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COKING INDUSTRY IN VIRGINIA

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Coke is a complex solid that is obtained from the heating of coal in the absence of sufficient air for complete combustion in a process known as carbonization. The material is gray-black to silvery gray, porous and brittle, and produces intense heat without smoke when it burns. Coke is more homogeneous than coal and is composed largely of carbon and hydrogen with minor oxygen, nitrogen, and sulfur. This product of carbonization, which is intermediate between coal and graphite, is an important industrial commodity. The carbonization process is accomplished either in byproduct or in nonrecovery ovens. The distinction between the two types of ovens depends on whether use is made of the volatiles that are given off from the burning coal during carbonization. Byproduct ovens capture the volatiles, which are a source of numerous commercial products, such as ammonia, crude tar, coal gas, crude oil, and oil derivatives. Nonrecovery ovens do not recover the liberated volatiles. The three coke producers currently operating in Virginia, Christie Coal and Coke Company, Inc., Jewell Smokeless Coal Corporation, and Westmoreland Coal Company, use nonrecovery ovens of the simple beehive and Mitchell types. The United States Bureau of Mines uses the term "beehive" to refer to all coke ovens that do not utilize the volatiles released during coking. Distinctions are made between the types of beehive ovens currently producing coke in Virginia.

Coking of coals for industrial use in the United States began in the latter part of the nineteenth century. In 1893, beehive and byproduct coke production was 9,477,580 tons, and the output steadily rose to 56,977,534 tons by 1923. (All production data are from annual editions of the U. S. Bureau of Mines Minerals Yearbook.) A decline in production began in 1924 and lasted until World War II. The war brought increased coke production because of the necessity for a great quantity of iron and steel products. Production of coke since the end of World War II has been fairly stable. Coke production in the United States during 1966 was 67,401,590 tons; of this amount, 65,959,298 tons (97.7 percent) were produced in byproduct ovens. The average value per ton for coke produced in 1966 was $15.16 for beehive coke and $17.35 for byproduct coke. During 1966 a total of 309,246 tons of coke was produced in Virginia, with an average value of $15.56 per ton. In that year coke was produced by five companies which utilized 772 ovens at six plants. Market distribution of coke produced in Virginia in 1966 was as follows: foundries, 33.28 percent; blast furnaces, 30.64 percent; other industrial plants, 36.06 percent; and residential heating, 0.02 percent. The latest available figures indicate the total coke production in Virginia for 1967 as 466,677 tons with three plants in operation at the end of the year. Data pertaining to the production of coke in Virginia for the period 1940-66 are presented in Table 1.

Table 1.—Beehive coke production in Virginia. (Data from annual editions of U. S. Bureau of Mines Minerals Yearbook.)

	No. of Plants	Total No. of Ovens	Coke Produced (short tons)
1940	8	1284	198,379
1941	8	1286	324,573
1942	5	753	350,521
1943	5	751	293,324
1944	5	753	243,116
1945	5	749	191,032
1946	5	750	171,242
1947	5	750	211,876
1948	5	750	200,911
1949	5	750	157,812
1950	5	750	197,879
1951	5	748	287,116
1952	5	848	202,328
1953	5	848	188,033
1954	4	482	72,092
1955	4	483	140,555
1956	4	483	165,968
1957	4	483	202,958
1958	5	663	153,828
1959	5	663	179,595
1960	5	663	180,435
1961	5	663	174,105
1962	5	667	109,455
1963	6	877	83,141
1964	6	877	167,446
1965	6	759	264,313
1966	6	772	309,246

Over 90 percent of the coke produced in the United States is utilized in blast furnaces of the iron and steel industry. Most of the remainder is consumed in foundries and in industrial plants for chemical processing and for manufacture of industrial gases; a minor percentage is used for residential heating. Coke breeze, which is less than one-half inch in size, is used mainly as a boiler fuel and as a reductant in electric furnaces that smelt phosphate rock to produce elemental phosphorus.

Coke plants are generally located in areas where suitable coking coals are readily available. The plants may be within the coal-mining areas, or at steel mills to which coking coals may be conveniently transported. The principal mining of bituminous coking coals in the United States is in the Appalachian coal region from Pennsylvania to Alabama, and the coals utilized for coking are of Pennsylvanian age. Alabama, Kentucky, Pennsylvania, West Virginia, and Virginia have been the largest suppliers of these coking coals.

Coke plants are operated close to the coal-source area basically for economic reasons. The plants either utilize coal from captive mines or purchase coal from a supplier. Many steel mills operate their own coke plants outside the coal-producing areas, in which case the coking coals must be transported to the coke plant. Some steel companies hold all or part interest in the coal mines that supply raw materials for their coke. A captive operation permits the coke producer to maintain the desired quality control for coal utilized in the coking operation and also insures a ready supply for plant operation when demand for coal is increased. Coals that are used for conversion to metallurgical coke must meet certain specifications established by the coke plant in which they are used. The specifications are dependent on the operating conditions of the plant, the coking coals available, and the restrictions imposed by consumers served.

One of the most important and difficult problems of the coking industry is that of uniformity in the raw material and in plant operating conditions. Many different oven designs have been proposed to solve the problem of nonuniform heating during carbonization due to nonuniform coal. Undesirable effects that may arise from nonuniform heating include increased coking time and hence diminished total output, increased heat consumption in the ovens, a wide range in mechanical properties, and reduced yield of chemical coking products. The quality of the finished coke is dependent upon many properties, such as size, strength, porosity, density, and the ash, sulfur, phosphorous, moisture, and volatile content. The best coke for blast-furnace use is uniform in size, strength, structure, and chemical composition. This uniformity is necessary in order to insure a smooth and economical blast-furnace operation that will efficiently reduce the ore and supply heat to melt the metal.

In Virginia, beehive coking came into use during the latter part of the nineteenth century. At first the oval beehive ovens were constructed from clays. Later, the clays were supplanted by masonry and fire brick as construction materials. The ovens were lined with fire brick and the space between the lining and the outside wall filled with waste brick in order to minimize the loss of heat. Present plants in Virginia are basically modifications of this type of oven. Coke production in Virginia currently is confined to Buchanan and Wise counties. The Norton and

Wise formations of Pennsylvanian age are the main sources of the coking coals utilized in Virginia. Large tonnages of Pocahontas coal from the Lee Formation are mined in Buchanan County for out-of-State shipment.

Christie Coal and Coke Company, Inc.

Christie Coal and Coke Company, Inc. operates 70 beehive ovens just west of U. S. Highway 23 at Esserville in Wise County (Figure 1). One hundred of these ovens were originally built at this site by John A. Esser around the time of World War I. The ovens are constructed of brick covered with a reddish clay and are built into the face of a hillside. These ovens are igloo shaped, circular inside, and have only one door. They are approximately 12 feet in diameter inside, with a height of about 8 feet near the trunnel head, or hole in the center of the roof, through which the coal is dumped. The roof slopes to about 6 feet around the sides of the oven.

Figure 1. Original beehive ovens at Christie Coal and Coke Company, Inc.

Seventy-five percent of the coking coal used at the Christie plant is from the Taggart seam. This coal, which is in the lower part of the Wise Formation, contains about 2.75 percent ash. The remainder of the coal used comes from the Lyons seam of the Wise Formation and contains about 6 percent ash. The Lyons coal is crushed and pulverized at Christie's preparation plant, whereas the Taggart coal is used as received. The coals used in the coke ovens at this plant are three-fourths inch and smaller in size.

After the coal has been prepared, it is carried by conveyor belts to the storage bins. Coal is transported as needed from the storage bins to the ovens by a lorry, which is a small coal car that runs on rails located on the roof and back half of the coke ovens. The lorry is filled with coal under the storage bins and moved along the rails to the oven that is to be charged. A charge of approximately 7 tons of coal is dumped into the trunnel head, or opening in the roof of the oven. The opening on the front of the oven is walled in with bricks after the oven is charged with coal. A small space is left at the top of the bricks to regulate the amount of air in the oven. A yellow-red mud, which is prepared by hand, is then used to fill open spaces between the bricks. A small amount of coke breeze is mixed with the mud to enable it to stick more effectively. The coal is ignited by residual heat in the ovens from the previous charge and is carbonized for a 72-hour or 96-hour period at temperatures ranging from 2000° to 2200°F.

After the coal is carbonized, the brick door is broken in with a sledge. Water is sprayed over the hot coke by spray heads attached to a steel pipe that is manually inserted into the hot coke oven. This water is obtained from the Guest River. After the coke is sprayed, it is left to cool for about one-half hour. Then a 12-foot beaver bar, which is a double-strength pipe 1 inch in diameter with a flat tail 4 inches wide at one end, is used to manually pull the coke from the oven. It is shoveled into a flatbed wheelbarrow and dumped onto one of five elevated mechanical belt conveyors that load the coke into hopper cars (Figure 2). About 4 tons of coke are recovered from a charge of 7 tons of coal, and approximately 7 oven loads of coke can be loaded into a hopper car.

The coke is then transported in the hopper cars to the adjacent processing plant where it is crushed, screened, and sized. Coke that is not utilized as 8-inch by 2-inch material is crushed to 2 inches

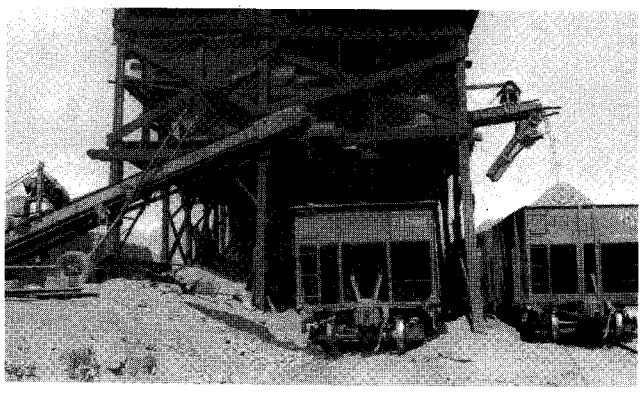

Figure 2. Coke loader and processing plant at Christie Coal and Coke Company, Inc.

and smaller in the primary crusher; fragments larger than 2 inches are recycled back through a secondary crusher before being screened and sized. Sizes of coke produced are 8 inches by 2 inches, 2 inches by 3/4 inch, 3/4 inch by 1/8 inch, and 1/8 inch and smaller.

At present about 60 men are employed at Christie Coal and Coke Company, Inc., and approximately 2200 tons of coke are produced each month. About two-thirds of this material is utilized as metallurgical coke. Some of this is used by consumers in Roanoke and Lynchburg, but most is sent out of State. The plant has shipped coke to Arkansas, Texas, New York, Pennsylvania, and Missouri. Composition of coke produced at this plant since June 1967 is as follows: fixed carbon, 91.44 to 92.41 percent; ash, 6.62 to 6.69 percent; moisture, 1.05 percent; and volatile matter, 0.89 to 0.90 percent.

Jewell Smokeless Coal Corporation

Jewell Smokeless Coal Corporation operates more than 200 Mitchell-type coke ovens just north of the intersection of U. S. Highway 460 and State Road 628, northeast of Vansant in Buchanan County. The Mitchell-type ovens are 6 feet wide, and from the floor of the oven to the trunnel head, the height is about 10 feet 6 inches. The oven doors are constructed of calcined flint and aluminous cement and are reinforced with steel anchor bars. The company is now experimenting with planned expansion cracks which may eliminate door breakage, caused by the vibration and shaking of the hydraulically operated machine used to remove the oven doors. The company is also constructing oven doors made from fire brick, reinforced by steel T-bars.

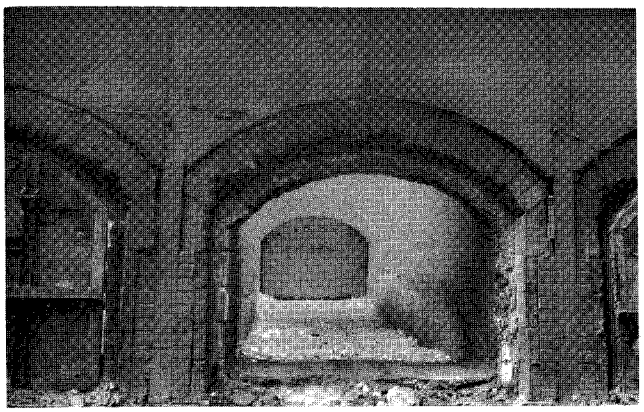

Figure 3. Hot Mitchell-type oven that has just been discharged at Jewell Smokeless Coal Corporation.

This company operates 7 days a week, discharging and charging each alternate Mitchell oven every day (Figure 3). The charge of coal varies from 8 to 13 tons per oven, with an average charge of 10 tons. The coals used at the plant are mined within a 10-mile radius. Presently the Kennedy seam supplies most of the coal for the plant; the Raven (Red Ash), Splash Dam, and Jawbone coal seams have been utilized in the past. All of these seams are in the Norton Formation. The coal contains approximately 70.00 percent fixed carbon, 25.32 percent volatile matter, and 4.68 percent ash on a dry basis. Most of the coal utilized in the coke ovens is 1/4 inch and smaller.

Coal is brought from the mine to the tipple both by rail and by truck. The raw coal is washed, crushed, screened, and conveyed by belt to a storage bin at the north end of the coke plant. The coal is charged to the ovens as needed by a belt conveyor. One man operates a scale at the storage bin and is advised through a short-wave radio system at the plant when to send the coal to recharge the ovens. This operator can set the scale for the desired amount of coal to be charged into the oven. Two doors in the storage bin automatically close when the correct amount of coal is on the belt conveyor leading to a tripper car that runs on rails around the conveyor belt. A chute in the car drops coal into the oven through the trunnel head.

After the oven has been charged, the coal is leveled by a mechanical device on the pusher side of the oven, and a utility car that contains clay material is positioned in front of the door at each end of the oven. This clay is mixed with coke breeze to improve its sticking quality and used to fill the cracks around the oven doors. Holes in the oven doors are then opened to supply the necessary air as burning progresses. The Mitchell ovens are operated at a temperature of approximately 2400° to 2500° F.

After the coal has been carbonized, the mechanical pusher is positioned at the front end of the oven, and a quenching and loading car at the opposite oven door (Figure 4). Through the radio system, the operator of the pusher is told when the car is ready for the coke. The hot material is partly quenched by sprays of water as it is transported up a metal flight conveyor and dropped into a coke car. Water sprayers on the back of the quench car are utilized to further cool the coke. Before reaching the processing plant, the coke is again sprayed with water at a quench-

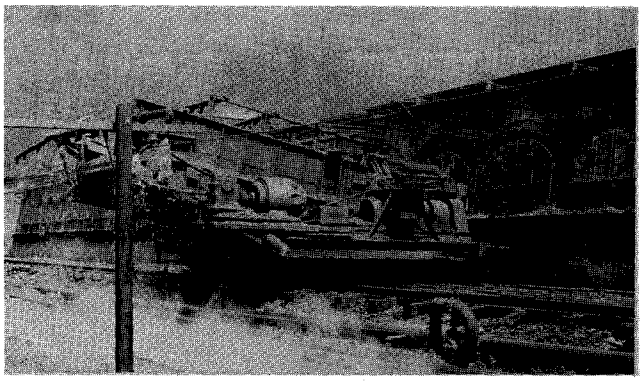

Figure 4. Quench car at Jewell Smokeless Coal Corporation.

ing station. The coke cars are then transported to bins where the material is discharged onto a belt conveyor that contains a weighing device and leads to the processing plant.

At the processing plant, the coke is sized to meet customer specifications. After the coke is sized, it is transported by belt to railroad cars for shipment. Coke production by the Jewell Smokeless Coal Corporation, about 1000 tons per day, is sold primarily to blast-furnace operations.

Westmoreland Coal Company

Westmoreland Coal Company operates a coke plant approximately 15 miles northeast of Big Stone Gap, near Roaring Fork in Wise County. The plant utilizes nonrecovery Mitchell-type ovens, which differ from standard beehive ovens in that they are rectangular in shape and the coke is pushed mechanically, instead of being pulled, from the oven. The company operates three batteries of 60 ovens each. These ovens are 32 feet long and 9 feet high inside. The floor slopes toward the discharge end of the oven, and the door on the discharge end is 7 inches higher and 4 inches wider than the opposite door. This larger door opening aids in making a more effective and complete removal of the coke.

Each working day, alternate ovens are discharged and recharged. About 30 men are employed at the plant, which produces approximately 10,000 tons of coke per month. Coal for coking is removed from the company's Pine Branch mine, which is located near the plant in the Taggart coal seam of the Wise Formation. The average composition of the coal, on a dry basis, is as follows: fixed carbon, 62.30 percent; volatile matter, 35.00 percent; and ash, 2.70 percent.

The coal is transported from the mine along a 1500-foot conveyer belt to the preparation plant. Coal to be used for coking is screened, sized to 1/4 inch and smaller, and cleaned and then transported by belt to the storage area from which it is taken by conveyor belt to the charging bin as needed. Two connected lorries, which run on rails along the back half of the oven roof, are loaded with a weighed amount of coal from the charging bin and then positioned above the ovens to be charged. This two-lorry system allows two ovens to be charged at the same time. The lorries, each of which carries a standard oven charge of 10 tons, first drop one-half of their load into each of the two ovens. Then a mechanically operated leveler bar is run into the ovens to level the coal, and the remainder of the charge is added; this system of charging aids in minimizing heat loss. While the ovens are being leveled, the two lorries, which are operated by one man, may return to the charging bin to be refilled with coal.

After the oven is charged, the mud cars move along rails on each end of the oven. The car on the pusher side is operated by two men, while the mud car on the discharge side is operated by three men. The oven doors are set in place and a yellow-gray mud with a high percentage of clay, extracted from a nearby area, is utilized in filling up the cracks around the doors. Sufficient heat to ignite the coal remains in the oven from the previous charge. Gases from the coal also ignite and burn above it; these burning gases supply additional heat. Oven temperatures range from 2300° to 2400° F. Excess gases are expelled through the top of the oven which is left open during the carbonizing process.

Figure 5. Hot coke in Mitchell-type oven at Westmoreland Coal Company.

When the coke is ready to be removed, the oven doors are manually pulled out by the hangers (Figure 5), breaking the mud seal. The doors are in two sections and the top half is broken out first. Then a quenching device, operated by one man from a machine on rails, is run into the oven above the coke. Mud from the doors is washed away by the water as it runs in a ditch beside the ovens. Some structural damage results to the ovens from this method of quenching. The recharging process follows approximately four ovens behind the quenching car, in order to allow the oven to cool slightly and the process to be carried out more smoothly.

The quenched coke, after it has been allowed to steam for a time, is removed from the oven by a mechanical steel pusher (Figure 6). The coke (approximately 6 tons) is pushed out of the oven into a loader, from which it is transported by a metal flight conveyor with a screen to a hopper car (Figure 7). Above the metal flight conveyor is a counter-conveyor belt with a spike roll that separates out the larger pieces of coke. About four oven loads of coke are required to fill one hopper car. These cars transport coke to the adjacent crushing plant. Oven-run coke (6 inches by 2 inches) for blast furnace utilization is shipped direct, and the rest of the coke is dumped through refractory steel plates in the bottom of the hopper cars into a bin. From this bin, the coke is elevated to the primary crusher where it is crushed and screened; oversize coke is sent through this process again. Three separate railroad cars are used to collect the three different sizes of coke produced: 2 inches by 5/8 inch, 5/8 by 1/8 inch, and 1/8 inch and smaller. There is approximately 60 percent recovery of coke from the original charged coal, depending on the time of year, moisture content, and other factors. The average composition of coke at Westmoreland Coal Company is: volatile matter, 0.85 percent; fixed carbon, 94.65 percent; and ash, 4.50 percent.

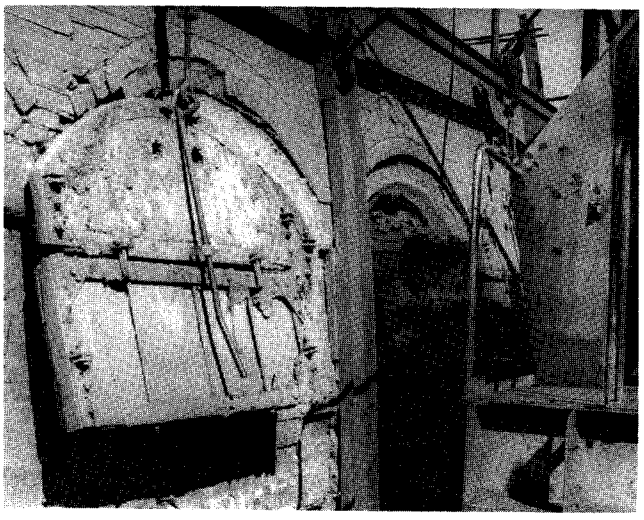

Figure 6. Mechanical pusher in opening of oven door at Westmoreland Coal Company.

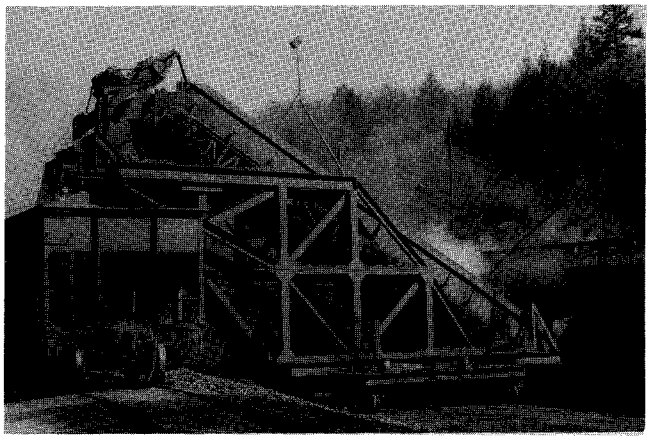

Figure 7. Coke being loaded into hopper car at Westmoreland Coal Company.

The major uses of the coke produced at this plant are in the iron and steel industry, in the chemical industry as a source of carbon and as a reductant, in fertilizers, and for the production of carbide products. About one-third of the company's coke production is shipped to Pennsylvania and the Great Lakes area. About one-sixth of the coke produced is utilized in Florida for the processing of phosphates.

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NEW PUBLICATIONS

Report of Investigations 16. GEOLOGY OF THE MARTINSVILLE WEST QUADRANGLE, VIRGINIA, by James F. Conley and E. Clayton Toewe; 44 p., 1 map in color. Price: $1.75 (plus 4 percent State sales tax).

The Martinsville West quadrangle is located in west-central Henry County in the southwestern Piedmont of Virginia. The quadrangle is underlain by rocks tentatively assigned a Cambrian or Precambrian age which are part of the inner Piedmont belt. They consist of sillimanite-mica schist, interbedded quartzite, biotite gneiss, and amphibolite. In the major downwarped structure in the area, these rocks were partially melted and converted into granite gneiss. This granite gneiss was in turn invaded by small dikes of ultramafic

composition which have been altered to tremolite-talc schists. In possible late Paleozoic time the Leatherwood granite was emplaced, and it was subsequently intruded by Rich Acres Norite. The norite is cut by numerous feldspar-quartz pegmatites. During Late Triassic time diabase dikes were emplaced along zones of fracture. The major structure in the area is the nose and east limb of a northeastward-plunging syncline that is outlined by skialithic remnants of metamorphosed sedimentary rocks and foliations preserved in the paragneisses.

Crushed stone, sand and gravel, mica, and magnetite have been produced in the quadrangle, although the only mineral commodity in current production is crushed stone. Other mineral resources within the mapped area which might be of economic interest are: feldspar, kaolin, emery, soapstone, sillimanite, quartz, clay, gem stones, and vermiculite.

Report of Investigations 17. GEOLOGY OF THE BENNS CHURCH, SMITHFIELD, WINDSOR, AND CHUCKATUCK QUADRANGLES, VIRGINIA, by Nicholas K. Coch; 39 p., 4 maps in color. Price: $4.50 (plus 4 percent State sales tax).

The Benns Church, Smithfield, Windsor, and Chuckatuck quadrangles are located in the southeastern Virginia portion of the Coastal Plain. Stratigraphic units exposed in the quadrangles are unconsolidated sediments that range in age from late Miocene to Recent. The oldest unit is the fossiliferous Yorktown Formation that was deposited under marine conditions in warm shallow water during a period of relative tectonic stability. Overlying the Yorktown Formation are the Sedley and Bacons Castle formations that are transitional between the underlying and overlying units. The clastic sediments in the Sedley and Bacons Castle formations, and the unconformity separating them, indicate more tectonic activity in a western source area than there was before or after their deposition. Stratigraphically above the Bacons Castle formation are Pleistocene marine and estuarine units, the Windsor, Norfolk, and Sand Bridge formations. These units underlie the plains, flats, and scarps in the area, and provide stratigraphic evidence for determining the changes in sea level which occurred during the Pleistocene Epoch.

The Isle of Wight plain, at altitudes of 80 to 95 feet, slopes gently eastward from the Surry scarp to the Suffolk scarp. This plain is underlain by the Windsor Formation, a complex of nearshore marine and estuarine sediments deposited when sea level reached a maximum altitude of +95 to +100 feet. The Suffolk scarp is an eastward-facing escarpment that trends north-south across the Benns Church and Chuckatuck quadrangles. This scarp is a former shoreline capped by the sand facies of the Norfolk Formation; the formation was deposited when relative sea level reached a maximum altitude of +45 to +50 feet. The Churchland flat, east of the Suffolk scarp, is underlain by the Sand Bridge formation, a complex of lagoonal and estuarine sediments deposited when relative maximum sea level was at +17 feet. Stratigraphic relations at the Suffolk scarp indicate that the scarp was a coastal shoreline in Norfolk time and an intracoastal shoreline in Sand Bridge time. The maximum sea levels associated with these relict marine features were determined from the altitudes of the highest occurrence of fluvial-estuarine sediments landward of the shoreline, and by the highest occurrence of beach sand along the former shorelines.

The morphologic features in the area studied are not underlain by simple marine "terrace-formations" that record only one sea-level position for each "terrace." Each of these morphologic features is underlain by several distinct stratigraphic units that can be subdivided into mappable facies; each of these stratigraphic units is evidence of a different Pleistocene sea level.

ADDITION TO STAFF

Mr. Marshall S. Miller joined the Division staff on January 6, 1969, and will assist with studies in economic geology, especially fuel resources. He received a B.S. degree in geology in 1966 from West Virginia University where he has also completed the required courses for the M.S. degree. Before coming to the Division, Mr. Miller was employed as a field engineer by Schlumberger Well Services in Illinois for 1 1/2 years. Mr. Miller is married and has one daughter.

THE MINERAL INDUSTRY IN VIRGINIA IN 1968 [1]

PRELIMINARY DATA

The total value of 1968 mineral output in Virginia rose to a new high of $299 million, according to estimates by the Bureau of Mines, United States Department of the Interior. The value was 5 percent greater than the $284 million reported in 1967, the previous record high value year.

Mineral fuels produced in the State included coal, natural gas, and limited quantities of oil; production was confined to southwestern Virginia. The production of bituminous coal, the leading commodity in terms of both tonnage and value, increased for the sixth consecutive year and was 4 percent higher than in 1967, the previous record year. Production of natural gas increased in 1968, while petroleum output was unchanged.

Reflecting somewhat heightened construction activity in Virginia in 1968, the production of cement (both portland and masonry), clay, sand and gravel, and stone increased. Shipments of portland and masonry cement increased substantially. Clay output rose 6.5 percent while the output of sand and gravel increased 3 percent. Total stone production rose 2 percent, due primarily to increased output of crushed limestone. Crushed stone comprised virtually all (99.8 percent) of the total output and dimension stone the remainder. Dimension stone, which comprised 9 percent of total stone value, declined moderately in output but gained moderately in value due to higher unit prices in 1968. Gypsum, however, among commodities supplying the building and construction industry, was an exception, declining substantially in output and value. Lime gained 5 percent in both output and value primarily because of increased demand for industrial lime as consumption by chemical and metallurgical industries continued to grow. Production of salt for use in the preparation of salt-based chemicals increased substantially. Output of aplite, kyanite, and feldspar decreased substantially.

Production of both lead and zinc increased 2 percent; the ratio of zinc output to lead output was about 5.5 to 1. Production of ilmenite and rutile decreased moderately. Ilmenite, which comprised most of the tonnage, declined moderately in both output and value, while rutile declined sharply.

[1] Prepared by David J. Kusler, U. S. Bureau of Mines, Pittsburgh, Pennsylvania.

Table 1.—Mineral production in Virginia.[1]

Mineral	1967 Quantity	1967 Value (thousands)	Preliminary 1968 Quantity	Preliminary 1968 Value (thousands)
Clays ..... thousand short tons	1,382	$ 1,623	1,472	$ 1,808
Coal (bituminous) ..... do	36,721	171,183	38,100	NA
Gem stones	NA	7	NA	7
Lead (recoverable content of ores, etc.) ..... short tons	3,430	960	3,498	920
Lime ..... thousand short tons	829	10,345	870	10,858
Natural gas ..... million cubic feet	3,818	1,149	4,100	1,234
Petroleum (crude) ..... thousand 42-gallon barrels	3	NA	3	NA
Sand and gravel ..... thousand short tons	9,863	12,494	10,147	12,857
Stone ..... do	31,324	52,470	31,857	54,673
Zinc [2] (recoverable content of ores, etc.) ..... short tons	18,846	5,088	19,160	5,173
Value of items that cannot be disclosed: Aplite, cement (portland and masonry), feldspar, gypsum, iron ore (pigment material), kyanite, salt, soapstone, and titanium concentrate (ilmenite and rutile).	—	28,366	—	211,079
Total	—	283,685	—	298,609

NA Not available.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Recoverable zinc valued at the yearly average price of Prime Western slab zinc, East St. Louis market. Value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

GEOGRAPHIC NAMES IN VIRGINIA

It is the purpose of the United States Board on Geographic Names to render formal decisions on new names, proposed changes in names, and names that are in conflict which are submitted for decision by individuals, private organizations, or government agencies. Communications about geographic names should be addressed to: J. O. Kilmartin, Executive Secretary, Domestic Geographic Names, U. S. Geological Survey, Washington, D.C. 20242.

Als Run: stream, 1.4 miles long, heads on west slope of Freezland Flat, flows south to Jerrys Run 5.5 miles north-northwest of West Augusta and 20 miles northwest of Staunton; Augusta County, Virginia; 38°20′29″ N, 79°20′45″ W. Not:Jerry Run.

Big Bald Knob: mountain, elevation 4120 feet, at northeast end of Bald Ridge, 2 miles northeast of The Pinnacle and 20 miles northwest of Staunton; Augusta County, Virginia; 38° 21′20″ N, 79°17′50″ W. Not: Bald Knob, Hardscrabble Knob.

Big Hill: hill, highest elevation 1952 feet, 3.7 miles northwest of Brownsburg and 7 miles east of Goshen; Rockbridge County, Virginia; 37°58′30″ N, 79°21′50″ W. Not: The Big Hill.

Black Oak Hill: hill, 2.6 miles long, elevation 2080 feet, 2 miles southwest of Craigsville; it is bounded on the south and northwest by Cove Run and on the southeast by the Little Calfpasture River; Augusta and Rockbridge counties, Virginia; 38°02′15″ N, 79°25′30″ W. Not: Black Oak Ridge.

Body Lick Branch: stream, 2 miles long, heads at 38°16′07″ N, 79°21′33″ W, flows southeast to Ramseys Draft 2 miles southwest of West Augusta and 16 miles northwest of Staunton; Augusta County, Virginia; 38°15′05″ N, 79° 20′15″ W. Not: Gum Corner Hollow.

Brandy Station: village, 16 miles south-southwest of Warrenton; Culpeper County, Virginia; 38°30′05″ N, 77°53′35″ W. Not: Brandy [former decision].

Broadway: valley, 3 miles long, heads at 38°10′ 10″ N, 79°27′50″ W, trends northeast along the course of Hamilton Branch to a point 0.5 mile southwest of Deerfield; Augusta County, Virginia; 38°11′35″ N, 79°25′10″ W. Not: Hamilton Draft.

Buffalo Branch: stream, 7 miles long, heads at 38°09′36″ N, 79°16′55″ W, flows northeast to the Middle River 1.5 miles south of Churchville; Augusta County, Virginia; 38°12′20″ N, 79°10′02″ W. Not: Marble River.

Byrd Spring Creek: stream, 2.2 miles long, heads at 38°01′10″ N, 79°22′44″ W, flows north-northwest to the Little Calfpasture River 2.5 miles south of Craigsville; Augusta and Rockbridge counties, Virginia; 38°02′53″ N, 79° 23′36″ W. Not: White Branch.

Calfpasture River: stream, 37 miles long, heads at 38°20′35″ N, 79°17′45″ W, flows south-southwest to join the Little Calfpasture River to form the Maury River 3 miles southeast of Goshen; Augusta and Rockbridge counties, Virginia; 38°56′56″ N, 79°27′36″ W. Not: Big Calfpasture River, Calf Pasture River, Great Calfpasture River, North River.

Capon Run: stream, 7 miles long, heads in West Virginia at 38°47′45″ N, 78°51′40″ W, flows southwest, into Virginia, to the North Fork Shenandoah River 5.6 miles north of the settlement of Fulks Run; Rockingham County, Virginia, and Hardy County, West Virginia; 38° 44′40″ N, 78°55′15″ W. Not: Lost River, Pewee Run.

Chestnut Lick Hollow: ravine, 1.8 miles long, heads at 38°17′23″ N, 79°22′23″ W, trends east-southeast to Ramseys Draft 2 miles northwest of West Augusta and 17 miles northwest of Staunton; Augusta County, Virginia; 38°17′ 00″ N, 79°20′38″ W. Not: Georgia Camp Hollow, Leslie Lick Hollow.

Dean Branch: stream, 2.5 miles long, heads at the junction of Dungeon and Eastwood branches at 36°52′38″ N, 80°59′54″ W, flows southeast to Cripple Creek, 1.5 miles northwest of Ivanhoe; Wythe County, Virginia; 36° 51′35″ N, 80°58′55″ W.

Dungeon Branch: stream, 3 miles long, heads at 36°53′33″ N, 81°02′32″ W, flows southeast to join Eastwood Branch to form Dean Branch 6.5 miles southeast of Wytheville; Wythe County, Virginia; 36°52′38″ N, 80°59′54″ W. Not: Dean Branch, Pungeon Branch.

East Dry Branch: stream, 7 miles long, heads at 38°12′40″ N, 79°17′37″ W, flows east to Buffalo Branch 1.8 miles southwest of Churchville; Augusta County, Virginia; 38°12′07″ N, 79°10′ 52″ W. Not: Dry Branch.

Ellis Run: stream, 4 miles long, heads at 37° 26′ 25″ N, 79°44′15″ W, flows north to Back Creek 1.2 miles northeast of Lithia; Botetourt County, Virginia; 37°29′33″ N, 79°44′10″ W. Not: Alex Run, Dry Branch.

Falls Hollow: ravine, 2.5 miles long, heads at 38°10′25″ N, 79°17′45″ W, trends east-northeast to the valley of Buffalo Branch 0.4 mile west of Christian; Augusta County, Virginia; 38°10′53″ N, 79°15′20″ W. Not: Buffalo Branch.

Fanny Hollow: ravine, 2.5 miles long, heads at 38°07′53″ N, 79°22′42″ W, trends northwest to Phillips Lick 2.5 miles south of Deerfield; Augusta County, Virginia; 38°09′25″ N, 79°24′18″ W. Not: South Fork Philips Lick.

Freezland Flat: mountain, elevation 4045 feet, 1.5 miles northwest of The Pinnacle and 20 miles northwest of Staunton; Augusta County, Virginia; 38°21′03″ N, 79°20′00″ W. Not: Freezeland Flat.

Grassy Field Hollow: ravine, 1.5 miles long, trends southeast to Shaws Fork 7.5 miles northwest of West Augusta and 22 miles northwest of Staunton; Highland County, Virginia; 38° 22′16″ N, 79°21′55″ W. Not: Kenilworth Draft, Mud Lick Draft.

Gum Corner Hollow: ravine, 1.5 miles long, heads at 38°15′45″ N, 79°21′54″ W, trends southeast to Body Lick Branch 2 miles southwest of West Augusta and 16 miles northwest of Staunton; Augusta County, Virginia; 38°15′14″ N, 79° 20′20″ W. Not: Body Lick Branch.

Hayslette Creek: stream, 2.4 miles long, heads at 37°47′50″ N, 79°38′15″ W, flows southeast to Colliers Creek 0.3 mile northwest of Collierstown; Rockbridge County, Virginia; 37°47′20″ N, 79°35′40″ W. Not: Haislet Creek, Haislets Creek, Halls Creek.

Kiser Hollow: ravine, 2 miles long, heads on Great North Mountain at 38°07′35″ N, 79°23′ 20″ W, flows northwest to the Calfpasture River 3.5 miles south of Deerfield; Augusta County, Virginia; 38°08′37″ N, 79°24′38″ W. Not: Scott Hollow, Wide Hollow.

Left Fork Holloway Draft; ravine, 2.5 miles long, heads at 38°13′40″ N, 79°25′53″ W, trends southeast to Holloway Draft 1.8 miles northeast of Deerfield; Augusta County, Virginia; 38°12′53″N, 79°23′10″ W. Not: Cowpasture Branch.

Leslie Lick Hollow: ravine, 1.4 miles long, heads at 38°16′43″ N, 79°22′08″ W, trends east to Ramseys Draft 2 miles northwest of West Augusta and 17 miles northwest of Staunton; Augusta County, Virginia; 38°16′55″ N, 79° 20′37″ W. Not: Chestnut Lick Hollow.

Little Mountain: mountain, 2.5 miles long, 4 miles northwest of the settlement of Fulks Run; Rockingham County, Virginia; 38°44′45″ N, 78°55′40″ W [northeast end], 38°42′35″ N, 78°57′00″ W [southwest end]. Not: Huges Mountain, Hughs Mountain.

Long Meadow: watercourse, 6.5 miles long, heads at 38°33′15″ N, 78°47′15″ W, trends northeast to the North Fork Shenandoah River 4 miles west of New Market; Rockingham County, Virginia; 38°38′08″ N, 78°45′00″ W. Not: Glade Run, Long Glade Run.

Mather Gorge: gorge, 1.8 miles long, in the Potomac River, extends southeast from Great Falls to the south tip of Bear Island, 13 miles northwest of the center of Washington, D. C.; named for Stephen Tyng Mather, 1867-1930, first Director of the National Park Service and advocate of the planned development of the District of Columbia; Montgomery County, Maryland, and Fairfax County, Virginia; 39°00′00″ N, 77°15′15″ W [northwest end], 38°58′42″ N, 77°14′13″ W [southeast end].

Maury River: stream, 40 miles long, heads at the confluence of the Calfpasture and Little Calfpasture rivers at 37°56′56″ N, 79°27′36″ W, flows south to the James River 1 mile south of Glasgow; named for Commodore Matthew Fontaine Maury [1806-1873], U. S. Navy hydrographer and oceanographer; Rockbridge County, Virginia; 37°37′25″ N, 79°26′42″ W. Not: Calfpasture River, North River.

Mill Creek: stream, 20 miles long, heads at 38° 09′45″ N, 79°28′07″ W, flows south to the Calfpasture River at the town of Goshen; Bath and Rockbridge counties, Virginia; 37°59′12″ N, 79°29′40″ W. Not: Big Mill Creek, North Mill Creek.

Peak, The: peak, elevation 3674 feet on south end of Bald Ridge 2 miles southwest of The Pinnacle and 18 miles northwest of Staunton; Augusta County, Virginia; 38°18′34″ N, 79° 20′30″ W. Not: The Pinnacle.

Piney Branch: stream, 2 miles long, heads at 37°55′50″ N, 79°31′40″ W, flows east-northeast to Guys Run 3 miles south of Goshen;

Rockbridge County, Virginia; 37°56'10" N, 79° 29'32" W. Not: White Rock Branch.

Pinnacle, The: peak, elevation 3241 feet, on Bald Ridge 2 miles northeast of The Peak and 18 miles northwest of Staunton; Augusta County, Virginia; 38°19'50" N, 79°19'15" W.

Ramseys Draft: valley, 9 miles long, trends south from the junction of its Left and Right Prongs to the Calfpasture River, 16 miles northwest of Staunton; Augusta County, Virginia; 38° 14'40" N, 79°20'15" W. Not: Ramsey Draft.

Scott Hollow: ravine, 2 miles long, heads on Great North Mountain at 38°07'43" N, 79°23' 03" W, trends northwest to the Calfpasture River 3.5 miles south of Deerfield; Augusta County, Virginia; 38°08'38" N, 79°24'38" W. Not: Fannie Hollow.

Skidmore Island: island, 0.5 miles long, at the south end of Magothy Channel, 1.5 miles east of Kiptopeke; Northampton County, Virginia; 37°08'17" N, 75°55'45" W. Not: Long Point Island.

Somerton: settlement, 4 miles west-southwest of Whaleyville and 12 miles southeast of Franklin; Nansemond County, Virginia; 36°34'12" N, 76°45'05" W. Not: Sommerton [former decision], Summerton.

Staples Hollow: ravine, 2 miles long, heads at 38°06'30" N, 79°24'20" W, trends southeast to the town of Craigsville; Augusta County, Virginia; 38°05'10" N, 79°23'10" W. Not: Staple Hollow, Staples Draft.

Stillhouse Run: stream, 2.5 miles long, heads on Shenandoah Mountain at 38°13'20" N, 79°28' 50" W, flows northwest to the Cowpasture River 5 miles northeast of Williamsville; Highland County, Virginia; 38°15'00" N, 79°30'33" W. Not: Stillhouse Draft.

Stuples Hollow: ravine, 2.8 miles long, heads at 38°06'20" N, 79°25'00" W, trends south-southeast to Grassy Run at Craigsville; Augusta County, Virginia; 38°04'28" N, 79°23'16" W. Not: Staple Branch, Stuple Branch, Stuples Branch.

Tims Draft: ravine, 2 miles long, heads at junction of its Right and Left Forks at 38°13'53" N, 79°22'13" W, trends south to the Calfpasture River 1.5 miles northeast of Deerfield; Augusta County, Virginia; 38°12'12" N, 79°22' 32" W.

Tizzle Branch: stream, 3.5 miles long, heads on Shenandoah Mountain at 38°13'08" N, 79°26' 03" W, flows southeast to the Calfpasture River, 1.5 miles east-northeast of Deerfield; Augusta County, Virginia; 38°12'07" N, 79° 22'37" W. Not: Tisdale Branch.

Union Springs Run: stream, 5.5 miles long, heads at 38°28'55" N, 79°07'20" W, flows east-southeast to join Redbanks Run to form Beaver Creek 10 miles west of Harrisonburg; Rockingham County, Virginia; 38°26'56" N, 79°03' 37" W. Not: Beaver Creek, Wood Creek.

Wallace Draft: ravine, 2.5 miles long, heads on Great North Mountain at 38°05'36" N, 79° 25'30" W, trends southeast to Grassy Run at Craigsville; Augusta County, Virginia; 38° 04'25" N, 79°23'37" W.

West Augusta: community, on right bank of Calfpasture River 15 miles northwest of Staunton; Augusta County, Virginia; 38°16'15" N, 79° 18'30" W. Not: Lebanon.

West Dry Branch: stream, 3.5 miles long, heads at 38°12'07" N, 79°17'52" W, flows northwest to the Calfpasture River 3.8 miles northeast of Deerfield; Augusta County, Virginia; 38° 13'42" N, 79°20'45" W. Not: Dry Branch.

Wilkerson Gap: gap, elevation 2563 feet, in the Blue Ridge 1.5 miles north of Flat Top Mountain; Bedford and Botetourt counties, Virginia; 37°28'23" N, 79°34'52" W. Not: Wilkinson Gap.

UPDATING OF TOPOGRAPHIC MAPS

An updating program for the 7.5-minute topographic quadrangle map series, designed to keep abreast of changes in cultural features in the State, is currently in progress. Preparation of 65 maps in areas of industrial, residential, and commercial growth was begun in 1968. These are to be made by overprinting in magenta on current maps, cultural changes noted from inspection of 1968 aerial mapping photographs. It is planned to have the updated maps for sale within a year of initiation of work. A continuous evaluation study has been initiated to assure that quadrangles in need of revision and updating are placed into the program. Currently maps are being updated for the following cities and towns: Harrisonburg, Waynesboro, Charlottesville, Covington, Clifton Forge, Roanoke, Salem, Lynchburg, Richmond, Newport News, Emporia, Marion, Norton, St. Paul, Big Stone Gap, Pennington Gap, Wise, and Appalachia. New mapping to revise the topography and culture of eight maps in the Petersburg-Hopewell area was also begun in 1968.

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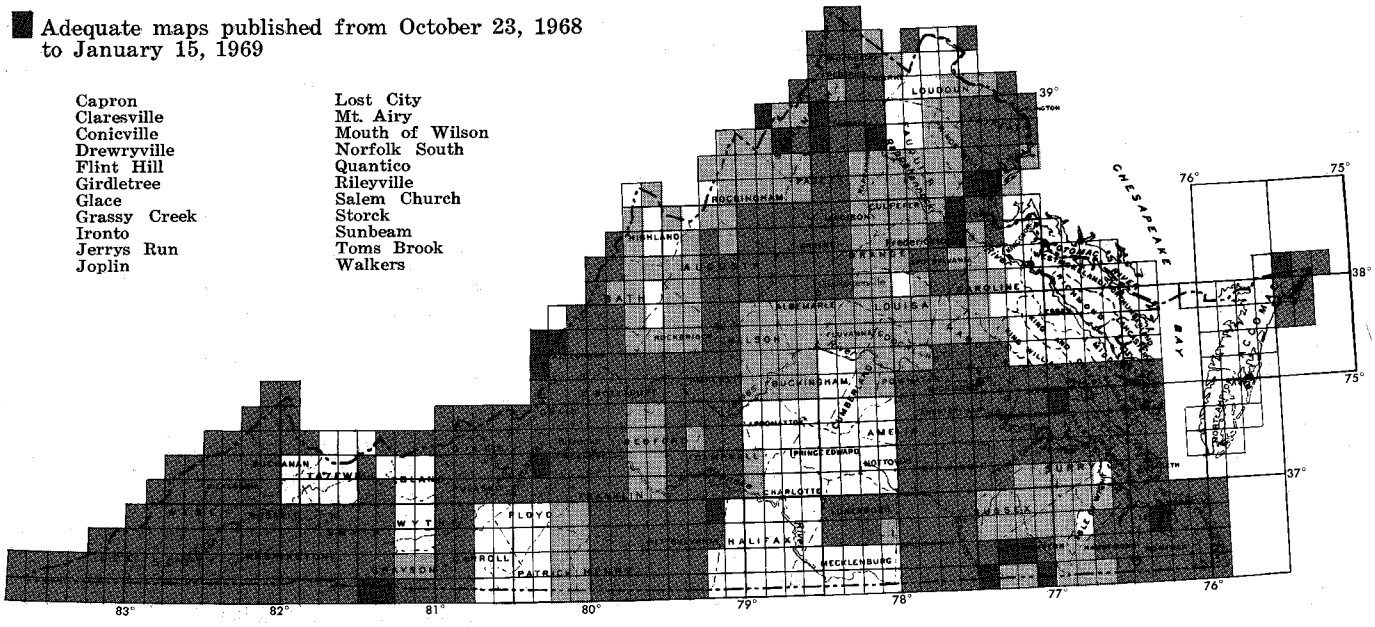

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