2.41
2100	Red brown	Very hard	8.0	6.0	2.43
2200	Dk. brown	Steel hard	10.5	1.8	2.31
2300	Dk. brown	Steel hard	Expanded	2.1	2.13

Bloating Test: Negative

Potential Use: Common brick

SAMPLE: R-1825

County: Highland

Locality: Roadcut, 1.9 miles northeast of Monterey, on the southeast side of U. S. Highway 220 approximately 0.2 mile northeast of the junction with State Road 632.

Description: Dark-gray shale with a few interbedded thin layers of dark-gray siltstone is exposed in the roadcut. The shale weathers to form grayish-orange angular fragments. The shale and siltstone are stained rusty brown by iron oxide. An overburden of clay, 2 feet in thickness, is present.

Formation or age: Romney shale

Sampled interval: Representative of exposure of shale, up to 6.5 feet in height, sampled for a distance of 245 feet.

Type: Shale

Unfired strength: Low

pH: 5.9

Raw Properties: Not plastic, short and gritty working, requires 19 percent water of plasticity, no drying defects, 5.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. buff orange	Soft crumbly	6.0	12.2	2.47
1900	Lt. buff orange	Fairly hard	6.0	10.0	2.45
2000	Lt. brown red	Very hard	8.5	5.2	2.37
2100	Red brown	Steel hard	9.0	2.3	2.19
2200	Brown	Steel hard	Expanded	1.9	1.49
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: Common brick

SAMPLE: R-1826

County: Highland

Locality: Exposure on the north side of State Highway 84 at the intersection with State Road 600, just west of Mill Gap.

Description: Approximately 190 feet of olive-gray shale and interbedded thin layers of fine-grained, olive-gray sandstone are exposed. The shale weathers to form grayish-orange and light olive-gray angular fragments, and some of the shale and sandstone is stained rusty brown by iron oxide. Joints are present but are poorly developed. The rocks have a strike of N. 20° to 28° E. and a dip that ranges from 85° SE. to 77° NW. An overburden of soil 2 feet thick is present.

Formation or age: Romney shale

Sampled interval: Sample across 190 feet of shale in southwestern part of the exposure.

Type: Shale
pH: 5.8

Unfired strength: Average

Raw Properties: Fairly plastic, smooth working, requires 20 percent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Very lt. brown	Fairly hard	3.5	14.2	2.60
1900	Lt. brown	Steel hard	7.0	7.7	2.50
2000	Lt. brown	Steel hard	7.0	7.1	2.50
2100	Brown red	Steel hard	8.0	8.3	2.46
2200	Dk. brown	Steel hard	9.5	2.4	2.43
2300	Dk. gray brown	Steel hard	Expanded	1.5	2.25

Bloating Test: Negative

Potential Use: Decorative brick and tile (mottled effect very attractive).

SAMPLE: R-1827

County: Highland

Locality: Exposure, 5.5 miles southwest of Mustoe, on the west side of U. S. Highway 220 at the intersection with State Road 611.

Description: Approximately 35 feet of dark-gray fissile shale is exposed. The shale weathers to form light-gray and grayish-orange angular fragments. Concretions of faintly laminated dark-gray siltstone, up to 5.5 feet long, occur in the shale. Joints are present but there are no well-defined sets. The joint planes have been stained rusty brown by iron oxide. The rocks are folded into a syncline and anticline both of which are broken by minor faults.

Formation or age: Romney shale

Sampled interval: Sample across an estimated 35 feet of shale.

Type: Shale

Unfired strength: Low

pH: 6.3

Raw Properties: Not plastic, short and gritty working, requires 22.0 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. brown	Soft crumbly	1.5	23.3	2.44
1900	Lt. brown	Soft crumbly	1.5	20.6	2.37
2000	Lt. brown	Fairly hard	2.5	15.6	2.35
2100	Brown	Steel hard	2.5	12.0	2.30
2200	Dk. brown	Steel hard	3.0	7.8	2.32
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1859

County: Highland

Locality: Roadcut, about 5.6 miles east of McDowell, on the northeast side of U. S. Highway 250 approximately 1.1 miles northwest of the Augusta-Highland county line.

Description: Exposed in the roadcut are approximately 30 feet of olive-gray shale with interbedded thin to medium layers of fine-grained, olive-gray sandstone. The shale weathers to form grayish-orange and dark yellowish-orange angular fragments. Closely spaced jointing imparts a blocky appearance to the sandstone. Joints and bedding planes are stained rusty brown by iron oxide. The rocks have a strike of N. 40° to 45° E. and a dip of 28° to 36° SE., and are overlain by 1 foot of soil.

Formation or age: Brallier shale

Sampled interval: Sample across 30 feet of shale

Type: Shale

Unfired strength: Low

pH: 6.0

Raw Properties: Fairly plastic, slightly short working, requires 24.0 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff orange	Soft crumbly	—	—	2.68
1900	Buff orange	Soft crumbly	—	—	2.69
2000	Dk. buff	Fairly hard	—	—	2.68
2100	Red brown	Steel hard	—	—	2.61
2200	Dk. brown	Steel hard	—	—	2.47
2300	Near black	Steel hard	Expanded	—	—

Potential Use: Brick and tile, lightweight aggregate

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Sp. Gr.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	2.56	159.4	1.7	No bloating
1900	2.18	135.8	1.5	No bloating
2000	1.46	91.0	2.1	Fair bloating
2100	1.29	80.0	2.3	Good bloating
2200	1.06	66.0	4.2	Good bloating

Firing Characteristics: Fair lightweight aggregate material. Product very strong with low absorption. Bulk weights are on the heavy side.

SAMPLE: R-1860

County: Highland

Locality: Roadcut on the north side of U. S. Highway 250 approximately 1.0 mile west of the intersection with State Road 645 in McDowell.

Description: An estimated 105 feet of dark-gray fissile shale is exposed in the roadcut. The shale weathers to form grayish-orange angular fragments. Concretions of dark-gray laminated siltstone up to 4 feet in length occur in the shale. Joints are well developed but there are no well-defined sets. Joint and bedding planes are stained rusty brown and dark yellowish orange. The rocks have a strike of N. 25° to 45° E. and a dip of 20° to 33° SE. The shale is cut by a northwestward-dipping normal fault and a southwestward-dipping reverse fault. Slickensides and breccia zones occur along the fault planes. A third fault, which has a dip to the southwest, is exposed. The shale was sampled to the base of a zone containing several large concretions in the southeastern portion of the exposure. An overburden of soil up to 3 feet in thickness is present.

Formation or age: Romney shale

Sampled interval: Sample across an estimated 105 feet of shale.

Type: Shale

Unfired strength: Very low

pH: 4.8

Raw Properties: Not plastic, short working, requires 20 percent water of plasticity, no drying defects, 2.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff	Soft crumbly	2.5	23.5	2.60
1900	Buff	Soft crumbly	2.5	21.1	2.61
2000	Dark buff	Fairly hard	5.0	16.7	2.55
2100	Dark red brown	Steel hard	5.0	12.4	2.45
2200	Dark brown	—	Expanded	9.3	1.94
2300	Brown gray	—	Expanded	—	—

Bloating Test: Negative*Potential Use:* None

SAMPLE: R-1861

County: Highland

Locality: Roadcut, 2.0 miles southeast of Monterey, on the west side of U. S. Highway 250 approximately 0.2 mile south of the intersection with State Road 629.

Description: Approximately 55 feet of pale yellowish-brown shale and interbedded thin layers of fine-grained, dark yellowish-orange, weathered sandstone are exposed in the roadcut. Small concretions of olive-gray siltstone up to 6 inches in length occur in the shale. The shale weathers to form light-brown, grayish-orange and light-red angular fragments. One prominent joint set, which has a strike of N. 80° E. and a dip of 79° N., is present. Closely spaced jointing imparts a blocky appearance to some of the sandstone layers. A few bedding and joint planes are stained rusty brown by iron oxide. The rocks have a strike of N. 5° W. to N. 5° E. and a dip of 30° NE. to SE. An overburden of soil 6 inches thick is present.

Formation or age: Clinton (?) formation

Sampled interval: Sample across 55 feet of shale

Type: Shale
pH: 5.85

Unfired strength: Very low

Raw Properties: Not plastic, short working, requires 22 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

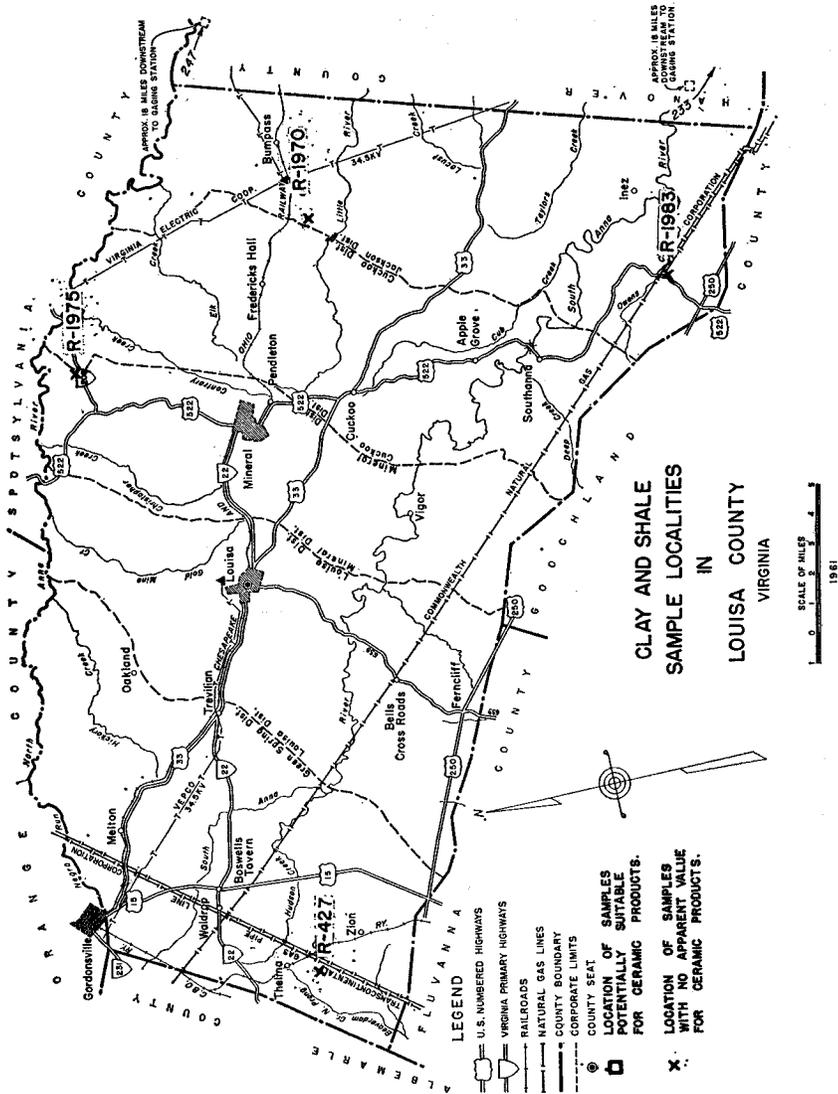
Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff	Soft crumbly	5.0	17.1	2.73
1900	Buff	Soft crumbly	5.0	14.7	2.64
2000	Dark buff	Fairly hard	7.5	7.2	2.51
2100	Red brown	Steel hard	9.0	4.8	2.57
2200	Dark brown	Steel hard	Expanded	—	—
2300	Black	Steel hard	Expanded	—	—

Potential Use: Common brick

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	2.38	148.3	0.8	No bloating
1900	2.32	144.5	0.5	No bloating
2000	1.60	99.7	1.4	Fair bloating
2100	1.55	96.6	2.3	Fair bloating
2200	1.28	79.7	5.8	Fair bloating

Firing Characteristics: Expansion inadequate for lightweight aggregate.



Location Map of Louisa County

LOUISA COUNTY

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

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-427	Residual clay and saprolitic material	None
R-1970	Quaternary clay	None
R-1975	Residual clay	None
R-1983	Flood-plain clay	None

SAMPLE: R-427

County: Louisa

Locality: Cleared area of a stock pond 1.1 miles south of the intersection of State Roads 615 and 640 at Thelma, and 0.3 mile south of the intersection of State Roads 615 and 694.

Formation: Residual clay and saprolitic material

Type: Clay (high silica)

pH: 6.7

Raw Properties: Not too plastic, short and gritty working, requires 20 percent water of plasticity, no drying defects, 1.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Orange buff	Soft crumbly	2.0	16.3	2.64
2000	Orange buff	Soft crumbly	2.0	16.0	2.66
2100	Orange buff	Soft crumbly	2.0	15.0	2.65
2200	Dk. buff	Soft crumbly	3.5	14.7	2.66
2300	Tan	Soft crumbly	4.5	13.1	2.64
2400	Gray tan	Fairly hard	6.0	10.7	2.60

Blotting Test: Negative

Potential Use: None

SAMPLE: R-1970

County: Louisa

Locality: Exposure, 2.8 miles west of Bumpass, on the east side of State Road 609 approximately 0.2 mile south of the intersection with State Road 618.

Description: A series of auger holes encountered 4 feet of light-brown, light-gray, and reddish-brown clay below 3 feet of soil.

Formation or age: Quaternary

Sampled interval: Composite sample of clay from auger holes drilled to a depth of 4 feet.

Type: Clay
pH: 5.8

Unfired strength: Average

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	35 - 40	Kaolin	40 - 50
Mica	2 - 3	Fe (OH) _x	2
Feldspar	0 - 5	Montmorillonite	5 - 8

Raw Properties: Fairly plastic, smooth, gritty, slightly short working, requires 36.0 percent water of plasticity, no drying defects, 9.5 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u> <u>Shk.</u>	<u>% Abs.</u>	<u>Approx.</u> <u>Sp. Gr.</u>
1800	Dk. orange buff	Soft crumbly	11.0	21.3	2.69
1900	Dk. orange buff	Fairly hard	11.0	22.5	2.78
2000	Dk. orange buff	Fairly hard	14.0	17.8	2.76
2100	Lt. brown	Hard	17.0	14.0	2.74
2200	Brown	Hard	17.0	13.1	2.71
2300	Darker brown	Hard	17.0	11.1	2.64

Blotting Test: Negative

Potential Use: None

SAMPLE: R-1975

County: Louisa

Locality: Roadcut, 5.8 miles north of Mineral, on the north side of State Highway 208 approximately 1.2 miles east of the intersection with U. S. Highway 522.

Description: Light-gray and yellowish-brown clay is exposed in the roadcut. The clay is overlain by 3 feet of sand and gravel.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, 4 feet in height, that was sampled for a distance of 65 feet.

Type: Clay
pH: 6.3

Unfired strength: Average

Raw Properties: Plastic, fine grit, smooth and sticky working, requires 22.0 percent water of plasticity, no drying defects, 6.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800	Dk. orange buff	Soft crumbly	6.0	17.9	2.64
1900	Dk orange buff	Soft crumbly	9.0	16.3	2.60
2000	Dk. orange buff	Soft crumbly	9.0	16.5	2.63
2100	Brown	Fairly hard	9.0	15.7	2.64
2200	Dk. brown	Hard	10.0	14.7	2.61
2300	Very dk. brown	Hard	12.5	12.9	2.55

Bloating Test: Negative

Potential Use: None (unless used with a lower firing clay)

SAMPLE: R-1983

County: Louisa

Locality: Roadcut, 5.1 miles south of Southanna, on the east side of U. S. Highway 522 approximately 1.9 miles north-east of the intersection with U. S. Highway 250 at Gum Spring.

Description: Reddish-brown flood-plain clay, is exposed along the roadcut. The clay contains angular grains of quartz.

Formation or age: Flood-plain clay

Sampled interval: Representative of exposure of clay, up to 6 feet in height, that extends for a distance of 100 feet.

Type: Clay

Unfired strength: Very low

pH: 6.4

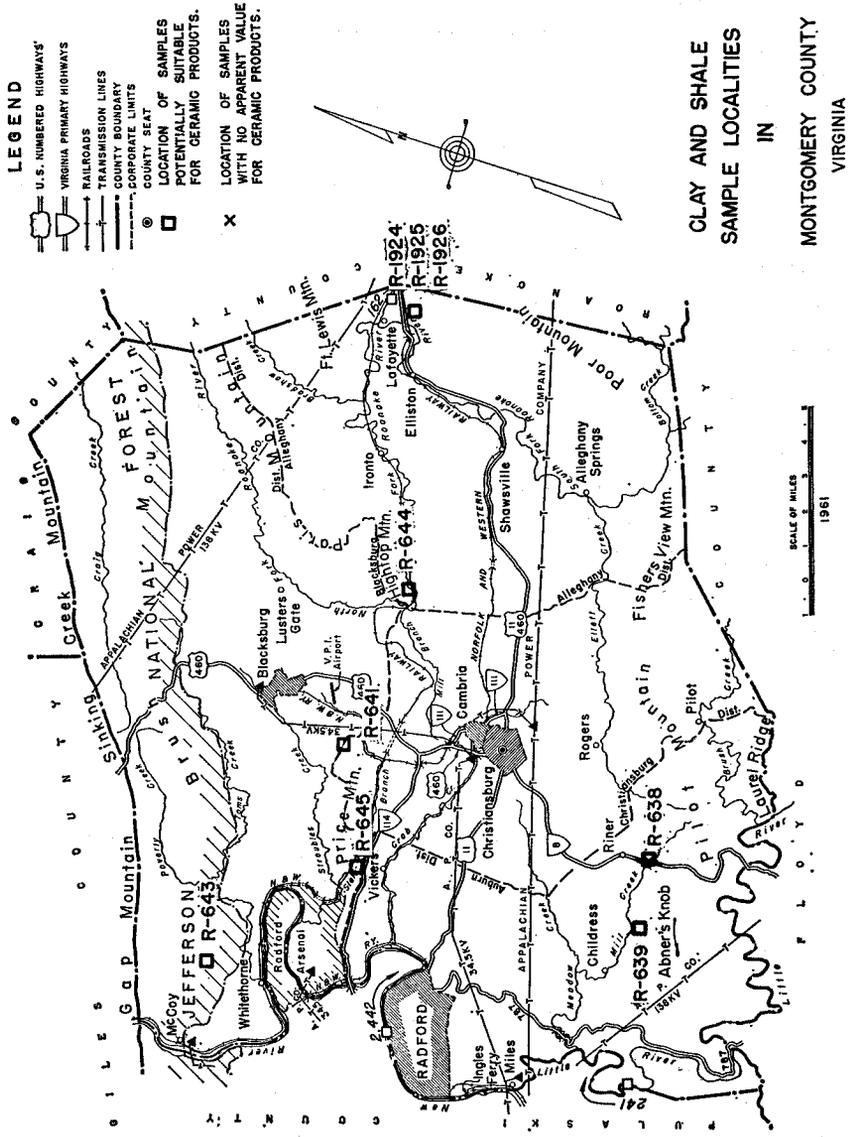
Raw Properties: Not plastic, short, mealy and sandy working, requires 30.0 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk. orange buff	Soft crumbly	6.5	28.9	2.78
1900	Dk. orange buff	Soft crumbly	6.5	27.6	2.78
2000	Lt. brown buff	Soft crumbly	8.5	24.3	2.77
2100	Brown	Soft crumbly	8.5	23.3	2.79
2200	Dk. brown	Fairly hard	8.5	19.7	2.73
2300	Dk. gray brown	Hard	10.8	13.7	2.64

Bloating Test: Negative

Potential Use: None



Location Map of Montgomery County

MONTGOMERY COUNTY

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

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-638	Rome shale	Common brick
R-639	Rome shale	Common brick
R-641	Maccrady (?) shale	Common brick
R-643	Maccrady shale	Common brick and tile
R-644A	Weathered and un- weathered Martinsburg (?) shale	Low-grade common brick, and lightweight aggregate
R-644B	Weathered Martinsburg (?) shale	Common brick
R-644C	Unweathered Martins- burg (?) shale	Common brick (?)
R-645	Maccrady (?) shale	Common brick
R-1924	Unweathered Rome shale	Common brick
R-1925	Weathered and un- weathered Rome shale	Brick and tile
R-1926	Weathered Rome shale	Brick

SAMPLE: R-638

County: Montgomery

Locality: Roadcut on State Highway 8 about 1 mile south of Riner.

Description: About 215 feet of intercalated yellowish-orange siltstone, light olive-gray shale, and dusky-red shale are exposed. The light olive-gray shale weathers to form small pegs, and the dusky-red shale weathers to form angular fragments. A few thin-bedded, laminated, brownish sandstones are intercalated with the other rocks. About 1 foot of overburden is present.

Formation or age: Rome formation

Sampled interval: Sample across 215 feet of shale and siltstone.

Type: Shale
pH: 7.0

Unfired strength: Low

Composition: X-ray and Petrographic Analyses

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	60 - 70	Montmorillonite	10 - 15
Sericite	3 - 5	Iron oxides	2 - 3
Chlorite	5 ±		

Raw Properties: Not too plastic, short working, requires 21.0 percent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dk. orange buff	Soft crumbly	4.5	14.0	2.62
2000	Lt. red	Fairly hard	6.5	11.1	2.61
2100	Dk. red brown	Very hard	9.0	3.6	2.52
2200	Dk. red brown	(Melted)	Expanded	—	—

Bloating Test: Slight

Potential Use: Common red brick (firing range short)

SAMPLE: R-639

County: Montgomery

Locality: Roadcut on the north side of State Road 669 about 2 miles west of Riner.

Description: Approximately 90 feet of dusky-red, greenish-gray, and dusky-yellow shale is exposed in the roadcut. The greenish-gray shale weathers to form angular fragments. Thick-bedded, medium-blue, calcareous mudstone occurs at the northeastern end of the exposure. The beds have a strike of about N. 85° E. and appear to have a steep southeast dip.

Formation or age: Rome formation

Sampled interval: Sample across 90 feet of shale.

Type: Shale

Unfired strength: Low

pH: 8.00

Raw Properties: Not plastic, short working, requires 21 percent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Red	Soft crumbly	4.5	15.2	2.65
2000	Dk. red	Fairly hard	5.0	12.6	2.65
2100	Dk. red brown	Hard	8.5	6.6	2.60
2200	Dk. brown	Glazed	—	2.5	2.18
2300	Dk. brown	—	Expanded	1.3	2.65
2400	Dk. brown	—	Expanded	8.9	2.65

Bloating Test: Slight expansion

Potential Use: Common red brick (firing range short).

SAMPLE: R-641

County: Montgomery

Locality: Roadcut on State Road 657 just north of Merrimac and about 2.4 miles south of Blacksburg.

Description: Exposed in the roadcut are about 75 feet of olive-brown and light olive-gray lumpy shale and a few intercalated olive-green siltstones. Medium- to thick-bedded, fine-grained, light-brown and olive-green sandstone occurs at the southeastern and northwestern ends of the exposure. The rocks have a strike of N. 70° E. and a dip of 20° to 30° SE.

Formation or age: Maccrady (?) shale

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

Type: Shale
pH: 6.60

Unfired strength: Low

Raw Properties: Short and fairly smooth working, requires 26 percent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800	Buff	Soft crumbly	5.0	17.2	2.69
2000	Buff	Fairly hard	7.5	12.6	2.66
2100	Med. red	Very hard	10.5	6.6	2.62
2200	Dk. brown	Steel hard	13.0	2.0	2.51
2300	Dk. brown	Steel hard	—	2.7	2.32
2400	Black brown	—	Expanded	10.3	—

Bloating Test: Negative

Potential Use: Common red brick

SAMPLE: R-643

County: Montgomery

Locality: Roadcut, 2.3 miles east of McCoy, on the north side of State Road 696 approximately 1.1 miles north of the intersection with State Road 652.

Description: About 29 feet of grayish-red and light-brown lumpy shales which weather to form angular fragments and small peg-shaped chips are exposed in the roadcut. Thin- to medium-bedded, fine-grained, yellowish-brown and reddish-brown weathered sandstone occurs at the southwestern end of the cut. The rocks have a strike of N. 85° E. and a dip of 28° SE., and have 2 feet of overburden.

Formation or age: Maccrady shale

Sampled interval: Sample across 29 feet of shale

Type: Shale

Unfired strength: Average

pH: 5.00

Raw Properties: Fair plasticity, slightly short working, requires 32 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Medium buff	Soft crumbly	4.5	21.0	2.66
2000	Medium buff	Fairly hard	9.0	13.2	2.64
2100	Red	Hard	12.0	7.0	2.59
2200	Dk. red brown	Steel hard	14.0	1.3	2.53
2300	Brown black	Steel hard	Expanded	3.0	2.26
2400	Black	—	Expanded	7.5	—

Bloating Test: Slight expansion

Potential Use: Common brick and tile.

SAMPLE: R-644A

County: Montgomery

Locality: Roadcut, 4.7 miles southeast of Blacksburg, on the north side of State Road 603 about 0.4 mile east of the intersection with State Road 641.

Description: Olive-green fissile shale containing a few intercalated thin-bedded, fine-grained, yellowish-brown weathered sandstones is exposed for a distance of 1000 feet along the roadcut. The shale weathers to form small peg-shaped chips and angular fragments, and has about 1 foot of overburden.

Formation or age: Martinsburg (?) shale

Sampled interval: Composite sample of weathered and unweathered shale.

Type: Weathered and unweathered shale

pH: 6.6

Unfired strength: Low

Raw Properties: Not plastic, short working, requires 28 percent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dk. buff	Soft crumbly	5.5	23.0	2.78
2000	Lt. red	Fairly hard	8.5	14.0	2.74
2100	Dk. red	Hard	12.0	8.2	2.68
2200	Dk. red brown	Steel hard	13.5	2.5	2.54
2300	Brownish black	—	Expanded	3.6	2.31
2400	Black	—	Expanded	7.7	—

Potential Use: Low-grade common brick, lightweight aggregate.

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>% Abs.</u>	<u>Bulk</u> <u>Sp. Gr.</u>	<u>Lb/ft³</u>	<u>Remarks</u>
1900	1.7	1.97	122.7	No bloating
2000	4.3	1.31	81.6	No bloating
2100	5.5	1.24	77.3	Slight bloating
2200	3.7	0.89	55.4	Good bloating, very sticky

Firing Characteristics: The expanded aggregate has low absorption, excellent strength, and the bloating range is rather short.

SAMPLE: R-644B

Sampled interval: Sample of hand-picked weathered shale from Locality 644A.

Type: Weathered shale
pH: 5.16

Unfired strength: Low

Composition: Spectrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
K ₂ O	3.75	Mn	Trace
CaO	.09	Fe ₂ O ₃	4.3
TiO ₂	1.1		

Raw Properties: Short working, not too plastic, some fine grit, requires 23 percent water of plasticity, no drying defects, 1.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk. buff	Soft crumbly	4.0	20.4	2.72
2000	Lt. red	Soft crumbly	5.5	13.2	2.65
2100	Med. red	Fairly hard	8.5	9.6	2.61
2200	Dk. red brown	Steel hard	10.0	5.1	2.56
2300	Dk. brown	Steel hard	11.5	2.6	2.44
2400	Dk. brown	Steel hard	10.0	2.5	2.46

Bloating Test: Slight expansion

Potential Use: Common brick

SAMPLE: R-644C

Sampled interval: Sample of hand-picked unweathered shale from Locality 644A.

Type: Unweathered shale
pH: 6.65

Unfired strength: Low

Raw Properties: Not too plastic, short working, requires 21 percent water of plasticity, no drying defects, 1.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk. buff	Soft crumbly	4.5	17.3	2.70
2000	Med. buff	Fairly hard	5.0	9.9	2.64
2100	Dk. red brown	Very hard	8.0	5.0	2.57
2200	Med. brown	Steel hard	8.0	4.4	2.49
2300	Dk. brown	—	—	—	—
2400	Gray black	—	—	—	—

Potential Use: Common brick (?)

Bloating Test:

Temp. °F	% Abs.	Bulk Sp. Gr.	Lb/ft ³	Remarks
1800	3.9	2.26	140.7	No bloating
1900	3.9	2.19	136.4	No bloating
2000	1.9	2.25	140.1	No bloating
2100	1.4	1.67	104.0	No bloating
2200	4.1	1.23	76.6	Slight bloating, overfired sticky
2300	2.3	1.27	79.1	Slight bloating, overfired very sticky

Firing Characteristics: Too short a firing range and slightly sticky. (Might be sintered.)

SAMPLE: R-645

County: Montgomery

Locality: Roadcut, 0.7 mile north of Vicker, on the north side of State Highway 114 about 0.8 mile west of the east intersection with State Road 659.

Description: Approximately 34 feet of weathered light olive-gray shale and grayish-red lumpy shale with a few intercalated fine-grained brownish sandstones are exposed for a distance of 550 feet along the roadcut. The rocks have a strike of N. 85° W. and a dip of 45° SW., and have up to 6 feet of overburden.

Formation or age: Maccrady (?) shale

Sampled interval: Sample across 34 feet of shale.

Type: Shale

Unfired strength: Low

pH: 5.6

Raw Properties: Fair plasticity, short working, requires 25 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dk. buff	Soft crumbly	4.5	13.8	2.67
2000	Lt. red	Hard	8.5	6.4	2.59
2100	Dk. red	Steel hard	12.5	1.5	2.51
2200	Dk. brown	—	11.0	0.4	2.23
2300	Dk. brown	—	Expanded	8.8	2.16
2400	Brownish black	—	Expanded	11.9	—

Bloating Test: Positive

Potential Use: Common brick.

SAMPLE: R-1924, 1925, and 1926 *County:* Montgomery

Locality: Quarry of Old Virginia Brick Company, Inc., 1.7 miles east of Elliston, on the south side of U. S. Highway 11 about 0.8 mile west of the Montgomery-Roanoke county lines.

Formation or age: Rome formation

SAMPLE R-1924

Sampled interval: Composite of unweathered shale from company stockpile believed to be representative of unweathered shale in quarry.

Type: Shale

Unfired strength: Very low

pH: 6.1

Raw Properties: Not plastic, short and gritty working, thixotropic, require 22 percent water of plasticity, no drying defects, 2.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dk. buff brown	Soft crumbly	2.0	19.1	2.63
1900	Dk. buff brown	Soft crumbly	2.0	17.2	2.63
2000	Brown red	Hard	5.0	14.8	2.61
2100	Dk. brown	Very hard	8.0	10.6	2.58
2200	Dk. brown	(Vitreous and melting)	Expanded	1.4	2.20

Bloating Test: Negative

Potential Use: Common brick

SAMPLE R-1925

Sampled interval: Sample is a blend of 50 percent weathered and 50 percent unweathered shale from company stockpiles.

Type: Shale

Unfired strength: Low

pH: 6.1

Raw Properties: Not plastic, thixotropic, short and gritty working, requires 22 percent water of plasticity, no drying defects, 1.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff brown	Soft crumbly	2.5	17.0	2.64
1900	Buff brown	Soft crumbly	3.5	15.8	2.62
2000	Med. red brown	Very hard	5.5	12.9	2.60
2100	Dk. brown	Steel hard	Expanded	1.4	1.81
2200	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: Brick and tile

SAMPLE R-1926

Sampled interval: Composite of weathered shale from company stockpile believed to be representative of the weathered shale in quarry.

Type: Shale
pH: 6.2

Unfired strength: Very low

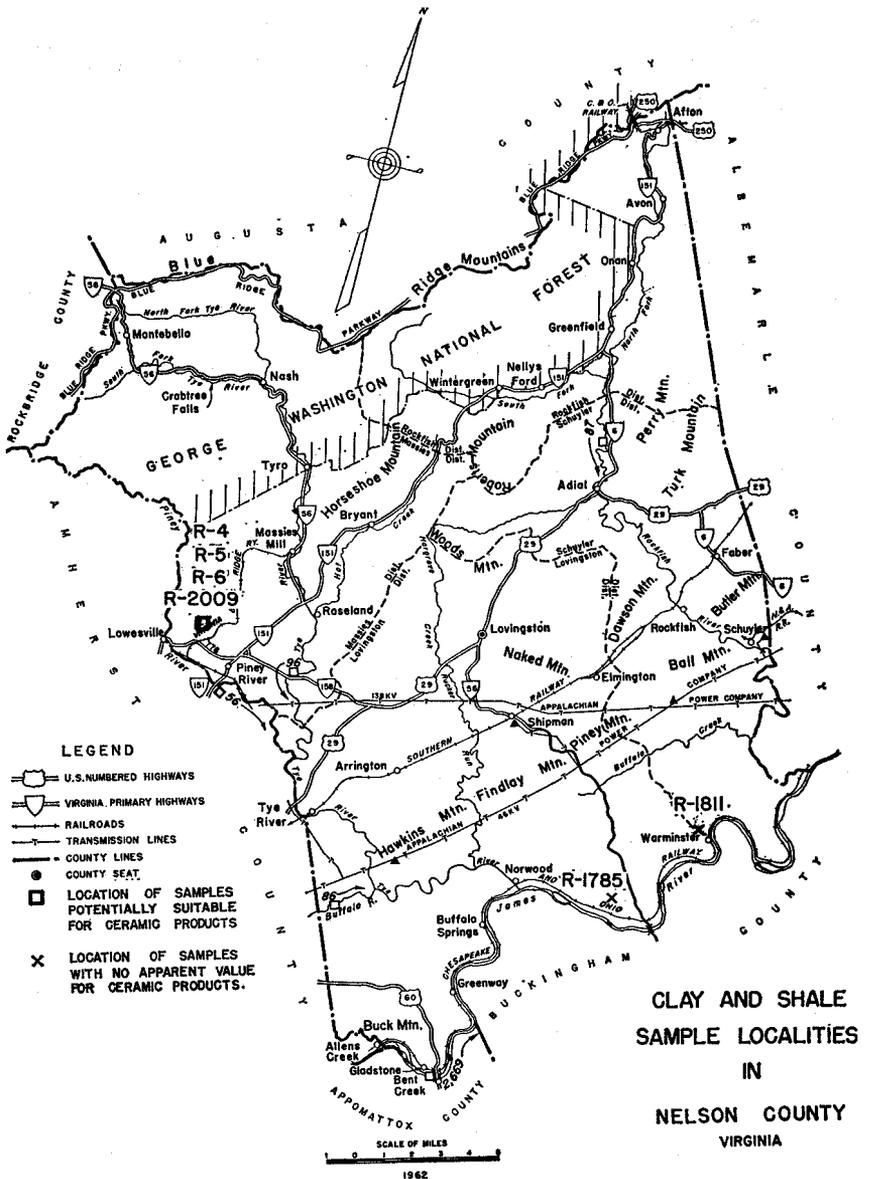
Raw Properties: Not plastic, short and gritty working, requires 25.0 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk. buff brown	Soft crumbly	4.0	22.4	2.66
1900	Dk. buff brown	Soft crumbly	5.0	21.1	2.67
2000	Brown	Hard	5.5	18.7	2.65
2100	Dk. brown	Very hard	10.0	8.4	2.48
2200	Dk. brown	Steel hard	Expanded	4.5	2.20
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: Brick



Location Map of Nelson County

NELSON COUNTY

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

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-4 (See R-2009)	Residual clay	Super-duty refractories; ceramic whiteware after beneficiation
R-5	Residual clay	None
R-6	Residual clay	Super-duty refractories; ceramic whiteware after beneficiation
R-1785	Recent (?) clay	None
R-1811	Precambrian or early Paleozoic phyllite	None
R-2009	Residual clay	High-heat-duty refractories and some types of ceramic ware

SAMPLE: R-4, R-5, R-6, and R-2009

County: Nelson

Locality: A pit on the Bart Thompson property, 2.0 miles northwest of Piney River, on the west side of State Road 676 about 1.0 mile north of the intersection with State Road 778.

Formation or age: Residual clay

SAMPLE R-4

Sampled interval: Sample from pit

Type: Clay

pH: 5.5

Composition: X-ray and Petrographic Analysis

<u>Raw Sample</u>	<u>Approximate %</u>	<u>Beneficiated</u>	<u>Approximate %</u>
Kaolin	50 to 60% \pm 10	Kaolin	65 - 75% \pm 10
Quartz	30 to 40% \pm 5	Quartz	20 - 25% \pm 5
Mica	10%	Mica	10%
Fe ₂ O ₃	\pm 2%	Iron	2%

Crude Material

Raw Properties: Fairly plastic and smooth working, some sand, requires 40 percent water of plasticity, no drying defects, 3 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u>		<u>Approx.</u>
			<u>Shk.</u>	<u>% Abs.</u>	<u>Sp. Gr.</u>
1800	Lt. ivory	Soft crumbly	4.0	35.5	2.63
2000	Lt. ivory	Soft crumbly	4.0	35.5	2.64
2100	Off-white	Soft crumbly	6.0	27.2	2.58
2200	Off-white	Soft crumbly	10.5	23.3	2.56
2300	Off-white	Fairly hard	10.5	18.4	2.46
2400	Off-white (spotted)	Fairly hard	10.5	20.6	2.59

Pyrometric cone equivalent between cones 33-34 (1745°-1760° C, 3173°-3200° F).

Beneficiated

Raw Properties: Fairly plastic, smooth, slightly fatty working, requires 57 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Potential Use: Super-duty refractories and if properly beneficiated might qualify for ceramic whiteware.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Ivory	Soft crumbly	5.0	36.5	2.58
2000	Off-white	Soft crumbly	6.0	28.8	2.59
2100	Off-white	Soft crumbly	9.0	25.5	2.59
2200	White	Soft crumbly	9.0	24.0	2.56
2300	White	Soft crumbly	9.0	21.8	2.54
2400	White	Fairly hard	11.0	19.8	2.53

Pyrometric cone equivalent between cones 33-34 (same as crude material).

SAMPLE R-5

Sampled interval: Sample from pit

Type: Clay

Composition: X-ray and Petrographic Analysis

Raw sample	Approx. %	Raw sample	Approx. %
Quartz	30 - 40%	Mica	20 - 25%
Kaolin	30 - 40%	Iron oxide	5%

The quartz is very fine grained, beneficiation did not improve material. This sample is much higher in mica than the X-ray indicates.

Raw Properties: Fairly plastic and smooth working, slightly fatty, requires 32 percent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. red brown	Soft crumbly	6.0	37.9	2.83
2000	Lt. red brown	Soft crumbly	6.0	38.4	2.82
2100	Med. red brown	Soft crumbly	10.5	26.4	2.78
2200	Med. gray	Fairly hard	10.5	21.8	2.75
2300	Med. gray	Fairly hard	13.5	17.5	2.75
2400	Gray brown	Hard	15.0	13.7	2.70

Pyrometric cone equivalent below 23.

Bloating Test: Negative

Potential Use: None

SAMPLE R-6

Sampled interval: Core from drill hole 25 feet deep

Type: Clay

Composition: X-ray and Petrographic Analysis

Raw sample	Approx. %	Beneficiated	Approx. %
Kaolin	50 - 60% ± 10	Kaolin	75 - 80%
Quartz	25 - 40% ± 10	Quartz	10 - 20%
Mica	± 5%	Mica	10 ± 2%
Fe ₂ O ₃	± 2%	Fe ₂ O ₃	± 2%

Crude Material

Raw Properties: Fairly smooth, not too plastic, short working, required 40 percent water of plasticity, no drying defects, 2 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Very lt. cream	Soft crumbly	2.0	39.5	2.59
2000	Very lt. cream	Soft crumbly	2.0	39.1	2.60
2100	Off-white	Soft crumbly	5.0	32.8	2.63
2200	Off-white	Soft crumbly	7.5	28.8	2.61
2300	Off-white	Fairly hard	7.5	25.7	2.59
2400	Off-white (spotted)	Fairly hard	10.0	22.3	2.61

Pyrometric cone equivalent between cones 33-34 (1745-1760° C - 3173-3200° F.)

Beneficiated

Raw Properties: Not too plastic, short and fatty working, requires 40 percent water of plasticity, no drying defects, 3 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Ivory	Soft crumbly	3.0	31.1	2.63
2000	Off-white	Soft crumbly	4.5	35.0	2.64
2100	White	Soft crumbly	7.5	32.2	2.66
2200	Off-white	Soft crumbly	7.5	30.5	2.62
2300	Off-white	Soft crumbly	7.5	29.0	2.65
2400	Off-white	Fairly hard	8.0	24.6	2.60

Pyrometric cone equivalent between cones 33-34.

Potential Use: Super-duty refractories and if properly beneficiated might qualify for ceramic whiteware.

SAMPLE R-2009

Sampled interval: Sample from pit

Type: Clay
pH: 6.2

Unfired strength: Low

Data For Beneficiated Material

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	1 - 2	Zeolites	1 - 2
Mica	15 ±	Mont., Chlorite	1 ±
Kaolin	65 - 70	Glass (isotropic)	2 - 3
Feldspar	5 - 8		

Microscopic: Clear glassy grains apparently from a pneumatolitic deposit or slightly altered granitic (pegmatitic) deposit.

Pyrometric cone equivalent: 33 (1745° C)

Raw Properties: Fairly plastic, short and fatty working, requires 43 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u>		<u>Approx.</u>
			<u>Shk.</u>	<u>% Abs.</u>	<u>Sp. Gr.</u>
1800	Lt. cream	Soft crumbly	4.0	43.1	2.56
2000	Off-white	Soft crumbly	5.5	38.1	2.57
2100	Off-white	Soft crumbly	5.5	35.6	2.59
2200	Off-white	Soft crumbly	6.0	34.1	2.59
2300	Off-white	Fairly hard	7.0	28.3	2.54
2400	Off-white	Hard	9.0	26.2	2.56

Bloating Test: Negative

Potential Use: High-heat-duty refractories and some types of ceramic ware.

SAMPLE: R-1785

County: Nelson

Locality: The farm of Mr. C. H. Wood, 3.7 miles east of Norwood, on the north side of State Road 647 about 1.2 miles west of the intersection with State Road 777.

Description: Vertical auger holes were drilled to a depth of 4.5 feet in a pasture just north of a farm home. The holes encountered up to 1 foot of yellowish-brown clay underlain by 3.5 feet of dark reddish-brown clay. The clay contains subrounded grains of quartz up to 1 mm in size. Other nearby hills and ridges are capped by similar alluvial clays.

Formation or age: Recent (?)

Sampled interval: Composite sample of clay from vertical auger holes drilled to a depth of 4.5 feet.

Type: Clay

Unfired strength: Average

pH: 6.0

Raw Properties: Fairly plastic, smooth working, requires 24.0 percent water of plasticity, 6.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff orange	Soft crumbly	6.5	18.7	2.79
1900	Buff orange	Soft crumbly	9.0	18.1	2.79
2000	Buff orange	Soft crumbly	10.0	15.5	2.76
2100	Light brown	Fairly hard	10.0	14.8	2.76
2200	Brown	Fairly hard	10.0	13.6	2.72
2300	Dark brown	Hard	10.0	13.6	2.70

Bloating Test: Negative

Potential Use: None (unless used with a lower maturing clay)

SAMPLE: R-1811

County: Nelson

Locality: Roadcut, 0.5 mile northwest of Warminster, on the southeast side of State Road 626 approximately 0.3 mile north of the intersection with State Road 604.

Description: Exposed in the roadcut are an estimated 15 feet of dark-gray phyllite which weathers to form light greenish-gray angular fragments. The phyllite contains lenticular zones of white quartz up to 6 feet in length. Two prominent joint sets are present. One set has a strike of N. 75° W. and a dip of 27° NE.; the other set has a strike of N. 15° W. and a dip of 42° SW. The cleavage has a strike of N. 65° E. and a dip of 23° to 33° NW. An overburden of sand and gravel, up to 5 feet in thickness, is present.

Formation or age: Precambrian or early Paleozoic

Sampled interval: Sample across an estimated 15 feet of phyllite.

Type: Micaceous clay
pH: 6.95

Unfired strength: Low

Raw Properties: Fair plasticity, short and gritty working, requires 25.0 percent water of plasticity, no drying defects, 2.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. brown	Soft crumbly	1.5	20.5	2.51
1900	Lt. brown	Soft crumbly	1.5	19.8	2.48
2000	Lt. brown	Soft crumbly	5.0	16.5	2.45
2100	Med. brown	Fairly hard	5.0	13.5	2.46
2200	Dk. brown	Very hard	5.0	13.4	2.43
2300	Very dk. brown gray	Steel hard	8.5	2.8	2.38

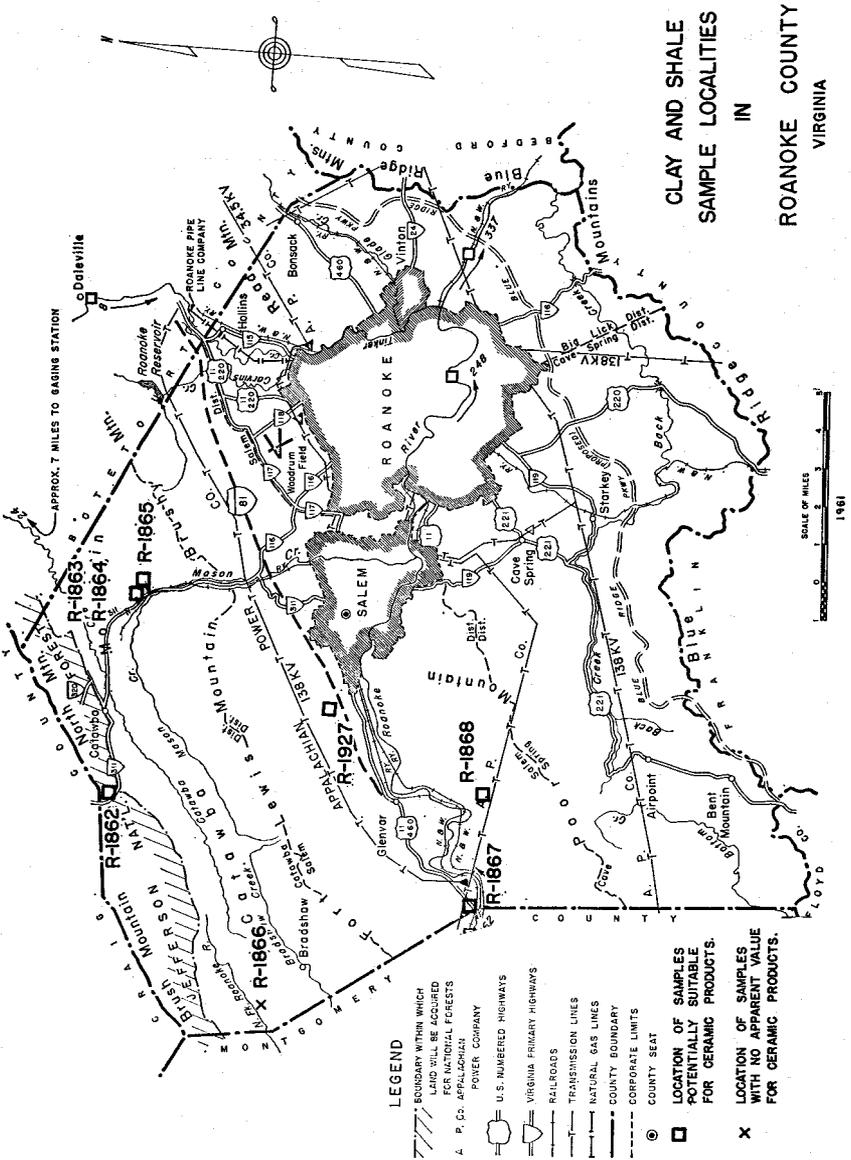
Bloating Test: Negative

Potential Use: None

SAMPLE: R-2009

County: Nelson

(See Sample R-4)



Location Map of Roanoke County

ROANOKE COUNTY

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

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-1862	Chemung shale	Common brick
R-1863	Romney (?) shale	None
R-1864	Brallier (?) shale	Common brick
R-1865	Residual clay	Common brick if blended with clay having lower shrinkage
R-1866	Edinburg shale	None
R-1867	Rome shale	Sintered aggregate
R-1868	Rome shale	Common brick and sintered aggregate
R-1927	Devonian shale	Brick

SAMPLE: R-1862

County: Roanoke

Locality: Exposure, 2.2 miles west of Catawba, on the north-east side of State Highway 311 just northwest of the intersection with State Road 624.

Description: An estimated 65 feet of olive-gray shale and interbedded medium to thick layers of fine-grained olive-gray sandstone are exposed. The shale weathers to form grayish-orange angular and peg-shaped fragments. Jointing imparts a blocky appearance to some of the sandstone layers. The rocks have a strike of N. 55° to 65° E. and a dip of 47° to 81° SE. Two northwestward-dipping minor faults have caused fracturing in some of the rocks. An overburden of soil up to 3 feet in thickness is present. The shale was sampled from the top of a thick-bedded olive-gray sandstone in the northwestern part of the exposure to the base of a thick-bedded olive-gray sandstone in the southeastern part.

Formation or age: Chemung formation

Sampled interval: Sample across an estimated 50 feet of shale.

Type: Shale

Unfired strength: Very low

pH: 6.1

Raw Properties: Slightly plastic, short working requires 22 percent water of plasticity, no drying defects, 5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff	Soft crumbly	5.0	20.8	2.65
1900	Buff	Soft crumbly	5.0	19.9	2.66
2000	Buff	Hard	5.0	16.0	2.65
2100	Dk. red brown	Steel hard	6.0	11.2	2.61
2200	Dk. brown	Steel hard	10.0	7.0	2.46
2300	Near black	Steel hard	Expanded	5.9	2.31

Bloating Test: Slight expansion

Potential Use: Common brick

SAMPLES: R-1863 and R-1864

County: Roanoke

Locality: An abandoned quarry, 3.4 miles east of Catawba, on the north side of State Road 912 just east of the intersection with State Highway 311.

Description: Approximately 95 feet of dark-gray fissile shale is exposed in the quarry. The shale weathers to form grayish-orange angular fragments, and bedding and joint planes are stained rusty brown and dark yellowish orange. Some of the shale has been fractured and subsequently recemented with iron oxide. Overlying the dark-gray shale is 55 feet of olive-gray shale that contains concretions of olive-gray siltstone 1.5 feet in length. This shale weathers to form light olive-gray and grayish-orange angular fragments, and contains joint planes which are stained rusty brown and dark gray.

Formation or age: Romney (?) shale

SAMPLE R-1863

Sampled interval: Sample across 95 feet of dark-gray shale

Type: Shale

Unfired strength: Very low

pH: 6.1

Raw Properties: Not plastic, short and gritty working, requires 22 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff	Soft crumbly	2.5	15.0	2.46
1900	Buff	Soft crumbly	2.5	14.9	2.48
2000	Buff	Fairly hard	5.0	14.6	2.55
2100	Lt. brown	Very hard	6.0	9.1	2.44
2200	Gray brown	Steel hard	7.5	4.4	2.10
2300	Gray brown	Steel hard	Expanded	8.0	2.06

Bloating Test: Negative

Potential Use: None (sample very high in silica)

SAMPLE R-1864

Formation or age: Brallier (?) shale

Sampled interval: Sample across 55 feet of olive-gray shale

Type: Shale

Unfired strength: Low

Raw Properties: Not very plastic, short and slightly gritty working, requires 23 percent water of plasticity, 4.0 percent drying shrinkage.

Fired Properties:

<u>Temp.</u> <u>°F</u>	<u>Color</u>	<u>Hardness</u>	<u>% Lin.</u> <u>Shk.</u>	<u>% Abs.</u>	<u>Approx.</u> <u>Sp. Gr.</u>
1800	Lt. brown	Hard	6.0	15.8	2.64
1900	Lt. brown	Very hard	7.0	13.4	2.62
2000	Brown red	Steel hard	10.0	9.2	2.60
2100	Dk. brown	Steel hard	12.5	2.3	2.44
2200	Black	—	Expanded	—	1.70
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: Common brick

SAMPLE: R-1865

County: Roanoke

Locality: Bank of small pond, 3.5 miles east of Catawba, on the north side of State Road 912 and about 0.2 mile east of the intersection with State Highway 311.

Description: Dark yellowish-orange and yellowish-gray clay is exposed along the eastern bank of the pond. A few mottled zones of reddish-brown clay occur in the exposure. The clay contains rounded grains of quartz up to 1 mm in size and weathered fragments of shale. An overburden of sandy clay 3 feet thick is present. The clay was sampled from a zone of partially weathered shale at the northern end of the pond to State Road 912 on the south.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, 5 feet in height, sampled for a distance of 95 feet.

Type: Clay

Unfired strength: Average

pH: 5.9

Raw Properties: Plastic, smooth working, requires 35 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Orange buff	Fairly hard	10.0	21.1	2.68
1900	Orange buff	Hard	12.0	21.0	2.62
2000	Lt. red brown	Very hard	15.0	13.1	2.62
2100	Med. brown	Very hard	15.0	8.5	2.52
2200	Dark brown	Steel hard	15.5	7.1	2.42
2300	Black	Steel hard	15.5	6.4	2.30

Bloating Test: Negative

Potential Use: Might be used for common brick if blended with clay having a lower shrinkage.

SAMPLE: R-1866

County: Roanoke

Locality: Roadcut, 1.5 miles northwest of Bradshaw, on the southeast side of State Road 785 about 0.1 mile southwest of the intersection with State Road 650.

Description: Exposed in the roadcut are 15 feet of dark-gray fissile calcareous shale with a few interbedded thin layers of dark-gray limestone. Joints occur in the rocks but no well-defined sets are present. Some of the joint planes are stained rusty brown by iron oxide. The rocks have a strike of N. 51° to 54° E. and a dip of 30° to 40° SE., and are overlain by 1 foot of soil.

Formation or age: Edinburg formation

Sampled interval: Sample across 13 feet of shale

Type: Shale
pH: 8.0

Unfired strength: Very low

Raw Properties: Not plastic, gritty and very short working, requires 24.0 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Sandy buff	Soft crumbly	6.0	21.2	2.57
1900	Sandy buff	Soft crumbly	6.0	19.4	2.46
2000	Sandy buff	Soft crumbly	6.0	22.4	2.57
2100	Lt. brown gray	Hard	Expanded		—
2200	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: None (High in calcareous material. Specimen for 2100° F cracked when removed from kiln.)

SAMPLE: R-1867

County: Roanoke

Locality: Exposure, 3.3 miles southwest of Glenvar, on the northwest side of U. S. Highway 11 just northeast of the Roanoke-Montgomery county line.

Description: Ten feet of grayish-red shale that weathers to form pale-red angular and peg-shaped fragments is exposed. A few layers of olive-gray shale are interbedded with the grayish-red shale. Joints occur in the shale but no well-defined sets are present. The rocks have a strike of N. 75° to 77° E. and a dip of 45° SE.

Formation or age: Rome formation

Sampled interval: Sample across 10 feet of shale

Type: Shale

Unfired strength: Low

pH: 8.4

Raw Properties: Not plastic, short working, requires 22.0 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Med. brown	Soft crumbly	6.0	16.9	2.55
1900	Dk. brown	—	7.5	11.1	2.48
2000	Near black	Steel hard	8.0	8.0	2.46
2100	Near black	Steel hard	Expanded	1.3	1.77

Bloating Test: Negative

Potential Use: Probably lightweight aggregate by the sintering process. (High in calcareous material and firing range very short.)

SAMPLE: R-1868

County: Roanoke

Locality: Roadcut, 2.8 miles south of Glenvar, on the east side of State Road 612 about 1.0 mile south of the intersection with State Road 639.

Description: Exposed in the roadcut are 85 feet of grayish-red and olive-gray shale and interbedded thick layers of fine-grained, olive-gray laminated sandstone. The shale weathers to form pale-red and light olive-gray angular fragments. Joints occur but there are no well-defined sets. The rocks have a strike of N. 89° W. and a general dip of 75° SW. At the northeastern end of the exposure the rocks are tightly folded into a southeastward-plunging syncline and anticline broken by a minor fault. The shale was sampled from the top of a covered zone at the northeastern end to the base of a massive-appearing bed of olive-gray shale at the southwestern end.

Formation or age: Rome formation

Sampled interval: Composite sample across 83 feet of shale.

Type: Shale

Unfired strength: Low

pH: 8.2

Raw Properties: Not plastic, short and sandy working, requires 22 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. brown	Soft crumbly	3.0	21.6	2.65
1900	Lt. brown	Soft crumbly	3.0	18.6	2.61
2000	Med. brown	Fairly hard	5.0	15.2	2.56
2100	Dk. brown	Very hard	9.0	8.9	2.54
2200	Dk. brown	Steel hard	12.5	2.9	2.29
2300	—	—	Expanded	—	—

Bloating Test: Slight expansion

Potential Use: Common brick (Expansion inadequate for aggregate by rotary kiln; might be used if sintered)

SAMPLE: R-1927

County: Roanoke

Locality: Quarry of Old Virginia Brick Company, Inc., located on the northeast side of State Road 619, about 1.0 mile north of plant on U. S. Highway 11, just west of Salem.

Formation or age: Devonian

Sampled interval: Composite of shale from company stockpile believed to be representative of shale in quarry.

Type: Shale

Unfired strength: Low

pH: 6.2

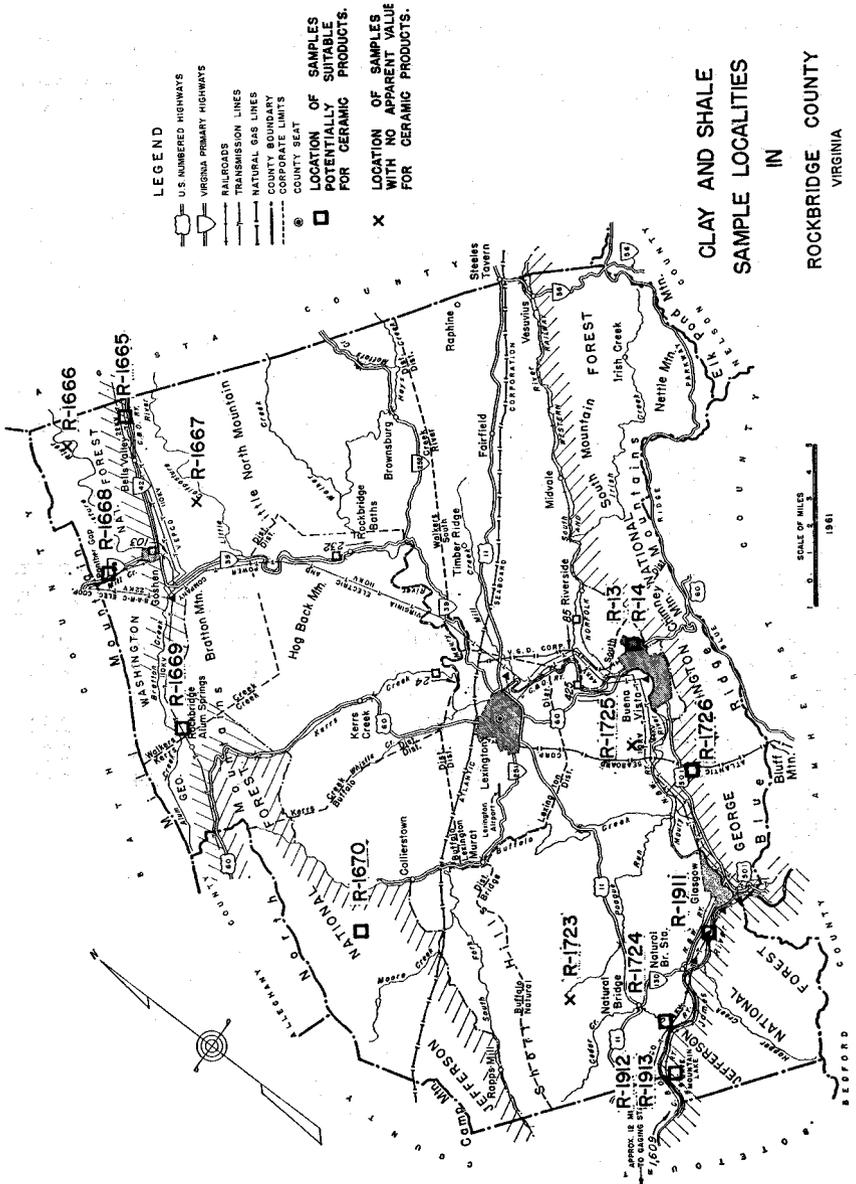
Raw Properties: Slightly plastic, short and fairly smooth working, requires 19.0 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Med. buff	Soft crumbly	2.5	20.4	2.68
1900	Buff orange	Soft crumbly	2.5	18.8	2.69
2000	Buff red	Fairly hard	4.0	16.4	2.68
2100	Lt. brown	Steel hard	6.0	12.9	2.66
2200	Dk. brown	Steel hard	7.5	10.6	2.61
2300	Dk. brown gray	Steel hard	10.0	8.4	2.59

Bloating Test: Negative

Potential Use: Brick



Location Map of Rockbridge County

ROCKBRIDGE COUNTY

Samples were collected from 13 localities in Rockbridge County. Laboratory testing indicates the following potential uses for the raw material:

<u>Sample</u>	<u>Material</u>	<u>Potential Use</u>
R-13	Residual clay	Intermediate-heat-duty refractories, ceramic white-ware, pottery, mineral filler
R-14	Residual clay	Used with less plastic materials to improve plasticity and increase green strength
R-1665	Brallier (?) shale	Common brick and tile, lightweight aggregate
R-1666	Romney shale	None
R-1667	Romney (?) shale	None
R-1668	Brallier (?) shale	Brick and lightweight aggregate
R-1669	Brallier (?) shale	Brick, tile, and lightweight aggregate
R-1670	Martinsburg shale	Brick and tile
R-1723	Residual clay	None
R-1724	Rome shale	Sintered aggregate
R-1725	Residual clay	None
R-1726	Rome shale	Sintered aggregate
R-1911	Quaternary clay	Chemical stoneware, pottery, decorative brick and tile, and chimney-flue tile
R-1912	Quaternary clay	Brick, sewer pipe (?)
R-1913	Quaternary clay	Brick, sewer pipe (?)

SAMPLE: R-13

County: Rockbridge

Locality: A pit near the eastern city limits of Buena Vista formerly operated by the Dickenson Firebrick Company.

Formation or age: Residual clay

Sampled interval: Sample of off-white clay from 5-foot bench in old pit

Type: Kaolin with quartz, mica? *Unfired strength:* Low
pH: 5.00

Crude Material

Raw Properties: Very plastic and smooth working, requires 32 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Off-white	Soft crumbly	2.5	30.5	2.65
2000	Off-white	Soft crumbly	2.5	28.4	2.65
2100	White	Soft crumbly	4.5	24.9	2.64
2200	White	Fairly hard	4.5	22.6	2.65
2300	White	Fairly hard	6.0	20.8	2.57
2400	White	Hard	6.0	20.8	2.55

Pyrometric cone equivalent — between cones 27 and 28 (2921-2939° F)

Potential Use: This clay could be used in ceramic whiteware, for intermediate-duty refractories, as a basic pottery material, and possibly as a mineral filler.

Beneficiated

Raw Properties: Fairly plastic, smooth working, requires 34 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800	White	Soft crumbly	5.0	27.6	2.55
2000	White	Soft crumbly	5.0	26.2	2.57
2100	White	Soft crumbly	5.5	23.7	2.58
2200	White	Fairly hard	9.0	18.5	2.57
2300	White	Fairly hard	10.5	12.0	2.45
2400	White	Steel hard	10.5	12.5	2.48

Pyrometric cone equivalent between cones 29-30 (2984-3002° F).

Test to determine the potential use of R-13 as a basic pottery and artware material:

BATCH COMPOSITION %

Batch No.	1	2	3	4
R-13	60.0	50.0	40.0	40.0
Feldspar	10.0	—	30.0	—
Nepheline Syenite	—	20.0	—	30.0
E.P.K.	30.0	30.0	20.0	20.0
Ball clay	—	—	10.0	10.0
Total	100.0	100.0	100.0	100.0

FIRED DATA

Temp. °F	1		2		3		4	
	% Abs.	% Shk.						
1800	26.8	5.0	23.4	5.0	22.4	4.0	22.7	8.5
2000	24.6	10.0	17.6	8.5	11.2	10.0	8.5	14.5
2200	13.4	12.5	4.1	12.5	4.1	12.0	2.3	15.0
2250	—	—	—	—	2.3	13.0	0.8	17.5
2400	8.4	15.0	1.3	17.0	—	—	—	—

Batches 3 and 4 mature at about Cone 5 (2156° F).

A slip using batch composition No. 4 was made and a number of pottery shapes were cast:

Slip Composition:

	%
R-13	40.0
Nepheline Syenite	30.0
E.P.K.	20.0
Ball clay	10.0
	100.0

0.2% calgon used as a deflocculating agent.

Slip Properties:

Specific gravity	1.81
Water	40.0%
Drying shrinkage	6.0% (Approx.)
Firing shrinkage	14.0% (Approx.)
% Abs.	1.0%
Firing temperature	2120°F (1 hr. soak)

Casting Properties:

The slip tends to become slightly sluggish while in the mold. Casting time 15 minutes. Thickness of the cast shapes was very uniform, interior surfaces were sharp and clean.

SAMPLE: R-14

County: Rockbridge

Locality: Drill hole, 2500 feet north of pit (Locality R-13) and within the Green Forest Industrial Park.

Formation or age: Residual clay

Sampled interval: Tan-yellow clay taken from core at depth of 173 feet below surface.

Type: Clay

Raw Properties: Plastic, smooth-working, slightly sticky, requires 34 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin. Shk.	% Abs.	Approx. Sp. Gr.
1800	Salmon	Soft crumbly	2.5	29.4	2.71
2000	Lt. red brown	Hard	12.0	14.3	2.73
2100	Brown	Steel hard	14.0	9.4	2.67
2200	Brown	Steel hard	16.0	7.2	2.65
2300	Brown	Steel hard	17.5	3.2	2.56
2400	Brown	Steel hard	17.5	2.9	2.54

Bloating Test: Negative

Potential Use: Could probably be used with less plastic materials to improve plasticity and increase green strength.

SAMPLE: R-1665

County: Rockbridge

Locality: Roadcut on the northwest side of State Highway 42 about 1.4 miles northeast of the intersection with State Road 614 in Bells Valley.

Description: Exposed in the roadcut is 18 feet of light olive-gray shale which weathers to form yellowish-gray angular fragments. A few concretions of siltstone, less than 6 inches in length, are present in the shale. The rocks have a strike of N. 45° E. and a dip of 40° NW., and are overlain by up to 4 feet of soil. Two prominent joint sets are present. One set has a strike of N. 80° E. and a dip of 65° SE., and the other set has a strike of N. 50° W. and a dip of 73° SW. Some joint and bedding planes have been stained rusty brown by iron oxide.

Formation or age: Brallier (?) shale

Sampled interval: Sample across 18 feet of shale

Type: Shale
pH: 8.5

Unfired strength: Very low

Raw Properties: Not plastic, short working, requires 19.0 percent water of plasticity, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Orange buff	Fairly hard	5.0	13.5	2.65
1900	Lt. red brown	Very hard	6.0	8.4	2.61
2000	Lt. red brown	Steel hard	7.5	6.4	2.58
2100	Brown	Glazed	7.5	7.8	2.26

Potential Use: Common brick and tile (fired colors rather poor), lightweight aggregate.

Bloating Test:

Temp. °F	Bulk Dens.	Lb/ft ³	% Abs.	Remarks
1800	1.61	100.3	7.0	No bloating
1900	1.02	63.5	3.7	Good bloating
2000	1.02	63.5	3.3	Good bloating
2100	0.69	42.9	4.7	Overbloomed and very sticky
2200	0.53	33.0	4.2	Overbloomed, melting and very sticky

Rotary Kiln Tests:

Screen Analyses of Shale Crushed for Rotary Kiln Feed

Sieve Size	Percent Retained
— $\frac{3}{4}$ " + $\frac{1}{2}$ "	20.2
— $\frac{1}{2}$ " + $\frac{1}{4}$ "	54.2
— $\frac{1}{4}$ " + 8 mesh	13.2
—8 mesh	12.4
Total	100.0
Container	
Weight Lb/ft. ³	75.0

Crushing Characteristics: Good

Maximum Temp. °F.: 1990

Minimum Temp. °F.: 1940

Optimum Temp. °F.: 1975

Sticking Temp. °F.: 2000

Retention Time (min): 18.0

Quenching effect: None

Container weight

Fired Lb/ft.³: 41.0

Properties of Aggregate by Laboratory Method

Size	— $\frac{3}{4}$ " + $\frac{1}{2}$ "
Bulk Sp. Gr.	1.16
Lb/ft ³	72.3
% Abs.	4.6
Size	— $\frac{1}{2}$ " + $\frac{1}{4}$ "
Bulk Sp. Gr.	1.14
Lb/ft ³	71.0
% Abs.	4.2

Size	— $\frac{1}{4}$ " + 8 mesh
Bulk Sp. Gr.	1.28
Lb/ft ³	79.7
% Abs.	5.4

Screen Analyses of Fired Aggregate Crushed to $\frac{3}{8}$ "

<u>Sieve Size</u>	<u>Percent Retained</u>
$\frac{3}{8}$ "	4.5
— $\frac{3}{8}$ " + $\frac{1}{4}$ "	57.0
— $\frac{1}{4}$ " + 8 mesh	28.3
—8 + 20 mesh	7.7
—20 + 65 mesh	1.3
—65	1.1
Total	100.0

Properties of Lightweight Concrete
2" cubes cured 6 hours (autoclave)

Cement/yard	5 sacks
Fine aggregate %	50.0
Coarse aggregate %	50.0
Bulk. Sp. Gr.	1.45
Lb/ft ³	90.3
% Abs.	9.9
Compression (psi)	5250

No particular difficulty was experienced during the rotary kiln test on this sample. The kiln feed did not segregate and the optimum temperature was easy to maintain. The aggregate makes satisfactory lightweight concrete. The percent absorption is very low and the compressive strengths compare favorably with commercial lightweight materials.

SAMPLE: R-1666

County: Rockbridge

Locality: Roadcut, 2.7 miles north of Bells Valley, on the east side of State Road 600 approximately 1.6 miles south of the Rockbridge-Augusta County line.

Description: Exposed in the roadcut is about 160 feet of dark-gray fissile shale which weathers to form yellowish-gray rectangular plates. Some of the shale contains lenticular zones of dark-gray siltstone up to 2.5 feet long and 1 foot thick which contain fractures filled with white calcite and weather dark yellowish orange. One prominent joint set, which has a strike of N. 35° W. and a dip of 54° SW., is present. Some joint and bedding planes are stained rusty brown by iron oxide. The rocks have a strike of N. 25° to 30° E., and a southeast dip. Minor folding is present. The amount of folding increases in the southeastern part of the exposure where the shale has been brecciated and recemented with iron oxide. The shale is cut by a fault which has a strike of about N. 30° E. and a dip of 20° SE. The rocks have up to 1 foot of overburden.

Formation or age: Romney shale

Sampled interval: Sample across about 160 feet of shale.

Type: Shale

Unfired strength: Very low

pH: 7.65

Raw Properties: Not too plastic, short and slightly fatty working, requires 22 percent water of plasticity, no drying defects, 2.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dk. buff	Soft crumbly	4.0	25.6	2.62
2000	Med. red (scummed)	Hard crumbly	5.0	19.0	2.52
2100	Dk. red brown	Hard	7.5	13.8	2.49
2200	Dk. brown	Glazed	6.0	5.2	1.97
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1667

County: Rockbridge

Locality: Exposure, 2.5 miles east of Goshen, at the junction of State Roads 601 and 615.

Description: Approximately 50 feet of dark-gray shale is exposed. The shale weathers to form grayish-orange angular fragments, and some of the bedding and joint planes are stained reddish brown by iron oxide. Closely spaced jointing, which has a strike of N. 75° W. and a northeast dip, causes the shale to break up into small fragments. Other poorly developed joint sets are present. The rocks have a strike of N. 40° to 50° E. and a dip of 40° SE., and are overlain by up to 3 feet of soil. Some minor folding can be seen near the center of the exposure.

Formation or age: Romney (?) shale

Sampled interval: Sample across 50 feet of shale.

Type: Shale
pH: 7.55

Unfired strength: Very low

Raw Properties: Not too plastic, short and slightly fatty working, requires 22 percent water of plasticity, no drying defects, 4.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Buff	Soft crumbly	4.0	20.6	2.64
2000	Dk. buff	Fairly hard	6.0	13.7	2.54
2100	Lt. red brown	Hard	10.0	9.4	2.48
2200	Dk. red brown	Very hard	10.0	5.7	2.28
2300	Reddish gray	—	Expanded	6.7	1.93
2400	Med. gray	—	Expanded	9.4	1.76

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1668

County: Rockbridge

Locality: Roadcut, 2.1 miles northwest of Goshen, on the north side of State Highway 39 about 0.3 mile west of the intersection with State Road 600.

Description: Exposed in the roadcut are about 110 feet of light olive-gray shale and a few interbedded thin layers of fine- to medium-grained dark-brown sandstone. The shale weathers to form grayish-orange angular fragments. One prominent joint set, which has a strike of N. 50° W. and a dip of 87° SW., is present. Some joint and bedding planes have been stained reddish brown by iron oxide. The rocks have a strike of N. 30 to 35° E. and a dip of 50° SE., and are overlain by 1 foot of soil.

Formation or age: Brallier (?) shale

Sampled interval: Sample across 105 feet of shale.

Type: Shale

Unfired strength: Low

pH: 8.7

Raw Properties: Fair plasticity, short working, requires 21 percent water of plasticity, no drying defects, 4 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Orange buff	Fairly hard	3.5	17.9	2.62
1900	Orange buff	Very hard	5.0	14.9	2.59
2000	Darker buff	Steel hard	7.5	11.0	2.57
2100	Brown	Steel hard	9.5	5.9	2.48
2200	Brown	Glazed	Expanded	4.5	2.21

Potential Use: Brick and lightweight aggregate

Bloating Test:

Temp. °F	% Abs.	Bulk Sp. Gr.	Lb/ft ³	Remarks
1800	1.5	1.96	122.0	No bloating
1900	2.5	1.68	104.6	Slight expansion
2000	1.4	1.37	85.4	Good expansion
2100	2.1	1.06	66.0	Over fired and very sticky
2200	2.8	0.97	60.0	Overbloomed, melting, and very sticky

Rotary Kiln Tests:

Screen Analysis of Unfired Material

Sieve Size	Percent Retained
— $\frac{3}{4}$ " + $\frac{1}{2}$ "	13.5
— $\frac{1}{2}$ " + $\frac{1}{4}$ "	63.1
— $\frac{1}{4}$ " + 8 mesh	13.4
—8 mesh	10.0
Total	100.0

Crushing characteristics: Very good

Retention time in kiln: 17.0 minutes

Maximum temp. °F: 2010

Minimum temp. °F: 1980

Best bloating temp. °F: 2005

Processing characteristics: Good

ASTM container method:

Weight of unfired shale Lb/ft³: 82.0Weight of fired shale Lb/ft³: 52.0

Screen Analysis of Fired Material

Crushed to pass $\frac{3}{8}$ " sieve (ASTM specifications for lightweight aggregate used in concrete blocks)

Sieve Size	Percent Retained
$\frac{3}{8}$ "	16.2
— $\frac{3}{8}$ " + $\frac{1}{4}$ "	60.9
— $\frac{1}{4}$ " + 8 mesh	18.3
—8 + 20 mesh	2.8
—20 + 64 mesh	1.1
—65 (passing)	0.7
Total	100.0

Properties of Lightweight Concrete
2" cubes cured 6 hours (autoclave)

Cement/yard	5 sacks
Fine aggregate %	50.0
Coarse aggregate %	50.0
Bulk. Sp. Gr.	1.33
Lb/ft ³	82.9
% Abs.	7.5
Compression (psi.)	5500

This aggregate makes satisfactory lightweight concrete. The percent absorption is very low and the compressive strengths compare favorably with commercial lightweight materials.

SAMPLE: R-1669

County: Rockbridge

Locality: Roadcut, 6.5 miles southwest of Goshen, on the east side of State Road 780 approximately 1.3 miles north of the intersection with State Road 633.

Description: About 25 feet of olive-gray shale with interbedded thin layers of medium-grained, dark-gray sandstone is exposed in the roadcut. Some of the sandstone layers are cross bedded. One prominent joint set, which has a strike of N. 3° E. and a dip of 68° NW., is present. Joint and bedding planes are stained rusty brown by iron oxide. The rocks have a strike of N. 10° to 15° E. and a dip of 25° SE., and are covered by 1 foot of overburden.

Formation or age: Brallier (?) shale

Sampled interval: Sample across 25 feet of shale

Type: Shale

Unfired strength: Low

pH: 7.20

Raw Properties: Not too plastic, short working, requires 20 percent water of plasticity, no drying defects, 3.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. red buff	Soft crumbly	2.0	22.5	2.69
2000	Lt. red	Soft crumbly	4.5	20.3	2.72
2100	Very dk. red	Fairly hard	9.0	12.4	2.57
2200	Very dk. red brown	Very hard	5.5	8.8	2.47
2300	Black brown	Very hard	6.0	6.5	2.18
2400	Black brown	—	Expanded	12.5	2.01

Potential Use: Brick, tile, and lightweight aggregate.

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>% Abs.</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>Remarks</u>
1800	4.3	2.34	145.8	No bloating
1900	6.9	1.70	105.9	No bloating
2000	8.7	1.40	87.2	Fair bloating
2100	11.3	1.13	70.4	Good bloating, and slightly sticky
2200	7.1	1.02	63.5	Good bloating, and sticky

SAMPLE: R-1670

County: Rockbridge

Locality: Exposure, 2.6 miles west of Collierstown, at the junction of State Roads 696 and 655.

Description: Approximately 130 feet of olive-gray shale containing a few medium- to thick-bedded layers of weathered laminated mudstone is exposed. A few blebs of white calcite occur in the shale. Poorly developed fracture cleavage causes the shale to break down into small grayish-orange angular fragments as it weathers. Some of the bedding and fracture planes have been stained rusty brown by iron oxide. The rocks have a northeast strike and a dip of 35° to 80° SE., and are overlain by about 1 foot of soil.

Formation or age: Martinsburg shale

Sampled interval: Sample across 130 feet of shale and mudstone.

Type: Shale
pH: 7.30

Unfired strength: Average

Raw Properties: Plastic, fairly short working, requires 25 percent water of plasticity, no drying defects, 4.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr
1800	Lt. red buff	Hard crumbly	5.0	18.7	2.56
2000	Dull med. red	Fairly hard	9.0	15.4	2.57
2100	Dk. red brown	Very hard	10.5	8.0	2.41
2200	Black brown	Glazed	—	6.6	1.74
2300	—	(Melted)	—	—	—

Bloating Test: Negative

Potential Use: Brick and tile

SAMPLE: R-1723

County: Rockbridge

Locality: Roadcut, 2.7 miles northwest of Natural Bridge, on the north side of State Road 691 about 0.2 mile east of the intersection with State Road 610.

Description: Reddish-brown and yellowish-brown clay is exposed in the roadcut. A few yellowish-brown mottled zones occur in the reddish-brown clay. The clay weathers to form small angular fragments and appears to have been derived from the weathering of a dark-gray limestone which is cut by numerous veins of white calcite.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, 10 feet in height, that extends for a distance of 160 feet.

Type: Clay

Unfired strength: Average

pH: 6.35

Raw Properties: Fair plasticity, slightly sticky and fine grittiness working, requires 34 percent water of plasticity.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Dark buff	Soft crumbly	8.5	25.5	2.74
2000	Lt. red	Soft crumbly	12.0	16.9	2.70
2100	Lt. red brown	Fairly hard	14.0	13.8	2.68
2200	Med. brown	Hard	14.0	10.2	2.56
2300	Dk. brown	Very hard	15.5	8.5	2.49
2400	Near black	Steel hard	—	—	2.15

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1724

County: Rockbridge

Locality: Roadcut, 1.1 miles south of Natural Bridge, on the north side of State Road 608 approximately 0.4 mile north of the intersection with State Road 708 at Gilmore Mills.

Description: Grayish-red and greenish-gray shale is exposed along the roadcut. The shale weathers to form light grayish-red and dark-brown angular and peg-shaped fragments. A few thin layers of medium-grained, dark yellowish-orange laminated sandstone are interbedded with the shale. One prominent joint set, which has a strike of N. 15° W. and a dip of 80° SW., is present. Joint planes have been stained rusty brown by iron oxide. The rocks have a strike of N. 55° to 65° E. and appear to have a general southeast dip. An overburden of soil about 1 foot thick is present.

Formation or age: Rome formation

Sampled interval: Representative of exposure of shale, 8 feet in height, that extends for a distance of 180 feet.

Type: Shale
pH: 6.95

Unfired strength: Very low

Raw Properties: Not plastic, short working, requires 21 percent water of plasticity, no drying defects, 3.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Lt. red	Soft crumbly	5.5	13.9	2.65
2000	Dull red	Hard	10.0	7.1	2.56
2100	Brown	—	10.0	2.5	2.22
2200	Brown	—	Expanded	—	—
2300	—	(Melted)	—	—	—

Potential Use: Lightweight aggregate by the sintering method. Bloating range too short for rotary kiln.

Bloating Test:

<u>Temp.</u> <u>°F</u>	<u>Bulk</u> <u>Dens.</u>	<u>Lb/ft³</u>	<u>% Abs.</u>	<u>Remarks</u>
1800	2.19	136.4	2.4	No bloating
1900	1.74	108.4	2.4	No bloating
2000	1.50	93.5	1.6	Slight bloating
2100	1.11	69.2	15.3	Slightly sticky
2200	1.04	64.8	10.1	Very sticky
2300	1.08	67.3	12.0	Overbloated, very sticky

SAMPLE: R-1725

County: Rockbridge

Locality: Roadcut, 3.3 miles southwest of Buena Vista, on the east side of State Road 608 about 0.2 mile southwest of the intersection with State Road 699.

Description: Moderate reddish-brown clay containing some mottled zones of light-gray clay is exposed along the roadcut. Some angular fragments of white chert occur in the clay which appears to have been derived from weathering of limestone or dolomite of Cambrian age.

Formation or age: Residual clay

Sampled interval: Representative of exposure of clay, up to 8 feet in height, that extends for a distance of 170 feet.

Type: Clay
pH: 5.95

Unfired strength: Very low

Raw Properties: Not plastic, short and sandy working, requires 26 percent water of plasticity, no drying defects, 7.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff red	Soft crumbly	9.0	20.0	2.77
2000	Buff red	Soft crumbly	10.5	18.9	2.77
2100	Lt. brown	Soft crumbly	10.0	17.8	2.75
2200	Brown	Soft crumbly	10.0	17.1	2.73
2300	Med. brown	Soft crumbly	10.0	17.5	2.73
2400	Dk. brown	Soft crumbly	10.0	17.2	2.69

Bloating Test: Negative

Potential Use: None

SAMPLE: R-1726

County: Rockbridge

Locality: Exposure, 4.3 miles southwest of Buena Vista, on the southeast side of U. S. Highway 501 at the intersection with State Road 792.

Description: The sampled portion of the exposure consists of about 90 feet of grayish-red and light olive-gray shale and interbedded thin layers of fine-grained yellowish-orange cross-bedded sandstone. The light olive-gray shale weathers to form yellowish-gray peg-shaped fragments, and the grayish-red shale weathers to form angular fragments. One prominent joint set, which has a strike of N. 30° E. and a dip of 75° SE., is present. Some of the joint planes have been stained rusty brown by iron oxide. The rocks have a strike of N. 10° W. to N. 10° E. and a dip of 25° SW. to 30° NW. The shale was sampled to the base of a zone of weathered shale in the southwestern part of the exposure. An overburden of soil, 2 feet in thickness, is present.

Formation or age: Rome formation

Sampled interval: Sample across 85 feet of shale

Type: Shale

Unfired strength: Very low

pH: 7.15

Raw Properties: Not plastic, short, and gritty working, requires 20 percent water of plasticity, no drying defects, 2 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx. Sp. Gr.
			Shk.	% Abs.	
1800	Buff brown	Soft crumbly	2.0	16.6	2.63
2000	Red brown	Hard	7.5	8.6	2.60
2100	Dark brown	Very hard	9.5	4.2	2.52
2200	Dark brown	Glazed	Expanded	—	—

Bloating Test: Slight

Potential Use: Might make fair lightweight aggregate by sintering process.

SAMPLE: R-1911

County: Rockbridge

Locality: Clay pit of Locher Brick Co., Inc., located on the north side of State Highway 130 about 1.5 miles west of Glasgow.

Formation or age: Quaternary

Sampled interval: Composite sample of light-gray clay from company stockpile believed to be representative of clay in pit.

Composition: X-ray and Petrographic Analysis

	<u>Approx. %</u>		<u>Approx. %</u>
Quartz	70 - 75	Sericite (mica)	8 - 10
Montmorillonite	3 - 5	Feldspar	Altered
Kaolin (type)	10 - 15	FeO	0.5±

Raw Properties: Plastic, fairly sticky, slightly gritty, requires 24.0 percent water of plasticity, no drying defects, 5.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Lt. ivory to off-white	Soft crumbly	3.5	16.9	2.63
2000	Lt. ivory to off-white	Soft crumbly	5.5	15.4	2.63
2100	Ivory	Fairly hard	9.5	12.1	2.59
2200	Lt. ivory buff	Very hard	11.5	7.01	2.49
2300	Lt. buff gray	Steel hard	11.5	4.1	2.42
2400	Gray	Steel hard	11.5	2.7	2.40

Bloating Test: Negative

Potential Use: Chemical stoneware, pottery, decorative brick and tile, and chimney flue tile.

SAMPLES: R-1912 and 1913 *County:* Rockbridge

Locality: Clay pit of Locher Brick Co., Inc., 2.8 miles southwest of Natural Bridge, on the south side of State Road 608 at the Rockbridge-Botetourt county line.

Formation or age: Quaternary

SAMPLE R-1912

Sampled interval: Composite sample of grayish-orange and pale yellowish-brown clay from company stockpile believed to be representative of clay in pit.

Type: Clay

Unfired strength: Average

pH: 7.3

Raw Properties: Very plastic, slightly short, sticky and gritty working, requires 23.2 percent water of plasticity, no drying defects, 5.5 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Dk. orange buff	Soft crumbly	5.5	16.0	2.61
1900	Dk. orange buff	Soft crumbly	6.0	14.8	2.61
2000	Dk. buff	Hard	6.0	13.7	2.60
2100	Lt. brown	Very hard	7.0	11.1	2.58
2200	Dk. brown	Steel hard	10.0	6.8	2.46
2300	Gray brown	Steel hard	10.0	2.9	2.32

Bloating Test: Negative

Potential Use: Brick, sewer pipe (?)

SAMPLE R-1913

Sampled interval: Sample is a blend of 90 percent R-1912 and 10 percent R-1911 by weight.

Type: Clay
pH: 8.0

Unfired strength: Average

Raw Properties: Very plastic, sticky, gritty, and slightly fatty working, requires 26.0 percent water of plasticity, no drying defects, 5.0 percent drying shrinkage.

Fired Properties:

Temp. °F	Color	Hardness	% Lin.		Approx.
			Shk.	% Abs.	Sp. Gr.
1800	Orange buff	Soft crumbly	4.0	16.1	2.62
1900	Orange buff	Soft crumbly	6.0	15.2	2.62
2000	Lt. brown	Fairly hard	6.0	14.1	2.62
2100	Rich brown	Steel hard	10.0	10.6	2.58
2200	Dk. brown	Steel hard	10.0	5.9	2.45
2300	Brown gray	Steel hard	10.0	3.8	2.29

Bloating Test: Negative

Potential Use: Brick, sewer pipe (?)