

GEOLOGIC MAP OF THE MT. AXTELL QUADRANGLE,
GUNNISON COUNTY, COLORADO

By D. L. Gaskill, J. E. DeLong, Jr., and D. M. Cochran

Table 1.—Coal mine inventory and summary, Mt. Axtell quadrangle, Gunnison County, Colorado
(Leaders (--) mean no data)

Coal mine location no.	Coal mine names(s); operator(s)	Years operated	Coal bed(s) and thickness in feet (meters)	Coal rank ¹	Production in short tons (metric tons)	Numerals keyed to reference list		Remarks
						Coal analyses	General	
1	Alpine No. 1; Rocky Mtn. Fuel Co.	1897-98	Bed B, 4.5-8.5 (1.4-2.6)	b	4,815 (4,368)	--	9, 10, 30	Original opening of White Ash mine. Slightly coking.
2	Alpine No. 2; Rocky Mtn. Fuel Co., Alpine Fuel Co.	1900-46	Bed B, 6.0-8.0 (1.8-2.4)	sub A- hvb A	2,132,260 (1,934,386)	4, 11, 13, 17, 18, 30 33, 34, 39	4, 8-12, 17-26, 30, 36, 37, 44, 45	153 ft (47 m) deep shaft; workings coextensive with Alpine No. 1, Smith, Sunbeam, and White Ash mines.
3	Baldwin (South Park, Citizen); Union Coal Co., Union Pacific Coal Co., Citizen Coal Co.	1881-93	Bed B, 4.0-6.8 (1.2-2.1)	hvb C hvb B	268,467+ (243,553+)	4, 13, 1B	4, 8-10, 15, 19, 21, 23, 26-28, 30, 42-45	150 ft (46 m) deep shaft; workings coextensive with Black Diamond, Union, and Superior(?) mines. Slightly coking. Worked in 1893 and later(?) as the Citizen mine.
--	Becket; W. C. Becket	1883-84	Bed C?, 5.0 (1.5)	an	500 (454)	--	4, 20	Original site(?) of Richardson mine.
--	Bentley	--	--	--	--	--	--	May refer to White Ash mine or to the Star mine in the adjacent Squirrel Creek quadrangle.
4	Black Diamond (B. D.); Black Diamond Coal Co.	1894-98	Bed B, 5.0-6.0 (1.5-1.8)	b	22,069 (20,021)	--	4, 9, 30, 44	--
5	Carbon Creek; Carbon Creek Coal Co., W. Waugh, A. G. Smith, L. G. White	1925-27 1931-44 1948-50	Bed B, 4.0-6.0 (1.2-1.8)	b- sa	11,489 (10,423)	--	4, 8-10, 24, 29, 30	Many faults. Original location of the Augusta coal claim in 1880.
B	Castle Creek	About 1910 and later	1.0-3.0± (0.3-0.9±)	b	un	--	--	Several short, caved adits with small dumps on the south side of Castle Creek. Coal zone estimated to be about 300 ft (91 m) above coal bed B.
--	Citizen	--	--	--	--	--	--	See Baldwin mine.
7	Holley; N. A. Holley Coal Co.	1894-97	Bed C?, 5.0-6.0 (1.5-1.8)	b	8,426 (7,644)	--	4, 9, 20, 44	--
8	Kubler (New Baldwin); Kubler Coal Co., LaPlante and Sons, Rocky Mtn. Fuel Co.	1881- ? 1885-98 1907-13 1913-15 1934-39 1946-49	Bed B, 5.0-7.0 (1.5-2.1)	hvb C	283,000+ (256,738+)	1, 4, 11, 17, 18, 30, 39, 40	4, 8-11, 13, 17-19, 22, 44, 45	Workings coextensive with Nu No. 2 Mine. 4-5 percent pitch of coal bed. Two beds may have been mined. Lower mined bed reported to be about 70 ft (21 m) below bed B.
9	LaPlante; D. L. LaPlante	1884-85	Bed A, 4.0 ± (1.2 ±)	b	un	17, 18, 30, 39	10, 17, 30	Shaft and 400 ft (122 m) long drift.
10	Lewis	About 1890	Bed B?, 3.9 (1.2)	b	un	--	23	--
--	Mount Carbon Coal Extension	1881	Bed C, 3.5-4.5 (1.1-1.4)	b	un	--	20, 22	Located between Nu No. 2 and Holley mines. Two adits with sizable dumps in coal bed about 115 ft (35 m) above bed B in area of Nu No. 2 workings.
11	Mount Carbon Coal Tunnel; Mount Carbon- Anthracite Coal Co., Ohio Creek-Anthracite Coal Co., W. Hinds	1885-91	3.5 (1.1)	b- sa	un	15, 16, 30	20, 22, 27, 30, 42, 44	1,148 ft (350 m) long adit cuts three steeply inclined coal beds on west flank of Carbon Peak. Large mine dump; 20 coke ovens. Mined coal bed about 600 ft (183 m) stratigraphically below top of Mesaverde Formation.
--	New Baldwin	--	--	--	--	--	--	See Kubler mine. May also refer to the LaPlante No. 2 mine in adjacent Squirrel Creek quadrangle.

Table 1.—Coal mine inventory and summary, Mt. Axtell quadrangle, Gunnison County, Colorado—Continued

[Leaders (—) mean no data]

Coal mine location no.	Coal mine name(s); operator(s)	Years operated	Coal bed(s) and thickness in feet (meters)	Coal rank ¹	Production in short tons (metric tons)	Numerals keyed to reference list		Remarks
						Coal analyses	General	
12	Nu No. 1; Partch Brothers	1939-55	Bed B, 4.0-6.0 (1.2-1.8)	hvb C-hvb B	222,740 (149,035)	4, 13, 18, 34, 40	1, 2, 4, 8, 9, 19, 24, 34, 35, 44	Connects with the Ohio Creek No. 2 mine.
13	Nu No. 2; Nu Coal Co., Partch Brothers	1954-69	Bed B, 5.0-7.0 (1.5-2.1)	hvb C-hvb A	221,982 (201,382)	3, 13, 18, 34	2, 4, 6, 8, 9, 20, 30, 34	Coextensive with the Kubler mine.
14	Ohio Creek No. 1; Ohio Creek Coal Co., C. M. Long, G. D. Manfield, Staples Brothers	1917-51	Bed B, 5.5-8.3 (1.7-1.9)	hvb C-hvb B	186,312 (169,022)	3, 4, 13, 18, 33, 34	1, 4, 7-9, 17, 24, 34	Coextensive with the Great Western Coal mine in the adjacent Crested Butte and Flattop Mountain quadrangles. Entry adit in adjoining Squirrel Creek quadrangle.
15	Ohio Creek No. 2 (O-C Mine); Ohio Creek Coal Co., S. L. Staples, Weaver Brothers	1952-80	Bed B, 5.0-6.0 (1.5-1.8)	hvb C	94,371 (85,613)	3, 4, 13, 17, 18, 33, 34	7-10, 18-20, 24, 25, 34	Coking qualities. Coextensive with the Ohio Creek No. 1 and Nu No. 1 mines. Entry adit in adjoining Squirrel Creek quadrangle.
16	Owen	About 1880	>1.0 (>0.3)	b	un	--	22	--
17	Purrier; Henry Purrier Coal Co.	1888-92	Bed C?, 4.0± (1.2±)	b	un	30	8, 20	--
18	Richardson; Richardson Coal Co., Mount Carbon Anthracite Coal Co., Gomer Dollard, Weaver Brothers	1874-? 1884-86 1930-34 1936-45 1947-51	Zone C?, upper bed, 1.6 (0.5) lower bed, 2.8-5.0 (0.9-1.5)	lvb B an	24,000 (21,773)	4, 11, 16-18, 30, 34	4, 8-10, 12, 17-19, 22, 30, 31, 34, 44, 45	Coking and anthracite coal. Locally mined two beds, separated by about 4.5 ft (1.4 m) of shale. Coal underlies Mount Carbon laccolith.
19	Ruby-Anthracite (Floresta No. 1); Caledonia Fuel Co., Union Pacific Coal Co., Colorado Fuel and Iron Co.	1893-1900	3.5-4.5 (1.1-1.4)	an	118,194 (107,226)	4, 11, 15-18, 26, 30, 44	4, 8-10, 12, 14, 15, 17-23, 26, 28, 30, 32, 36, 38, 41, 42, 44, 45	Premium quality anthracite coal; some coking coal. Faulted and intruded by dikes. In the Paonia Shale Member about 1,400 ft (427 m) below the top of the Mesaverde Formation. Overlies the roof of the Anthracite Range laccolith.
20	Smith (Old Baldwin); A. G. and J. M. Smith, R. Stajdohar, E. L. Dutcher and L. D. Hardin	1947-66	Bed B, 4.5-8.0 (1.4-1.8)	hvb C	32,238 (29,246)	3, 34	1, 5, 9, 20, 34	Part of the Alpine No. 2 workings. Smith operations mined pillars.
21	Sunbeam; Gunnison Coal Co., Sunbeam Coal & Coke Co., Thomas Nesbeth	1894-97	Bed B, 8.0-8.0 (1.8-2.4)	hvb C	28,769 (26,099)	4	4, 20, 30, 36, 44	Coextensive with the Alpine No. 2 mine. Entry adit in adjoining Squirrel Creek quadrangle.
--	Superior; Superior Coal Co., Alex Waugh	1895-97	Bed B(?), 4.0-5.0 (1.2-1.5)	sub B	3,654 (3,315)	4	4, 9, 20, 44	Location uncertain; probably in sec. 8, T. 15 S., R. B6 W. and coextensive with Baldwin, Union, and Black Diamond mines.
22	Unknown	--	Bed A	--	--	--	--	Old mine at junction of Carbon Creek and Owens Gulch.
23	Unknown	--	3.6-5.0 (1.1-1.5)	b-an	un	--	--	Several adits and prospects with dumps between Ohio Pass and the Ruby-Anthracite mine.
24	Unknown	About 1908	Bed B, 5.0 (1.5)	--	--	--	30	30 ft (9 m) deep shaft.
25	Union (H. & H. Union); Union Coal Co., Union Pacific Coal Co., Hare & Hirdman	1897-1902 1951-52	Bed B, 6.0 (1.8)	hvb C	58,080 (52,690)	--	4, 8, 9, 16, 20, 42	Coextensive with the Baldwin (South Park) mine.
--	White Ash; G. I. Bentley	1895-97	Bed B, 8.0 (2.4)	b	12,000+ (10,887+)	--	4, 20	Called Alpine No. 1 mine (1897-98).

¹Abbreviations:

- un, unknown
- b, bituminous
- hvb A, high-volatile bituminous A, B, or C
- sa, semianthracite
- an, anthracite
- sub A, subbituminous A or B
- lvb B, low-volatile bituminous B

Table 2.—Partial list of metaliferous mines and prospects

(Leaders (—) mean no data)

Metal mine, prospect, or mining claim location no.	Mine, prospect, or lode claim name and mineral survey no.	Reported metal occurrence	Remarks
1	Boomerang, 4401	--	Adit and several prospect pits. May intersect Forest Queen vein system on west side of Coal Creek. Vein breccia, quartz gangue, and sulfides on dumps.
2	Blind King, 2757	Ag	Two adits on N. 30° W. and N. 10° W.-trending shears (elevation 9,900–9,990 ft). Quartz-sulfide veins cut porphyry sill.
3	Burlington, 3137	Ag	Includes group of four timbered shafts and shaft house at junction of nearly vertical, mineralized fault fissures trending N. 10° W. and N. 45° W. Shaft about 1,200 ft (366 m) north of above at junction of N. 10° W. fissure and crosscutting mineralized structure. Two timbered shafts along N. 10° W. mineralized vein to west may be on Burlington claim.
4	Daisy M.	--	Adit about 500 ft (152 m) east of Coal Creek. Mostly unaltered sandstone on large dump.
5 ¹	Davy Crockett, 3299	--	Two adits. Sulfide minerals on dumps.
6	Eclipse	--	--
7	Ella (Ellis), 3802	Ag	Two timbered shafts and trench, head frame, and older boiler. N. 10° E.-trending quartz-sulfide vein. Same vein as the Eureka.
8	Eureka	Ag	800-ft (244-m) tunnel along N. 10° E. fault and mineralized vein connects three timbered shafts. Shaft, 150 ft (46 m) deep, connected with 75-ft (23-m) drift and tunnel in 1883. Quartz veins contain ruby silver.
9	Fairview	Ag	Several shafts and prospects along N. 15° E., mineralized fault fissure which is 5–6 ft (2 m) wide. Same vein as Yellow Jacket.
10 ¹	Forest Queen, 745	Ag, Au, Zn, Pb, Cu, Sn, Mo	Main production period 1879–97. Intermittent activity 1901–02, 1917–19, 1934–35, 1945–51, and 1959 to present. Connects with Ruby King and Mountain Gem workings along same veins(s). 3,000–4,000 ft (914–1219 m) of lateral workings on seven or eight levels. About 1,500 ft (457 m) of shafts, raises, and stopes in a vertical interval of about 450 ft (137 m). 800-ft (244-m) drainage tunnel on 200-ft (61-m) level (flooded). Developed along complex fault zone, downthrown about 200 ft (61 m) to southeast. Zone includes numerous fissure veins 20–100 ft (6–30 m) or more apart. Forest Queen vein averages about 5 ft (1.5 m) wide, is vertical to nearly vertical in upper 300 ft (91 m), then pitches southeast. Ore minerals include sulfides, arsenides, and antimonides of silver: proustite and pyrargyrite (ruby silver), stephanite (wire silver), argyrodite, argentite, argentiferous tetrahedrite, native silver, gold and ruby silver in arsenopyrite, minor sphalerite and galena, traces of copper (chalcocopyrite and enargite), molybdenum, and tin. Chief ore is argentiferous arsenopyrite. Ore averaged about 140 oz Ag/ton in early years. Later shipments averaged nearer 20 oz Ag/ton and about 0.3 oz Au/ton. Gangue minerals mostly quartz, calcite, clay minerals, and pyrite. Some rhodochrosite, barite, and siderite locally. Main shaft 285 ft (87 m) deep.
11 ¹	Forfeit, 5525	Ag	Adit and prospects along several N. 7° W.-trending, nearly vertical faults and mineralized veins.
12	General Moltke, 2389	--	Adit with mineralized vein rock on dump.
13	Granddad	--	--
14	Keystone	Zn, Pb, Ag, Cu, Au	Largest and most productive metal mine in this quadrangle and periodically the largest in the county. Eight levels connected by shafts and three entries. Developed along two high-angle fault-fissure veins. Keystone vein explored more than 3,000 ft (914 m) laterally and 1,100 ft (335 m) vertically. Fault zone up to 9 ft (3 m) wide. Union vein explored in lower levels of mine, about 2,000 ft (607 m) laterally and 300 ft (91 m) vertically. About 13,000 ft (3962 m) of lateral workings and 4,600 ft (1402 m) of shafts and raises by 1961. Ore minerals include pyrrhotite, argentiferous tetrahedrite, chalcocopyrite, sphalerite, argentiferous galena, gold, and some ruby silver. Ore bodies 3–6 ft (1–2 m) wide. Periodically third in production of silver and zinc and fourth in production of lead in Colorado. Active from about 1883–89, 1914, 1945–56, 1958–72, and 1974 to present.
15 ¹	Last Chance, 4955	Ag, Au	Vertical fault-fissure vein parallel to Forest Queen vein.
16	Little Frank, 3138	--	Several adits with large dumps. Shaft and prospect pits aligned along two parallel quartz-pyrite veins trending N. 10° W. Veins about 250 ft (76 m) apart.
17	Louvisa Tunnel	--	500 (800?) ft (152 (244?) m) tunnel driven to intersect the Mammoth vein. Entry strikes S. 70° E.
18	Lyons, 2755	--	Probably includes a timbered shaft and large dump on 10,600-ft contour and two adits at about 10,800- and 10,900-ft elevations near north quadrangle boundary. Workings on quartz-sulfide veins trending about N. 15–30° W. on west side of Elk Creek.
19	Mammoth, 19527, and Great Eastern, 4262	Ag	Four deep shafts (two timbered), adits, and numerous prospect pits along fault and quartz-sulfide veins trending N. 10–30° E. Wasatch beds are west of fault and a porphyry sill is east of fault.
20 ¹	Mountain Gem, 4257, 4258	Ag, Au	Connected with Forest Queen workings along same vein system. Several hundred feet (meters) of lateral workings with large stoped areas. Main shaft 250 ft (76 m) deep.
21	My Boys	--	--
22	National, 3737	Ag	Two adits and shaft. Native silver.
23	Priceless, 3736A-B	--	Several pits, adits, and shafts(?). Dumps in this area were used to construct dam at Lake Irwin north of quadrangle.
24 ¹	Republic, 1348	--	Tunnel and shaft. Shaft at corner of ore bin behind John Hahn cabin, probably on the Last Chance vein.
25	Roosevelt No. 1	--	Three deep pits or caved shafts on vertical, N. 30° W., mineralized fault fissure that is 4 ft (1 m) wide. Two shafts at top of the 10,805-ft hill are on a 3 ft (1 m) wide, N. 10° E., quartz-sulfide fissure.
26	Roosevelt No. 2	--	Timbered shaft on top of ridge at 10,750-ft elevation on vertical, pyritized N. 35° E. fault fissure that is 5 ft (1.5 m) wide. Prospect on N. 10° W. altered zone is about 600 ft (183 m) southeast of above.
27	Roosevelt No. 3	--	Complex of four shafts and adit near southwest side of Copley Lake on N. 60° E. mineralized fault fissure. Wasatch beds north of fault; porphyry sill south of fault.

Table 2.—Partial list of metaliferous mines and prospects—Continued

[Leaders (—) mean no data]

Metal mine, prospect, or mining claim location no.	Mine, prospect, or lode claim name and mineral survey no.	Reported metal occurrence	Remarks
28 ¹	Ruby King, 1209	Ag, Au, Pb, Zn	Connected with Forest Queen workings by four levels. Main shaft 400 ft (122 m) deep. Three levels in main shaft at 150, 200, and 260 ft (46, 61, and 79 m) below collar. About 1,400 ft (427 m) of lateral workings, about 480 ft (146 m) of shafts and winzes, and several hundred feet of raises and stopes. 800-ft (244-m) drainage tunnel on 200-ft (61-m) level (flooded). Upper 70 ft (21 m) of main shaft in moraine. 6-in. (15-cm) coal seam cut in shaft at 280 ft (85 m). Remarks apply to the Forest Queen fault zone; mineralization and mining activity also apply to the Ruby King workings.
29	Ruby Queen, 3138	--	Two shafts and prospects on north-south shear. Ruins of shaft house. Timbered shaft about 100 ft (30 m) south-west of above on N. 10° W. quartz-sulfide vein.
30	Silver Queen	--	Adit driven in Wasatch beds. Several adits and prospects in altered rock aligned along east-trending veins near the southwest corner of the Silver Queen claim.
31	Venango, 2679	Ag, Pb, Cu	Adit at 10,880-ft contour: (90 ft (27 m) long, with 200-ft (61-m) winze and 100-ft (30-m) drift) on 40-ft (12-m) wide, altered and mineralized shear zone trending N. 25° W. A barren tunnel 420 ft (128 m) long, at the 10,740-ft contour is about 250 ft (76 m) southwest of above.
32	Yellow Jacket, 15036	--	Shaft on N. 15° E. fault fissure. Same vein as Fairview.
33	Yellow Dog and Pearl B	U	Prospect pits and adit in conglomeratic and carbonaceous sandstone.

¹See inset map of the Forest Queen mine area. Most of the unnamed prospects, adits and shafts without a coal symbol (c) show some sulfide mineralization.

REFERENCES

[Numerals in parentheses are location numbers]

Bancroft, 1890 (10, 28)
 Bolmer, 1962 (14)
 Burchard, 1881-85 (3, 8, 10, 14, 15, 18-20, 28, 29, 31, 32)
 Colorado Division of Mines, 1897-1979 (10, 14, 20)
 Eckel, 1961 (10)
 Emmons and others, 1894 (9, 10, 31)
 Goodknight, 1981 (33)
 Gunnison County Court House records (1-33)
 Hahn, John H., Forest Queen mine operator, oral commun. and unpublished data, reports, assays, and maps, 1980 (5, 10, 15, 20, 24, 28)
 Hall, 1895 (8, 10, 15)
 Hollowell, 1883a (10, 31)
 Ingham, 1888 (10, 15, 28)
 Lakes, 1889 (10)
 Sharp, 1978 (14)
 Socolow, 1955 (10, 14, 20, 28, 31)
 U.S. Bureau of Mines, 1926-33 (3)
 _____ 1934-78 (10, 14)
 U.S. Geological Survey, 1883-1922 (10, 14, 20, 28)
 Vandenbusche, 1981 (10, 14, 20, 24, 28, 31)

REFERENCES

[Number referred to in table 1]

- Aresco, S. J., and Haller, C. P., 1953, Analyses of tipple and delivered samples of coal: U.S. Bureau of Mines, Report of Investigations 4972, p. 9.
- Aresco, S. J., Haller, C. P., and Abernathy, R. F., 1956, Analyses of tipple and delivered samples of coal: U.S. Bureau of Mines, Report of Investigations 5270, p. 6.
- _____, 1959, Analyses of tipple and delivered samples of coal: U.S. Bureau of Mines, Report of Investigations 5489, p. 5.
 Bancroft, H. H., 1890, Nevada, Colorado, and Wyoming: San Francisco, Calif., The History Company, 827 p.
 Bolmer, R. L., 1962, Sinking methods and costs for a small vertical shaft with steel supports—Keystone mine, Crested Butte, Colorado: U.S. Bureau of Mines Information Circular 8086, p. 2-4.
- Boreck, D. L., and Murray, D. K., 1979, Colorado coal reserves depletion data and coal mine summaries: Colorado Geological Survey Open-File Report 79-1, 65 p.
 Burchard, H. C., 1881-85, Annual reports of the Director of the Mint upon the production of the precious metals in the United States during the calendar years 1880-84: Washington, D. C., U.S. Government Printing Office.
- Canis, F. H., and Gaz, L. A., 1966, Map of the Old Baldwin (Smith) mine, Gunnison County, Colorado: Denver, Colo., unpublished map on file at the Colorado Division of Mines, scale 1:1,200.
- _____, 1967, Map of the Nu mine No. 2, Gunnison County, Colorado [includes map of the Kubler mine]: Denver, Colo., unpublished map on file at the Colorado Division of Mines, scale 1:1,200.
- Canis, F. H., King, S. T., Schaaf, E. E., and La Plante, F. R., 1977, Map of the Ohio Creek mine No. 2, Gunnison County, Colorado [includes maps of the Great Western and Ohio Creek No. 1 mines]: Denver, Colo., unpublished map on file at the Colorado Division of Mines, scale 1:1,200.
 Cochran, D. M., Robinson, C. H., and Bartleson, B. L., 1978, Engineering and environmental geologic maps, Mount Emmons project, Gunnison County, Colorado: Lakewood, Colo., C. S. Robinson and Associates, unpublished maps prepared for the Climax Molybdenum Company.
 Collins, B. A., 1977, Geology of the coal basin area, Pitkin County, Colorado, in Veal, H. K., ed., Exploration frontiers of the central and southern Rockies: Denver, Colo., Rocky Mountain Association of Geologists Field Conference Guidebook, v. 1977, p. 363-377.

8. Colorado Division of Mines, 1979, History of Colorado coal mines (1883-1979), v. F-G (Gunnison County): Denver, Colo., unpublished manuscript on file at the Colorado Division of Mines.
 _____ 1886-1979, A summary of mineral industry activities in Colorado: Denver, Colo., Colorado Division of Mines, annual and biannual reports for the years 1886-1979.
9. _____ 1883-1979, Colorado State inspector of coal mines: Denver, Colo., Colorado Division of Mines, annual and biannual reports for the years 1883-1979.
10. Colorado State Planning Commission, 1940, Map of the West Elk Mountains coal fields, Gunnison County, Colorado: Denver, Colo., scale 1:62,500.
 Colton, R. B., Patterson, P. E., Holligan, J. A., and Anderson, L. W., 1975, Preliminary map of the landslide deposits, Montrose 1° x 2° quadrangle, Colorado: U.S. Geological Survey Miscellaneous Field Studies Map MF-702, scale 1:250,000.
 Cross, C. W., 1894, The laccolitic mountain groups of Colorado, Utah, and Arizona: U.S. Geological Survey 14th Annual Report, pt. 2, p. 157-241.
11. Dapples, E. C., 1938, Geology and coal deposits of the Anthracite-Crested Butte quadrangles, Gunnison County, Colorado: Madison, Wis., University of Wisconsin, unpublished Ph. D. thesis, 216 p.
12. _____ 1939, Coal metamorphism in the Anthracite-Crested Butte quadrangles, Colorado: Economic Geology, v. 34, no. 4, p. 369-398.
13. Dawson, L. C., and Murray, D. K., compilers, 1978, Colorado coal directory and source book: Colorado Geological Survey Resource Series 3, 225 p.
14. De Golyer, E. L., 1911, The metamorphism of coals of a portion of the Anthracite and Crested Butte quadrangles, Colorado: Norman, Okla., University of Oklahoma, unpublished B.S. thesis, 87 p.
 DeLong, J. E., Jr., Barrows, Peter, and Storch, S., 1979, Geologic map of the Mt. Axtell area, Mt. Emmons project: Golden, Colo., unpublished map on file at Climax Molybdenum Company.
 Dowsett, F. R., Jr., Ganster, M. W., Ranta, D. E., Baker, D. J., and Stein, H. J., 1981, Geology of the Mount Emmons molybdenum deposit, Crested Butte, Colorado, in Epis, R. C., and Callender, J. F., eds., Western Slope Colorado: New Mexico Geological Society Field Conference, 32nd, western Colorado and eastern Utah, 1981, Guidebook, p. 325-331.
 Eckel, E. B., 1961, Minerals of Colorado—A 100-year record: U.S. Geological Survey Bulletin 1114, 399 p.
15. Eakins, L. G., 1890, Coal analyses from Gunnison County, Colorado, in Clarke, F. W., A report of work done in the division of chemistry and physics: U.S. Geological Survey Bulletin 64, p. 55-57.
16. Emmons, S. F., Cross, C. W., and Eldridge, G. H., 1894, Description of the Elk Mountains, in Anthracite-Crested Butte [quadrangles], Colorado: U.S. Geological Survey Geologic Atlas, Folio 9, 19 p.
17. Fieldner, A. C., Cooper, H. M., Abernathy, R. F., and Snyder, N. H., 1937, Analyses of Colorado coals: U.S. Bureau of Mines Technical Paper 574, p. 34-37, 70-75, 173-180.
 Gaskill, D. L., Colman, S. M., DeLong, J. E., Jr., and Robinson, C. H., 1986, Geologic map of the Crested Butte quadrangle, Gunnison County, Colorado: U.S. Geological Survey Geologic Quadrangle Map GQ-1580, scale 1:24,000.
 Gaskill, D. L., and Godwin, L. H., 1963, Redefinition and correlation of the Ohio Creek Formation (Paleocene) in west-central Colorado, in Geological Survey Research 1963: U.S. Geological Survey Professional Paper 475-C, p. C35-C38.
 _____ 1966, Geologic map of the Marcellina Mountain quadrangle, Gunnison County, Colorado: U.S. Geological Survey Geologic Quadrangle Map GQ-511.
 Gaskill, D. L., Godwin, L. H., and Mutschler, F. E., 1967, Geologic map of the Oh-Be-Joyful quadrangle, Gunnison County, Colorado: U.S. Geological Survey Geologic Quadrangle Map GQ-578.
 Gaskill, D. L., Mutschler, F. E., and Bartleson, B. L., 1981, West Elk Volcanic Field, Gunnison and Delta Counties, Colorado, in Epis, R. C., and Callender, J. F., eds., Western Slope Colorado: New Mexico Geological Society Field Conference, 32nd, western Colorado and eastern Utah, 1981, Guidebook, p. 305-315.
 Gaskill, D. L., Rosenbaum, J. G., King, H. D., Meeves, H. C., and Bieniewski, K. L., 1977, Mineral resources of the West Elk Wilderness and vicinity, Delta and Gunnison Counties, Colorado: U.S. Geological Survey Open-File Report 77-751, 111 p.
 Giles, T. F., 1980, Reconnaissance of ground-water resources in the vicinity of Gunnison and Crested Butte, west-central Colorado: U.S. Geological Survey Water Resources Investigations Open-File Report 80-12.
 Godwin, L. H., and Gaskill, D. L., 1964, Post-Paleocene West Elk laccolith cluster, west-central Colorado, in Geological Survey Research 1964: U.S. Geological Survey Professional Paper 501-C, p. C66-C68.
 Goodknight, C. S., 1981, Uranium in the Gunnison Country, Colorado, in Epis, R. C., and Callender, J. F., eds., Western Slope Colorado: New Mexico Geological Society Field Conference, 32nd, western Colorado and eastern Utah, 1981, Guidebook, p. 183-189.
18. Goolsby, S. M., Reade, N. S., and Murray, D. K., 1979, Evaluation of coking coals in Colorado: Colorado Geological Survey Resource Series 7, 72 p.
19. Grosvenor, N. E., 1964, Coal mines of Colorado, Gunnison County: Golden, Colo., Colorado School of Mines Foundation, Inc., maps and index to mines.
20. Gunnison County Court House records: Gunnison, Colo.
21. Hall, Frank, 1895, History of the State of Colorado: Chicago Ill., The Blakesly Printing Co., v. 4, p. 150-152, 525.
22. Hollowell, J. K., 1883a, Gunnison, Colorado's bonanza county: Denver, Colo., Colorado Museum of Applied Geology and Mineralogy, Geological Monograph 2, 168 p.
 _____ 1883b, Tertiary coal measures of Gunnison County, Colorado: Kansas City Review of Science and Industry, v. 6, p. 688-696.
 Hayden, F. V., 1881, Geological and geographical atlas of Colorado: U.S. Geological and Geographical Survey of the Territories, 20 plates.

- Hills, R. C., 1890, Orographic and structural features of Rocky Mountain geology: Colorado Scientific Society Proceedings, v. 3, p. 362-458.
23. _____ 1893, Coal fields of Colorado: U.S. Geological Survey Mineral Resources of the U.S., 1892, p. 319-365.
 24. Horn, G. H., Adair, J. S., and Cammack, K. V., 1938, Geology of a portion of the Ohio Creek mining district, Gunnison County, Colorado: Denver, Colo., U.S. Geological Survey, unpublished report and map.
 - Ingham, G. T., 1888, Digging gold among the Rockies: Philadelphia, Pa., Hubbard Brothers, 452 p.
 - Johnson, L. A., 1961, Geology of the Anthracite Range, Gunnison County, Colorado: Lawrence Kans., University of Kansas, unpublished M.S. thesis, 47 p.
 - Johnson, R. C., and May, Fred, 1980, A study of the Cretaceous-Tertiary unconformity in the Piceance Creek basin Colorado: The underlying Ohio Creek Formation (Upper Cretaceous) redefined as a member of the Hunter Canyon or Mesaverde Formation: U.S. Geological Survey Bulletin 1482-B, 27 p.
 25. Jones, D. C., and Murray, D. K., 1976, Coal mines of Colorado—statistical data: Colorado Geological Survey Information Series 2, 27 p.
 26. Lakes, Arthur, 1886, The coal field of Crested Butte, Gunnison County, Colorado: Colorado School of Mines Annual Report of Fieldwork, p. 103-128.
 27. _____ 1889, Geology of Colorado coal deposits: Colorado School of Mines Annual Report of Fieldwork, p. 103-128.
 28. _____ 1906, Colorado anthracite: Mines and Minerals, v. 26, p. 275-276.
 - _____ 1909, The principal mining areas of Gunnison County, Colorado: Mining Science, v. 60, p. 196-197.
 - Landis, E. R., 1959, Coal resources of Colorado: U.S. Geological Survey Bulletin 1072-C, p. 131-232.
 29. La Plante, F. R., 1941, Map of the Carbon Creek mine, Gunnison County, Colorado: Denver, Colo., unpublished map on file at the Colorado Division of Mines, scale 1:1,200.
 30. Lee, W. T., 1912, Coal fields of Grand Mesa and the West Elk Mountains, Colorado: U.S. Geological Survey Bulletin 510, 237 p.
 - Lipman, P. W., Mutschler, F. E., Bryant, Bruce, and Steven, T. A., 1969, Similarity of Cenozoic igneous activity in the San Juan and Elk Mountains, Colorado, and its regional significance, in Geological Survey Research 1969: U.S. Geological Survey Professional Paper 650-D, p. D33-D42.
 31. McNatt, J. Q., 1950, Map of the Richardson mine, Gunnison County, Colorado: Denver, Colo., unpublished map on file at the Colorado Division of Mines, scale 1:1,200.
 32. McNatt, J. Q., and Friend, L. H., 1919, Map of the Floresta mine, Gunnison County, Colorado: Denver, Colo., unpublished map on file at the Colorado Division of Mines, scale 1:4,800.
 33. Manuel, W. A., 1928, Colorado coal report A, some analyses and properties of coal mostly from the western slope: Golden, Colo., Colorado School of Mines, unpublished Ph. D. thesis, 134 p.
 34. Murray, D. K., Fender, H. B., and Jones, D. C., 1977, Coal and methane gas in the southeastern part of the Piceance Creek basin, Colorado, in Veal, H. K., ed., Exploration frontiers of the central and southern Rockies: Denver, Colo., Rocky Mountain Association of Geologists Field Conference Guidebook, v. 1977, p. 379-405.
 - Mutschler, F. E., Ernst, D. R., Gaskill, D. L., and Billings, Patty, 1981, Igneous rocks of the Elk Mountains and vicinity, Colorado—Chemistry and related ore deposits, in Epis, R. C., and Callender, J. B., eds., Western Slope Colorado: New Mexico Geological Society Field Conference, 32nd, western Colorado and eastern Utah, 1981, Guidebook, p. 317-324.
 35. Nu Mine Coal Company, 1954, Map of the Nu mine No. 1, Gunnison County, Colorado: Denver, Colo., unpublished map on file at the Colorado Division of Mines, scale 1:200.
 - Peale, A. C., 1874, Surface geology—Gunnison River and its tributaries (Chapter 3), Eruptive rocks—trachytes-trachorheites-basalts (Chapter 8), and Economical geology (Chapter 9), in Hayden, F. V., ed., A report of progress for the year 1874: U. S. Geological and Geographical Survey of the Territories, p. 94-95, 98-100, 175-176.
 - _____ 1877, On a peculiar type of eruptive mountains in Colorado, in Hayden, F. V., ed., U.S. Geological and Geographical Survey of the Territories Bulletin 3, p. 551-564.
 - Ranta, D. E., Ganster, M. W., Dowsett, F. R., Jr., Baker, D. J., and Stein, H. J., 1978, Bedrock geology of the lower south side of Mt. Emmons, Mt. Emmons project: Golden, Colo., unpublished map on file at Climax Molybdenum Company.
 36. Rickard, T. A., 1907, Journeys of observation (notes on geology and ores of Mexico): San Francisco, Calif., Dewey Publishing Co., 255 p.
 - Robinson, C. H., and Dea, P. A., 1981, Quaternary glacial and slope-failure deposits of the Crested Butte area, Gunnison County, Colorado, in Epis, R. C., and Callender, J. F., eds., Western Slope Colorado: New Mexico Geological Society Field Conference, 32nd, western Colorado and eastern Utah, 1981, Guidebook, p. 155-163.
 37. Rocky Mountain Fuel Company, 1946, Map of the Alpine Coal mine, Gunnison County, Colorado: Denver, Colo., unpublished map on file at the Colorado Division of Mines, scale 1:1,200.
 38. Ruffner, E. H., 1874, Reports of a reconnaissance in the Ute County: U.S. Army Corps of Engineers, U.S. Government Printing Office, 89 p.
 39. Selvig, W. A., and Fieldner, A. C., 1922, Fusibility of ash from coals of the United States: U.S. Bureau of Mines Bulletin 209, p. 19.
 - Sharp, J. E., 1978, A molybdenum mineralized breccia pipe complex, Redwell Basin, Colorado: Economic Geology, v. 73, p. 369-382.
 40. Snyder, N. H., and Aresco, S. J., 1953, Analyses of tippel and delivered samples of coal: U.S. Bureau of Mines Bulletin 516, p. 10.
 - Socolow, A. A., 1955, Geology of the Irwin district, Gunnison, County, Colorado: New York, N.Y., Columbia University, unpublished Ph. D. thesis, 187 p.

- Soule, J. M., 1976, Geologic hazards in the Crested Butte-Gunnison area, Gunnison County, Colorado: Colorado Geological Survey Information Series 5, 34 p.
41. Sprigg, N. C., 1926, Anthracite in Gunnison County: Mountain State Mining Age, v. 11, p. 16-17.
- Taylor, C. K., 1930, A brief history of Irwin, a ghost town: Gunnison, Colo., Western State College, unpublished M A. thesis, 49 p.
42. Union Coal Company, 1901, Map of the Union mine, Gunnison County, Colorado [includes workings of the Baldwin (South Park-Citizen) and other coal mines]: Denver, Colo., unpublished map on file at the Colorado Division of Mines, scale 1:1,200.
43. Union Pacific Coal Company, 1940, History of the Union Pacific Coal mines 1886 to 1940: Omaha, Nebr., The Colonial Press, chap. 10, p. 110-112.
- U.S. Bureau of Mines, 1926-33, Mineral resources of the United States: U.S. Bureau of Mines annual reports for the calendar years 1920-32.
- _____ 1934-78, Mineral yearbook annual reports for the calendar years 1934-78.
44. U.S. Geological Survey, 1883-1922, Mineral resources of the United States: U.S. Geological Survey annual reports for the calendar years 1882-1919.
45. Vandenbusche, Duane, 1981, The Gunnison country: Gunnison, Colo., B and B Printers, Inc., chap. 11, p. 211-229.

