SPECIAL PUBLICATION NO. 3

1972 SUMMARY OF COAL RESOURCES IN COLORADO

by

A. L. Hornbaker and Richard D. Holt

COLORADO GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES
STATE OF COLORADO
DENVER, COLORADO

1973

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PREFACE

This report was initially prepared for the 1973 KEYSTONE COAL INDUSTRY MANUAL where it will appear as the Colorado Chapter. It includes more descriptive material concerning the geology of the coal fields and regions and more analyses of the various coal seams or groups of coal seams than previously presented in the Coal Manual.

This summary or preliminary report precedes a much more detailed analysis of historical data, geology of the coal fields and regions, and of the total coal resources of the state, to be published later. This report, therefore, should serve a need in providing information on the coal resources of the state, not otherwise available, prior to the publication of the more comprehensive report.

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Any omissions or errors are the responsibility of the authors.

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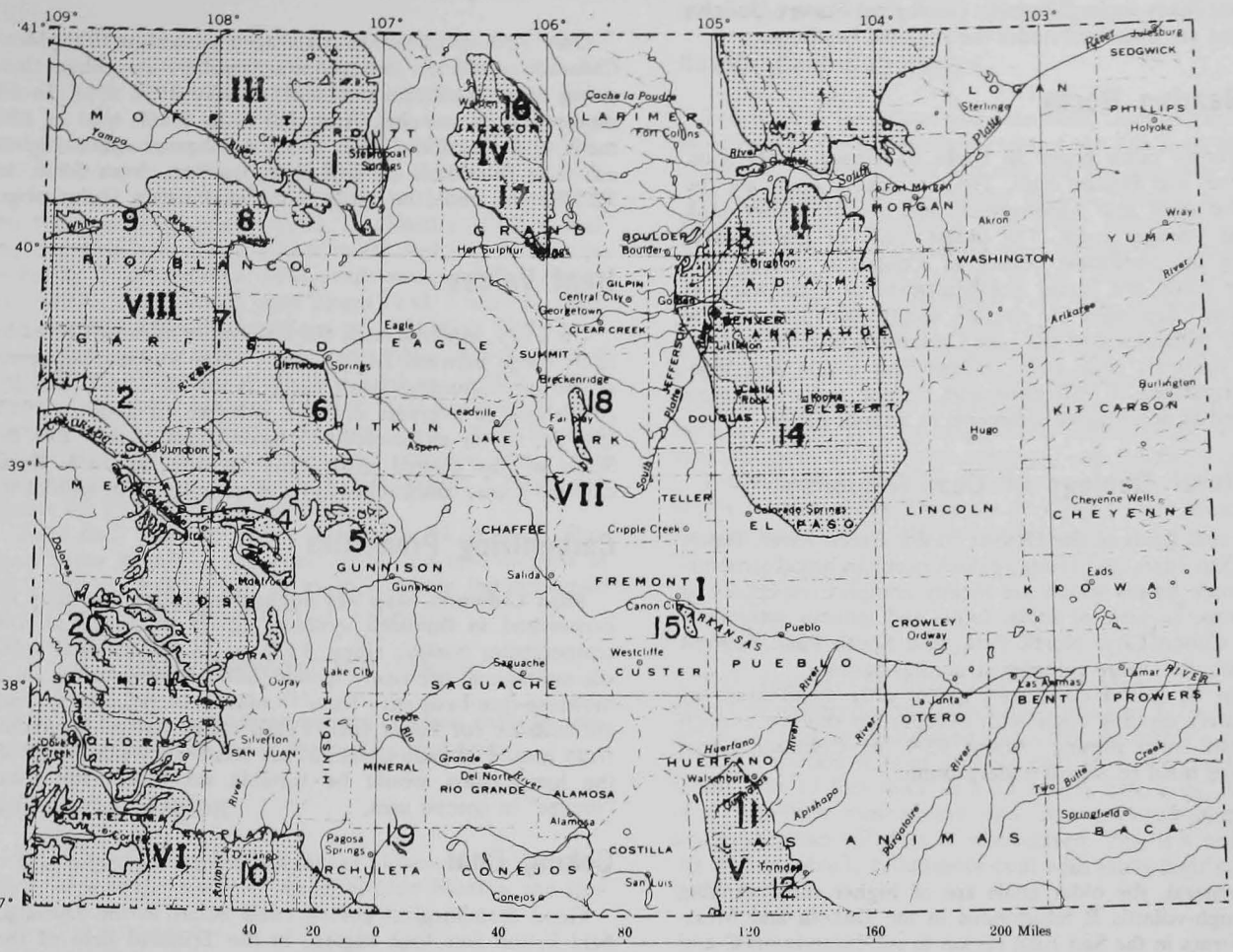
ABSTRACT

Colorado has approximately 10% of the total U. S. coal resources. These resources occur in eight coal regions and 20 coal fields that occupy about 28% of the total area of the state. Most of the coal is of Upper Cretaceous age but some is of much younger Paleocene and Eocene age. The higher rank coals are generally in older Upper Cretaceous strata of the San Juan region while the lower rank coals are in the youngest Upper Cretaceous and Tertiary rocks in the Denver Basin and Green River regions. The coals generally range in rank from high-volatile B bituminous to subbituminous and lignite, however igneous intrusions and structural deformation locally metamorphosed the coal to semianthracite and anthracite. About 77% of the coal in Colorado is bituminous, 23% subbituminous and less than 1% anthracite.

Total coal resources are conservatively estimated at 230,164 million tons to depths of 6,000 feet. Approximately 560 million tons of coal have been produced to date. As technology improves so that coals deeper than 3,000 feet can be utilized, and as drill and core data become available, estimates of total coal resources will probably increase substantially. The Uinta region has the largest coal resource followed in order by the Green River region, the Denver Basin region, the North Park region and the San Juan region.

1972 - SUMMARY OF COAL RESOURCES IN COLORADO



Coal regions and fields in Colorado

COAL REGIONS

I	Canon City
II	Denver Basin
III	Green River
IV	North Park
V	Raton Basin
VI	San Juan
VII	South Park
VIII	Uinta

COAL FIELDS

1. Yampa	11. Walsenburg
2. Book Cliffs	12. Trinidad
3. Grand Mesa	13. Boulder-Weld
4. Somerset	14. Colorado Springs
5. Crested Butte	15. Canon City
6. Carbondale	16. North Park
7. Grand Hogback	17. Middle Park
8. Danforth Hills	18. South Park
9. Lower White River	19. Pagosa Springs
10. Durango	20. Nucla-Naturita

Coal-Bearing Areas

Colorado's coal resources occur in diverse physiographic and structural environments. Physiographically they occur in the Great Plains, the Southern Rocky Mountains, the Wyoming Basin, and the Colorado Plateau provinces (Fenneman, 1946). Eight coal regions have been recognized and named by the U. S. Geological Survey and the Colorado Geological Survey.

About 28% of Colorado, roughly 29,600 square miles in 32 counties, is underlain by coal-bearing rocks. These contain approximately 10 percent of the United States original coal resources at depths to 6,000 feet, (Averitt, 1967).

The coal regions, alphabetically, as shown on the map, (Colorado Geological Survey Bulletin 34-A, 1972), are:

I Canon City	V Raton Basin
II Denver Basin	VI San Juan
III Green River	VII South Park
IV North Park	VIII Uinta

In the major regions the many small coal fields named in

Prepared by A. L. Hornbaker and Richard D. Holt, Colorado Geological Survey

early days of development have been grouped into 20 principal coal fields as in Colorado Geological Survey Bulletin 34-A, and are discussed under the regional headings.

Coal-Bearing Rocks

Colorado's coals occur in rocks of Upper Cretaceous, Paleocene, and Eocene ages. The Cretaceous coals are the most abundant and wide-spread, and are of higher rank than the younger coals. The oldest coals, of Dakota age, occur in the southwest corner of Colorado. Successively younger coals are found northeastward and eastward in formations deposited in coastal swamplands during the irregular withdrawal of the Late Cretaceous interior seas.

The youngest coals occur in the Fort Union and Wasatch formations of Paleocene and Eocene age which were deposited as non-marine sediments in interior basins.

Structural Geology of Coal Regions

The coal fields of the Denver Basin, Green River, Raton Basin, San Juan, and Uinta regions occur in broad structurally simple basins which are locally complex, especially at their rims, because of folds, faults and igneous intrusions.

The Canon City, North Park, and South Park Regions are in smaller, more complex structural basins.

These structural conditions afford only small areas of moderately dipping coals with overburden shallow enough to permit strip mining. About 95% of Colorado's coal resources must be mined underground.

Rank

In general, the older coals are of higher rank, ranging from high-volatile B bituminous in the Dakota and Mesaverde strata in the San Juan region to sub-bituminous C and lignite in the youngest Cretaceous and Tertiary of the Denver Basin and Green River regions.

Locally, however, structural deformations and igneous intrusions have caused an increase in rank of some coals to anthracite. About 77% of the coal resources are bituminous, 23 percent subbituminous and less than 1 percent semianthracite or anthracite.

Some of the older coals of the San Juan and Raton regions have coking properties. So, also, do some of the up-graded coals in the altered beds at the southeast margins of the Uinta region.

Colorado coals generally are nonweathering and most are nonagglomerating. The few areas of coking coals are discussed separately.

Moisture, Ash, and Sulfur Content

On an as-received basis, the moisture content of most Colorado coals ranges from 1.0% to about 20%, but in a few localities, such as the sub-bituminous coals near Colorado Springs in the Denver Basin, moisture is as high as 35%. From several hundred analyses, an estimated average is about 12%. Ash generally ranges between 2.1% to about 15%, but in a few cases is as high as 29.3%. An estimated average is about 6%.

Colorado coals are mostly low sulfur; more than 99% contain less than 1.0% sulfur and more than half contain less than 0.7% sulfur. Normal sulfur content varies from 0.2% to about 1.1%, but in some metamorphosed areas, sulfur content locally may be as high as 4.8%. Normal sulfate and organic sulfur content are low. Abnormal pyritic content can be reduced by conventional cleaning or preparation processes. Nearly all can easily be processed to less than 0.5% sulfur.

Washability

Only 32% of Colorado coals were washed in 1971. Most Colorado coals do not require beneficiation other than sizing to meet market demands, usually 2½" x 0". In 13 representative samples, from 0.6% to 3.1% was in 100 mesh to 0 fraction. These fractions showed much higher ash than the whole or any other fraction, from 5.8% to 32.2%, and could be easily eliminated where undesirable.

Heat Values

On a dry, ash-free basis the heat value of most Colorado coals range between 14,500 and 13,300 Btu/lb., but some of the subbituminous coals range as low as 11,440 Btu/lb. An estimated average, dry and ash-free, is about 13,950 Btu/lb., or on an as-received basis about 11,370 Btu/lb. Some of the altered coals rank as high as 88% fixed carbon, a true anthracite, but the quantity is insignificant.

Carbonizing Properties

Most Colorado coals are nonagglomerating and may be carbonized in fluidized systems. Chars produced at low temperatures contain about 8.5% to 14.4% residual volatile matter and are easily ignited. Char heating values on a moisture-free basis vary from 14,600 to 14,960 Btu/lb. and are suitable for boiler fuel. Lump chars can be produced from most Colorado coals but are relatively weak. Some of the lump chars would be suitable substitutes for coke "breeze" in special uses.

Coking Coal

Good metallurgical coking coals occur in the Durango field in the San Juan region, in the Trinidad field of the Raton region, and in the Crested Butte, Somerset, and Carbondale fields in the southeast Uinta region, and are discussed in the regional descriptions.

Specific Gravity

The lowest specific gravity coal, 1.280, was from the Paonia mine, at Paonia, Delta County, in the southwest Uinta region. The highest, 1.461, was from the Horace mine, at Crested Butte, Gunnison County, in the metamorphosed southeast Uinta region.

Average specific gravity for cleaned bituminous Colorado coal is 1.332, and for subbituminous coal, 1.291. For estimating reserves these values calculate to 1800 T/acre-foot and 1770 T/acre-foot respectively.

Coal Mining and Production

Recorded production of coal in Colorado, since 1864, totals about 560 million tons. Annual production reached a million tons in 1882 and two million tons in 1888. The peak of 12 million tons in 1910 dropped to 8 million in 1914, but rose to 12½ million tons during the period 1917-1920. The low of 5¼ million tons in 1934 was followed by a peak of more than 8 million tons in the war years of 1942-44. The irregular low production of 3 to 3½ million tons from 1952 to 1963 yields to mechanization and increased to more than 6 million in 1970, was reduced to 5⅓ million by the strike in 1971, but was over 5½ million in 1972.

Mine price varies with conditions and quality from approximately $3.70 per ton for subbituminous in remote locations to more than $9.00 per ton for high-grade coking coal, averaging near $5.70 for a total value of $31.5 mil-

lion in 1969, $34.3 million in 1970, and $30.3 million in 1971.

Strip mining started in the early 1950s, and by 1962, 7 of Colorado's 117 mines were open pits, producing 556,000 tons or 14% of the 3,400,000 tons total. Since 1962, from 6 to 11 strip mines have been operating and in 1972, 8 of 37 mines operating were open pits which produced 2,449,000 tons of 44% of the 5,530,000 tons total, employing only 135 or 9.6% of Colorado's 1401 coal miners. Of the 54 mines operating in 1970, 13 closed in 1971 including one strip mine; but 4 new mines were in production including 2 strip mines. Five small mines closed during early 1971, and 5 more were closed (and 3 idle) in 1972.

About 4¾ million tons mined in 1971 were bituminous coal, and about ½ million tons were subbituminous. About one-half of Colorado's coal was used in electric power plants in the state. Most of the other half was used in steel manufacture, beet sugar refining, and miscellaneous industrial, government, railroad, and domestic uses. Total out-of-state use in 1971 was 1⅔ million tons. Comparable figures for 1972 were not yet available.

Total daily capacity of all mines was 34,198 tons. Production per man-hour increased from 13.4 tons in 1961 to 25.0 tons in 1969 because of mechanization, but decreased to 21.0 tons in 1971 due to several influences.

Coal Regions and Fields

For geological considerations the regions will be discussed in order of the age of the coals, oldest first.

San Juan Region

This region, located in southwest Colorado, includes the north edge of the San Juan Basin of New Mexico, the Red Mesa-Mesa Verde platform, and the Cortez saddle and monocline westward toward the Paradox Basin in Utah.

Dakota Coal Sub-Region

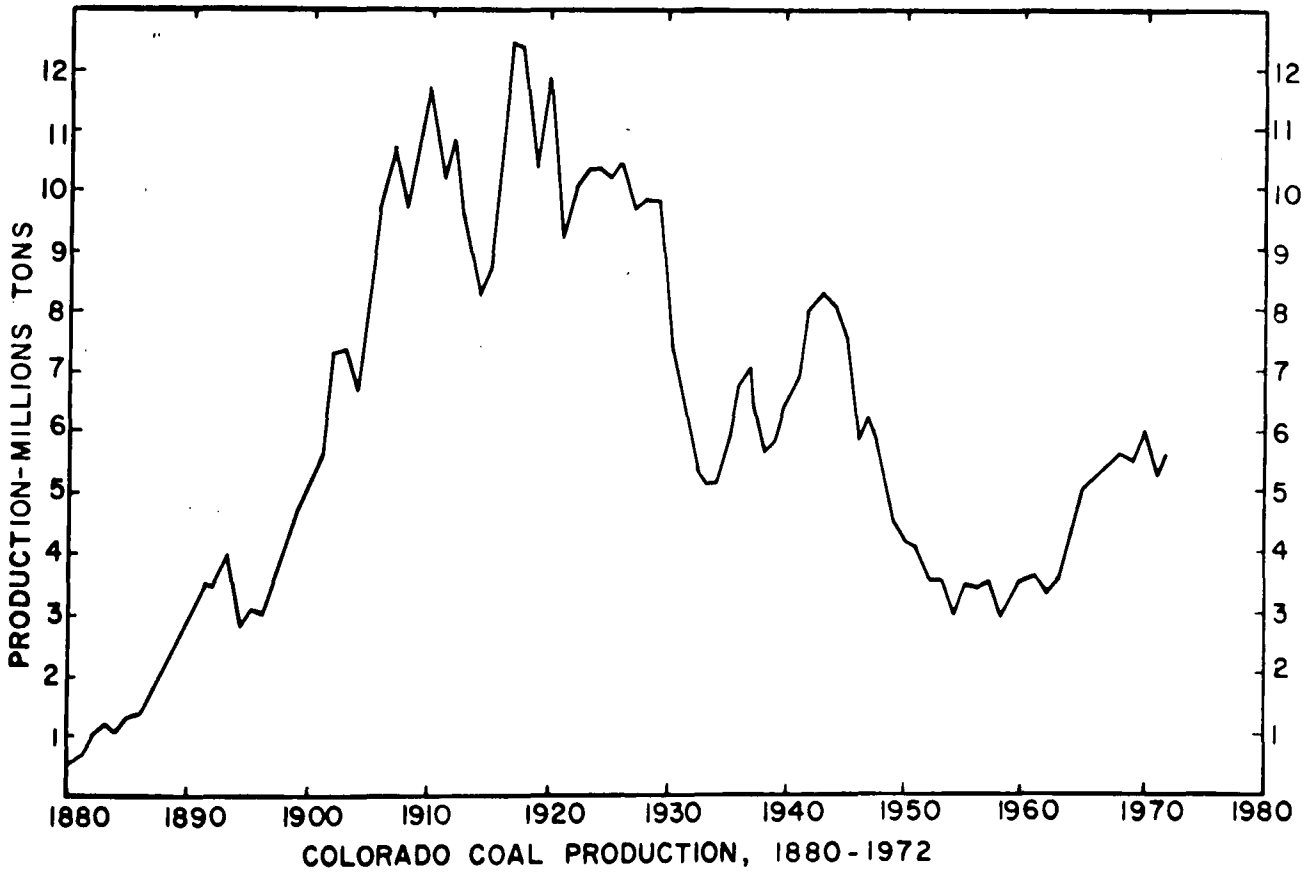
The Dakota sandstone and associated coals are known to be present in the Colorado portion of the San Juan Basin at depths of 3,000 to 8,000 feet and are not presently considered recoverable. In the narrow Dakota outcrop along the Hogback near Durango a few small areas of coal are mined. These are discussed in the Durango field section.

Coals occur in many places in the Dakota outcrop area west of Mesa Verde National Park and northward from Cortez to the Colorado River near Grand Junction. In some areas the coal is thick enough and clean enough to have been mined. Generally these coals are thin and discontinuous, and mostly of poor quality because of high ash content. These Dakota coals have considerable range in rank but generally are high-volatile C and B bituminous.

The range of analyses from uncorrelated Dakota coal seams from 4 mines northeast of Cortez with thicknesses ranging from 2'8" to 4'8" is as follows:

As-received basis	*Range of analyses*
Moisture	1.9-8.1%
Ash	5.0-18.3%
Sulfur	.5-.8%
Btu/lb.	10,440-13,630
Fus. temp., °F.	2,110-2,910+

The New Mexico Bureau of Mines Memoir 25, 1971, reporting on recent exploration and coring in T 36-37 N, R 14-16 W, east and northwest of Cortez, indicates a reserve of 158.8 million tons of Dakota coal in fairly continuous seams 3 to 13 feet thick in a 34 square mile area. A total of 119 million tons of this coal is considered strippable under less than 150 feet of overburden. This is a non-coking high-volatile C bituminous coal with fairly high ash and 0.7% sulfur.



COLORADO COAL PRODUCTION, 1880-1972

In the Nucla-Naturita area of western Montrose County, where the Peabody Nucla multiple-bench strip mine supplies coal to the Nucla power plant south of Uravan, there are three mineable seams 3 to 5 feet thick with the middle seam, or "No. 1 seam", the most important. The analyses from three mines in the area averages:

As-received basis	*Average of analyses*
Moisture	2.5-13.5%
Ash	6.1-12.8%
Sulfur	.5-1.1%
Btu/lb.	10,010-13,380
Fus. temp., °F.	2,620-2,910+

If 10% of the 5,000 square miles of coal-bearing strata contains coals half as good as the average 5.5 million tons per square mile found in the 50 square miles of explored areas, a total of 1,375 million tons of Dakota coal at less than 3,000 feet depth may underlie this sub-region. Exploration for these scattered mineable areas will be difficult.

Durango Field

In earlier reports, the Colorado portion of the San Juan region has been divided into the Durango field area, the "hogback", the Red Mesa area (or Hesperus field), and the Mesa Verde area which included the National Park and the Mesa area south and west of Durango.

In Colorado Geological Survey Bulletin 34-A, 1972, all of these are included in the newly defined "Durango field". This field includes all of the Colorado portion of the San Juan basin and stretches from near Cortez on the west to east of Pagosa Springs on the east.

Coals are included in three horizons of Upper Cretaceous age: the Dakota, the Menefee Formation of the Mesaverde group, and the much younger Upper Cretaceous Fruitland Formation.

The Dakota Formation crops out along the outer rim of the hogback in Archuleta and La Plata Counties. These Dakota coal seams are fewer, thinner, dirtier, and are more discontinuous than those found in areas to the south and west, and constitute about a 5 million ton resource.

The Menefee coals are best developed from approximately 10 miles east of Durango westward. They occur in three distinct groups, the "middle group" being relatively unimportant. The lower 60 feet of the formation form the "lower group" and the upper 200 feet form the "upper group". The Menefee coals are high-volatile A and B bituminous rank and are of coking quality in structurally affected areas near Durango.

Through the years, more than 50 mines have operated in the Durango coal field but only 14 mines have operated in the past 10 years, all in the Menefee coals in the Hesperus area just west of Durango. Only one of the four operating mines in 1971 was a strip mine, most of the produced coal being used at the Durango electric power plant. Range-of-analyses of the coals, 3′2″ to 6′7″ thick, from the mines in the Durango field, 3 in the "Hesperus seam" and 7 "undesignated", are as follows:

As-received basis	*Average of analyses*
Moisture	1.6-10.7%
Ash	3.4-16.6%
Sulfur	.6-1.2%*
Btu/lb.	10,860-14,070
Fus. temp., °F.	2,020-3,000

* Local pyritization in one mine caused up to 4.7% sulfur in one mine-run sample.

In about 40% of the 2,200 square mile area of the Durango field there are 9,634 million tons of coal, measured and indicated, under less than 3,000 feet of overburden (Landis, 1959). Total additional coal inferred on a zone basis, in the field, is estimated to be about 11,080 million tons. Also, in an area of approximately 400 square miles below the hogback at depths from 3,000 to 6,000 feet, an additional 5,200 million tons are estimated from well log data.

The Durango field, therefore, is believed to have had approximately 25,914 million tons of coal in place to a depth of 6,000 feet. Adding the estimated 1,375 million tons of Dakota coal area to the northwest, the San Juan region coal resources total about 27,300 million tons.

Unita Region

The coal fields of the Colorado portion of the Uinta Region occur on the moderately to steeply dipping flanks of the Piceance Basin, a southeastward extension of the Uinta Basin of Utah.

This simple synclinal structure is modified by folds, faults, and intrusions along the margins creating areas of considerable structural complexity. The southeastern part of the Uinta Region, in Gunnison County, in which these conditions have increased the rank of some of the coals to anthracite, is considered as a southeastern sub-region for separate discussion. This then separates a Northeastern sub-region and a Southwestern sub-region in which the coals are not metamorphosed.

Southwest Uinta Sub-Region

This sub-region is an easterly extension of the Book Cliffs field of eastern Utah. It extends to the Colorado River near Grand Junction and continues along the rim of Grand Mesa southeast to about 10 miles west of the Gunnison County line near Paonia. It also includes an outlier 40 miles southeast of Paonia known as Tongue Mesa coal field.

Book Cliffs Field

On the southwest rim of the Piceance basin the Upper Cretaceous coal-bearing formations generally are nearly flat-lying, but locally are complexly tilted and faulted. Some high-volatile B bituminous coal is found, but most of the coal is high-volatile C bituminous.

These coals occur in three important zones in the Mount Garfield Formation of the Mesaverde group and in the Anchor tongue of the upper Mancos shale formation along the western edge of the basin. Because of the eastward withdrawal of the Upper Cretaceous sea, all of these coals are younger "Mesaverde" than the Menefee Formation coals at Durango, and are roughly time-equivalents of the Fruitland coals of the San Juan Region.

The "Anchor seam", the lowest coal, is in a tongue of the Mancos shale. It is 6′2″ thick in the Nearing (Farmer's) mine 20 miles northwest of Grand Junction, and has the following analysis:

As-received basis	*Range of analyses*
Moisture	8.2-9.8%
Ash	5.9-9.8%
Sulfur	1.0-1.7%
Btu/lb.	11,910-12,330
Fus. temp., °F.	2,190-2,790

The "Palisade seam", which may be any of several singly occurring seams in the "Palisade zone" at the base of the Mount Garfield Formation, occurs throughout the Book Cliffs field, with increasing importance eastward. Usually only one seam of mineable thickness occurs in this zone in any one locality. A composite of analyses of this coal from several mines in seams from 2′8″ to 9′4″ thick is as follows:

As-received basis	*Range of analyses*
Moisture	3.3-14.0%
Ash	4.9-17.4%
Sulfur	.5-1.6%
Btu/lb.	10,950-13,560
Fus. temp., °F.	2,130-2,910+

In the western part of the field the **"Carbonera seam",** which includes any seam in the "Carbonera zone" or

"middle zone", has a thickness from 7'6" to 8'6" and a range of analyses as follows:

As-received basis	*Range of analyses*
Moisture	9.3-11.4%
Ash	7.2-14.4%
Sulfur	.4-.6%
Btu/lb.	10,470-11,150
Fus. temp., °F.	2,850

In the eastern part of the field the **"Cameo seam",** or seams in the "Cameo zone", have accounted for more than two-thirds of the Book Cliffs field production to date. This seam ranges in thickness from 3'6" to 10'5" and has the following range of analyses:

As-received basis	*Range of analyses*
Moisture	5.4-11.5%
Ash	5.2-15.5%
Sulfur	.5-1.3%
Btu/lb.	10,410-12,460
Fus. temp., °F.	2,520-2,960

Mineable reserves of coal in place, "measured and indicated", in 255 square miles of the Book Cliffs field were estimated to be 2,293 million tons (Landis, 1959). In an additional 145 square miles these coal zones at depths to 3,000 feet are estimated to contain a possible resource of about 1,300 million tons of coal. In an additional area of about 400 square miles, with the coal zones at depths between 3,000' and 6,000', a possible reserve of up to 3,600 million tons may be present. This indicates a total resource of coal in place of about 7,193 million tons in the Book Cliffs field to a depth of 6,000 feet.

One mine, near Cameo, 15 miles east of Grand Junction furnished coal to the Cameo electric power station during 1971. No other mines were operated in this field.

Grand Mesa Field

The Grand Mesa coal field is southeast of Grand Junction. The younger "Mesaverde" coal zones of the Mount Garfield Formation continue southeastward and the coal seams become more numerous. These coals are of slightly lower rank, grading from high-volatile C bituminous to subbituminous A. Correlation of 6 to 8 fairly persistent seams, all in the Paonia shale member, has been attempted. These letter upward from "A" to "F" in various localities, or locally are numbered "#1 and #2". The lowest seams are the most persistent and productive. There are usually not more than 2 or 3 seams or mineable thickness in any one locality.

These coals are so similar in composition that one composite analysis can represent all of them, ranging from 4'6" to 14'0" in thickness:

As-received basis	*Range of analyses*
Moisture	9.8-20.0%
Ash	2.1-16.1%
Sulfur	.5-1.8%
Btu/lb.	9,360-11,670
Fus. temp., °F.	2,060-2,970

"Measured and indicated" reserves originally present in 96 square miles of the Grand Mesa field were 1,569 million tons, (Landis, 1959). Only 139 million tons are high-volatile C bituminous, the rest being subbituminous A. These coal zones should be present in an additional 184 square miles at depths to 3,000 feet with possibly 3,086 million tons of coal. Approximately 250 additional square miles could possibly contain as much as 4,000 million tons of coal in seams more than 5 feet thick to depths of 6,000 feet. The Grand Mesa field total coal resources in place to 6,000 feet depth may be as much as 8,655 million tons, with about 9% being high-volatile C bituminous and the rest subbituminous A rank. Two small mines at Cedaredge, near the middle of the Grand Mesa field were operated in 1971, one being a strip mine.

Tongue Mesa Field

Forty miles southeast of the Grand Mesa field, beyond the Black Canyon of the Gunnison, on Cimarron Ridge between the Uncompahgre River and Cimarron Creek is Tongue Mesa. This physiographic feature is an outlier of Upper Cretaceous age coal-bearing rocks capped and preserved by late Upper Cretaceous volcanics. The coal-bearing rocks correlate with those of the Grand Mesa section to the northwest and with the San Juan basin section to the southeast.

Near the top of the mesa is a 900 foot thick coal-bearing section that correlates with the Fruitland-Kirtland Formation of the San Juan Basin and with the Paonia shale in the Grand Mesa area. Outcrops are badly obscured by landslides and talus, but 3 or more coals occur in the lower half with easterly dips of about 2 degrees.

The principal, and most persistent coal, the Cimarron (or Lou Creek) seam, is from 8 to more than 40 feet thick, and has been mined on both sides of the ridge. Several other mines have operated in stratigraphically higher seams 5 to 7 feet thick. The coal is subbituminous B in rank. Some of the coal is considerably oxidized, and much of it is bony. Because of difficult access, this coal does not compete with the better coals of the Somerset field which are used in the Jim Bullock electric power plant at Montrose, only 15 miles away. Range of an analyses:

As-received basis	*Range of analyses*
Moisture	14.2-16.0%
Ash	6.7-8.4%
Sulfur	.5-.9%
Btu/lb.	9,350-10,220
Fus. temp., °F.	2,450-2,480

In 58 square miles of the Tongue Mesa field surveyed, Landis (1959) reported an estimated 2,355 million tons of coal originally in place. More recent studies and coring indicate that the original resource could be estimated as high as 4,000 million tons. Since only underground mining is feasible in these thick seams, only about 1/6 to ¼ of the coal is recoverable.

The total coal resources to 6,000 foot depth in the Southwest Uinta sub-region, in the Book Cliffs field, Grand Mesa field, and Tongue Mesa field, can be estimated at about 19,850 million tons with roughly the west half being high-volatile B and C bituminous coal and the eastern half subbituminous A and B coal.

Southeast Uinta Sub-Region

This sub-region where the Cretaceous age coals have been increased in rank by low-order metamorphism caused by structural deformation and igneous intrusion, has had development in three recognized fields: Somerset, Crested Butte and Carbondale.

Somerset Field

The younger "Mesaverde" coals in the Bowie shale member, or "lower group", and the Paonia shale member, or "upper group" are well developed at outcrops along the valley of the North Fork of the Gunnison River and its tributaries near Somerset in western Gunnison and eastern Delta Counties. These are high-volatile C and B bituminous coals. In the eastern half of the field the coals are moderately to strongly coking. Three large mines and one smaller mine along the railroad in the main valley produced metallurgical coal in 1972.

In the western edge of the field 3 or 4 uncorrelated seams in the Bowie shale member have been mined. Also, 2 or 3 uncorrelated seams in the Paonia shale section have been mined and are of lower rank than the Bowie coals, as indicated in the following range of analyses:

Bowie shale, "lower group" coals: Mined seams range in thickness from 8'6" to 17'8".

As-received basis	*Range of analyses*
Moisture	7.4-13.6%
Ash	2.4-11.4%
Sulfur	.5-.8%
Btu/lb.	10,040-12,500
Fus. temp., °F.	2,475-2,810

Paonia shale, "upper group" coals: Mined seams range in thickness from 12′0″ to 13′0″.

As-received basis	*Range of analyses*
Moisture	10.5-22.4%
Ash	4.3-13.9%
Sulfur	.3-.8%
Btu/lb.	8,160-10,610
Fus. temp., °F.	2,910+

In the center of the field, at Somerset, two main seams are mined from the Bowie group, the "lower" or "B" seam (also called Somerset, Juanita, and King) and the "upper" or "C" seam. These seams range in thickness from 5′8″ to 25′0″, and are of fair to good coking quality. A range of analyses can apply to both "B" and "C" seams of the Bowie group:

As-received basis	*Range of analyses*
Moisture	2.3-8.2%
Ash	2.8-12.0%
Sulfur	.4-.7%
Btu/lb.	12,070-13,900
Fus. temp., °F.	2,220-2,910+

In the eastern part of the field, the "D" or Oliver seam and the "E" or "Hawks Nest" seam are identified in the Paonia or "upper" group. These, too, are of coking quality, and a range of analyses representative of both seams is as follows: Mined seams range in thickness from 7′0″ to 10′0″.

As-received basis	*Range of analyses*
Moisture	4.2-8.1%
Ash	2.8-10.4%
Sulfur	.4-.9%
Btu/lb.	12,090-13,400
Fus. temp., °F.	2,150-2,910+

Estimated mineable reserves measured and indicated in 133 square miles of the Somerset field are 3,348 million tons of bituminous coal, (Landis, 1959), about one half of which is high-volatile B bituminous and of coking quality. To a 3,000 foot depth, an additional area of about 87 square miles could add as much as 2,190 million tons to the resources.

The complex structural nature of the field and the uncertainties of the stratigraphic section dictate a conservative estimate of additional resources to a 6,000 foot depth. It is possible that in another 100 square miles in the Somerset field, 2,000 to 2,500 million tons of good bituminous coal could be present at depths to 6,000 feet. Field total then could be as much as 8,038 million tons originally in place to this depth.

Crested Butte Field

This field is in the southeast end of the Piceance basin where the coal-bearing "Mesaverde" strata have been folded, faulted, and intruded by igneous rocks. South of the town of Crested Butte the coals are increased in rank through metamorphism to high-volatile C and B bituminous and are of good coking quality. North and west of town the coals are metamorphosed to semi-anthracite and anthracite.

Six correlated coal seams are all in the Paonia shale (upper) group. Analyses of the coal seams, numbered upward stratigraphically, are recorded from 4 mines in the "#1" seam, 9 mines in the "#2" or "Kubler" seam, 6 mines in the "#3" seam, and one each identified as "#4", "#5", and "#6" seams. Some "#1" and "#2" seams, where altered to anthracite, were worked in thicknesses as low as 2′3″ to 3′2″. Most other seams were mined in 4′0″ to 8′8″ thicknesses, and "#3" seam had a maximum thickness of 13′10″. A representative range of analyses for the six seams is:

As-received basis	*Range of analyses*
Moisture	2.5-13.3%
Ash	3.2-9.1%
Sulfur	.4-1.9%
Btu/lb.	11,400-14,170
Fus. temp., °F.	2,130-2,480

About 15% of the measured and indicated coal reserves are semianthracite or anthracite. An estimated 244 million tons of coal were present in 35 square miles surveyed, (Landis, 1959). In the remaining 155 square miles of the field with coal seams occurring to a depth of 3,000′, an additional 1,000 million tons may be present. Probably not more than 50 additional square miles contain an estimated 320 million tons of coal to depths of 6,000′, making a field total of approximately 1,564 million tons. One small mine operated in the "#2" seam in this field in 1972.

Carbondale Field

This field is transitional from the highly faulted, folded, and intruded coal sections of the Crested Butte field northward to the steeply west-dipping monocline on the southeast rim of the Piceance Basin near Glenwood Springs

These younger "Meseverde" coal-bearing rocks seem to correlate roughly with the upper part of the Iles Formation, and the lower part of the Williams Fork Formation of the Grand Hogback and the Meeker area to the north.

In the southern half of the field the coals are metamorphosed to high-volatile A and medium-volatile bituminous and, locally, to semianthracite and anthracite. The bituminous coals are moderately to strongly coking. In the northern part of the field most of the coals are high-volatile B bituminous and non-coking.

The lowest coal, the "Black Diamond" seam, occurs in the Glenwood Springs area and is equivalent to the Black Diamond group at the top of the Iles Formation in the Meeker area. Range of analyses of "Black Diamond" coal is: Seam thickness ranges from 4′0″ to 16′0″.

As-received basis	*Range of analyses*
Moisture	11.1-14.1%
Ash	2.1-9.2%
Sulfur	.5-1.4%
Btu/lb.	10,360-12,310
Fus. temp., °F.	2,210-2,470

The 6 Williams Fork coals, correlative with the "Fairfield group" in the Meeker area, are lettered and named upward, "A", "B", "C", "D", "Allen", and "Anderson". The "D", "Allen", and "Anderson" seams, the most persistent and highest in quality, have been mined the most. The following range of analyses apply to the 3 seams where they are relatively little affected by metamorphism: Thickness of mined seams ranges from 4′0″ to 11′6″.

As-received basis	*Range of analyses*
Moisture	3.8-7.5%
Ash	1.9-10.5%
Sulfur	.4-1.5%
Btu/lb.	11,840-13,530
Fus. temp., °F.	2,160-2,840

Range of analyses of the "A", "B", and "C" seams in the same area is: Mined seams are from 4′0″ to 11′5″ thick.

As-received basis	*Range of analyses*
Moisture	5.1-8.9%
Ash	3.5-16.2%
Sulfur	.6-2.1%
Btu/lb.	10,160-12,820
Fus. temp., °F.	2,690-2,790

In the area of Coal Basin and southward, the upper group of coals are altered to semianthracite and anthracite. The seams mined in this area are the "Allen" ("Sunshine"), the "B" or coalesced "A" and "B" seams, the "Placita" seam and the "Coal Basin" seam which may correlate with the "D" or the "Anderson" seam. A range of analyses for these metamorphosed seams is as follows: The mined seams range in thickness from 3′2″ to 11′6″.

As-received basis	*Range of analyses*
Moisture	1.0-3.4%
Ash	3.4-10.0%
Sulfur	.5-.7%
Btu/lb.	12,470-15,190
Fus. temp., °F.	2,150-2,370

Only seven percent of the coal in the Carbondale field is anthracite. At least 50% of the bituminous coal is of coking quality. In 34 square miles of the field "measured and indicated" coal in place was estimated at 1,136 million tons, (Landis, 1959, & Donnell, 1962). The same coal strata occur in an additional 56 square miles to depths of 3,000' containing an estimated 1,870 million tons of coal. Similar coals at depths from 3,000' to 6,000' may underlie an additional 75 square miles, with a potential of 2,200 million tons.

Total resources originally in place in the Carbondale field area to a depth of 6,000' therefore may be as much as 5,206 million tons of coal. Three large mines in the Coal Basin area and one small one near Glenwood Springs were in operation in 1972 and produced 653,720 tons of coal.

The combined total resources for the Southeast Uinta sub-region, including the possible 1,564 million tons in the Crested Butte field and 8,038 million tons in the Somerset field may originally have been as much as 14,800 million tons of Cretaceous age coal.

Northeast Uinta Sub-Region

This sub-region includes the Cretaceous age coal-bearing rocks along the Grand Hogback on the east edge of the Piceance basin northward from Glenwood Springs to Meeker, and along the north rim of the basin westward to the Rangely area. Although folding and some faulting have tilted the strata to near vertical in part of the area, the coals have not been metamorphosed to higher rank.

Grand Hogback Field

The "Mesaverde" coal-bearing rocks are exposed with some very steep dips in the monoclinal fold forming the east rim of the Piceance basin. In the southern part of the field the coals are mostly high-volatile B bituminous, but in the northern part mostly high-volatile C bituminous. All are non-coking.

The coals of the "lower group" or "Black Diamond" group, at the top of the Iles Formation, are too thin and discontinuous to be of much importance. The "Black Diamond" coal, locally 8'10" thick where mined in the Rifle area, has the following analysis:

As-received basis	*Range of analyses*
Moisture	9.2%
Ash	3.7%
Sulfur	.6%
Btu/lb.	11,970
Fus. temp., °F.	2,210

Most of the coal in the Grand Hogback field is mined from nine seams in the "middle group" in the lower 2,500 feet of the Williams Fork Formation. These seams correlate with the "Fairfield group" in the Meeker area. In this area, they are identified in ascending order as the "A", "B", "C", "D", "Allen", "Anderson", "Wheeler", "E", and "F" seams.

The "Wheeler seam", 14'0" to 18'0" thick, is of major importance, with the range of analyses as follows:

As-received basis	*Range of analyses*
Moisture	3.4-8.3%
Ash	4.9-11.3%
Sulfur	.3-.8%
Btu/lb.	11,220-13,120
Fus. temp., °F.	2,130-2,620

The "Allen seam" where thickness ranges from 5'6" to 15'6" was a major producer. Average analyses, as follows:

As-received basis	*Range of analyses*
Moisture	3.5-10.7%
Ash	3.9-7.9%
Sulfur	.4-.5%
Btu/lb.	11,600-13,270
Fus. temp., °F.	2,060-2,370

The other seven identified seams in various mines range from 4'3" to 9'0" in thickness, and are quite similar with the following range of analysis:

As-received basis	*Range of analyses*
Moisture	2.9-10.5%
Ash	2.3-11.0%
Sulfur	.4-1.1%*
Btu/lb.	11,100-13,060
Fus. temp., °F.	2,090-2,910+

* In one mine, along a fault zone at Harvey Gap, ash was as high as 16.3% and sulfur as high as 2.6%.

An "upper zone", the "Keystone zone", about 1,000 feet higher in the Williams Fork Formation, probably correlates with the "Goff group" or the "Twenty mile zone" in some of the areas to the north. Four seams recognized in this zone are named in ascending order, "Keystone #4", "Keystone #3", "Keystone #2," and "Keystone #1". Coals from these seams are quite similar and a range of analyses is as follows: All are thin seams with a range of thickness from 3'6" to 4'6".

As-received basis	*Range of analyses*
Moisture	3.7-10.3%
Ash	5.4-9.2%
Sulfur	.3-.4%
Btu/lb.	11,020-13,120
Fus. temp., °F.	——

In the 48 square miles of the field surveyed, 885 million tons of coal were "measured and indicated", (Landis, 1959). These same coals underlie another 37 square miles at depths to 3,000 feet, with possible resources of about 760 million tons. At depths from 3,000 to 6,000 feet, under an additional 80 square miles, as much as 1,450 million tons of coal may be present. Total coal in the field originally in place to a depth of 6,000 feet is estimated at 3,095 million tons. One small mine, 7 miles west of Newcastle, operated in this field in 1972.

Danforth Hills Field

This field stretches for nearly 30 miles along the northeast side of the Piceance Basin northwest of Meeker. The strata dip to the southwest, but this regional dip is interrupted by several local gentle anticlinal structures.

The lower part of the "Mesaverde" is the Iles Formation and the upper part is the Williams Fork Formation.

A "lower coal group" is present near the base of the Iles Formation. The "Black Diamond group" occurs near the top of the Iles. The "Fairfield" coal group is near the base of the Williams Fork Formation. The "Goff group" occurs roughly 1,000 feet above the "Fairfield group". The "Lion Canyon group" occurs about 1,000 feet still higher in the section. Seams are quite discontinuous in all groups so they are not generally correlated.

No analyses were available for any coals in either the "lower group" of the Iles Formation, or for the "Goff group" of the Williams Fork Formation.

Range of analyses for coal seams in the "Black Diamond" group, from 5'1" to 18'1", which have been mined is as follows:

As-received basis	*Range of analyses*
Moisture	9.2-13.4%
Ash	3.7-10.0%
Sulfur	.4-.6%
Btu/lb.	11,220-11,970
Fus. temp., °F.	2,210-2,990

In the Williams Fork Formation, seams in the "Fairfield group" from 6'8" to 22'3" thick have been mined, with the following range of analyses:

As-received basis	*Range of analyses*
Moisture	9.4-14.4%
Ash	2.2-9.6%
Sulfur	.3-.9%
Btu/lb.	10,600-11,370
Fus. temp., °F.	2,310-2,730

Seams from 4'2" to 34'0" thick were mined in the "Lion Canyon" group, with the following range of analyses:

As-received basis	*Range of analyses*
Moisture	8.9%-15.5%
Ash	2.2-9.6%
Sulfur	.5-1.4%
Btu/lb.	10,690-11,790
Fus. temp., °F.	2,210-2,910+

Mines at the north edge of the field, near Axial, have mined the "Collum seam", which may correlate with the "Goff group" or the "Lion Canyon group". These coals ranged in thickness from 6′0″ to 28′9″, with the following range of analyses:

As-received basis	*Range of analyses*
Moisture	11.4-15.4%
Ash	2.2-6.3%
Sulfur	.3-1.0%
Btu/lb.	10,140-11,770
Fus. temp., °F.	2,220-2,480

These coals are generally high-volatile C bituminous in rank, but some of the younger coals in the northern part may be subbituminous. All are non-coking.

Original "measured and indicated" reserves of bituminous coal amounted to 7,854 million tons in 252 square miles of the field, (Landis, 1959). To depth of 3,000′ in an additional 18 square miles another 560 million tons may be present. Basin-ward, in an additional 70 square miles as much as 2,100 million tons of these coals may be present to a depth between 3,000′ and 6,000′. Total coal originally in place for the field to a depth of 6,000 feet may be as much as 10,514 million tons.

No railroad service reaches this area and development has been limited. One small mine, 7 miles northeast of Meeker operated in 1972 and produced 4,556 tons of coal.

Lower White River Field

The Lower White River field embraces an area from T 5 N, R 97 W, to the Utah state line, around the Rangely oil field and southward to T 3 S in the Douglas Creek drainage area. The coal bearing "Mesaverde" Formation crops out along the north rim of the Piceance basin west of the Danforth Hills.

All coals investigated in this field are in the Williams Fork (upper) member of the "Mesaverde", but some Iles (lower) coals may be present. Mines operated southeast of Rangely in seams from 8′0″ to 12′3″ thick mined high-volatile C bituminous coal with the following range of analyses:

As-received basis	*Range of analyses*
Moisture	11.2-14.1%
Ash	4.4-8.5%
Sulfur	.4-.5%
Btu/lb.	10,800-11,230
Fus. temp., °F.	2,280-2,900

About 7,012 million tons of coal were estimated to have been originally present in 553 square miles of the coal field, (Landis, 1959). In an additional 177 square miles as much as 2,250 million tons may be present at depths to 3,000′. Under an additional 200 square miles, at depths between 3,000′ and 6,000′, possible resources of 2,500 million tons may be present. The coal originally in place in this field to a depth of 6,000 feet may total as much as 11,762 million tons.

In the Northeast Uinta sub-region, from Glenwood Springs north and west to the Colorado-Utah state line, a total of about 25,370 million tons of coal are estimated to have been originally in place to a depth of 6,000′, by fields as follows:

Grand Hogback	3,095 million T.
Danford Hills	10,514 million T.
Lower White River	11,762 million T.
Total	23,371 million T.

Green River Region

The Colorado part of the Green River region of northwest Colorado is the southeastern trending extension of the Washakie Basin of Wyoming, known also as the Sand Wash Basin.

Yampa Field

Coal-bearing Cretaceous, Paleocene, and Eocene formations which crop out along the Yampa River drainage area constitute the Yampa coal field, the only one in the Colorado portion of the region. The Denver and Rio Grande Railroad probably was largely responsible for development of the field.

Relatively gentle local folding along the south edge of the basin grades into more complicated structures eastward. On the southeast and east rims of the basin, local folding is complex and complicated by faulting and minor intrusives. Very locally the intrusives and structural deformation have increased the rank of the coals to anthracite.

The "Mesaverde" coals occur in the Iles and Williams Fork Formations. Coals in the lower Iles are rare, but a few occurrences in the western part of the Yampa coal field indicates possible maximum development of that zone under deep cover in a northwesterly direction.

Coals in the upper Iles, correlated with the "Black Diamond group" of the Danforth Hills, are of major importance in the extreme southeast area near Oak Creek. "Seams" or "zones" number "1", "2", and "3" were correlated in the Oak Creek area. In later studies, "2" and "3" were correlated with "A" and "B" seams of a master lettered correlation which extends from "A" to "S" for the entire Yampa field. The "1" seam also is called "Brooks" and "Curtis". The "2" or "A" also is called "Pinnacle seam" in this area. Higher "seams" or "zones" "C", "D", and "E", also in the Black Diamond group, occur with increasing importance westward and to the north. In those directions "B" or "3" is also "Bear River seam" and "Sun mine seam", and "C" is also "Webber", "Butcher Knife", and "Rice mine" seam. These "Black Diamond group" coals generally are absent in the west half of the field. Mined seams range from 3′8″ to 12′4″ in thickness with the following range of analyses:

As-received basis	*Range of analyses*
Moisture	6.3-12.2%
Ash	4.3-11.3%
Sulfur	.3-.9%
Btu/lb.	11,090-12,560
Fus. temp., °F.	2,250-2,780

Most of this group, where not metamorphosed, is non-coking high-volatile C bituminous coal.

Coals in the lower part of the Williams Fork Formation constitute the "middle group", with seams "F" through "J", correlating with the "Fairfield group" in the Meeker area. Here the "H" is also called the "Wolf Creek seam", "I" the "Wadge", and "J" the "Lennox seam", with these names more common than the letters. The "F" and "G" zones, 10 to 16 feet thick locally, include multiple seams in the western part of the field. These named seams are generally the most important seams throughout the field.

Where mined east of Hayden, ranges in thickness for the same are: "Wolf Creek", 8′7″ to 18′7″; "Wadge", 4′6 to 11′9″; "Lennox", 3′0″ to 6′0″. South of Craig and east of Hamilton, in the Williams Fork Mountains area, the "J" or "Lennox zone is composed of multiple seams with thickness ranging from 3′6″ to 21′8″ and with local names such as "Searcy Gulch seam" and "Kellogg seam". The "Wadge" is a single 4 to 7 foot seam or is absent. The "Wolf Creek" zone has multiple seams of 3′ to 15′ which in one locality coalesce to a thickness of 42 feet with only minor partings.

Range of analyses is similar for all coals of this "middle" or "Fairfield" group, and is as follows:

As-received basis	*Range of analyses*
Moisture	7.7-11.8%
Ash	3.4-11.5%
Sulfur	.3-.6%*
Btu/lb.	10,740-12,260
Fus. temp., °F.	2,410-2,910*

* Local exceptions in the "Lennox" seams, where altered, show sulfur as high as 2.4%. This group of coals, where not metamorphosed, generally are high-volatile C bituminous non-coking coals.

Coals in the upper part of the Williams Fork Formation are in the "upper group" or "Twenty mile group" (lying above the Twenty mile sandstone marker), and may correlate with the "Goff group" and/or the "Lion Canyon group" of the Danforth Hills field to the south. Correlation letters are from "K" through "S" with "L" also called the "Crawford seam" and "Sleepy Cat seam"; "M" also called the "Carey seam"; and "Q" also called the "Dry Creek seam". These three are the most important in the "upper group" in the eastern half of the field. From Craig westward, in as much as 900 feet of section, as many as 8 seams from 3′ to 10′ thick may be present with 8 or more thinner interspersed beds. Correlations, even by the letter system, are difficult, and perhaps relatively unimportant until mining development is farther advanced. Most of these "upper group" coals are subbituminous A, and the range of analyses of the several seams mined is quite similar as follows: The mined seams range in thickness from 4′4″ to 10′4″.

As-received basis	*Range of analyses*
Moisture	14.2-16.9%
Ash	4.1-5.4%
Sulfur	.4-.9%
Btu/lb.	10,360-11,040
Fus. temp., °F.	2,070-2,480

Above the "Mesaverde" is about 2,000′ of Lewis shale. Overlying this is the late Upper Cretaceous Lance Formation with coal-bearing rocks in the lower part. These beds dip gently toward the northwest trending center of the basin, where they are covered by younger non-marine Tertiary age formations. In this gentler topography the coal seams usually are concealed at the surface.

Along the north edge of the Yampa valley, 3 miles north of Hayden, the "Lorella seam", 3′ to 10′ thick, has been mined. Also, in 4 mines east-northeast of Craig, a higher seam, the "Kimberly", 7′8″ to 11′8″ thick, has been mined, Two other mines about 9 and 16 miles northwest of Craig are probably the "Kimberly seam", 7′6″ to 11′9″ thick.

These Lance coals generally are subbituminous B or C, and have not been competitive with the better "Mesaverde" coals in the eastern part of the field. The range of analyses is quite similar for all of the "Lorella" and "Kimberly seams" as follows:

As-received basis	*Range of analyses*
Moisture	19.6-21.8%
Ash	4.1-6.5%
Sulfur	.5-.7%
Btu/lb.	9,660-9,720
Fus. temp., °F.	2,010-2,260

The Paleocene Fort Union, a non-marine coal-bearing formation, overlies the Upper Cretaceous Lance Formation.

The "Campbell seams", two 6 foot beds, 3 feet apart near the base of the Fort Union, were mined 10 miles northwest of Hayden. Four mines about 11 miles northeast of Craig were operated in the "Seymour seam, a 9′6″ to 17′0″ thick coal near the top of the Fort Union.

These are subbituminous B or C coals and not competitive with the better Cretaceous coals to the east unless they might be developed in a strippable area. The range of analyses of the "Campbell" and the "Seymour" seams are similar, and are as follows:

As-received basis	*Range of analyses*
Moisture	17.1-20.5%
Ash	3.9-7.8%
Sulfur	.2-.4%
Btu/lb.	9,500-10,080
Fus. temp., °F.	2,050-2,420

In the basin above the Fort Union is a considerable thickness of the continental Eocene Wasatch Formation which contains several coal-bearing zones as in the Wyoming area to the north. The outcrop of the Wasatch in the Sand Wash Basin is remotely located. The coals have been mined only from ranch mines and from the Sparks mine at the West Hiawatha oil field, less than 20 miles from the northwest corner of Colorado. No data is available on the Sparks coal, but generally the Wasatch coals are subbituminous B and C, and probably have the same range of analyses as the "Battle", "Creston", and "Hadsell" seams just to the north in the Great Divide Basin in Wyoming, as follows:

As-received basis	*Range of analyses*
Moisture	20.7-23.0%
Ash	11.2-13.8%
Sulfur	1.8-2.7%
Btu/lb.	8,250-8,710
Fus. temp., °F.	—

Although the Wasatch coals are lenticular, they would be expected to range from 6′ to 20′ in thickness in mineable areas, some of which could be strippable. None of these Wasatch coals have been included in the estimates of reserves.

In 828 square miles of the Yampa field where the coal reserves were measured or indicated, (Landis, 1959) 23,-607 million tons of coal were estimated as originally in place, ¾ of which was bituminous and ¼ subbituminous. In an additional 852 square miles, to depths of 3,000′, 21,300 million tons may be present. From 3,000′ to 6,000′ depths, in the deeper axial part of the Sand Wash Basin to the northwest, a smaller resource of 5,000 to 8,000 million tons could be present. Also in the Wasatch beds in that area, as much as 5,000 million tons of mineable coal may be found.

Total possible resources of coal in place in the Colorado part of the Green River region may be as much as 57,907 million tons. Roughly 2/3 of this is expected to be high volatile C bituminous, and the other ⅓ A, B, or C subbituminous.

Although more than 70 mines have operated in this field, only 7 were in operation in 1972. Three of these were underground with production capacity of about 1,600 tons per day. The other 4 were strip mines, with daily capacity of 10,600 tons per day. This is the only region in Colorado where strip coal may be of major importance. Of the estimated 5% of Colorado's coal resources considered strippable, about 90% is the Yampa field.

In 1970, the small McGregor electric power plant at Steamboat Springs used about 6,000 tons of coal, and the regional Hayden power plant near Hayden used 596,000 tons. A small amount was used locally and the rest shipped out of the area on the Rio Grande Railroad.

Raton Basin Region

The Colorado portion of the Raton Basin region extends northward from the Colorado-New Mexico state line to just north of Walsenburg and from the Sangre de Cristo Mountain Range eastward to Trinidad. Structurally it is a portion of the Raton Basin, an asymmetric syncline with its axis near the western margin. Dips are gentle on the east side and steep on the west flank where the strata are sharply up-turned along the mountain front. The center of the basin is penetrated by the Spanish Peaks which are Tertiary igneous stocks with many associated dikes, sills and laccoliths.

Coals occur in the Vermejo Formation of late Upper Cretaceous age, and in the Raton Formation of Upper Cretaceous and Paleocene age. Three crude coal "groups" are recognized, and some attempts have been made to correlate coal seams in various localities.

The "lower" coal group is in the lower part of the Ver-

mejo, and has from 1 to 14 seams of coal throughout the region. The "middle" coal group, with 1 to 5 seams is about 300 feet above the base of the Raton Formation, and the "upper" group, 700 to 1,000 feet higher, has only a few thin seams. All of the Raton Formation is missing in the northwest part of the region near La Veta.

More than 230 mines have operated in this region, mostly along the escarpment on the eastern edge of the region and along the drainage of the Purgatoire River that dissects the area west of Trinidad. Most of these mines were in thicker, more persistent, and higher quality Vermejo coal seams.

Coals in the southern part of the region generally are coking, while those in the northern part are non-coking. The division is approximately at the Huerfano County line, and the "Walsenburg field" includes the coals in that county, while those in Las Animas County constitute the "Trinidad field".

Walsenburg Field

Principal production has been from the Vermejo "lower" coal group. Named seams of this group, upwards, and their maximum mined thicknesses, are: Cameron-6'9", Lennox-6'4", Walsen-7'3", Pryor-5'5", Lower Robinson-5'0", (Rider-3'0"), Upper Robinson-6'0". Other names have been used in certain localities or mines which might correlate with some of these seams.

Vermejo coals in this field are high-volatile B and C bituminous, non-coking, and the range of analyses from all seams is quite similar as follows:

As-received basis	*Range of analyses*
Moisture	5.3-10.2 (19.2)%*
Ash	7.2-14.4 (19.3)%*
Sulfur	.4-1.3 (1.8)%*
Btu/lb.	11,050-12,880
Fus. temp., °F.	2,210-2,840

* The high moisture, ash, and sulfur entries in parentheses are from exceptional local conditions, notably in the La Veta area.

Limited mining of the "middle" group, in the Raton formation, in the area of Walsenburg and southward used local names for some seams, such as Lower Rugby-to 3'10", Upper Rugby-4'0" (also called Primrose), Mutual seam-6'0", and in some cases "A" seam and "B" seam where split. Also some nearby local seam names from the Trinidad field, such as "Cass", "Delagua", and "Boncarbo" were used rather loosely. The Raton Formation coals generally are high-volatile B or C bituminous, non-coking, with a common range of analyses as follows:

As-received basis	*Range of analyses*
Moisture	2.5-4.2%
Ash	5.3-13.5%
Sulfur	.4-1.0%
Btu/lb.	12,660-13,340
Fus. temp., °F.	2,230-2,730

Survey of 172 square miles of the field (Landis, 1959) indicated an estimated 1,190 million tons of coal originally in place. In an additional 48 square miles to total depth of the basin which would not exceed 3,000', an estimated additional 330 million tons may be present, making a field total of 1,490 million tons.

Total production from the approximately 90 mines which have operated through the years is 75,520,000 tons. Twelve mines operated in 1956 with production of 63,680 tons of coal. Eight mines were in operation in 1962 and produced 44,644 tons. Only 1 small mine operated in 1972 producing 5,234 tons before shut down.

Trinidad Field

More than 140 mines have operated in this field through the years in the three groups of coals. In the "lower" group, in the Vermejo Formation, as many as 14 mineable seams have been recognized. The principal seams, upward, with their range of mined thicknesses,—and possible equivalent and/or intervening locally named seams—are as follows: Berwind, 4'0"-7'0"; (Rainbow?); Cameron, 3'7"-7'8"; (Empire?); Walsen, 4'0"-5'0"; Hastings "A", and "B", (Lower and Upper Bunker Hill) (Majestic), 5'4"-8'8"; (Pryor); Rapson, 3'8"-5'0"; Ludlow, Lower and Upper?, 4'0"-5'3"; (Thomas); Gem (Robinson) (Peerless), 4'0"-7'5".

From Morley in the southeast corner of the Trinidad field westward to Weston, Tercio, and Stonewall, the common seams in this "lower" group, in ascending order are: Piedmont; Morley (Lower Starkville) (Engleville), 4'11"-7'10"; Upper Starkville (Upper Morley) (Engle-Starkville, 3'1"-6'6"; Cokedale, 6'0"-7'7"; Lower Sopris, 3'0"-4'0"; Sopris, 4'0". These and other locally named, numbered, or lettered seams have not been correlated with those above.

Most of these coals are high-volatile A bituminous, with some B, and all are coking coals. Ranges of analyses in most of these seams, under normal circumstances, are quite similar, and can be represented as follows:

As-received basis	*Range of analyses*
Moisture	1.6-5.8%
Ash	7.7-21.8%
Sulfur	.5-1.0%
Btu/lb.	11,430-13,510
Fus. temp., °F.	2,290-2,910

Locally some of these coals are affected by intrusions of igneous dikes and sills, some being increased in rank, and a few becoming natural coke.

Coal seams occur throughout the 1,000' to 1,600' of the Raton Formation, but most of the thicker and more persistent coals are in the "middle" group 300' to 500' above the base. The "upper" group, with fewer, thinner, and less extensive seams occurs in the upper one third of the formation. Principal seams along the eastern escarpment in ascending order, with ranges of mined thicknesses are: Bear Canyon (#6), 3'2"-4'0", (Alfreda); Cass, 5'9"-7'8"; Lower Rugby, 4'4"; Upper Rugby, 3'0"; Delagua, 3'6"-8'0"; Boncarbo, 4'0"-5'8". Westward, up the Purgatoire valley from Starkville to Weston and Stonewall, the principal named seams are Frederick (Zone E), 3'2"-5'10"; Primero (Zone I), 4'9"-7'11"; and Ciruela (Zone R) (Allen), 5'0". All of these are in the "middle" group. The ranges of Frederick and Primero analyses are quite similar, all of these coals being high-volatile A bituminous or high-volatile B bituminous, coking coals:

As-received basis	*Range of analyses*
Moisture	1.0-4.5%
Ash	5.3-16.4%
Sulfur	.4-1.1%
Btu/lb.	12,200-13,970
Fus. temp., °F.	2,230-2,910+

Recorded production from 141 mines in this field is 168,766,000 tons. In 1956, 22 mines produced 1,020,875 tons. In 1972, only one mine was in operation. The CF & I Steel Corp. Allen mine, in 6 sections of T 33 N, R 68 W at Stonewall, produced 616,000 tons of coking coal from the Ciruela (Allen) seam for the steel mills at Pueblo. Analyses are not available, but it is assumed that, except for possibly higher sulfur content, this coal is in the ranges noted above.

The electric power plant at Trinidad can use coal or gas, but in 1970 it used 100% natural gas. The Walsen plant at Walsenburg used about 12,000 tons of coal and no gas.

In the 872 square miles of the Trinidad field surveyed (Landis, 1959) an estimated 11,484 million tons of coal were originally present at depths less than 3,000 feet. Only an additional 18 square miles were thought to contain resources at a depth below 3,000 feet, and could hold a resource of as much as 237 million tons. Total for the field may be over 11,720 million tons of high-volatile A and B bituminous coking coal.

Total for the Raton Basin region could be more than 13,210 million tons, with almost 90% coking quality.

Canon City Region

Canon City Field

In an asymmetric synclinal fold just east of the Wet Mountains in the Colorado Piedmont section of the Great Plains is another outcrop of the coal-bearing rocks of the Cretaceous age Vermejo Formation. This is a northward continuation of the "lower" coal zone of the Raton Basin area. Dips on the east side of the field are gentle, but on the west side are moderate to steep and involve some locally important faulting. Surface mining is operated on the east side, but is limited because of massive sandstones just above the coal section.

As many as 16 coal seams have been recognized, but only 7 have any importance commercially. In ascending order, with ranges of mined thickness, these seams are: Rockvale, 3′0″-3′8″; Canon City, 3′0″-7′4″; Magnet, 4′6″; Radiant (Jack-O-Lantern), 3′4″-4′6″; Royal Gorge (Bassick), 4′0″; Chandler (Littel), 2′0″-4′6″; Brookside, 4′6″-6′7″ (10′0″). The general ranges of analyses for these seams under average conditions are:

As-received basis	*Range of analyses*
Moisture	5.4-15.0 (23.3)%
Ash	4.6-17.7 (22.6)%
Sulfur	.3-1.1 (2.4: 3.4)%
Btu/lb.	10,110-12,010 (9,630)
Fus. temp., °F.	2,030-2,720 (1,990-2,910+)

The figures in parentheses are local exceptions under special conditions, and some indicate cause and effect relationships in certain individual mines.

Most of this coal is high-volatile C bituminous, nonweathering, nonagglomerating, and non-coking. More than 70 mines have produced 39,440,000 tons of coal. In 1962, 25 mines including 2 surface mines produced 334,559 tons, but in 1972, 7 mines including 2 surface mines produced 214,948 tons.

The W. N. Clark power plant at Canon City generated 63% of its power in 1970 from 116,000 tons of coal,—the rest from natural gas. Some coal was used locally, but more than 140,000 tons were shipped out by rail.

Accurate surveys (Landis, 1959) have indicated an estimated 295 million tons of coal originally in place in the 36 square miles area of the field. Present resources are estimated at 217 million tons, with over 100 million tons recoverable from depths probably less than 2,000 feet.

South Park Region

South Park Field

Coal-bearing formations crop out around the rim of a twenty mile long syncline about 15 miles east of Fairplay at elevations of about 9,900 feet in the South Park intermontane basin in Park County.

These strata are younger than the Vermejo and Raton Formations of the Raton Mesa and Canon City regions. They are Paleocene in age and correlate with the Laramie Formation of the Denver Basin area. Much of the section is missing around the south end of the syncline near Hartzel, and only thin coal seams have been found. At the north end, near Jefferson, about 250 feet of section contains one or more seams which may attain mineable thickness under cover. Most of the east side is covered by a granitic thrust block.

On the west side, near Como, a "lower seam"-5′ to 12′, a "middle seam"-2′9″, and an "upper seam"-4′0″, with intervals of about 200′, were mined from 1870 to 1905 for railroad and local use. Deep weathering and dips to 45° made mining difficult. The seven or eight old mines have long been closed and flooded.

Recent analyses of a sample recovered from one of the old Como mines indicates subbituminous A or B coal with the following analyses:

As-received basis	*Range of analyses*
Moisture	6.3-15.5%
Ash	1.3-6.4%
Sulfur	.47-.53%
Btu/lb.	9,780
Fus. temp., °F.	2,700

An area of about 8 square miles down dip east of the Como mines was estimated (Landis, 1959) to have had about 92 million tons of coal originally present. Down to a depth of 3,000 feet, an additional 12 square miles could hold resources of about 135 million tons. No conjectures are made here concerning resources below that depth. Possible original total for the field could be as much as 227 million tons, but prospecting and mining will be difficult.

North Park Field

Coals have been mined in two areas of the North Park intermontane basin in Jackson County. The coals occur in about 3,500 feet of fresh-water clastics of the Coalmont Formation of Paleocene age, which is correlated with the Fort Union of the Green River region, and with the Denver Formation of the Denver Basin.

On the flanks of the McCallum anticline, in the northeast part of the basin southeast of Walden, the "Sudduth seam", 10 to 58′ thick, occurs at the base of the Coalmont, and the "Lower and Upper Winscom" (or "Lower and Upper Capron") seams, 8 to 12′ thick, occur about 2,000′ and 2,300′ higher in the section. Dips range from 20° to 85°.

In the southwest part of the basin, near Coalmont and northward, 5 seams occur in this formation and have been prospected or mined. Dips range from less than 10° to about 20° easterly, but the area is complexly block faulted. In ascending order the lower four unnamed seams are: a. an 8′6″ seam an unknown distance above the base of the Coalmont; b. an 18′ seam an unknown distance (100′-200′?) above a.; c. a 12′ seam about 1,250′ above b.; d. a 5′ seam about 1,000′ above c. About 360′ above these is the "Riach seam", 22 to 77′ thick, in which most of the mining was done.

In two small areas north of Coalmont, mines were operated in the thinner Mitchell and Monohan seams which possibly might be correlated with c. or d. above. The Mitchell seam is from 7′0″ to 11′0″ thick and the "Monahan seam" is about 4′6″ thick. Analyses of all mined seams fall in the same range, as follows:

As-received basis	*Range of analyses*
Moisture	13.6-(22.8)%
Ash	2.8-13.4%
Sulfur	.1-.9%
Btu/lb.	(8,840)-10,870
Fus. temp., °F.	2,100-2,680

All of the North Park field coals generally subbituminous B rank.

In 102 square miles surveyed, an estimated 3,735 million tons were originally in place, (Landis, 1959). It is believed that an additional 748 square miles are underlain by similar coal-bearing strata, some of which may be at depths greater than 3,000 feet. In those strata another 25,000 to 27,000 million tons of reserves may be present, making a possible total for the field of about 28,735 million tons of coal originally in place.

The North Park field is in a relatively remote area, at an elevation of more than 8,000 feet, presenting problems both in mining and in transportation. No mines are now active.

Middle Park Field

Just south of North Park, in Grand County, is the intermontane basin called Middle Park where the Colorado River heads. Some thin, impure lenticular coals occur in this basin in Paleocene strata of the same age and characteristics as the Coalmont Formation of North Park. These strata are called the Middle Park Formation, but are thought to be continuous with the Coalmont to the north.

Very limited exploration has revealed no mineable seams of coal, but the possibility of appreciable resources exists in an area of about 270 square miles of the Middle Park Formation. There is no satisfactory basis for an estimate of resources.

Denver Basin Region

The Denver Basin region is an area of about 8,000 square miles in eastern Colorado east of the Front Range which extends from near Colorado Springs north to near the Wyoming state line. Physiographically this is in the dissected Piedmont section of the Great Plains.

Structurally, it is a broad gentle basin, steeper on the west flank alont the uplifted mountain front. The margins of the Denver Basin region are defined by the outcrop of the basal coal-bearing part of the Laramie Formation. These beds are well exposed along the foothills hogbacks extending from near Colorado Springs to Boulder where dips may be near vertical but flatten rapidly to 5° or less into the basin. They are less well exposed northeastward to Greeley, and poorly exposed on the north, east, and south edges of the region. They occur at depths probably less than 1,000 feet throughout the region.

The coals occur throughout the area in the Laramie Formation of late Upper Cretaceous age, which correlates with the prolific Vermejo Formation of the Raton Mesa region. In the southern part of the basin a few lenticular coal seams also occur in the Paleocene Dawson arkose, more coarsely clastic than, but roughly time equivalent to part of the Raton Formation.

In the northern part of the basin, beds above the Laramie Formation contain lenticular coals. These are called the Arapahoe Formation, Upper Cretaceous-Paleocene age, and the Paleocene Denver Formation. These formations correlate in part with the Dawson arkose to the south and with the Coalmont Formation in the North Park region and the Fort Union in the Green River region.

Coals in the western part of the region are of higher rank than those in the eastern part. Coals in the western part generally are subbituminous B with some C, while those in the eastern part are subbituminous C, with some of the younger coals bordering on lignite.

Colorado Springs Field

In this report, the Colorado Springs field is not restricted to the mined area immediately north and east of the city, but is applied to all of the south part of the region in El Paso, Elbert, and Douglas Counties. This includes formerly mined areas in northeast El Paso County, and in central and eastern Elbert County known as Ramah-Fondis area and Buick-Matheson area.

At Colorado Springs three seams, A, B, and C are recognized in the basal Laramie. Only the lowest, "A" seam, is of mineable thickness, varying from 4′7″ to 17′1″. Range of analyses of the "A" seam is as follows:

As-received basis	*Range of analyses*
Moisture	19.2-(26.9)%
Ash	3.9-10.2%
Sulfur	.2-.5%
Btu/lb.	(8,000)-9,270 (10,140)*
Fus. temp., °F.	2,150-2,470

* Rank increased by metamorphism at Franceville.

The Laramie coals in the Buick-Matheson area at the east edge of the field are lenticular and not correlated. They were mined from the middle and upper part of the section at the south end of the area, and ranged from 8′0″ to 15′0″ thick. These are subbituminous C coals with high moisture and ash with the following range of analyses, some bordering on lignite:

As-received basis	*Range of analyses*
Moisture	33.1-35.0%
Ash	7.8-15.7%
Sulfur	.4-1.1%
Btu/lb.	6,150-7,340
Fus. temp., °F.	2,140-2,400

The younger Paleocene coals in the Dawson arkose Formation crop out in the Ramah-Fondis area nearer the center of the basin, and are of low-grade subbituminous rank bordering on lignite. These are very lenticular and generally have many thin partings of shale and sandstone. Mined thicknesses varied from 4′8″ to 7′4″, but one "pod" was estimated at 18′9″ including partings. Range of analyses of the Dawson seams is as follows:

As-received basis	*Range of analyses*
Moisture	33.1-34.4%
Ash	13.9-18.2%
Sulfur	.1-.5%
Btu/lb.	5,510-6,700
Fus. temp., °F.	2,480-2,530

In the 147 square mile area of Laramie coals surveyed, reserves of about 885 million tons were estimated to have been originally present, (Landis, 1959). In the three county area of the field, perhaps two thirds of the remaining 2,733 square miles may have comparable coals. This could add as much as 9,900 million tons of reserves to total depth in the basin, probably less than 1,000′, for a total of about 10,785 million tons of Laramie coals originally present.

In the 128 square miles of Dawson coals surveyed, (Landis, 1959), 474 million tons of reserves were estimated to have been originally present. Perhaps half of the remaining 1,600 square miles of Dawson Formation in the three county area may have comparable coals. This could add as much as 5,600 million tons of reserves, for a total of about 6,074 million tons of Dawson coals originally present.

Total for the Colorado Springs field part of the basin, in Douglas, Elbert, and El Paso Counties, is about 16,860 million tons. As much as two thirds of this or about 10,000 million tons is subbituminous C rank coal bordering on lignite. No mines are operating in these coals at present.

Boulder-Weld Field

In this report, the Boulder-Weld field is redefined to include all of Weld County to the eastern limits of the region. It also includes the area of exposed and mined seams along the foothills from Boulder south through Jefferson County, and eastward into the basin through Denver, Adams and Arapahoe Counties to the eastern limits of the region.

These limits are defined by the outcrop of coal-bearing beds in the lower 225 feet of the Laramie Formation. A lesser area of overlying coal-bearing strata of the Paleocene Arapahoe and Denver Formations, correlated with the Dawson arkose to the south, lies within the field.

The "Scranton district", an area 50 miles east of Denver, was active between 1860 and 1910. The Scranton seam in the Paleocene Arapahoe-Denver Formation, where mined, was 6′0″ to 10′0″ thick with many small partings. A 3 foot seam of coal 30′ below the Scranton, and a 7′6″ seam 85″ below that, were never mined. The Laramie coal zone is approximately 1,050 feet below the Scranton seam.

Survey data on 59 square miles of the Paleocene coals indicates an estimated reserve of 489 million tons originally present (Landis, 1959). Perhaps as much as one half of

the additional 1,525 square miles underlain by the Arapahoe-Denver section may have comparable coals. This could add estimated resources of about 6,100 million tons, making total estimated Paleocene coal resources in this field of 6,600 million tons.

The better quality, more extensive coals of the Laramie Formation, were produced from more than 150 miles along the northwest edge of the field northeast from Boulder toward Greeley. Also about 20 mines have been operated in the upturned beds along the foothills south of Boulder through the Golden area in Jefferson County to the Douglas County line. Scattered mining in the area north of Greeley took place near Briggsdale, near Eaton, and at the edge of Larimer County near Wellington. Seven seams, all in the lower 275 feet of the Laramie Formation, are recognized in the mines near Boulder, and are numbered upward. Seams 1 and 2 generally are thin and discontinuous and were seldom mined. Seam 3, known as the "Main Seam", is the most persistent and productive seam, and ranges from 4'0" to 14'0" thick. Seam 4, lenticular and discontinuous, ranging from 2'6" to 11'0", occurs mostly in the western part of the field. Seam 4 lies from 35 feet above Seam 3 to directly upon it. Where they coalesce they have been mined together.

Although Seam 5 is lenticular, varying from 4'11" to 10'1", it is quite extensive, and is known in the field as the "Middle Seam". Seam 6, known as the "Upper Seam" is more lenticular and less persistent, with mined thicknesses of 7'0" to 8'11". Seam 7 occurs sporadically, having limited lateral extent, and is of minor importance, ranging from 2'6" to 5'0" in thickness.

Ranges of many analyses of Seams 3, 5, and 6 were quite similar and may be grouped in the following analyses:

As-received basis	*Range of analyses*
Moisture	15.5-25.8%
Ash	3.3-10.1%
Sulfur	.2-.9%
Btu/lb.	8,890-10,660
Fus. temp., °F.	1,990-2,470

These coals generally are subbituminous B in rank, with slightly higher rank in the western part of the field and along the hogbacks in the foothills. However, these Laramie coals are subbituminous C in the eastern and northern parts of the field. Usually not more than 1 to 3 of the seams are of mineable thickness in any one area.

This is the one coal region in Colorado where shaft mining predominated over drifts or slopes. Depth of the shafts range from 250 to 450 feet.

Of historical interest is the fact that one of the machines which enabled underground coal mining to remain competitive with other fuels, the ripper-type continuous-mining machine, was developed in this field. The prototype was placed in the field in 1943 and was on the market in 1946.

In spite of mechanization, production in the field has declined since 1962 because of competition with low-priced natural gas and with lower cost surface-mined coal, as indicated here:

Year	*Mines in Operation*	*Production*
1956	8	643,812
1962	6	786,457
1972	3	574,707

Almost half of this coal in 1970 was used to generate electric power. In Denver, the Arapahoe plant generated 50% of its power from 277,000 tons, the Cherokee plant generated 72% of its power from 1,493,000 tons, and the Zuni plant, 10% of its power from 3,900 tons of coal. The Valmont plant, at Boulder, generated 65% of its power from 356,000 tons, and the Fort Collins plant generated 19% of its power from 4,000 tons of coal. At Colorado Springs, the Martin Drake power plant used 64,000 tons of coal to generate 15% of its power, and natural gas for 85%.

Most of the rest of Denver Basin coal is used in sugar beet and other local industries, on government contracts, and in limited domestic uses.

In the 502 square miles surveyed in the several mined areas, reserves of about 3,410 million tons were estimated to have been originally in place. In the additional 3,890 square miles of the field, perhaps two thirds may be underlain by comparable coals. This could add as much as 15,600 million tons of resources, making a possible total for the field of about 19,010 million tons of Laramie coal.

With the Paleocene lower-rank coals previously discussed, total resources for the Boulder-Weld field as here defined may be as much as 25,610 million tons.

Totals for the Denver Basin region would be:

Laramie coals	29,795 million T
Paleocene coals	12,469 million T
Total	42,469 million T

Approximately one third of the Laramie coals, or about 10,000 million tons in the western part of the region are subbituminous B rank. All of the rest are subbituminous C rank, with some on the eastern margin bordering on lignite.

Grand Total Coal Resources in Colorado

Total coal resources originally in place in Colorado at depths to 6,000 feet are:

Region	Millions of tons
San Juan	27,300
Uinta	60,020
Green River	57,907
Raton Basin	13,210
Canon City	295
South Park	227
North Park	28,735
Denver Basin	42,470
GRAND TOTAL	230,164

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RANGE OF ANALYSES OF COLORADO COALS ON AN "AS-RECEIVED" BASIS

Regions, fields & coals	% Moisture	% Ash	Sulfur	Btu/lb	Ash fusion °F.
San Juan Region					
Dakota coals NE of Cortez	1.9- 8.1	5.0-18.3	.5- .8	10,440-13,630	2,110-2,910+
Nucla-Naturita area	2.5-13.5	6.1-12.8	.5-1.1	10,010-13,380	2,620-2,910+
Durango field	1.6-10.7	3.4-16.6	.6-1.2	10,860-14,070	2,020-3,000
Uinta Region					
Southwest Uinta Sub-region					
Book Cliffs field					
"Anchor seam"	8.2- 9.8	5.9- 9.8	1.0-1.7	11,910-12,330	2,190-2,790
"Palisade seam"	3.3-14.0	4.9-17.4	.5-1.6	10,950-13,560	2,130-2,910+
"Carbonera seam"	9.3-11.4	7.2-14.4	.4- .6	10,470-11,150	2,850
"Cameo seam"	5.4-11.5	5.2-15.5	.5-1.3	10,410-12,460	2,520-2,960
Grand Mesa field					
Coals in Paonia sh.	9.8-20.0	2.1-16.1	.5-1.8	9,360-11,670	2,060-2,970
Tongue Mesa field					
Several seams	14.2-16.0	6.7- 8.4	.5- .9	9,350-10,220	2,450-2,480
Southeast Uinta Sub-region					
Somerset field					
Bowie sh. coals	7.4-13.6	2.4-11.4	.5- .8	10,040-12,600	2,470-2,810
Paonia sh. coals	10.6-22.4	4.3-13.9	.3- .8	8,160-10,610	2,910+
Near center of field					
Bowie gp. "B" & "C"	2.3- 8.2	2.8-12.0	.4- .7	12,070-13,900	2,220-2,910+
Eastern part of field					
Paonia gp. "D" & "E"	4.2- 8.1	2.8-10.4	.4- .9	12,090-13,400	2,150-2,910+
Crested Butte field					
Six Paonia sh. seams	2.5-13.3	3.2- 9.1	.4-1.9	11,400-14,170	2,130-2,480
Carbondale field					
"Black Diamond" seam	11.1-14.1	2.1- 9.2	.5-1.4	10,360-12,310	2,210-2,470
"D", "Allen" & "Anderson"	3.8- 7.5	1.9-10.5	.4-1.5	11,840-13,530	2,160-2,840
"A", "B", & "C"	5.1- 8.9	3.5-16.2	.6-2.1	10,160-12,820	2,690-2,790
"Allen", "B", "Placita" &"Coal Basin"	1.0- 3.4	3.4-10.0	.5- .7	12,470-15,190	2,150-2,370
Northeast Uinta Sub-region					
Grand Hogback field					
"Black Diamond"	9.2	3.7	.6	11,970	2,210
"Wheeler seam"	3.4- 8.3	4.9-11.3	.3- .8	11,220-13,120	2,130-2,620
"Allen seam"	3.5-10.7	3.9- 7.9	.4- .5	11,600-13,270	2,060-2,370
Seven other seams	2.9-10.5	2.3-11.0	.4-1.1	11,100-13,060	2,090-2,910+
Keystone zone coals	3.7-10.3	5.4- 9.2	.3- .4	11,020-13,120	------
Danforth Hills field					
"Black Diamond" gp.	9.2-13.4	3.7-10.0	.4- .6	11,220-11,970	2,210-2,990
"Fairfield" gp.	9.4-14.4	2.2- 9.6	.3- .9	10,600-11,370	2,310-2,730
"Lion Canyon" gp	8.9-15.5	2.2- 9.6	.5-1.4	10,690-11,790	2,210-2,910+
"Collum seam"	11.4-15.4	2.2- 6.3	.3-1.0	10,140-11,770	2,220-2,480
Lower White River field					
Williams Fork coals	11.2-14.1	4.4- 8.5	.4- .5	10,800-11,230	2,280-2,900
Green River Region					
Yampa field					
"Black Diamond gp."	6.3-12.2	4.3-11.3	.3- .9	11,090-12,560	2,250-2,780
"Fairfield gp."-"Wolf Ck","Wadge","Lennox	7.7-11.8	3.4-11.5	.3- .6	10,740-12,260	2,410-2,910
"Upper or Twenty Mile gp."	14.2-16.9	4.1- 5.4	.4- .9	10,360-11,040	2,070-2,480
"Lorella" & "Kimberly"	19.6-21.8	4.1- 6.5	.5- .7	9,660- 9,720	2,010-2,260
"Campbell" & "Seymour"	17.1-20.5	3.9- 7.8	.2- .4	9,500-10,080	2,050-2,420
Fort Union "Sparks"	20.7-23.0	11.2-13.8	1.8-2.7	8,250- 8,710	------
Raton Basin Region					
Walsenburg field					
Vermejo coals	5.3-10.2	7.2-14.4	.4-1.3	11,050-12,880	2,210-2,840
Raton coals	2.5- 4.2	5.3-13.5	.4-1.0	12,660-13,340	2,230-2,730
Trinidad field					
Vermejo coals	1.6- 5.8	7.7-21.8	.5-1.0	11,430-13,510	2,290-2,910
Raton coals--"Frederick","Primero" et al	1.0- 4.5	5.3-16.4	.4-1.1	12,200-13,970	2,230-2,910+
Canon City Region					
Canon City field					
Seven Vermejo coals	5.4-15.0	4.6-17.7	.3-1.1	10,110-12,010	2,030-2,720
South Park Region					
South Park field					
Como area mines	6.3-15.5	1.3-6.4	.4- .5	9,780	2,700
North Park field					
Coals in Coalmont fm.	13.6-22.8	2.8-13.4	.1- .9	8,840-10,870	2,100-2,680
Denver Basin Region					
Colorado Springs field					
"A" seam	19.2-26.9	3.9-10.2	.2- .5	9,270-10,140	2,150-2,470
Buick-Matheson area	33.1-35.0	7.8-15.7	.4-1.1	6,150- 7,340	2,140-2,400
Dawson lignite	33.1-34.4	13.9-18.2	.1- .5	5,510- 6,700	2,480-2,530
Boulder-Weld field					
Seams "3", "5" & "6"	15.5-25.8	3.3-10.1	.2- .9	8,890-10,660	1,990-2,470

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