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STRUCTURAL CLAY PRODUCTS INDUSTRY

ROBERT S. WOOD

Bricks were first made by hand in Virginia about 350 years ago. In the beginning of the twentieth century brick plants had limited production and later they were enlarged or became obsolete because of improved methods in the technology of brick manufacture. At present modern plants produce large quantities of brick that have uniform size and smooth texture. The trend toward increased production has not been deterred in that there were 68 brick plants in 1911 and now in 1962 there are 13 brick plants and one tile plant in operation. These plants are located throughout Virginia (Figure 1).

The Webster Brick Co., Inc., Suffolk, and the Colonial Brick of Williamsburg, Inc., Five Forks, produce brick in the Williamsburg-Norfolk area. Redford Brick Co., Daniels Brick and Tile Co., Inc., and Southside Brick Works, Inc., operate plants in the Richmond area. The Brick and Tile Corp. is located at Lawrenceville in Brunswick County. Brick plants located in the northern part of the State include Webster Brick Co., Inc., at Somerset, Woodbridge Clay Products Co., near Manassas, and Shenandoah Brick and Tile Corp. in Winchester. Three producers operate plants in the Lexington-Roanoke area: Locher Brick Co., Glasgow; Webster Brick Co., Inc., Webster; and Old Virginia Brick Co., Inc., Salem. Brick plants operating in southwestern Virginia include Appalachian Shale Products Co. near Marion and General Shale Products Corp. in Richlands.

In 1960 Virginia producers used 1,347,766 short tons of clay valued at $1,394,655 in the production of structural clay products. The products manufactured included common brick, face brick, decorative brick, drain tile, flue tile, and pottery.

Raw Materials

Clays have a wide range of physical and chemical properties and specifications of clay for brick manufacture depend upon the type of finished product desired and the manufacturing process used. Important properties in evaluating each clay include plasticity, workability, drying characteristics, drying shrinkage, fired shrinkage, absorption, and fired color.

Manufacturers usually blend two or more clays to improve the quality of the finished product. Each clay possesses certain properties, for example, one may have poor working properties but low shrinkage, another may have excellent working properties but high shrinkage. When combined, the mixture will have desirable properties for a fired product.

Clay is an abundant naturally occurring material that is derived from the weathering of preexisting rocks. A clay may be classified on the basis of its occurrence as residual or transported. A residual clay is one which remains essentially in place after it is formed by the weathering of the parent rock. Transported clays are those carried from their place of origin in solution and

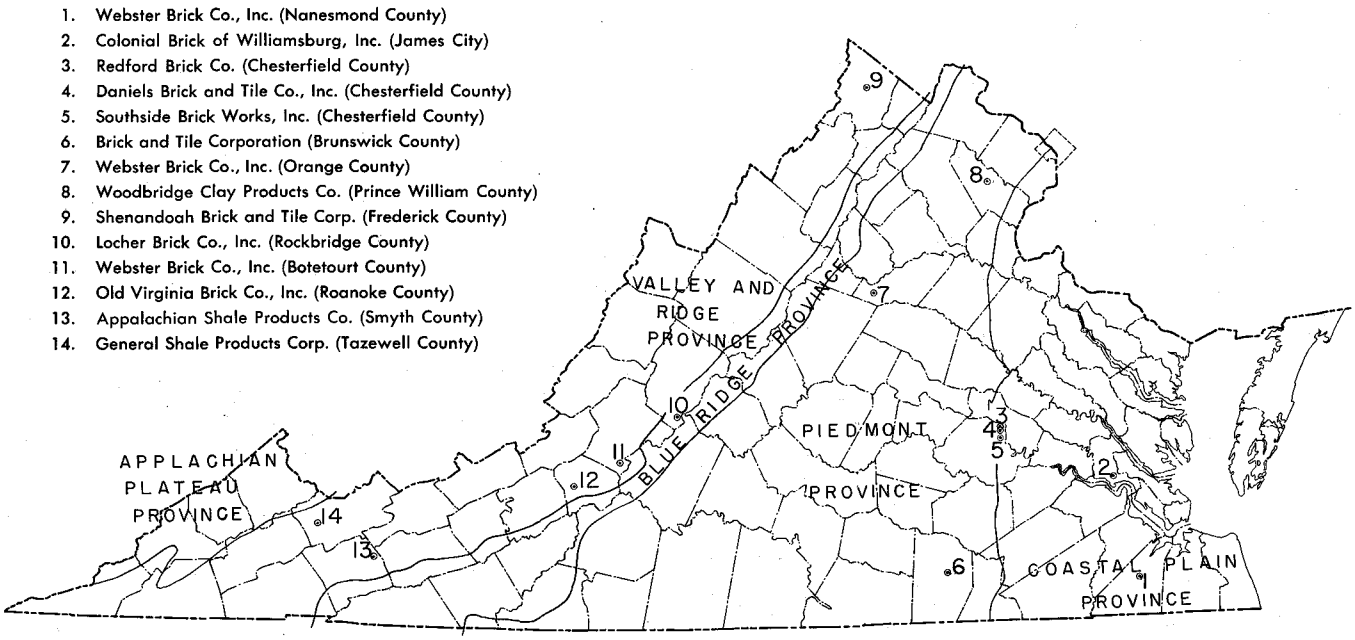

Figure 1—Location of brick and tile plants in Virginia.

suspension by running water and deposited in seas, lakes, stream courses, lagoons, deltas, and swamps. The characterstics of a clay may be modified by later geologic events. Compaction of a clay resulting from the increased weight of overlying sediments may harden it sufficiently to form a shale or mudstone. Under conditions of increased pressure and temperature a shale or mudstone may be ultimately transformed into slate, phyllite, or schist. Any of the above source materials may be used in the manufacture of structural clay products and are obtained from localities throughout Virginia (Figure 1). Production in the Coastal Plain province is from clay of Pleistocene age which occurs as a thin veneer that overlies older sediments. In the Richmond area, the Daniels Brick and Tile Co., Inc., the Redford Brick Co., and the Southside Brick Works, Inc., mine clay of Pleistocene age which is exposed along the James River. Clay of probable Pleistocene age (Figure 2) is used by the Colonial Brick of Williamsburg, Inc. and the Webster Brick Co., Inc., Suffolk plant.

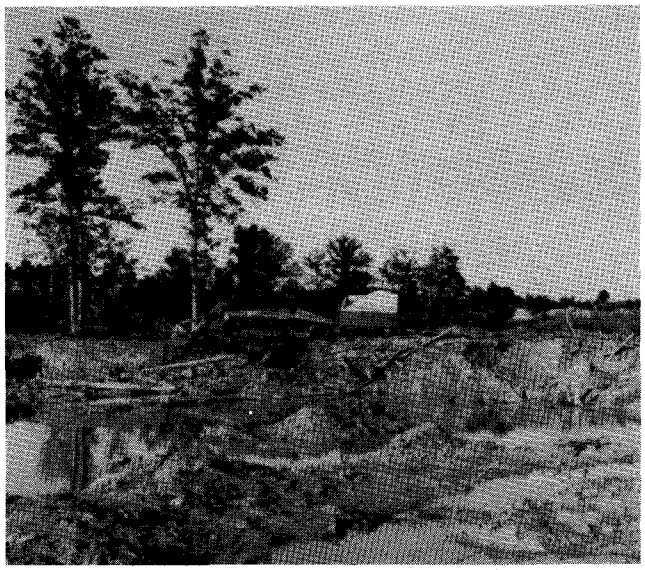

Figure 2—Clay pit, Webster Brick Co., Inc., Suffolk

Six companies are mining raw materials for brick manufacture in the Piedmont province. Shale and mudstone of Triassic age are quarried by the Woodbridge Clay Products Co., and the Webster Brick Co., Inc., Somerset (Figure 3). Schist is mined by the Redford Brick Co. and the Southside Brick Works, Inc., from a jointly owned quarry located near Winterpock, Chesterfield County, and by the Daniels Brick and Tile Co., Inc., from a quarry near Poole Siding, Dinwiddie County. Each of these companies blend the schist with Pleistocene clay to produce a mixture suitable for firing into ceramic products. The Brick and Tile Corp., Lawrenceville, quarries weathered schist from one locality and clay from three localities; the clay may be blended with the schist to produce a mixture having characteristics suitable for brick manufacture.

Clay materials of Cambrian, Ordovician, Devonian, and Quaternary ages are used in the manufacture of brick in the Ridge and Valley province. The Appalachian Shale Products Co., the Old Virginia Brick Co., Inc., and the Webster Brick Co., Inc. quarry shale from the Rome formation of Cambrian age. Shale from the Martinsburg formation of Ordovician age is used by the Shenandoah Brick and Tile Corp. Shales of Devonian age are mined by the General Shale Products Corp. and the Old Virginia Brick Co., Inc., and clay of Quaternary age by the Locher Brick Co., Inc.

Processes

The methods of processing clay materials vary with the characteristics of the raw materials used, the type of finished product desired, and the individual preference of the manufacturer.

Primary crushing, the initial processing of the raw materials to reduce the fragments to less than three inches in size, is accomplished by a single- or a double-roll crusher, a disintegrator, or a hammer mill. Secondary crushing is accomplished by smooth rolls, a dry pan, a disintegrator, or a hammer mill. The pulverized material passes through heated vibrating screens that remove the coarser fragments which are returned on a conveyor belt to the secondary crushing system. The screened material is carried by conveyor belt to surge bins for storage.

Figure 3—Shale quarry, Webster Brick Co., Inc., Somerset

The pulverized clay mixture is used in the soft mud process and the stiff mud process of manufacture (Table 1).

Table 1. Methods of manufacturing used in the production of brick and tile.

Company	*Location*	*Raw Materials*	*Process Used*	*Type of Kiln*	*Fuel*
Appalachian Shale Products Co.	Groseclose	Shale	Stiff mud	Tunnel	Oil
Brick and Tile Corp.	Lawrenceville	Schist & clay	Stiff mud	Tunnel	Oil
Colonial Brick of Williamsburg	Five Forks	Clay	Soft mud	Scove	Wood
Daniels Brick and Tile Co., Inc.	Richmond	Clay & schist	Stiff mud	Intermittent	Natural Gas
General Shale Products Corp.	Richlands	Shale	Stiff mud	Intermittent	Coal
Locher Brick Co., Inc.	Glasgow	Clay	Stiff mud & soft mud	Intermittent & tunnel	Natural gas, coal & wood
Old Virginia Brick Co., Inc.	Salem	Shale	Stiff mud & soft mud	Tunnel	Natural gas
Redford Brick Co.	Richmond	Schist & clay	Stiff mud & soft mud	Intermittent & tunnel	Natural gas
Shenandoah Brick and Tile Corp.	Winchester	Shale	Stiff mud & soft mud	Tunnel	Natural gas
Southside Brick Works, Inc.	Richmond	Schist & clay	Stiff mud	Tunnel	Natural gas
Webster Brick Co., Inc.	Roanoke	Shale	Stiff mud	Tunnel	Natural gas
Webster Brick Co., Inc.	Somerset	Shale & mudstone	Stiff mud & soft mud	Tunnel	Natural gas
Webster Brick Co., Inc.	Suffolk	Clay	Stiff mud	Intermittent	Natural gas
Woodbridge Clay Products Co.	Manassas	Shale & mudstone	Stiff mud	Tunnel	Natural gas

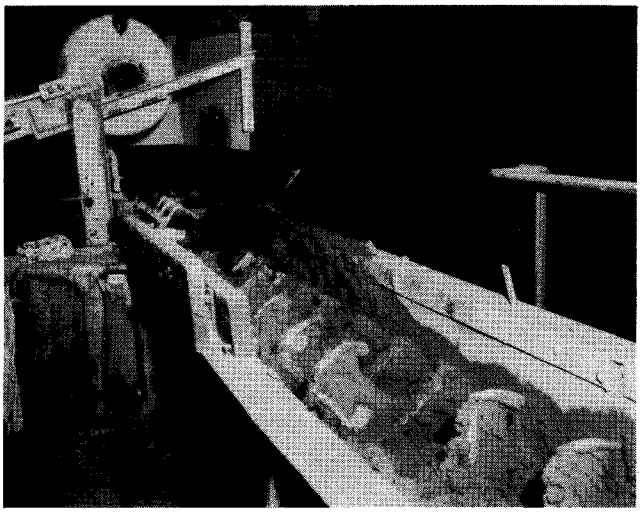

Figure 4—Pug mill used in the soft mud process, Redford Brick Co., Richmond

In the soft mud process, the pulverized clay mixture is tempered with water in a pug mill (Figure 4) until a homogenous, soft plastic mass is formed. The mill consists of a semi-cylindrical trough containing one or two power-driven bladed shafts. The blades blend the clay mixture with water and move it to the molding machine in which bricks are shaped (Figure 5).

In machine molding, the plastic clay is forced with a plunger into sand-coated wooden or steel molds. As the mold is ejected from the brick machine, the excess clay is struck off and the mold is jarred to loosen the brick. The bricks are discharged automatically onto steel pallets

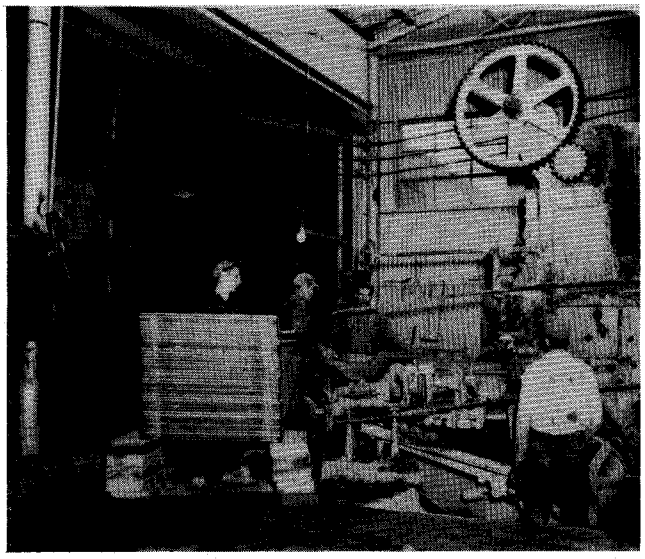

Figure 5—Soft mud brick machine, Old Virginia Brick Co., Inc., Salem

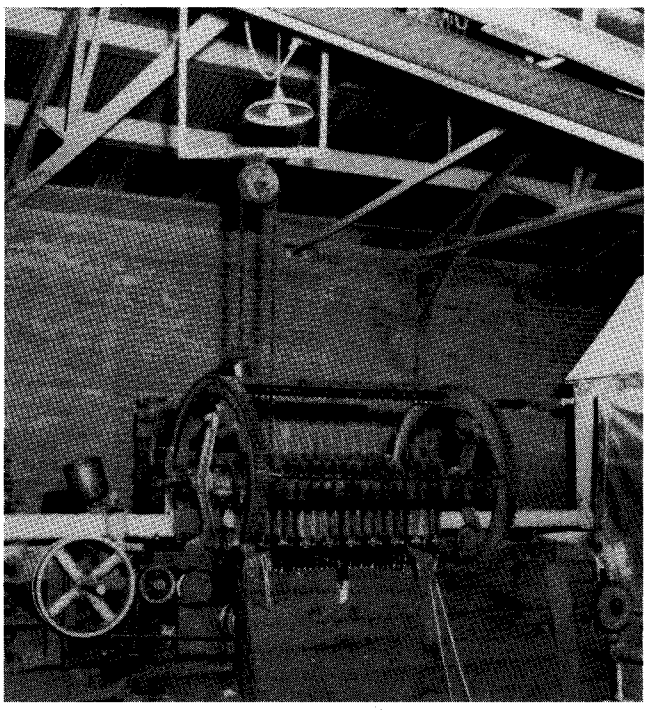

Figure 6—Extruded column of clay and cutting table, Webster Brick Co., Inc. Suffolk

that are loaded on specially designed racks of dryer cars. In hand molding, the plastic clay is thrown into sand-coated wooden molds. The excess clay is wiped off by a board drawn across the mold and the bricks are discharged onto a steel pallet by inverting the mold. The pallets are loaded onto the dryer cars or the bricks may be stacked on wooden racks for air drying.

In the stiff mud process one or two pug mills are used to blend the pulverized clay with sufficient water to form a homogenous stiff plastic mass. A revolving sealing auger attached to the central shaft of the pug mill forces the plastic clay through a shredder into a "deairing" chamber in which a partial vacuum is maintained. The deairing chamber produces high strength in both the green and fired brick, and increased workability. After the clay passes through the deairing chamber it is forced by a spiral auger through an oil lubricated die into a column that has the desired shape for brick or tile. As the clay column is extruded from the die, various devices are used to produce an ornamental surface. The column is moved by a conveyor belt to the cutting table where it is sliced by a series of tightly drawn wires (Figure 6). From the cutting table, the bricks are loaded on kiln cars to be dried and fired.

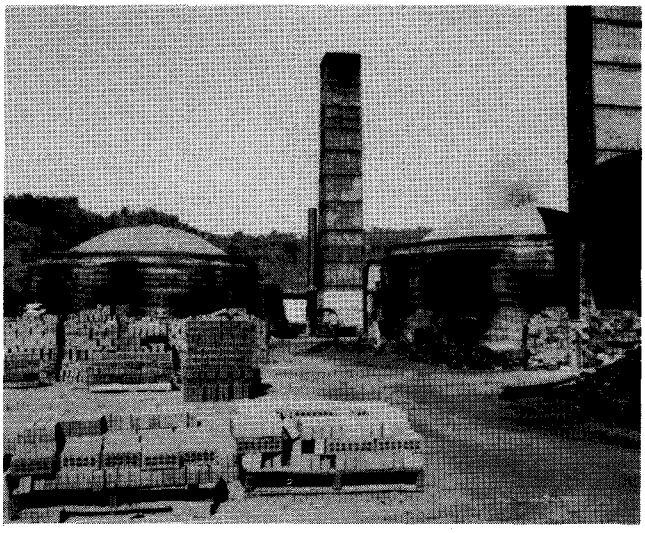

Figure 7—Intermittent kilns, General Shale Products Corp., Richlands

The clay products are dried in tunnel driers or drying rooms under controlled temperature and humidity. Tunnel driers are closed masonry structures generally more than 100 feet long. Kiln cars loaded with unfired, or green, bricks are passed slowly through the drier. The bricks are dried by heat exhausted during the cooling cycle of a tunnel kiln or an intermittent kiln. In some plants, additional heat for drying is supplied by supplemental burners. The temperature reached during drying is usually less than 400° F. In a tunnel dryer 18 to 48 hours are required for the bricks to dry.

At the Daniels Brick and Tile Co. plant, moisture is removed from unfired tile by a controlled steam drying process in a closed room. The tile is stacked by hand on wooden forms that are moved by a fork lift to the drying room where a temperature of 240° F. is maintained by steam heat. Drying requires approximately three days. After drying, the tile is transported by fork lift to an intermittent kiln.

The dried clay products are fired in either a down-draft intermittent kiln or a tunnel kiln. The intermittent kiln (Figure 7) is a circular (bee hive) or rectangular shaped masonry structure lined with fire brick and having permanent walls and a tight roof. Natural gas, coal, or wood are used as fuel in firing intermittent kilns. Vertical flues located in the interior of the kiln carry heat from the fire boxes to the top of the structure. The floor of the kiln contains openings that are connected to an underground flue system leading to a stack. After the dried clay products are stacked inside the kiln, (Figure 8) the access door is sealed with brick and mortar, and the kiln is fired to a temperature usually under 2100° F. for 79 to 96 hours. A subsequent cooling period of 48 to 96 hours is required.

The tunnel kiln offers greater heating efficiency, a more uniform product, greater control over the firing process, and less handling of the fired and unfired bricks. A tunnel kiln, a long tunnel-shaped furnace, may be 350 feet long and has four sections. Cars loaded with dried bricks are moved on a track into the interior of the kiln. In the first section, or charging portion, the bricks are warmed by hot air drawn through a duct system leading from the last section, or cooling end, of the kiln. The warm air is circulated around the bricks by fans. Next the loaded kiln cars are passed into a preheating zone where the bricks are heated by hot air drawn from the firing zone and from oil or gas preheating burners. From the preheating section the bricks are passed to the main firing zone of the kiln where oil or gas side burners are used to fire the bricks at a temperature of approximately 2000° F. The fired

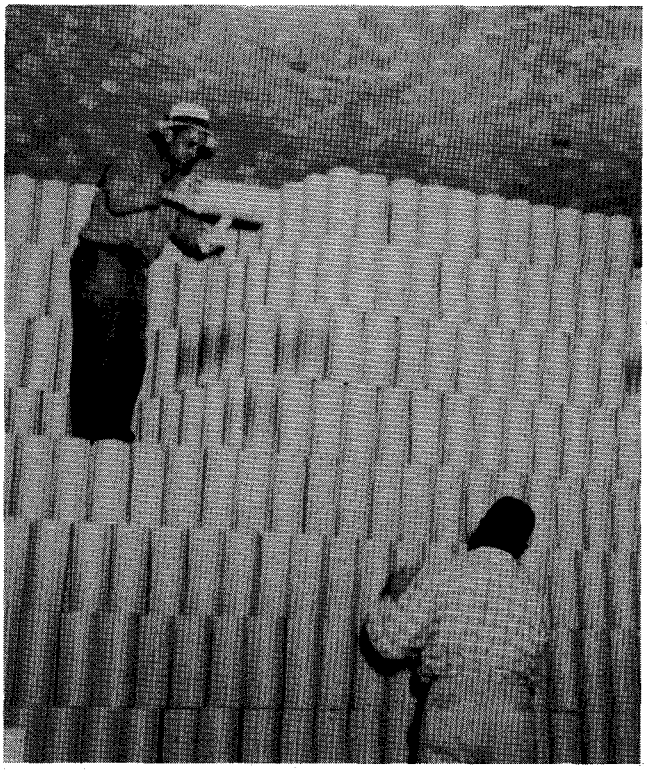

Figure 8—Loading tile in an intermittent kiln, Daniels Brick and Tile Co., Inc., Richmond

bricks then are moved into the cooling section where the temperature of the bricks is lowered by forced cool air and are relatively cool by the time the kiln cars are discharged (Figure 9).

After the fired products have cooled sufficiently, they are transported to the plant yard for packaging. Bricks are packaged in units that can be handled by a fork lift or by a pack hauler. The fork lift is used to load the packaged unit on flat bed trailers or on railroad boxcars. Tile is placed by hand on wooden forms that can be picked up by a fork lift.

The structural clay products industry of Virginia produces brick of different sizes, shapes, textures, and colors to meet both architectural and public demands. Textured bricks (Figure 10), smooth-face bricks, sand-finished bricks, and clay-finished bricks are among the varieties available; colors include various shades of red, brown, tan, and yellow. The standard-size brick measures 2¼″ × 3¾″ × 8″. Some manufacturers produce Roman bricks, 1⅝″ × 3¾″ × 11½″, and Norman bricks, 2¼″ × 3¾″ × 11½″ in size. A few companies produce bricks of special sizes and shapes including glazed headers, water table bricks, and beveled bricks.

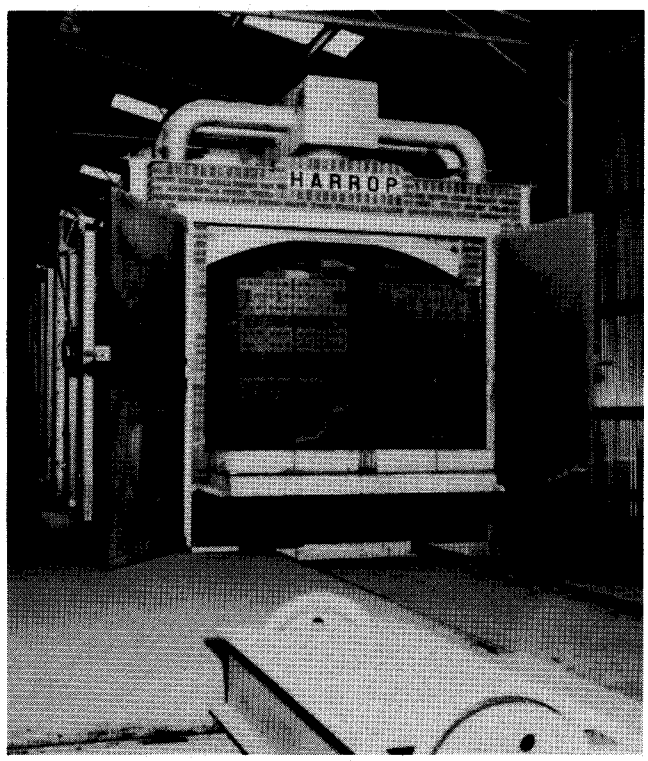

Figure 9—Fired bricks emerging from a tunnel kiln, Old Virginia Brick Co., Inc., Salem

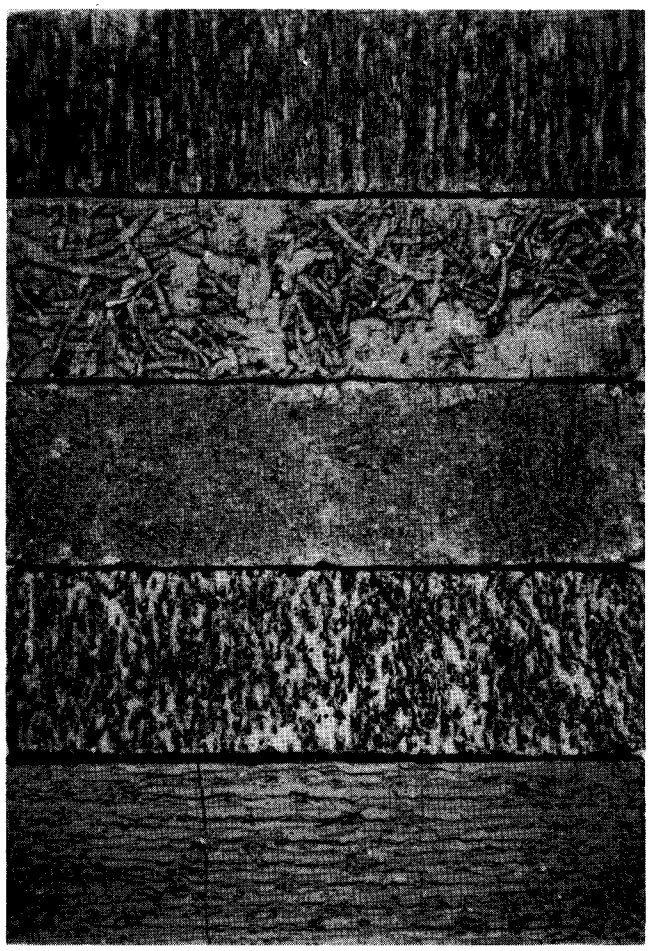

Figure 10—Some examples of face brick showing ornamentation

The Daniels Brick and Tile Corp. make drain tile and flue tile. This company manufactures drain tile 4″, 5″, 6″, and 8″ in diameter. Flue tile is manufactured by using the stiff mud process. Sizes of tile include 8″ × 8″, 8″ × 12″, and 12″ × 12″ rectangular sections. It is used for lining brick and masonry chimneys.

Flower pots and saucers are made by the Southern Pottery, Richmond. In the manufacturing process, the clay is initially reduced in size in a hammer mill, screened, and blended with water in a pug mill. The plastic clay is shaped by machine (Figure 11) and placed in a tunnel dryer for 16 hours. The dried shapes are fired to 1850° F. in either a tunnel kiln for 28 hours or in a shuttle kiln for 15 hours. A subsequent cooling period of from 12 to 18 hours is required before the flower pots and saucers may be handled.

Pottery is produced by hand methods at Colonial Pottery, Inc., Toano, and the Williamsburg Pottery, Lightfoot (Figure 12).

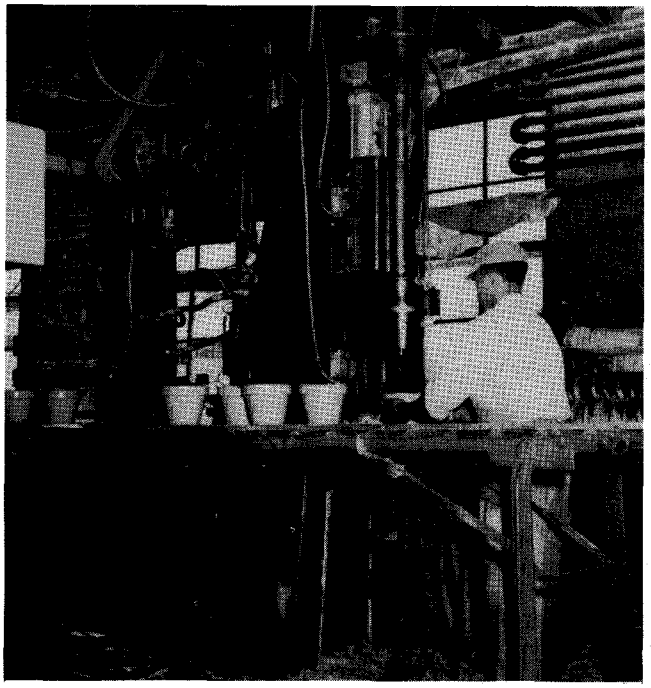

Figure 11—Machine used in shaping flower pots, Southern Pottery, Richmond

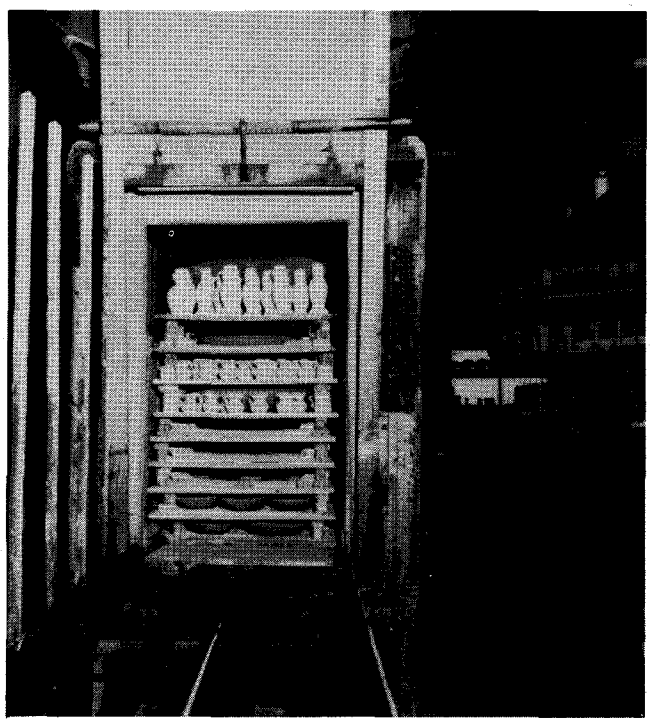

Figure 12—Earthenware stacked in furnace, Williamsburg Pottery, Lightfoot

The wholehearted cooperation of the companies mentioned in this article is acknowledged with appreciation.

New Publication

Min. Res. Rept. 3. MICA AND FELDSPAR DEPOSITS OF VIRGINIA by William Randall Brown. 195 p. Price: $2.00

Mica and feldspar have been produced commercially from pegmatites in Bedford, Amelia, Henry, Prince Edward, Charlotte, Pittsylvania, Cumberland, and Powhatan counties of Virginia. Mica, but as yet no feldspar, has also been produced from pegmatites in Franklin, Hanover, Goochland, Louisa, and Spotsylvania counties. By-product minerals, and locally the main mineral, of pegmatite mining include kaolin, quartz, beryl, columbite-tantalite, and gem and specimen minerals. Feldspar, in addition to extraction from pegmatites, has been recovered in considerable quantity from alaskite-syenite deposits in northwestern Bedford County; and aplite, with the same uses as feldspar, has been and is being quarried on a sizable scale in Nelson and Amherst counties.

Pegmatites, from which all of the mica and most of the feldspar in the State are produced, are unusually coarsely, and generally irregularly, crystallized bodies of igneous rock minerals, chiefly feldspar, quartz, and mica. The minerals in most commercial bodies tend to be more or less segregated into zones, a factor which greatly aids in exploration and exploitation of the deposits. Sheet mica is recovered mainly from wall zones, whereas feldspar is taken chiefly from coarser inner (intermediate) zones; quartz comprises the core of most bodies.

The alaskite-syenite deposits of Bedford County, which are quite different from the pegmatitic feldspar deposits, are granitoid rocks which appear to belong to the ancient crystalline complex of the Blue Ridge structural province. This association and certain other features suggest a kinship with the aplite (anorthosite) mass of Nelson and Amherst counties.

The outlook for continued large production of feldspar in the State appears to be very good, especially in view of the probable use of flotation and other methods of extraction which can make formerly unworkable deposits economic. High quality mica is still available at many mines in the State, but sizable production is not to be expected until unusually high prices again prevail.

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Numerous deposits, especially in Amelia and Franklin counties, however, appear presently to offer the possibility of economic operations for scrap and electric sheet mica.

Staff Changes of Virginia Division of Mineral Resources

Dr. Seymour (Samuel) Greenberg joined the Division on February 16, and will assist in petrographic and mineralogic studies. Previously he was employed by the Indiana Geological Survey where he published articles in sedimentary petrology, particularly clay mineralogy. Dr. Greenberg received his B. A. degree from Brooklyn College and A.M. and Ph.D. degrees from Indiana University. He served with the U. S. Army in Germany from 1953-55. He is a member of Geol. Soc. America, Soc. Econ. Paleontologists and Mineralogists, Min. Soc. America, Canadian Min. Soc., British Min. Soc. and Sigma Xi.

On February 16, Dr. Robert C. Milici began employment with the Division of Mineral Resources. He is compiling a new map of the geology of Virginia and will direct the stratigraphic studies including the determination and distribution of the various rock units found in the State. He graduated from Cornell University with an A.B. in Geology; he received his M. S. and Ph.D. in Geology from the University of Tennessee in 1955 and 1960, respectively. Dr. Milici was an instructor in Geology at the University of Tennessee 1955-58, and a geologist with the Tennessee Division of Geology 1958-62. He is married and has two children.

Mr. John M. Wilson has recently joined the Division Staff and is preparing an index to the geologic maps of the State which are greater than 1:24,000. He will help in preparation of geologic maps. While studying for a B.A. degree in Geology, which was obtained from Vanderbilt University, he was a laboratory assistant at that University. He was formerly employed with the U. S. Geological Survey, Ground Water Branch, in Nashville, Tennessee. He is married and has a daughter.

Mineral Industry News Notes

The Adams Construction Company is producing sand and gravel near Stony Creek, Sussex County, for use in paving and other road work. Part of the output is used by a company that manufactures concrete pipe.

J. B. Earle is operating a quarry in quartzite five miles east of Front Royal, Warren County, for the production of road aggregate and fill material.

The Benns Church Sand Company is producing sand at Benns Church, Isle of Wight County, for building purposes.

The E. G. Kenney Jr. Lime Company has ceased operations at its marl deposit east of Berryville and is now producing from a marl deposit near Millwood, Clarke County.

In February 1962, the W. E. Graham and Sons Division, Vulcan Materials Company, purchased and is operating the quarry of the Royal Stone Company in eastern Goochland County. This division has quarries in Fairfax, Halifax, and Mecklenburg counties.

The Honaker Sand Company produces sand from the Russell Fork River at Birchleaf, Dickenson County, for building purposes and for use by the coal industry. The company acquired this operation from the Paul Wright Sand Company in 1961.