Coal Resources of Tazewell County, Virginia, 1980

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Coal Resources of Tazewell County, Virginia, 1980

By KENNETH J. ENGLUND and ROGER E. THOMAS

A summary of the quantity and quality of low-sulfur coal resources in part of the southwestern Virginia coal field

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Coal Resources of Tazewell County, Virginia, 1980

By Kenneth J. Englund *and* Roger E. Thomas

Abstract

Economically important coal beds of Pennsylvanian age underlie about 96 square miles in the northwestern part of Tazewell County in the southwestern Virginia coal field. Coal has been mined commercially in Tazewell County since the early 1880's, mostly from large underground mines that utilized rail shipment. This production has been supplemented in recent years by coal from truck, strip, and auger mines.

Coal in Tazewell County ranges in rank from low-volatile to high-volatile A bituminous and generally increases in rank with depth. On an as-received basis, most of the coal is relatively low in ash (less than 9 percent), low in sulfur (less than 1 percent), and high in heat value (about 14,000 British thermal units). Analyses of trace element and major and minor oxide composition of 22 coal beds in Tazewell County indicate that none of the samples contain significant amounts of either potentially toxic or economically valuable trace elements.

Of 60 coal beds in Tazewell County, 37 beds are of sufficient thickness and extent to merit calculation of resources. Original coal resources in Tazewell County totaled about 2,541 million short tons, of which 323 million short tons, or 13 percent, have been mined or lost in mining, as of January 1, 1980. Of the estimated remaining resources, about 953 million short tons, or 43 percent, are measured or indicated resources that are in beds more than 28 in. thick and contain 1 percent or less sulfur. Assuming 54 percent recovery, as indicated by past mining in Tazewell County and in nearby areas, about 515 million short tons, or 23 percent of the estimated original low-sulfur coal resources, may be recoverable.

INTRODUCTION

Location

Coal-resource investigations were undertaken by the U.S. Geological Survey to assess the quantity and quality of low-sulfur coal in the central Appalachian basin. This report presents the results of these studies as of January 1, 1980, in Tazewell County, Va. The county includes an area of about 96 mi^2 of the southwestern Virginia coal field (fig. 1). Economically important coal deposits are mostly in the Appalachian Plateaus physiographic province in the extreme northwestern part of Tazewell County. This area is highly dissected and consists of narrow, steeply sloping ridges and deep V-shaped valleys that have been eroded into relatively flat-lying Lower and Middle Pennsylvanian coal-bearing strata. In contrast, the remainder of the county is underlain by older faulted and folded Paleozoic strata of the Valley and Ridge province. These strata are mostly marine and rarely contain terrestrial coal-bearing rocks.

Previous Investigations

Harnsberger (1919) made an early assessment of the coal resources of Tazewell County. He presented a comprehensive discussion of the coal geology and estimated that the original resources in 28 coal beds, each more than 14 in. thick, totaled 2,306.58 million short tons. A later statewide assessment by Brown and others (1952) excluded the amount of coal mined or lost in mining and prepared a relatively conservative estimate of 708.36 million short tons of remaining coal resources in 23 coal beds, each more than 14 in. thick in Tazewell County; however, substantially larger coal resources were indicated from estimates made for parts of the county on a 7½-minute quadrangle basis (fig. 2). These remaining-coal-resource estimates for as many as 31 coal beds in parts of Tazewell County were 31.59 million short tons in the Honaker quadrangle (Meissner, 1979), 813.82 million short tons in the Jewell Ridge quadrangle (Englund and Teaford, 1980), and 750.10 million short tons in the Amonate quadrangle (Windolph, 1986). Detailed geologic mapping of the coal beds in these quadrangles was supplemented by coal-thickness data from outcrops, mines, core holes, and mine maps. Also incorporated into these reports were coal analytical data, including proximate and ultimate analyses, calorific values, trace element contents, and major and minor oxides in coal ash. Trent and others (1982) discussed the coal quality of 12 samples from the Anawalt quadrangle and adjacent areas.

Present Investigations

Geologic mapping and associated studies in the Bramwell (Englund, 1968), Honaker (Meissner and Miller,

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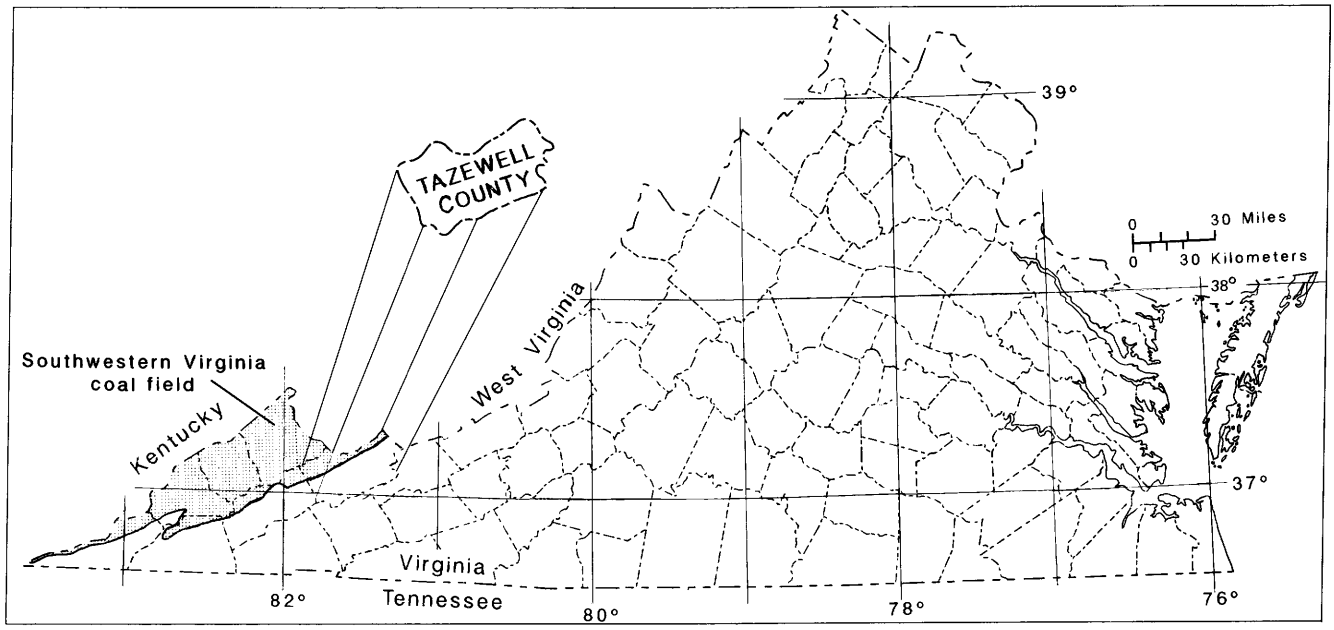

Figure 1. Extent of the southwestern Virginia coal field in Tazewell County, Va.

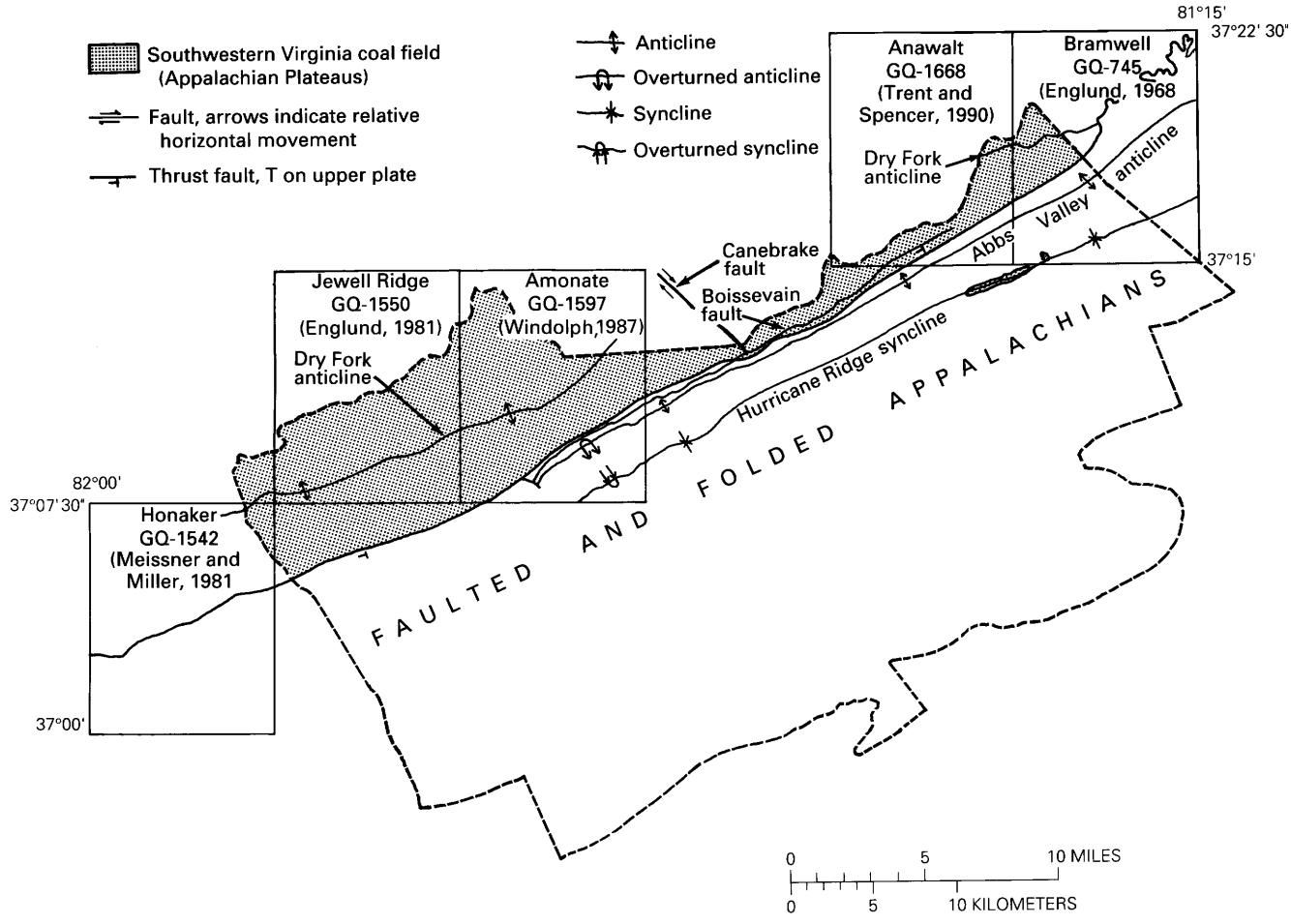

Figure 2. Geologic quadrangles in northwestern Tazewell County, Va.

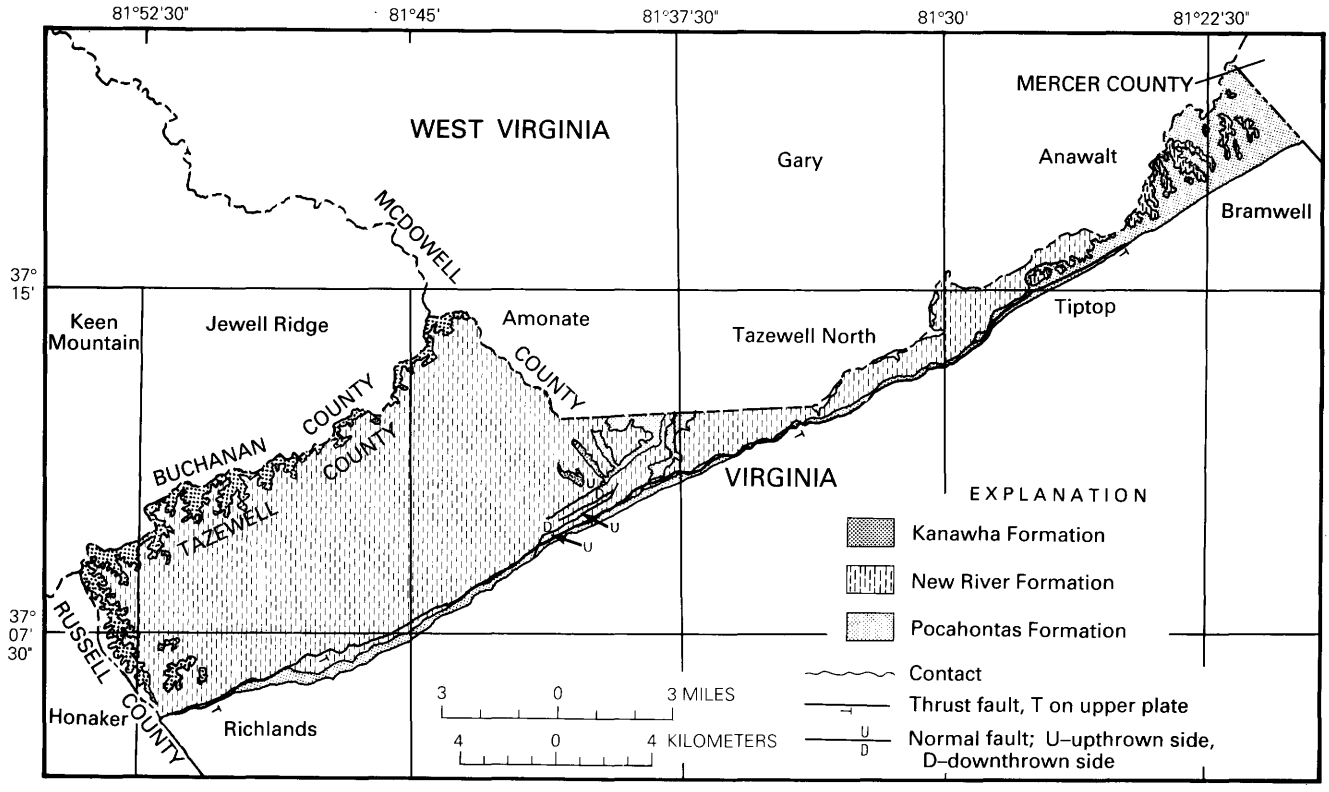

Figure 3. Generalized geology and location of quadrangles in the southwestern Virginia coal field of Tazewell County, Va.

1981), Jewell Ridge (Englund, 1981), Amonate (Windolph, 1986), and Anawalt (Trent and Spencer, 1990) quadrangles (fig. 2) provided data on the areal extent, thickness, chemical composition, rank, ash, and sulfur contents of the coal beds in Tazewell County. Additional coal-bed information for this report was obtained by mapping the remaining areas underlain by coal beds in the county, including parts of the Keen Mountain, Richlands, Tazewell North, Tiptop, and Gary quadrangles (fig. 3). Field investigations for this assessment consisted of (1) mapping coal-bed outcrops and strip mines, (2) locating mine adits and coal prospect pits, (3) describing stratigraphic sections of outcrops and drill core, and (4) sampling coal. Mine maps and core-hole records provided supplemental coal bed information.

Acknowledgments

The many contributions made by fieldwork collaborators, particularly C.R. Meissner, Jr., V.A. Trent, R.C. Warlow, and J.F. Windolph, Jr., are gratefully acknowledged. Thanks are also due W.H. Gillespie and H.W. Pfefferkorn for the aid provided by their biostratigraphic studies and J.H. Medlin and S.L. Wnuk for collecting coal samples. The preparation of coal-bed maps and planimetry of areas and the tabulation of coal-resource tonnages were expedited by the assistance of P.L. Johnson and N.K. Gardner. Special thanks are extended to the many coal and land companies that have generously provided mine maps, core-hole records, and access to their property and facilities. The officials and personnel of the Pocahontas Land Corporation and the Consolidated Coal Corporation have been especially helpful in this respect. Reviews by S.W. Schweinfurth and B.S. Pierce are sincerely appreciated.

STRATIGRAPHY

The coal deposits of Tazewell County are in an Upper Paleozoic terrestrial facies that was deposited during the northwestward progradation of clastic sediments across the Appalachian basin. This coal-bearing sequence totals about 5,500 ft in thickness in the county and has been subdivided into six formations—Bluefield, Hinton, Bluestone, Pocahontas, New River, and Kanawha—that range from Late Mississippian to Middle Pennsylvanian in age (pl. 1). In the Appalachian Plateaus in the northwestern part of the county, these formations are relatively flat lying and overlie a thick sequence of older Paleozoic rocks of predominantly marine origin. In the faulted and folded Appalachians, the coal-bearing formations occur locally in fault slices of

moderately to steeply dipping strata that include older Paleozoic rocks.

Upper Mississippian Series

Coal has been recorded in the Bluefield, Hinton, and Bluestone Formations of the Upper Mississippian Series in southwestern Virginia, including Tazewell County, since the early investigations of Campbell (1893, p. 38), Butts (1940, p. 402), and Cooper (1944, p. 169). These deposits, however, have attracted little interest and have not been mapped or mined. The Upper Mississippian formations are truncated progressively to the northwest of Tazewell County.

The Bluefield Formation conformably overlies the Upper Mississippian Greenbrier Limestone and consists of as much as 1,200 ft of gray, greenish-gray, and grayish-red, partly calcareous shale interbedded with a lesser amount of limestone and argillaceous limestone. Locally, the formation includes siltstone and sandstone beds as much as 80 ft thick. Coal beds as much as 12 in. thick have been observed at a few localities associated with rooted underclay and carbonaceous shale (Englund, 1968). Marine conditions prevailed during the accumulation of most of the Bluefield sediments but were interrupted periodically by the seaward encroachment of terrestrial clastic sediments and freshwater marsh deposits. These minor regressions in the Bluefield marked the beginning of a major regressive trend that accelerated during the deposition of overlying Mississippian and Pennsylvanian units.

The overlying Hinton Formation (pl. 1) is as much as 1,300 ft thick and is characterized by an abundance of grayish-red, partly calcareous shale and siltstone beds and smaller amounts of medium-gray and greenish-gray shale, sandstone, fossiliferous limestone, and a few thin beds of coal and carbonaceous shale underlain by rooted underclay. Two of these coal beds are 28 and 30 in. thick in roadcuts along State Route 16, about 2 mi southeast of Bishop (fig. 3) in west-central Tazewell County. This locality is on the northwestern limb of the Hurricane Ridge syncline (fig. 2), and because of a general increase in coal bed thicknesses to the southeast, the Hinton may be a favorable target for coal exploration in the subsurface to the southeast (Englund, Gillespie, and others, 1986). Shallow marine, barrier-bar, tidal-flat, and freshwater marsh environments prevailed during the deposition of the Hinton.

The Bluestone Formation, which disconformably overlies the Hinton where the intervening Princeton Sandstone is absent (pl. 1), totals as much as 850 ft in thickness. Except for an overall decrease in marine influence, the lithology and depositional environments of the Bluestone are similar to those of the Hinton. Several thin coal beds, generally less than 12 in. thick, are commonly associated with wedges of terrestrial strata in the Bluestone.

Lower Pennsylvanian Series

The Lower Pennsylvanian Pocahontas and New River Formations include the principal coal beds and most of the coal resources in Tazewell County. This sequence underlies the Appalachian Plateaus in the northwestern part of the county and occurs locally in upturned beds at the southeastern edge of the plateaus and in the trough of the nearby Hurricane Ridge syncline (fig. 2).

Coal-bearing strata assigned to the Pocahontas Formation (pl. 1) conformably overlie the Bluestone Formation and consist of sandstone, siltstone, shale, coal, and underclay beds that total about 700 ft. These rocks were deposited in a sequence of stacked delta lobes and associated onshore deposits that prograded northwestward from the southeastern side of the Appalachian seaway (Englund, 1974). Periodic abandonment of the major distributary system fostered the development of extensive swamps having thick peat deposits located in back-barrier lagoonal areas. The thickest peat accumulation coincided with major stillstands of sea level when minimal sediment influx and a stable shoreline allowed marine currents and waves to form a barrier bar system consisting of lithically and texturally mature quartz sand (Englund, Windolph, and others, 1986).

The overlying New River Formation (pl. 1) is also a coal-bearing sequence of sandstone, siltstone, shale, and underclay that is lithically similar to the Pocahontas Formation except for the presence of thicker and more widespread beds of quartzose sandstone and conglomerate in other areas. The sandstone and conglomerate units were deposited as barrier and offshore bar complexes parallel to the southeastern side of the Appalachian basin. These units are located to the northwest and to the southwest of Tazewell County, where thick beds of quartzose sandstone and conglomerate are assigned to the Lee Formation (fig. 4). The Lower Pennsylvanian strata in Tazewell County that are equivalent in time to the Lee Formation represent the lagoonal, deltaic, swamp, and fluvial deposits of back-barrier environments of the New River Formation, which also contains a regionally significant unconformity at the base of the Pineville Sandstone Member (fig. 4). Underlying beds, including the Pocahontas No. 9 coal bed, are eroded locally, and the Pocahontas Formation and Upper Mississippian formations are truncated progressively to the northwest from Tazewell County. The New River Formation attains a maximum thickness of about 1,900 ft in Tazewell County and includes 36 coal beds.

Middle Pennsylvanian Series

The Kanawha Formation (fig. 3) of Middle Pennsylvanian age conformably overlies the New River Formation and contains the youngest coal-bearing rocks of Tazewell County. About 400 ft of beds in the lower part of the formation crop out in the highest mountain tops on the

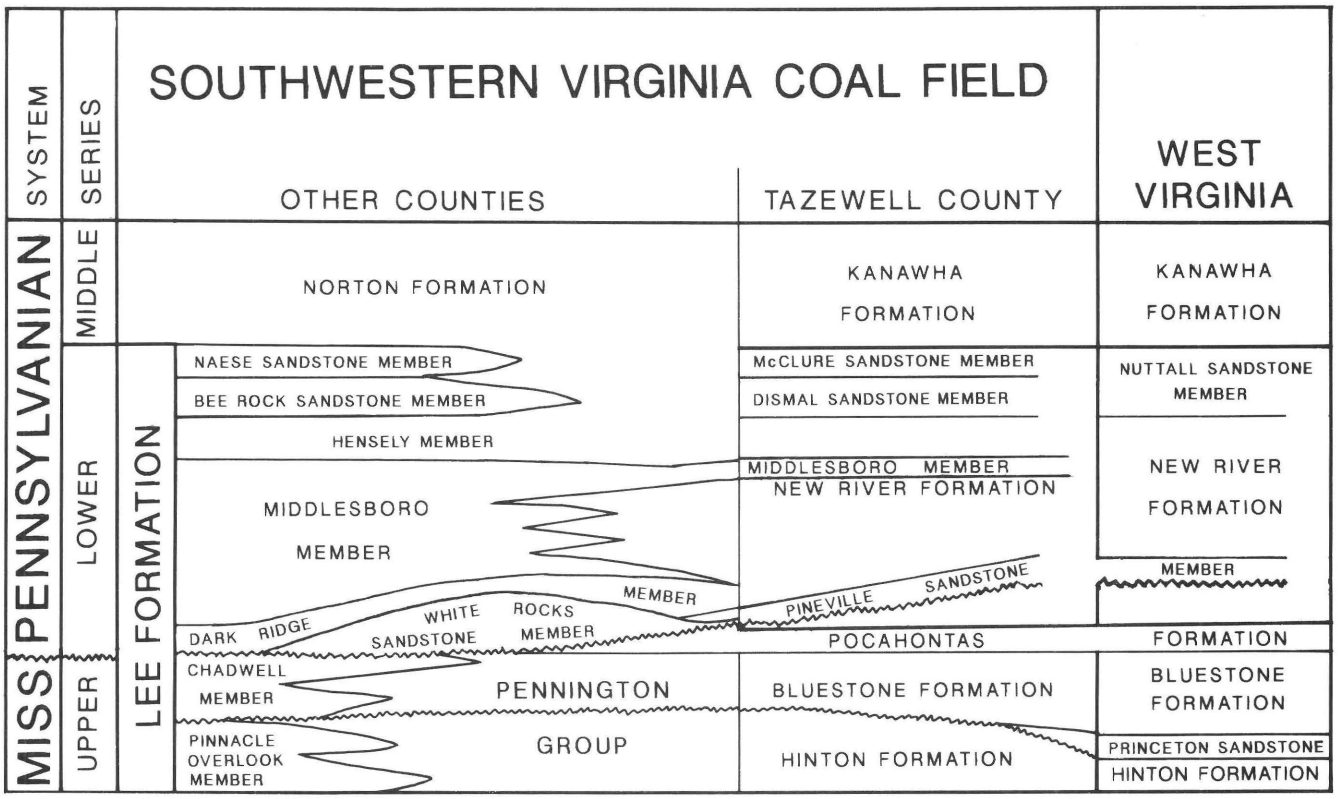

Figure 4. Correlations of formations in Tazewell County, Va., to formations in the rest of the southwestern Virginia coal field and West Virginia.

northwestern edge of the county. Fine- to medium-grained, feldspathic, micaceous sandstone is the dominant lithology. This sandstone was deposited in fluvial channels that extended northwestward across dark-gray lagoonal or bay-fill shale and associated back-barrier swamp deposits. Coal occurs in eight beds, three of which have been mined.

STRUCTURE

The coal deposits of Tazewell County occur in two structurally diverse areas: (1) the Appalachian Plateaus, where the rocks are relatively flat lying, and (2) the Valley and Ridge province, where the rocks are intensely folded and faulted. Coal beds in the Appalachian Plateaus exhibit dips from about 1° to 2° to the northwest or southeast (pl. 2*A*). The structure is dominated by the southwest-plunging Dry Fork anticline, which locally is bordered on the southeast by the shallow Pocahontas syncline (fig. 4). At the southeastern edge of the plateaus, the beds are upturned and locally overturned as a result of drag associated with thrusting from the southeast.

In the Valley and Ridge province, the coal beds are faulted and moderately to steeply dipping. In fault slices adjacent to the plateaus, steeply dipping Pennsylvanian coal beds have been extensively prospected and have been mined on a small scale, as indicated by several abandoned adits (fig. 5). Coal beds extend to depths of 400 to about 1,000 ft in the fault slices and to depths of less than a few hundred feet in the overturned core of the Hurricane Ridge syncline (fig. 2). Coal beds of Mississippian age crop out mostly on the moderately dipping flanks of the Hurricane Ridge syncline. Prospecting of these beds has been limited to a few localities, and there is no indication of commercial mining.

COAL RESOURCES

The principal coal deposits in Tazewell County are in the Pocahontas, New River, and Kanawha Formations (fig. 3). Of the 60 coal beds included in these formations, 37 beds are of sufficient thickness and extent to merit calculation of resources. These 37 beds are described in this section. The coal beds are mostly 2 to 4 ft thick, but locally they range from a few inches to as much as 11 ft thick.

The coal is of low-, medium-, and high-volatile A bituminous rank and generally increases in rank with depth. The coal is commonly banded with thin to thick vitrain bands and bright attritus. Dull attritus, fusain, and sparcely disseminated pyrite also occur in some beds. Coal in the Pocahontas Formation is finely cleated, whereas that in overlying formations tends to be more coarsely cleated. On an as-received basis, most of the coal is low in ash (less than

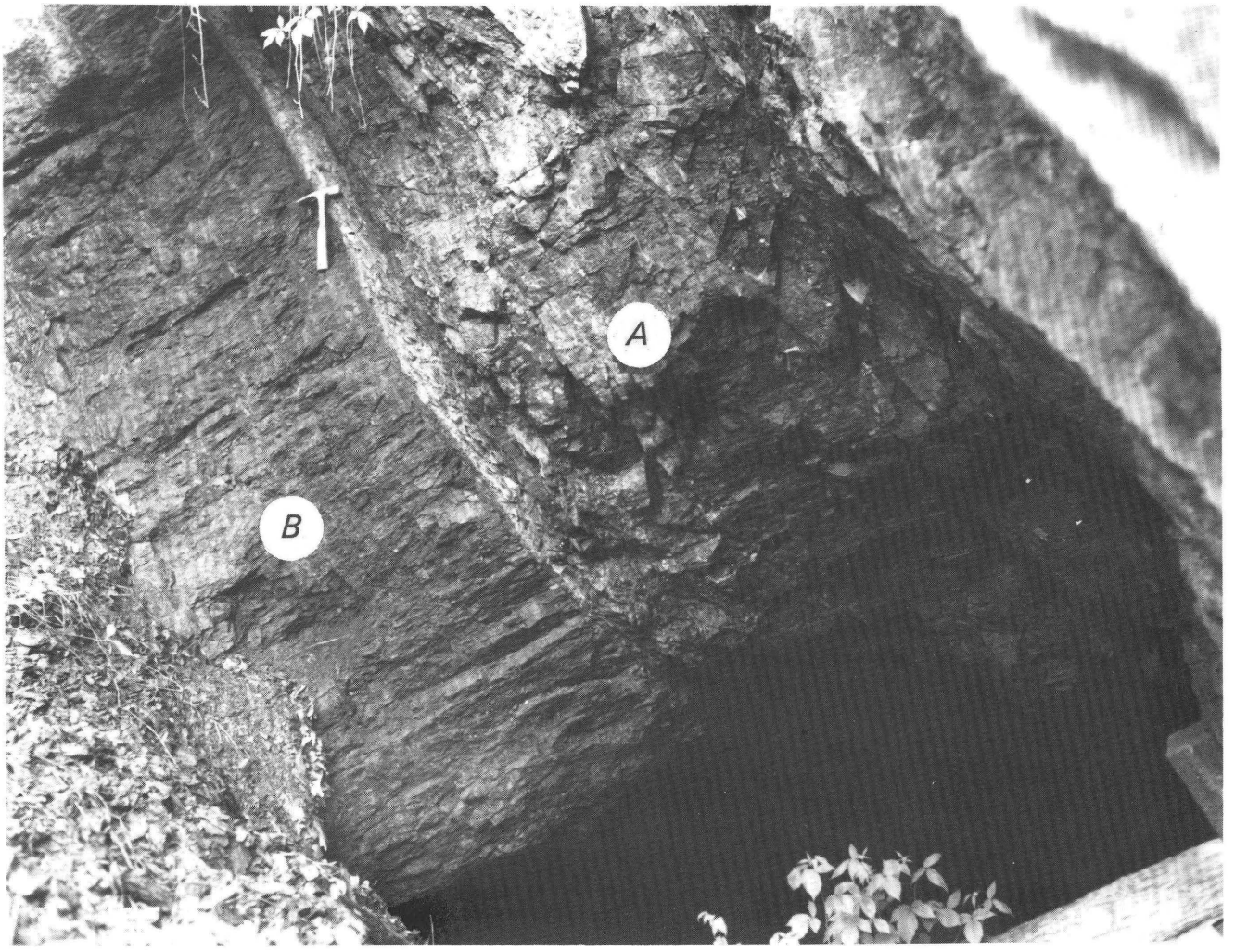

Figure 5. Overturned Pocahontas No. 4 coal bed (A) and the Upper split of the Pocahontas No. 4 coal bed (B) in an abandoned adit in the Tazewell North quadrangle. Hammer lies on parting between beds.

9 percent), low in sulfur (less than 1 percent), and high in heat value (about 14,000 Btu).

Analyses of trace element and major and minor oxide compositions of 22 coal beds in Tazewell County and nearby areas indicate that none of the samples contained significant amounts of potentially toxic or economically valuable trace elements (Englund and Teaford, 1980; Trent and others, 1982; Windolph, 1986). All analyses are from channel samples. The resources (tables 1 and 2) have been classified in this report as follows: (1) measured—bed occurs within ¼ mi of a measured thickness, (2) indicated—bed occurs from ¼ to ¾ mi from a measured thickness, and (3) inferred—bed occurs more than ¾ mi from a measured thickness, and the continuity of the coal can be inferred from geologic evidence. The coal has been further classified by thickness into the following categories: 14 to 28 in., 28 to 42 in., and more than 42 in. thick. All coal-bed thicknesses used in calculating resources exclude the thickness of partings. The thickness and reliability categories used in this report were established by the U.S. Geological Survey and the U.S. Bureau of Mines to obtain comparable results in preparing estimates (Huddle and others, 1963, p. 5). Later reports have elaborated on the application of these standards (Englund and others, 1976; Wood and others, 1983).

Coal Beds of the Pocahontas Formation

Squire Jim coal bed.—The Squire Jim coal is the first bed of economic importance above the base of the Pocahontas Formation. Its resources are mostly at depths of 1,000 ft or more, except for small areas of outcrop on the flank of the Dry Fork anticline near long 81°37′30″ W. and in upturned beds on the southeastern edge of the coal field (pl. 2*B*). This coal has not been mined, and development may have been hindered by partings and by a high ash content (Windolph, 1986). Exploratory core drilling

Table 1. Estimated original and remaining coal resources under more than 1,000 ft of overburden in Tazewell County, Va., as of January 1, 1980

[In thousands of short tons]

Formation	Coal bed	Remaining Resources												Estimated original resource	
		Measured[1]				Indicated[2]				Inferred[3]				Total					
		In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	Mined and lost in mining	Original resources
New River	Upper Seaboard	41	4		45	544	202		746	13			13	598	206		804		804
	Middle Seaboard	2,234	172		2,406	10,594	721		11,315	736			736	13,564	893		14,457		14,457
	Dirty Six	39			39	7			7					46			46		46
	Lower Seaboard	855	4,216		5,071	6,459	18,038		24,497	1,535	369		1,904	8,849	22,623		31,472		31,472
	Unnamed	371			371	2,870			2,870	19			19	3,260			3,260		3,260
	Sewell B(?)	856	224		1,080	4,876			4,876	23			23	5,755	224		5,979		5,979
	Sewell A(?)	1,538	3,943		5,481	11,703	16,922		28,625	134	3,364		3,498	13,375	24,229		37,604		37,604
	Sewell(?)	5,242			5,242	28,904			28,904	4,115			4,115	38,261			38,261		38,261
	Welch(?)	3,987	1,179		5,166	20,034	3,590		23,624	2,351	2,948		5,299	26,372	7,717		34,089		34,089
	Upper Horsepen (Upper split)	1,655	9,809	166	11,630	20,165	30,423		50,588	3,169	2,998		6,167	24,989	43,230	166	68,385		68,385
	Upper Horsepen	1,954	628		2,582	3,438	6,503		9,941	831			831	6,223	7,131		13,354		13,354
	Middle Horsepen Rider	780	79		859	4,667			4,667	2,737			2,737	8,184	79		8,263		8,263
	Middle Horsepen	3,568	762		4,330	14,839	926		15,765	1,394			1,394	19,801	1,688		21,489		21,489
	War Creek	2,479	870	400	3,749	8,725	2,137	11	10,873	782			782	11,986	3,007	411	15,404		15,404
	Fire Creek Rider	4,407			4,407	13,250			13,250	2,174			2,174	19,831			19,831		19,831
	Fire Creek	5,550	747		6,297	22,583	90		22,673	3,047			3,047	31,180	837		32,017		32,017
	Lower Little Fire Creek	1,259	266		1,525	5,595			5,595	1,082			1,082	7,936	266		8,202		8,202
Pocahontas	Pocahontas No. 7	4,465	526		4,991	11,482	269		11,751	1,637			1,637	17,584	795		18,379		18,379
	Pocahontas No. 4 (Upper split)	5,583	8,215	3,386	17,184	19,417	23,435	5,715	48,567	4,197	2,479	245	6,921	29,197	34,129	9,346	72,672	73	72,745
	Pocahontas No. 4	2,477	8,220	7,568	18,265	11,239	15,159	9,172	35,570	1,283	1,212	872	3,367	14,999	24,591	17,612	57,202	682	57,884
	Pocahontas No. 3	6,605	11,048	12,425	30,078	21,519	43,607	40,268	105,394	4,254	2,263	1,092	7,609	32,378	56,918	53,785	143,081		143,081
	Squire Jim	2,777	19,051	10,868	32,696	19,792	37,819	35,221	92,832	31,597	5,742	6,692	44,031	54,166	62,612	52,781	169,559		169,559
	Totals	**58,722**	**69,959**	**34,813**	**163,494**	**262,702**	**199,841**	**90,387**	**552,930**	**67,110**	**21,375**	**8,901**	**97,386**	**388,534**	**291,175**	**134,101**	**813,810**	**755**	**814,565**

[1] Measured—Bed occurs within 1/4 mi of a measured thickness.

[2] Indicated—Bed occurs from 1/4 to 3/4 mi from a measured thickness.

[3] Inferred—Bed occurs more than 3/4 mi from a measured thickness, and the continuity of the coal can be inferred from geologic evidence.

Table 2. Estimated original and remaining coal resources under less than 1,000 ft of overburden and grand total original and remaining coal resources in Tazewell County, Va., as of January 1, 1980

[In thousands of short tons]

Formation	Coal bed	Remaining Resources																Estimated original resources	
		Measured[1]				Indicated[2]				Inferred[3]				Total					
		In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	Mined and lost in mining	Original resources
Kanawha	Lower Banner			136	136											136	136	466	602
	Big Fork	40	26		66	18			18	51			51	109	26		135	2	137
	Kennedy	1,869	3,645		5,514	1,577	1,340		2,917	934			934	4,380	4,985		9,365	612	9,977
New River	Jewell	2,385	14,462	866	17,713	512	1,161		1,673					2,897	15,623	866	19,386	50,149	69,535
	Jawbone Rider	5,834			5,834	17,368			17,368	9,457			9,457	32,659			32,659		32,659
	Jawbone	5,600	17,322	7,151	30,073	13,340	24,766	2,447	40,553	1,193	4,520		5,713	20,133	46,608	9,598	76,339	8,872	85,211
	Tiller Rider	3,446	1,842	120	5,408	6,166	2,570		8,736	1,452			1,452	11,064	4,412	120	15,596		15,596
	Tiller	4,371	2,003		6,374	10,246	1,516		11,762	1,208	767		1,975	15,825	4,286		20,111	126	20,237
	Lee	1,029			1,029	805			805	241			241	2,075			2,075		2,075
	Castle(?)	511	184	989	1,684	3,189	4,839	2,141	10,169	836	2,590	1,753	5,179	4,536	7,613	4,883	17,032		17,032
	Upper Seaboard	5,406	7,389		12,795	11,029	5,722		16,751	464			464	16,899	13,111		30,010	7,722	37,732
	Middle Seaboard	12,233	9,725		21,958	38,556	13,902		52,458	3,079	35		3,114	53,868	23,662		77,530	215	77,745
	Dirty Six	5,825	4,123	632	10,580	8,604	1,995	1,133	11,732	20			20	14,449	6,118	1,765	22,332	52	22,384
	Lower Seaboard	9,614	13,966	2,195	25,775	22,729	29,544		52,273	2,373	236		2,609	34,716	43,746	2,195	80,657	8,356	89,013
	Unnamed	4,145	47		4,192	8,171	1		8,172	68			68	12,384	48		12,432		12,432
	Sewell B(?)	2,973	415		3,388	9,070			9,070	1,198			1,198	13,241	415		13,656		13,656
	Sewell A(?)	7,874	4,114		11,988	28,461	5,718		34,179	815	1,292		2,107	37,150	11,124		48,274		48,274
	Sewell(?)	19,242	6,721		25,963	44,527	9,111		53,638	2,615	282		2,897	66,384	16,114		82,498	576	83,074
	Welch(?)	13,408	2,894	257	16,559	28,387	4,534		32,921	953	1,067		2,020	42,748	8,495	257	51,500		51,500
	Upper Horsepen (Upper split)	8,282	21,644	9,033	38,959	8,808	43,733	6,117	58,658	845	6,514		7,359	17,935	71,891	15,150	104,976	1,609	106,585

Table 2. —Continued

Formation	Coal bed	Remaining Resources																Estimated original resources	
		Measured[1]				Indicated[2]				Inferred[3]				Total					
		In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	In beds 14–28 inches thick	In beds 28–42 inches thick	In beds more than 42 inches thick	Total	Mined and lost in mining	Original resources
New River—Continued	Upper Horsepen	8,017	4,780	2,665	15,462	14,909	3,704	189	18,802	2,394			2,394	25,320	8,484	2,854	36,658	1,511	38,169
	Middle Horsepen Rider	5,160	2,466		7,626	11,959	3,224		15,183	1,189			1,189	18,308	5,690		23,998		23,998
	Middle Horsepen	7,290	7,002	5,908	20,200	21,488	9,490	1,391	32,369	2,746			2,746	31,524	16,492	7,299	55,315	1,796	57,111
	War Creek	11,527	13,082	9,023	33,632	16,351	13,742	9,923	40,016	1,632		913	2,545	29,510	26,824	19,859	76,193	911	77,104
	Fire Creek Rider	10,428	2,983		13,411	11,180	365		11,545	2,476			2,476	24,084	3,348		27,432		27,432
	Fire Creek	17,589	3,240	10	20,839	33,894	2,487		36,381	3,519			3,519	55,002	5,727	10	60,739		60,739
	Upper Little Fire Creek	662			662	427			427					1,089			1,089		1,089
	Little Fire Creek	4,036	119		4,155	5,930			5,930	511			511	10,477	119		10,596		10,596
	Lower Little Fire Creek	2,185	122		2,307	2,070			2,070					4,255	122		4,377		4,377
	Lower Horsepen	6,543	1,966	348	8,857	4,418	708	99	5,225	403			403	11,364	2,674	447	14,485		14,485
Pocahontas	Pocahontas No. 7	9,889	1,640		11,529	13,835	1,721		15,556	105			105	23,829	3,361		27,190		27,190
	Pocahontas No. 6	2,165			2,165	5,691			5,691	2,122			2,122	9,978			9,978		9,978
	Pocahontas No. 4 (Upper split)	9,776	21,977	20,821	52,574	11,043	12,483	3,646	27,172	549	107	450	1,106	21,368	34,567	24,917	80,852	23,187	104,039
	Pocahontas No. 4	5,541	8,344	46,406	60,291	8,237	4,534	28,374	41,145	6,238	241	771	7,250	20,016	13,119	75,551	108,686	60,587	169,273
	Pocahontas No. 3	4,803	14,312	12,591	31,706	5,193	22,000	11,073	38,266	30		161	191	10,026	36,312	23,825	70,163	155,279	225,442
	Pocahontas No. 2	330	122		452	2,494			2,494	14,522			14,522	17,346	122		17,468		17,468
	Squire Jim	948	4,712	5,625	11,285	3,554	9,166	14,625	27,345	10,659	10,596	2,538	23,793	15,161	24,474	22,788	62,423		62,423
	Totals	220,976	197,389	124,776	543,141	434,236	234,076	81,158	749,470	76,897	28,247	6,586	111,730	732,109	459,712	212,520	1,404,341	322,028	1,726,369
	Grand totals of Tazewell County[4]	**279,698**	**267,348**	**159,589**	**706,635**	**696,938**	**433,917**	**171,545**	**1,302,400**	**144,007**	**49,622**	**15,487**	**209,116**	**1,120,643**	**750,887**	**346,621**	**2,218,151**	**322,783**	**2,540,934**

[1] Measured—Bed occurs within 1/4 mi of a measured thickness.

[2] Indicated—Bed occurs from 1/4 to 3/4 mi from a measured thickness.

[3] Inferred—Bed occurs more than 3/4 mi from a measured thickness, and the continuity of the coal can be inferred from geologic evidence.

[4] Includes resources from coal beds under less than 1,000 ft of overburden and from coal beds under more than 1,000 ft of overburden.

indicated that the bed has a maximum thickness of about 8 ft in the south-central part of the Amonate quadrangle, but it decreases to less than 14 in. thick to the southwest and northeast. The estimated resources in the Squire Jim coal bed total about 232 million short tons, of which 33 percent is in the >42-in.-thick category. Because of these large resources, the Squire Jim may be a target for future development.

Pocahontas No. 2 coal bed.—The Pocahontas No. 2 coal bed is relatively thin and is of little commercial importance in the study area. The bed crops out in the northeastern part of the county and is mostly 14–28 in. thick there (pl. 2*C*). To the northeast in the West Virginia portion of the Bramwell quadrangle, a few small mines have been operated in the bed. The Pocahontas No. 2 underlies extensive areas, but its minimal thickness and an underclay or shale parting as much as 8 in. thick have discouraged development. The only analyses available are from early investigations in nearby counties (Krebs and Teets, 1916). Those samples, from Raleigh and Mercer Counties, W. Va., contained an average of 0.93 percent sulfur and 4.6 percent ash; these are typical values for most coal beds in the Pocahontas Formation. Nearly all of the resources of 17.4 million short tons in the Pocahontas No. 2 are in the 14- to 28-in.-thick category.

Pocahontas No. 3 coal bed.—The thickest and most extensively mined coal bed in Tazewell County is the Pocahontas No. 3 (pl. 2*D*). It extends continuously across the northern part of the county and ranges from a maximum of more than 120 in. thick in the Bramwell quadrangle to less than 14 in. thick locally in the Richlands quadrangle. Analyses, on an as-received basis, of one sample collected in Tazewell County (U.S. Bureau of Mines Laboratory No. d170153), of two samples collected from McDowell County, W. Va. (U.S. Bureau of Mines Laboratory Nos. d170154 and w187041; Trent and others, 1982), and two samples collected from Buchanan County, Va. (U.S. Bureau of Mines Laboratory Nos. I–76102 and I–76103), show the following ranges in composition and calorific values:

	Low	High
Moisture (percent)	1.4	2.6
Volatile matter (percent)	16.2	22.9
Fixed carbon (percent)	66.3	77.8
Ash (percent)	4.3	7.6
Sulfur (percent)	.5	.7
Calorific value (Btu)	13,970	14,730

Of the total estimated original resources of 368.5 million short tons in the Pocahontas No. 3 coal bed, approximately 39 percent has been mined or lost in mining.

Pocahontas No. 4 coal bed.—The Pocahontas No. 4 coal bed is widely distributed but is variable in thickness (pl. 2*E*). The bed commonly ranges in thickness from a few inches to 48 in. or more within a distance of 1 to 2 mi. Pockets of coal are more than 84 in. thick in an adjoining area of the Anawalt and Tiptop quadrangles and more than 42 in. thick in the Amonate quadrangle. Both areas contain major mine workings. In the southwestern part of the Anawalt quadrangle, the Pocahontas No. 4 coal bed splits into two beds; the Upper split of the Pocahontas No. 4 is separated from the lower or principal bed by as much as 25 ft of sandstone and shale. Three analyses, on an as-received basis, from mines in the McDowell County, W. Va., portion of the Anawalt quadrangle show the following ranges in composition and calorific values (Trent and others, 1982):

	Low	High
Moisture (percent)	2.2	6.2
Volatile matter (percent)	21.3	24.0
Fixed carbon (percent)	59.9	72.3
Ash (percent)	4.2	11.4
Sulfur (percent)	.5	.7
Calorific value (Btu)	12,130	14,660

Of the total estimated original resources of 227 million tons in the Pocahontas No. 4 coal bed, approximately 27 percent has been mined or lost in mining.

Upper split of the Pocahontas No. 4 coal bed.—In the southwestern part of the Anawalt quadrangle, the Pocahontas No. 4 is split into two beds. The Upper split averages about 42 in. thick and has been extensively mined in the Tazewell North and Amonate quadrangles (pl. 2*F*). Belts of thin Upper split coal extend northwestward across parts of the Amonate and Jewell Ridge quadrangles and represent the location of channels that were eroded into the coal prior to the deposition of the overlying sandstone. The Upper split also is known as the Pocahontas No. 4 Rider and as the Pocahontas No. 5 coal bed. The Pocahontas No. 5 coal bed, as originally defined at the town of Pocahontas, Va., is thin and discontinuous in Tazewell County. Two analyses, on an as-received basis, from the Upper split of the Pocahontas No. 4 (identified previously as Pocahontas No. 5) from the McDowell County, W. Va., portion of the Tazewell North quadrangle show the following ranges in composition and calorific values (Wallace and others, 1952):

	Low	High
Moisture (percent)	1.8	2.0
Volatile matter (percent)	20.3	22.6
Fixed carbon (percent)	71.8	74.9
Ash (percent)	2.5	7.9
Sulfur (percent)	.5	.7
Calorific value (Btu)	14,400	15,430

Only about 13 percent of the total estimated original resources of 177 million short tons has been mined or lost in mining.

Pocahontas No. 6 coal bed.—The Pocahontas No. 6 is a thin, persistent bed that contains resources in the northeasternmost part of the county (pl. 2*F*). In the West Virginia portion of the Bramwell quadrangle, the coal is about 36 in. or more in thickness and has been widely mined. Two analyses of samples from mines in that area show the following ranges in composition and calorific values (Wallace and others, 1954):

	Low	High
Moisture (percent)	3.5	3.8
Volatile matter (percent)	19.4	21.0
Fixed carbon (percent)	74.8	76.5
Ash (percent)	2.5	5.8
Sulfur (percent)	.7	.7
Calorific value (Btu)	14,820	15,550

Total estimated original resources of nearly 10 million tons in the Pocahontas No. 6 coal bed are in the 14- to 28-in.-thick category.

Pocahontas No. 7 coal bed.—The Pocahontas No. 7 coal bed is thin and of little commercial importance in Tazewell County. It contains resources in the southwestern part of the coal field area, mostly in the Jewell Ridge, Amonate, and Richlands quadrangles (pl. 2*C*). More than 90 percent of the total estimated resources in the Pocahontas No. 7 coal bed are in the 14- to 28-in.-thick category.

Other coal beds in the Pocahontas Formation, including the Pocahontas No. 1, No. 2A, and No. 5 and the Goodwill, are too thin or discontinuous for the calculation of resources. An insignificant amount of resources occurs in the small areas where these coal beds are more than 14 in. thick.

Coal Beds of the New River Formation

Little Fire Creek coal zone.—One to three coal beds in a sequence of sandstone, shale, and underclay as much as 30 ft thick constitute the Little Fire Creek coal zone. The principal coal bed in this zone, the Lower Horsepen, is more than 42 in. thick locally in the Anawalt quadrangle (pl. 3*A*). The bed thins southwestward and is discontinuous in the Tazewell North quadrangle. Locally, in the southwestern part of the coal field area, the zone contains three coal beds identified as the Lower Little Fire Creek, Little Fire Creek (correlative with the Lower Horsepen), and Upper Little Fire Creek. Resources in these beds and the Lower Horsepen are mostly in the 14- to 28-in.-thick category. An analysis, on an as-received basis, of Lower Horsepen coal is as follows (Trent and others, 1982):

Moisture (percent)	1.9
Volatile matter (percent)	24.8
Fixed carbon (percent)	69.7
Ash (percent)	3.6
Sulfur (percent)	1.1
Calorific value (Btu)	14,740

Mining in the zone has been on a small scale at a few localities. As mined areas are of negligible size, total estimated original resources of 38.7 million tons are the same as the remaining resources (table 2).

Fire Creek coal bed.—The Fire Creek coal bed is a relatively thin, widespread bed in the study area. The bed exceeds 28 in. in thickness at a few scattered localities (pl. 3*B*), but more than 90 percent of the estimated resources of 92.8 million short tons is in the 14- to 28-in.-thick category. Analyses of the coal are unavailable, and mining has depleted an insignificant amount of coal.

Fire Creek Rider coal bed.—The Fire Creek Rider is a thin, moderately persistent bed occurring about 10–20 ft above the Fire Creek coal zone. Mining has been deterred by the general thinness of the bed (pl. 3*C*), and samples for analyses are unavailable. About 93 percent of the estimated resources of 47.3 million short tons is in the 14- to 28-in.-thick category.

War Creek coal bed.—The War Creek coal bed is thick and persistent in a belt adjacent to the southeastern edge of the southwestern Virginia coal field, principally in the Amonate quadrangle (pl. 3*D*). There, the bed is more than 42 in. thick in several large areas, which include several small mines. To the northwest, the bed decreases in thickness and is locally absent. An analysis, on an as-received basis, of the coal from a small-scale strip mine in the Anawalt quadrangle (Trent and others, 1982) is as follows:

Moisture (percent)	2.8
Volatile matter (percent)	26.8
Fixed carbon (percent)	66.1
Ash (percent)	4.3
Sulfur (percent)	.8
Calorific value (Btu)	14,430

Approximately 22 percent of the estimated original resources of 92.5 million short tons is in the >42-in.-thick category.

Middle Horsepen coal bed.—The Middle Horsepen coal bed occurs principally in the Tazewell North quadrangle, where it generally ranges from 36 to 60 in. thick, and in the southwestern part of the Amonate quadrangle, where it averages about 30 in. thick (pl. 3*E*). The bed has been extensively strip and underground mined in the Tazewell North quadrangle. Of the estimated remaining resources

of 76.8 million short tons, approximately 25.5 million short tons, or 33 percent, are in a bed more than 28 in. thick.

Middle Horsepen Rider coal bed.—A thin coal bed occurring about 20 ft above the Middle Horsepen coal bed is identified as the Middle Horsepen Rider. It contains resources as much as 36 in. thick in small adjoining areas of the Jewell Ridge, Amonate, Richlands, Keen Mountain, and Honaker quadrangles. These estimated resources total 32.2 million short tons, of which 82 percent is in the 14- to 28-in.-thick category.

Upper Horsepen coal bed.—The Upper Horsepen coal bed is the lowest of two to four coal beds occurring in a zone that also includes the Upper split of the Upper Horsepen coal bed. The thickest resources of the Upper Horsepen are in the Tazewell North and Tiptop quadrangles, where coal about 48–72 in. thick has been underground and strip mined (pl. 3*F*). Another large area of resources, from 14 to 42 in. thick, extends across parts of the Jewell Ridge and Amonate quadrangles. Analyses, on an as-received basis, of four samples collected in Tazewell County (Trent and others, 1982) show the following ranges in compositions and calorific values:

	Low	High
Moisture (percent)	0.9	3.0
Volatile matter (percent)	25.1	27.8
Fixed carbon (percent)	62.3	67.4
Ash (percent)	3.9	9.4
Sulfur (percent)	.5	.8
Calorific value (Btu)	13,780	15,000

Of the estimated remaining resources of 50 million short tons, about 18 million short tons or 35 percent are in one bed more than 28 in. thick.

Upper split of the Upper Horsepen coal bed.—The Upper split of the Upper Horsepen coal bed lies about 30 ft above the Upper Horsepen and has a somewhat similar distribution (pl. 4*A*). The bed is thickest in the Tiptop quadrangle, where it is locally as much as 84 in. thick, and much of the coal adjacent to the outcrop of the coal bed (pl. 4*A*) has been depleted by strip mining. Substantial resources occur southwest of the central part of the Amonate quadrangle, where the bed is entirely in the subsurface. An analysis, on an as-received basis, of the Upper split of the Upper Horsepen is as follows (Windolph, 1986):

Moisture (percent)	3.4
Volatile matter (percent)	25.1
Fixed carbon (percent)	65.2
Ash (percent)	6.3
Sulfur (percent)	.4
Calorific value (Btu)	14,200

About 130.4 million short tons, or 75 percent, of the estimated resources are in a bed more than 28 in. thick.

Welch(?) coal bed.—The Welch(?) coal bed occurs principally in the Jewell Ridge and, to a lesser extent, in adjoining quadrangles. It is thickest, about 36 in. or more, in an irregular belt adjacent to the southeast edge of the coal field (pl. 4*B*). The bed thins northwestward to 14 in. or less at the northwestern edge of the county. About 80 percent of the estimated resources is in the 14- to 28-in.-thick category. Mining of the Welch(?) coal has been deterred by the general thinness of the bed in areas where it crops out.

Sewell(?) coal bed.—A thin, persistent bed that lies about 80 ft above the Welch(?) in the southwestern part of the coal field area is tentatively identified as the Sewell coal bed. The bed is less than 28 in. thick, except in small areas of the Amonate and Tazewell North quadrangles where the bed is as much as 36 in. thick (pl. 4*C*). Development is limited to small-scale strip mining along the outcrop in the Amonate quadrangle. Analyses, on an as-received basis, of two samples of the Sewell(?) coal bed show the following ranges in composition and calorific values (Windolph, 1986):

	Low	High
Moisture (percent)	1.4	1.8
Volatile matter (percent)	23.4	24.0
Fixed carbon (percent)	70.0	70.8
Ash (percent)	3.4	5.2
Sulfur (percent)	.8	1.0
Calorific value (Btu)	14,570	14,840

Of the estimated remaining resources of 120.8 million short tons, 87 percent is in the 14- to 28-in.-thick category.

Sewell A(?) coal bed.—The Sewell A(?) coal bed crops out in the Amonate quadrangle, where it ranges from 0 to 22 in. thick. The bed increases in thickness southwestward into the subsurface and underlies an area adjacent to the southwestern edge of the county, where resources range from 28 to 42 in. thick (pl. 4*D*). Mining of the Sewell A(?) has been discouraged by the thinness of the bed in the outcrop area. About 40 percent, or 35.5 million short tons, is in the 28- to 42-in.-thick category.

Sewell B(?) coal bed.—The Sewell B(?) coal is a thin bed that occurs locally in the Jewell Ridge and adjacent quadrangles. The bed attains a thickness of about 36 in., but nearly all of its estimated resources of 19.6 million short tons are in the 14- to 28-in.-thick category.

Unnamed coal bed.—A thin, discontinuous coal bed that occurs between the Sewell B(?) and the Lower Seaboard coal bed in the Jewell Ridge, Richlands, and Amonate quadrangles is herein referred to as the unnamed coal bed. Nearly all of the estimated resources of 15.7 million short tons are in the 14- to 28-in.-thick category.

Lower Seaboard coal bed.—The Lower Seaboard is a widespread coal bed of mineable thickness, principally in the Jewell Ridge quadrangle, where it is accessible on the lower valley slopes in the southeastern part of the quadran-

gle (pl. 4*E*). The bed commonly ranges from 30 to 48 in. thick but locally is as much as 60 in. thick. It also crops out in the adjoining western part of the Amonate quadrangle, where most of the coal is in the 14- to 28-in.-thick category. The high quality of the Lower Seaboard coal is indicated by the following two analyses from the mined area in the southeastern part of the Jewell Ridge quadrangle (Englund and Teaford, 1980):

	Low	High
Moisture (percent)	1.9	2.0
Volatile matter (percent)	26.6	26.8
Fixed carbon (percent)	67.1	68.2
Ash (percent)	3.2	4.2
Sulfur (percent)	.9	1.2
Calorific value (Btu)	14,560	14,710

Of the estimated remaining resources, about 60 percent, or 68.5 million short tons, is more than 28 in. thick.

Dirty Six coal bed.—The Dirty Six coal bed crops out primarily in the western half of the Amonate quadrangle and contains most of its resources in this area. (pl. 4*F*). From a maximum thickness of 49 in. in this area, the bed thins westward and wedges out along the eastern edge of the Jewell Ridge quadrangle. Mining has been limited to a few small adits where coal was obtained for local use. Two analyses, on an as-received basis, show the following ranges in composition and calorific value (Windolph, 1986):

	Low	High
Moisture (percent)	2.8	3.0
Volatile matter (percent)	27.4	28.0
Fixed carbon (percent)	60.2	66.4
Ash (percent)	3.4	8.8
Sulfur (percent)	.9	1.9
Calorific value (Btu)	13,660	14,460

About 65 percent, or 14 million tons, of the estimated remaining resources is in the 14- to 28-in.-thick category.

Middle Seaboard coal bed.—The Middle Seaboard is a thin, persistent bed occurring in the Jewell Ridge and adjoining quadrangles (pl. 5*A*). Locally, the bed is as much as 40 in. thick and includes a few small underground mines in the southeastern part of the Jewell Ridge quadrangle. Only about 27 percent, or 24.5 million short tons, of the estimated remaining resources is more than 28 in. thick.

Upper Seaboard coal bed.—The Upper Seaboard coal bed occupies a narrow belt, about 2 mi wide, that extends northeasterly across parts of the Richlands, Jewell Ridge, and Amonate quadrangles (pl. 5*B*). Coal in the central part of this belt in the Jewell Ridge quadrangle ranges mostly from 30 to 36 in. in thickness and has been largely depleted by both underground and strip mining. About 13.3 million short tons, or 35 percent, of the estimated original resources are more than 28 in. thick.

Castle(?) coal bed.—The Castle(?) coal bed occurs locally at depth in adjoining areas of the Honaker, Keen Mountain, Richlands, and Jewell Ridge quadrangles. The bed is in the upper tongue of the Middlesboro Sandstone Member of the New River Formation, and because of scour during the deposition of this sandstone member, the coal is highly variable in thickness and may thin from 40 to 0 in. in less than 1 mi. Of the total estimated resources in the Castle(?) coal bed, about 12.5 million short tons, or 73 percent, are more than 28 in. thick.

Lee coal bed.—The Lee coal is a thin persistent bed that overlies the Upper tongue of the Middlesboro Sandstone Member of the New River Formation. The bed is generally less than 12 in. thick but increases to 24 in. thick in a small area of the Amonate quadrangle. The total estimated resources of 2 million short tons are in the 14- to 28-in.-thick category.

Tiller coal bed.—The Tiller is a thin coal bed that contains resources in a small adjoining area of the Jewell Ridge and Amonate quadrangles (pl. 5*C*). In the Jewell Ridge quadrangle, the bed is as much as 41 in. thick and has been mined at one locality. Analysis, on an as-received basis, of a sample from the area of mining is as follows (Englund and Teaford, 1980):

Moisture (percent)	2.3
Volatile matter (percent)	26.7
Fixed carbon (percent)	63.8
Ash (percent)	7.2
Sulfur (percent)	.7
Calorific value (Btu)	14,000

Only about 4 million short tons, or 21 percent, of the total estimated remaining resources in a bed are more than 28 in. thick.

Tiller Rider coal bed.—The Tiller Rider coal bed occurs locally in the southern part of the Jewell Ridge quadrangle and, to a lesser extent, in adjacent parts of the Richlands and Amonate quadrangles. The bed commonly ranges from 0 to 46 in. thick over short distances, and much of the variation in thickness is the result of erosion associated with the deposition of the overlying Council Sandstone Member. Of the total estimated resources, 4.5 million short tons, or about 14 percent, are more than 28 in. thick.

Jawbone coal bed.—The Jawbone coal bed is widely distributed in the Jewell Ridge and adjacent quadrangles in the southwestern part of the coal field area of Tazewell County (pl. 5*D*). Throughout most of this area, the bed ranges from 14 to 50 in. in thickness and commonly includes several inches of highly carbonaceous shale or claystone in one to five partings. Although development has been deterred in some areas by partings, strip and underground mining have been extensive in the Jewell Ridge and

Richlands quadrangles. Six analyses, on an as-received basis, of the Jawbone coal bed show the following ranges in composition and calorific values (Englund and Teaford, 1980):

	Low	High
Moisture (percent)	2.0	4.3
Volatile matter (percent)	17.9	23.4
Fixed carbon (percent)	67.1	70.0
Ash (percent)	7.2	10.7
Sulfur (percent)	.6	1.0
Calorific value (Btu)	13,160	14,170

Of the total estimated resources in the Jawbone coal bed, 56 million short tons, or 74 percent, are more than 28 in. thick.

Jawbone Rider coal bed.—The Jawbone Rider is a thin coal bed that occurs about 50 ft above the Jawbone coal bed and is similarly distributed in the southwestern part of the coal field area. Thicknesses of more than 28 in. are of limited extent; therefore, the total estimated resources of 32.7 million short tons are entirely in the 14- to 28-in.-thick category. The coal has a high sulfur content and has not been mined. An analysis, on an as-received basis, from the Jewell Ridge quadrangle is as follows (Englund and Teaford, 1980):

Moisture (percent)	3.8
Volatile matter (percent)	23.9
Fixed carbon (percent)	68.5
Ash (percent)	3.8
Sulfur (percent)	2.0
Calorific value (Btu)	14,430

Jewell coal bed.—The Jewell coal bed, also known locally as the Raven, Red Ash, or Iaeger, is the most extensively mined coal bed in Tazewell County (pl. 5*E*). Underground and strip mines have depleted large areas where the coal commonly ranged from 36 to 50 in. in thickness. Estimated remaining resources of 19.4 million short tons are mostly in the 14- to 28-in.-thick category and are located largely in the southwestern part of the Jewell Ridge quadrangle. Seven analyses, on an as-received basis, of the Jewell coal bed show the following ranges in composition and calorific values (Englund and Teaford, 1980):

	Low	High
Moisture (percent)	2.0	3.6
Volatile matter (percent)	20.7	28.7
Fixed carbon (percent)	63.9	74.5
Ash (percent)	2.4	5.5
Sulfur (percent)	.5	.9
Calorific value (Btu)	14,290	14,940

Other coal beds in the New River Formation, including the Pocahontas No. 8 and No. 9, Iaeger A and B, Aily, and several unnamed beds, are too thin or discontinuous to warrant the calculation of resources. Available data indicate that an insignificant amount of coal may occur in the few small areas where these beds are more than 14 in. thick.

Coal Beds of the Kanawha Formation

Kennedy coal bed.—The Kennedy coal bed underlies small hilltop areas along the Tazewell-Buchanan and Tazewell-Russell County lines (pl. 5*F*). The bed ranges mostly from 14 to 30 in. in thickness but attains a maximum thickness of 60 in. locally in the Richlands quadrangle. Much of the coal adjacent to the outcrop has been strip mined in a belt that averages about 100 ft in width. Shale, as much as 50 ft thick, comprises the highwalls of these operations. Two analyses, on an as-received basis, show the following ranges in composition and calorific values (Englund and Teaford, 1980):

	Low	High
Moisture (percent)	2.6	2.9
Volatile matter (percent)	29.5	30.2
Fixed carbon (percent)	64.0	64.5
Ash (percent)	3.1	3.2
Sulfur (percent)	.7	.9
Calorific value (Btu)	14,690	14,710

About 5 million short tons, or 53 percent, of the total estimated remaining resources are in beds more than 28 in. thick.

Big Fork coal bed.—Small hilltop areas along the Tazewell-Buchanan County line in the Jewell Ridge and Amonate quadrangles are underlain by the Big Fork coal bed. The bed is as much as 41 in. thick, but nearly all (81 percent) of the estimated remaining resources are in the 14- to 28-in.-thick category. A small-scale strip mine has been operated in the bed at one locality.

Lower Banner coal bed.—The Lower Banner is a thick, persistent bed that underlies hilltop areas along the Tazewell-Buchanan County line in the Keen Mountain and Jewell Ridge quadrangles. It is about 48 in. thick throughout the area. About 77 percent of the estimated original resources has been depleted by strip and underground mining. The estimated remaining resources are limited to a small area in the Keen Mountain quadrangle. Analysis, on an as-received basis, of a sample from this area shows the following values:

Moisture (percent)	2.7
Volatile matter (percent)	30.4
Fixed carbon (percent)	60.2
Ash (percent)	6.5
Sulfur (percent)	.6
Calorific value (Btu)	13,950

Other coal beds in the Kanawha Formation, including the Kennedy Rider, Bearwallow, Upper Banner, and a few unnamed beds, exceed 14 in. in thickness locally. Available data indicate that these areas are too small to contain a significant amount of resources.

MINING METHODS

Coal in Tazewell County is and has been extracted from both underground and strip mines. Nearly all of the underground operations consist of drift mines that extend into relatively flat-lying coal beds from adits located along the outcrop of a bed. The coal is mined by the room-and-pillar method, and pillars generally are recovered in the advanced stage of development. The sizes of these underground operations range from adits driven a few hundred yards into a coal bed to large railroad mines that have developed several square miles of a bed. Many of the smaller mines are operated seasonally to supply coal for local household use. Mechanization, including the use of cutting and loading machines, is widespread in the larger mines, which also have facilities for cleaning and sorting mined coal. Locally in the Bramwell and Anawalt quadrangles, the Pocahontas No. 3 coal bed was reached by inclined slopes or shafts.

Strip mining, which has accounted for as much as 25 percent of the coal mined in recent years, consists mostly of contour strip mining of hillsides. In these operations, coal in a belt from about 50 to 200 ft wide adjacent to an outcrop is uncovered by removing as much as 100 ft of overburden; the preferred overburden is shale. Localities where the coal beds are overlain by thick massive sandstone generally are avoided because of the increased cost of blasting and removal of sandstone in the highwall. Coal has also been auger mined in conjunction with many of these strip mining operations.

PRODUCTION

Coal has been mined in Tazewell County for more than 100 years. Annual production figures, available on a countywide basis, primarily in the U.S. Bureau of Mines Mineral Yearbooks (1918–79), show that a total of 174,041,556 short tons were mined in Tazewell County as of January 1, 1980 (table 3). The calculation of resources for this report for the same period indicates that 323,538,000 short tons of coal were mined or lost in mining in Tazewell County (table 2). A comparison of these two figures shows that approximately 54 percent of the coal was recovered in mining. This rate of recovery compares favorably with rates in adjacent McDowell and Mercer Counties, W. Va., where the rates of recovery have averaged 54.4 percent (Wallace and others, 1952) and 54.7 percent (Wallace and others, 1954), respectively.

Table 3. Coal production in Tazewell County, Va., 1883–1979

[Harnsberger (1919) and U.S. Bureau of Mines Mineral Yearbooks (1918–79)]

Year	Short Tons	Year	Short Tons
1883	92,350	1933	1,980,859
1884	256,435	1934	2,693,756
1885	511,575	1935	2,387,002
1886	639,751	1936	2,968,536
1887	781,155	1937	2,900,834
1888	948,300	1938	2,800,449
1889	807,046	1939	2,757,984
1890	759,038	1940	3,283,185
1891	696,966	1941	3,827,007
1892	614,333	1942	4,352,499
1893	653,374	1943	4,800,320
1894	827,706	1944	4,679,870
1895	962,269	1945	4,061,201
1896	785,345	1946	3,884,197
1897	708,338	1947	4,380,720
1898	782,015	1948	3,943,220
1899	844,027	1949	2,152,458
1900	970,866	1950	2,934,938
1901	776,568	1951	3,620,407
1902	723,753	1952	3,190,233
1903	840,195	1953	2,454,197
1904	871,720	1954	2,696,813
1905	961,380	1955	2,970,212
1906	910,638	1956	3,542,464
1907	1,116,534	1957	3,993,979
1908	980,014	1958	2,752,143
1909	975,665	1959	2,515,819
1910	1,187,146	1960	1,750,992
1911	1,281,224	1961	933,110
1912	1,302,043	1962	460,182
1913	1,447,351	1963	468,859
1914	1,323,530	1964	236,587
1915	1,647,081	1965	400,794
1916	1,588,044	1966	244,121
1917	1,631,849	1967	311,000
1918	1,624,736	1968	298,000
1919	1,208,814	1969	356,000
1920	1,323,712	1970	1,115,000
1921	1,253,902	1971	1,380,000
1922	1,563,847	1972	1,791,000
1923	1,492,875	1973	1,651,000
1924	1,801,430	1974	1,947,000
1925	2,128,115	1975	2,542,000
1926	2,347,552	1976	3,583,000
1927	2,254,257	1977	2,174,000
1928	2,410,491	1978	1,112,000
1929	2,809,076	1979	1,808,000
1930	2,506,636		
1931	2,214,956		
1932	1,807,586	Total	174,041,556

COAL RESOURCES

Method of Preparing Estimates of Resources

The estimated coal resources of Tazewell County were calculated according to the following procedures and definitions:

Thickness of beds.—Coal resources are reported in thickness categories of 14–28 in., 28–42 in., and more than 42 in. Coal beds less than 14 in. thick were omitted from the resource estimate, and in determining the total thickness of a bed, partings were excluded.

Weight of coal.—To compensate for variations in the weight of bituminous coal, an average weight of 1,800 short tons per acre-foot, or 150 short tons per acre-inch, is used in the calculation of resource tonnages. This figure is widely used in the central Appalachian basin (Wood and others, 1983).

Thickness of overburden.—Overburden categories of 0–1,000 ft and 1,000–2,000 ft are used in the reporting of calculated resources. About 73 percent of the estimated remaining resources is under less than 1,000 ft of overburden (table 2). The balance of resources lies beneath mountain ridges that add a few hundred feet of additional overburden. The calculation of strippable coal resources under relatively thin overburden was not attempted because (1) unmapped accumulations of colluvium on mountain sides, especially along drainage courses, are unstable in highwalls and are acquifers for water runoff; consequently, these deposits have been bypassed by many stripping operations and (2) the feasibility of strip mining is effected adversely by the presence of unmapped beds of thick sandstone in the overburden.

Classification of Measured, Indicated, and Inferred Resources

In addition to thickness categories, coal resources are also classified as "measured," "indicated," and "inferred" resources, according to the density and reliability of data on which the estimates are based.

Measured resources.—Measured resources are computed for areas where the thickness and areal extent of the coal bed are well defined by observation points in mine workings, prospects, drill holes, or natural outcrops. The density of data needed to establish the continuity of measured coal resources varies from bed to bed, but all observation points for measured resources are ½ mi or less apart. Except where local structural deformation interrupts the continuity of a coal bed, measured coal occurs in a belt, ¼ mi wide, adjacent to an outcrop line having closely spaced observation points.

Indicated resources.—Coal beds of known geologic continuity contain indicated resources where the observation points are ½ to 1½ mi apart. Indicated coal extends as much as ¾ mi from an observation point and generally occurs in a belt about ½ mile wide beyond the measured coal.

Inferred resources.—Coal is classified as inferred resources in areas where observation points are more than 1½ mi apart and the assumed continuity of the coal bed is supported by geologic evidence.

SUMMARY OF RESOURCE ESTIMATES

Coal beds in Tazewell County contained a total estimated original resource of 2,540,934,000 short tons. Of this total, 322,783,000 short tons, or 13 percent, have been mined or lost in mining, mostly from the Pocahontas No. 3, Pocahontas No. 4, and the Upper split of the Pocahontas No. 4; the Middle and Upper Horsepen; and the Jawbone and Jewell coal beds. All coal remaining within mined areas is considered lost, including coal left in pillars in or between mines and adjacent to mine boundaries, coal left to protect gas and oil wells, and other coal that is required by law to be left unmined, such as coal under some highways, railroads, and rivers.

The estimated remaining resources, excluding the amount of coal mined or lost in mining, total 2,218,151,000 short tons, of which 1,120,643,000 short tons, or 51 percent, are in beds from 14 to 28 in. thick. These thin beds include most of the rider coals that lie too close to other coal beds for underground recovery. Of the remaining estimated resource of 1,097,508,000 short tons more than 28 in. thick, about 65,109,000 tons, or 6 percent, are classed as inferred. The remaining measured and indicated resources total 1,032,399,000 tons, of which available analyses indicate that 78,963,000 tons in the Lower Horsepen, Lower Seaboard, and Dirty Six coal beds may contain more than 1 percent sulfur. Therefore, estimated measured and indicated resources in beds more than 28 in. thick and having an average sulfur content of about 1 percent or less total 953,436,000 short tons. Application of the 54 percent recovery factor, as determined by past mining in Tazewell County and mining in nearby counties, indicates that about 514,855,000 short tons of this low-sulfur coal may be recoverable.

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