THE DEEP CREEK DISTRICT OF THE VERNAL COAL FIELD, UINTA COUNTY, UTAH.

By CHARLES T. LUPTON.

INTRODUCTION.

POSITION AND EXTENT.

The Deep Creek district of the Vernal coal field (Pl. LX) contains approximately 25 square miles and is located on the south flank of the Uinta Mountains west of Green River in Uinta County, Utah,

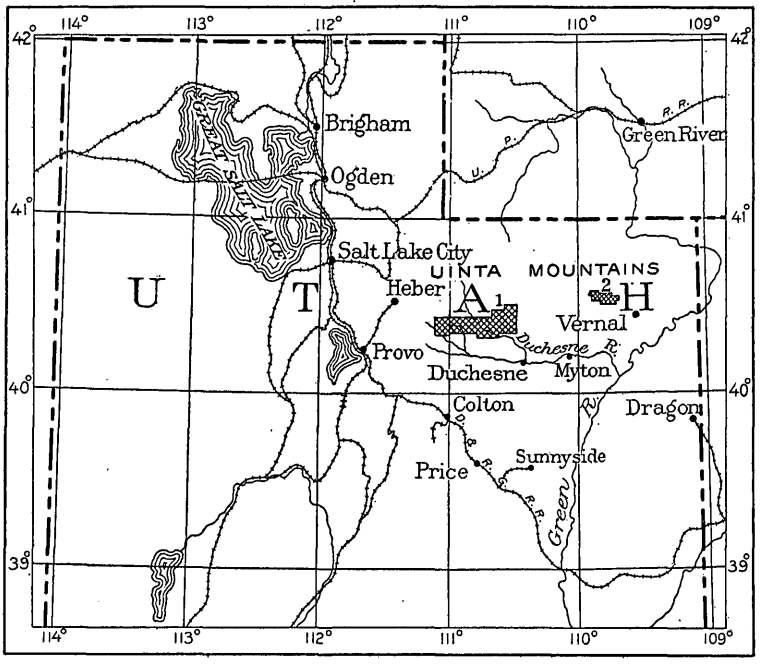


FIGURE 15.—Index map showing location of Blacktail Mountain (1) and Deep Creek district (2) coal fields, Utah.

approximately between parallels 40° 30′ and 40° 33′ and meridians 109° 42′ and 109° 52′ (fig. 15). It is bounded on the east by Little Mountain, which forms the divide between Ashley Valley and Deep Creek. The main divide, separating the area drained by Deep

Creek from that drained by Whiterocks River, forms the western boundary, which is about 35 miles east of the eastern boundary of the Blacktail Mountain coal field, also described in this bulletin, the intervening coal-bearing formation being covered by Tertiary and post-Tertiary rocks. In direct lines the coal field is about 10 miles northwest of Vernal, county seat of Uinta County, and about 15 miles north and slightly east of Fort Duchesne, but by wagon road it is 5 to 10 miles more. The post office nearest to the coal field is at Whiterocks, an Indian agency, where there is a population of 100 to 200 persons. It is about 6 miles south and slightly west from the westernmost exposure of coal-bearing rocks. Only one ranch is situated in the mapped area, but there are several cabins, unoccupied at the time the region was visited, near Deep Creek and its tributaries.

The following townships are partly or entirely within the Deep Creek district: T. 3 S., Rs. 18, 19, and 20 E., Salt Lake base and meridian; Tps. 1 and 2 N., Rs. 1 and 2 E., Uinta special base and meridian.

OBJECT OF INVESTIGATION.

The primary object of the investigation was to collect sufficient data for the classification of the land with regard to coal. A secondary purpose was to make a geologic study of the region for the purpose of securing definite information regarding its fuel resources. As this area is the westward continuation of the Vernal coal field, to which it is closely related structurally and stratigraphically, and which was mapped and described by Gale[1] in 1907, it is deemed advisable to consider it as a district of that field.

A summary of the previous coal investigations made in the Uinta Basin is given in this volume in a report on the Blacktail Mountain coal field, Utah. (See pp. 596–597.)

LAND SURVEY.

The entire Deep Creek district has been surveyed by the General Land Office. The northern and eastern portions of the field were surveyed with reference to the Salt Lake base and meridian, whereas that portion lying mainly south of the outcrop of the coal-bearing rocks and west of Deep Creek is controlled by the Uinta special base and meridian. Practically all land corners for which search was made were found, although more difficulty was experienced in finding corners in the region in which the survey was based on the Salt Lake base and meridian than in the region in which it was based on the Uinta special base and meridian.

[1] Gale, H. S., Coal fields of northwestern Colorado and northeastern Utah: Bull. U. S. Geol. Survey No. 415, 1910, pp. 204–219.

FIELD WORK.

The outcrops of coal beds were located by stadia traverse and their positions carefully determined with relation to land subdivisions. Sections of the coal were measured in mines, prospects, and natural exposures. The geologic boundaries were located for the most part on the Marsh Peak topographic sheet of the United States Geological Survey and later transferred to the original field sheets from which the accompanying map (Pl. LX) was compiled. The stratigraphic section of the Mancos shale and older formations presented on page 589 was measured by stadia. The pick and shovel were employed in numerous places in uncovering the coal.

PERSONNEL AND ACKNOWLEDGMENT.

The field work for this report was done with the assistance of A. E. Fath and W. L. Mielke. Thomas Birchell and Millard Massey served as camp hands and rendered considerable aid in various ways, and the officials of the land office at Vernal, Utah, promoted the work by their suggestions and courtesy.

ROADS AND TRAILS.

The main road through the coal field follows the valley of Deep Creek and connects the small settlement of Dry Fork, several miles to the northeast, with Fort Duchesne and Whiterocks, to the south and southwest. A less-traveled road joins the main road near the center of the coal field and leads southwest to Whiterocks. A few other private and very rarely traveled wood and coal roads and trails were noted.

DRAINAGE AND VEGETATION.

The larger part of the area is drained by Deep Creek and its tributaries, which finally empty into Duchesne River through Uinta River. The greater number of these streams are perennial. A small intermittent stream emptying into Whiterocks River drains the western part of the district.

The climate and vegetation of this area are similar to those of the Blacktail Mountain coal field (p. 601). Cedar and some aspen and pine were noted at various places in the field, and willows grow along the streams. The west slope of Little Mountain is probably more densely covered with vegetation than any other portion.

ACCESSIBILITY AND DEVELOPMENT.

The Deep Creek district is about 100 miles by wagon road from Dragon, the nearest railroad point. Owing to the fact that coal of about the same quality is present in large quantities in the Book

Cliffs, adjacent to the railroad, it can be predicted with safety that fuel from this region will never be transported by wagon to a great distance. Should the "Moffat road" (Denver, Northwestern & Pacific Railway) be constructed through the Uinta Basin, it probably will follow the course of Duchesne River westward to Duchesne (formerly Theodore). To reach the coal in this district it would be necessary to construct a branch 18 to 20 miles in length, probably joining the main line in the vicinity of Fort Duchesne. The construction of such an outlet would undoubtedly stimulate coal mining in all parts of the Vernal field.

The amount of coal that has been removed from various mines can be estimated only very roughly. The amount taken from the Government mines is about 1,600 tons. The Larsen mine probably has produced 100 to 200 tons. The output of the Reynolds mine is much greater and may have reached 1,000 or 1,500 tons or more. Some coal, probably not more than 50 tons altogether, has been mined from other small prospects.

Until a railroad is constructed into this portion of the Uinta Basin the future development of coal mining will depend upon the demand created by the settlers living in the region. Considering the small area of this district, the probabilities are that it will never become a large producer. The demand for this coal will increase as the present supply of wood in this region is depleted. It is not at all likely, however, that the coal in the Mancos shale on the east side of Little Mountain and to the southeast in the vicinity of Vernal will ever be a strong competitor of the coal of the Deep Creek district, owing to the fact that the Vernal coals are much farther away from the settlements to the west and are practically of the same grade as that in this district.

TOPOGRAPHY.

Topographically this district consists of the broad valley of Deep Creek, extending almost north and south through the east central part of the field, the west slope of Little Mountain, and the east slope of the prominent divide separating the drainage basin of Whiterocks River from that of Deep Creek. A valley representing the outcrop of the Cretaceous shale extends along the south side of the field and is due mainly to the fact that the shale is more easily affected by erosion than the harder adjacent rocks. An immense thickness of conglomerate and sandstone overlying the shale forms a "hogback" at the south side of this valley. This "hogback" is much more prominent west of Deep Creek than it is east of that stream. The rocks which underlie the Cretaceous shale are inclined from almost flat to 37° S., and consist of alternating beds of hard and soft rocks, the surface of which when eroded consists of "hog-

backs" and valleys extending parallel to the strike of the strata. Little Mountain, which is the most prominent topographic feature in the belt of coal-bearing rocks, bounds the area on the east. The conglomerate which caps this mountain outcrops in cliffs and very steep slopes, which are due to recent landslides. In the western part of the area recent deposits of gravel and hillwash merge with the conglomerate which unconformably overlies the Cretaceous shale, forming a broad ridge (the south slope of Mosby Mountain) which conceals the strata that form "hogbacks" and shale valleys to the east.

GEOLOGY.

STRATIGRAPHY.

The geologic formations outcropping in the Deep Creek district range from Recent to pre-Cretaceous in age, and include recent terrace gravel, Bishop conglomerate, Uinta (?) formation, Wasatch formation, Mancos shale, Dakota(?) sandstone, and Flaming Gorge formation. These formations are identical with those described by Gale in the main part of the Vernal field, except that in the vicinity of Vernal the lower part of the Mesaverde formation is present in its normal position overlying the Mancos shale, whereas in the valley of Deep Creek the conglomerate of the Wasatch formation rests upon an eroded surface of the Mancos shale, showing that the Mesaverde formation is not present at the surface. This interesting overlap is discussed more fully in the section on the Wasatch formation.

QUATERNARY SYSTEM.

RECENT.

Along Deep Creek (Pl. LX) terraces 30 to 50 feet above water level are capped by alluvium and gravel. A rich soil covers a considerable part of the area where the topography is smooth.

PLEISTOCENE.

According to Atwood[1] the edge of the glaciated region does not extend into the area mapped but lies 6 or 7 miles to the north. The bed of gravel which terminates the district on the west is probably composed in part of pebbles washed down from the glacial deposits to the north. Some of the gravel in the valley of Deep Creek undoubtedly has been derived from glacial deposits.

[1] Atwood, W. W., Glaciation of the Uinta and Wasatch mountains: Prof. Paper U. S. Geol. Survey No. 61, 1909, pp. 41, 42, Pl. IV.

TERTIARY SYSTEM.

PLIOCENE (?) SERIES.

Bishop conglomerate.—Little Mountain, which topographically forms the eastern boundary of the district, is capped with a conglomerate of unknown thickness. This bed in its physical characteristics corresponds to that first described by Powell[1] as the Bishop Mountain conglomerate and later referred to by geologists of the Fortieth Parallel Survey[2] as the Wyoming conglomerate. Wherever it has been examined on the south side of the Uinta Mountains it varies in thickness from a thin film to 500 feet or more. The materials that compose it range from coarse sand grains up to bowlders 5 or 6 feet in diameter. They consist for the most part of reddish, grayish, and banded quartzites, derived from areas several miles to the north along the axis of the mountains. The cementing material is calcareous and ferruginous. Wherever there is a fresh exposure the conglomerate seems to be well consolidated and stands in nearly vertical cliffs. The prevailing color, as viewed from a distance, is yellowish gray. It occupies the tops of outlying ridges and peaks. This conglomerate is not known to the west on the south side of Uinta Mountains between Little Mountain (Pl. LX) and Farm Creek Peak, located near the east side of the Blacktail Mountain coal field (Pl. LXII), a distance of 45 or 50 miles, except in a small area a few miles northwest of this district reported by the geologists of the Fortieth Parallel Survey[3] but not visited by the present writer. Undoubtedly this conglomerate was deposited at about the same time and under the same conditions as described by Rich[4] on the north flank of the Uinta Mountains. He assigned the formation questionably to the Pliocene. A similar assignment of the formation is made for this district and for the Blacktail Mountain field upon the evidence furnished by Rich, though it may be Pleistocene.

EOCENE SERIES.

Uinta(?) formation.—On Deep Creek, about 5 miles south of the area mapped, flat-lying rocks, prevailingly sandy and of a brick-red color, are exposed in the west-facing cliffs a short distance west of the creek. A detailed section of these strata was measured, but no fossils were found. These beds probably represent the Uinta formation as defined by Osborn,[5] and may possibly include the upper part of the Bridger formation.

---

[1] Powell, J. W., Geology of the Uinta Mountains: U. S. Geol. and Geog. Survey Terr., 2d div., 1876, pp. 169, 170, and atlas map B.

[2] King, Clarence, Hague, Arnold, and Emmons, S. F., U. S. Geol. Expl. 40th Par., vol. 2, Descriptive geology, 1877, pp. 205, 226, and 258.

[3] King, Clarence, U. S. Geol. Expl. 40th Par., Atlas, Green River Basin sheet, map II, west half.

[4] Rich, J. L., The physiography of the Bishop conglomerate, southwestern Wyoming: Jour. Geology, vol. 18, 1910, pp. 601–632.

[5] Osborn, H. F., Bull. U. S. Geol. Survey No. 361, 1909, pp. 54–57.

Wasatch formation.—The Wasatch formation in this district corresponds stratigraphically and lithologically with the Wasatch formation as described and mapped by Gale in the main part of the Vernal coal field, a few miles to the southeast. The formation consists of conglomerate, sandstone, sandy clay, and some thin beds of limestone. In the Deep Creek locality the conglomerate, which is pale red to pink in color, predominates, as may be observed in the section on pages 588–589. The materials comprising the conglomerate are fairly well rounded, and consist of limestone, sandstone, quartz, calcite, and chert, ranging in size from sand grains to bowlders 3 feet in diameter, but are for the most part less than 6 inches in their greatest dimension. In places a zone about 20 feet thick at the base of this formation is saturated with asphaltum.

The rocks overlying the conglomerate consist mainly of reddish sand and sandy clay, several hundred feet thick. Exposures are poor along Deep Creek south from the top of the southernmost well-exposed ridge of conglomerate below the mouth of Mosby Creek for a distance of 3 to 5 miles. "Hogbacks" here and there suggest beds of sandstone or conglomerate. The Wasatch formation overlies the Mancos shale unconformably. This is an unusual condition and signifies that there is a remarkable erosional unconformity and overlap along the south flank of the Uinta Mountains. In the vicinity of Vernal, as shown by Gale,[1] only the lower part of the Mesaverde formation is present at the surface, but from that place east into Colorado the formation increases in amount present, and near Meeker the entire formation is exposed to view. These facts show plainly that this erosional unconformity and overlap is greater toward the west. The region immediately west of the Deep Creek district is so covered with late Tertiary and Pleistocene material that the character of the contact between the Wasatch and underlying formations could not be studied.

CRETACEOUS SYSTEM.

Mancos shale.—The Mancos shale consists of two members, the upper comprising 2,100 feet of drab clay shale and the lower about 400 feet of sandstone and shale and two coal beds. The upper part of the lower member, consisting of sandstone and sandy shale about 200 feet thick, contains near the top the principal coal beds of the formation. In most places only one important coal bed is present, but a second bed thick enough to be considered was noted near Deep Creek. Yellowish-brown clay shale 75 feet thick underlies the sandy part. Directly underlying the shale is a blue sandy shale which weathers gray, outcrops in a low, smooth ridge, and contains great numbers of fish scales. This shale has all the characteristics of

[1] Gale, H. S., Coal fields of northwestern Colorado and northeastern Utah: Bull. U. S. Geol. Survey No. 415, 1910, pp. 204–219.

and is in the same stratigraphic position as the Mowry shale member of eastern Wyoming. The base of the Mancos shale is composed of 50 feet of drab and yellow shale.

Dakota(?) sandstone.—The Dakota(?) sandstone consists of 175 to 200 feet of sandstone, fine conglomerate, and clay shale. The top of the formation is marked by a coarse-grained yellowish-brown sandstone 5 to 10 feet thick. Underlying this are drab and yellowish-gray shales, about 100 feet thick, with a few thin beds of sandstone. The next 15 to 20 feet of the section is composed of a friable yellowish-gray sandstone, which contains in places a bed of limonite 2 to 4 inches thick. Under this sandstone is a drab shale approximately 30 feet thick. The base of the formation is a gray coarse-grained sandstone 20 to 30 feet thick, which in places contains some brownish conglomerate, the pebbles of which range up to one-half inch in diameter.

PRE-CRETACEOUS ROCKS.

Underlying the Dakota(?) sandstone is a mass of fine conglomerate, sandstone, shale, and sandy shale, blue, maroon, pink, gray, yellow, and drab in color. This portion of the section was not studied in detail, and was not measured. According to Gale[1] these rocks would be the upper part of the Flaming Gorge formation.

DETAILED SECTION.

The portion of the following section ranging from the Wasatch to the base of the Dakota(?) sandstone was measured on Deep Creek east of the center of the area represented on the accompanying map (Pl. LX); the Uinta (?) rocks were measured on the west side of Deep Creek 3 to 5 miles south of the area mapped.

Section of rocks measured in and near Deep Creek valley, north of Fort Duchesne, Utah.

	Ft.	in.
Uinta (?) formation:		
Conglomerate, poorly consolidated; pebbles consist mainly of sandstone and red and gray quartzite, ranging up to bowlders 3 feet in diameter. Considerable calcareous material is mixed with this conglomerate	15	
Sand, pink, with a few thin beds of gray sandstone	37	
Sandstone, pink-gray, fine grained, locally lenticular	4	
Sandstone, grayish brown, very soft, fine grained	5	
Sandstone, brick-red, argillaceous, with a few streaks of gray containing some clay	17	6
Conglomerate, matrix brick-red, pebbles fairly well rounded, of red quartzite, bluish-gray limestone, green quartzitic sandstone, ranging up to 1½ inches in diameter. Base very irregular. Ledge maker locally	12	

[1] Op. cit., pp. 45, 46, 53–55.

Uinta formation—Continued.	Ft.	in.
Sandstone, pink and purple	12	
Conglomerate, fine grained, pinkish green; in places grades into a coarse-grained sandstone	7	6
Sandstone, reddish gray, fine grained	24	6
Sandstone and shale alternating, sandstone gray, shale red	10	
Sandstone, pink, argillaceous, with a few thin indurated lenses of sandstone; upper part drab in color	20	
Sandstone, reddish gray, soft, coarse	1	
Sandstone, red	2	6
Sandstone, brick-red	4	
Sandstone, pink, argillaceous, very soft, with one or two indurated layers about 4 inches thick	84	
Sandstone, gray, with thin streaks of yellow and pink	3	
Sandstone, pinkish drab near top, argillaceous	5	
Sandstone, lenticular	1	
Sandstone, pink, argillaceous	3	
Conglomerate, pinkish gray; material consists of red pebbles of quartzite, subangular, bluish-gray limestone and some sandstone	1	
Sandstone, brick-red with one or two bluish-gray streaks, argillaceous	6	
Sandstone, pink, coarse grained	4	6
Sandstone, argillaceous, red with a few gray streaks	19	
Conglomerate, pink, pebbles up to the size of a pea	3	
Sandstone, brick-red, part gray	5	6
Sandstone, variegated in color, lenticular	1	6
Clay, brick-red with streaks of gray, sandy	14	
Sandstone, yellow	7	
Sandstone and sandy shale, faint purple	4	6
Conglomerate, greenish gray and red; pebbles subangular, consisting of red quartzite, blue limestone, and some sandstone	2	6
Shale, sandy, brick-red; contains pockets of conglomerate	2	
Conglomerate, fine grained; pebbles range up to 1½ inches in diameter and consist of red quartzite, blue limestone, and some sandstone	2	
Sandstone, brick-red, fine grained	26	
Conglomerate, grayish green and variegated; pebbles consist of red quartzite, blue limestone, and some sandstone	2	10
Sandstone, variegated, in places shaly	29	
	398	4

NOTE.—Intervening between the bed last described above and the top of the known Wasatch given below are several hundred feet of sandstone and clay of various colors with "hogbacks" protruding here and there suggesting beds of conglomerate or sandstone. These strata probably represent the lower part of the Uinta (?) formation, the Bridger formation, and upper part of the Wasatch formation. The Bridger forma-

	Ft.	in.
tion may not be represented at this locality and the conditions may be similar to those at the east end of the Blacktail Mountain coal field in T. 1 S., R. 5 W., Uinta special base and meridian (Pl. LXII), where the Bridger formation overlaps the Green River formation and the lower part of the former is overlapped by beds that probably are equivalent to the Uinta (?) formation.		
Wasatch formation:		
Conglomerate, grayish brown, pebbles well rounded, various sizes	35	
Conglomerate (?) not well exposed	50	
Sandstone and clay, variegated	20	
Conglomerate, large and small pebbles, poorly rounded; limestone predominates, resistant	45	
Conglomerate (?), poorly exposed, contains some red sand and clay	100	
Conglomerate, well-rounded pebbles of various sizes	25	
Clay, sandy, red	15	
Conglomerate of rather small subangular quartz and calcite pebbles	120	
Sandstone, gray to white	20	
Limestone, concretionary layer	2	6
Sandstone and clay, with some gypsum, yellow and drab, red at base	25	
Conglomerate, well-rounded pebbles up to bowlders 2½ feet in diameter, matrix of lower part yellow and sandy, upper part pink	8	
Conglomerate, gray, angular and well-rounded pebbles of limestone, sandstone, quartz, chert, and calcite	45	
Sandstone and clay, yellow; contains some limonite	20	
Sandstone, yellow	3	6
Conglomerate, calcareous matrix, sandstone pebbles ranging from sand grains up to bowlders 3 feet in diameter; beds of gray sandstone 1 foot thick were noted in the conglomerate. Pebbles, subangular, are poorly cemented near top	35	
Sandstone, gray, fine grained	6	
Conglomerate, pebbles ranging from sand grains up to 2 inches in diameter, matrix lime; pebbles consist of limestone, sandstone, and quartz, well rounded	7	
Sandstone, yellow, thin bedded, massive locally	12	
Sandstone, brown, ledge maker, massive	6	
Sandstone and clay, variegated, red predominates	35	
Sandstone, gray, conglomeratic	5	
Sandstone and clay, variegated, red, gray, and drab	65	
Sandstone, gray, with yellow streaks, ledge maker	1	
Sandstone and sandy clay, gray, pink, and drab, fine grained	35	
Sandstone, brown, weathers gray, contains asphaltum	7	
Clay, sandy, pink	8	
Sandstone, brown, fine grained, ledge maker	3	
Clay, drab and pink, sandy	8	

	Ft.	In.
Wasatch formation—Continued.		
Sandstone, dark, medium grained, saturated with asphaltum	15	
Conglomerate, saturated with asphaltum	6	
Unconformity.		
	788	
Mancos shale:		
Shale, drab	2,100±	
Shale, drab, sandy	3	
No. 4 Coal, good		7
No. 4 Shale, bony		1½
No. 4 Coal, good and bright	1	
Shale and sandstone, poorly exposed	25	
Sandstone, gray, with a little shale near base, rather massive and slightly cross-bedded	125	
Sandstone, yellowish gray	60	
Shale, drab and yellowish brown	75	
Shale, drab, weathers bluish gray; contains fish scales	50	
Shale, drab and yellow	50	
	2,489	8½±
Dakota (?) sandstone:		
Sandstone, yellowish brown, coarse grained	7	
Shale, drab, yellow, sandy	100±	
Sandstone, yellow, saccharoidal; contains limonite in joints 2 to 4 inches thick	18	
Shale, drab	30±	
Sandstone, gray, coarse grained; contains local lenses of fine-grained brown conglomerate	25	
Flaming Gorge formation:	180±	
Conglomerate, sandstone, sandy shale, and clay shale, blue, maroon, pink, gray, yellow, and drab.		

STRUCTURE.

The Deep Creek district is situated on the south flank of the Uinta Mountains east of their center (fig. 15, p. 579). The rocks described above strike nearly east and west and dip southward from almost flat to 37° as shown by structure section A–B on Plate LX. The lowest dip (19° S.) in Deep Creek valley was noted in the SE. ¼ SE. ¼ sec. 27, T. 3 S., R. 19 E., Salt Lake meridian, on one of the sandstone beds overlying the coal. Westward from this place the inclination of the beds increases gradually to 22° S. at the west margin of the area. Eastward from Deep Creek the dip increases rapidly to 37° near the center of sec. 30, T. 3 S., R. 20 E., Salt Lake meridian, about one-third of a mile southwest from the Larsen mine, situated on the west flank of Little Mountain. At the Larsen mine the strata are almost flat, with a slight southward dip. The thick conglomerate at the base of the Wasatch formation dips about 30° S. in sec. 4, T. 1 N., R. 2 E., Uinta special meridian. The area under discussion is prac-

tically free from faults except in the vicinity of the Larsen mine, where several small ones were noted. The throw of these faults is small but is sufficient to be troublesome in mining the coal.

THE COAL.

The coal of the Deep Creek district is low-grade bituminous, judging from its physical and chemical characteristics, which are fully described on page 17 of this report. Only one sample, laboratory No. 10812, was collected for analysis in this district. As this somewhat weathered coal shows a calorific value of 11,920 British thermal units on the air-dried basis, it seems safe to assume that fresh coal would produce 12,000 or more British thermal units. One main coal bed extends in outcrop throughout the greater part of this area. At one locality just east of Deep Creek, in the SE. ¼ SE. ¼ sec. 27, T. 3 S., R. 19 E., Salt Lake meridian, two beds were noted. The second bed, observed only at this locality, is thin and contains considerable bone and shale (No. 6 [1]).

OCCURRENCE.

The sections of coal obtained will be considered in order from east to west, beginning at the easternmost exposure of coal at the Larsen mine (No. 7), in the NW. ¼ NE. ¼ sec. 30, T. 3 S., R. 20 E., Salt Lake meridian. At this locality a total of 3 feet 1½ inches of coal was noted, broken by partings of bone, as shown in the section. The strata are practically flat with possibly a slight dip to the south. This mine has an excellent roof of gray massive sandstone 3 to 5 feet thick, but the floor is unsatisfactory, consisting of soft red shale. The mine is equipped with an iron track and a mine car that holds three-fourths of a ton. At the time of examination the main entry had been driven 100 feet. The coal from this mine is used mainly by the settlers in the valley.

Southwest and west from the Larsen mine the coal is not exposed for about 3 miles. Just east of Deep Creek, in the SE. ¼ SE. ¼ sec. 27, T. 3 S., R. 19 E., Salt Lake meridian, coal section No. 5 shows that the coal bed is thinner than at location No. 7. Here the bed contains no partings and is only 1 foot 9 inches thick. The roof is sandstone, the lower part of which is slightly shaly, and the floor is hard resistant sandstone. At this place the strata dip 19° S. and strike N. 80° to 90° W.

Coal section No. 6 represents a second coal bed which was seen only in the SE. ¼ SE. ¼ sec. 27, T. 3 S., R. 19 E., Salt Lake meridian. This coal bed at this place is 4 or 5 feet below the principal coal bed and is of little economic importance.

[1] Numbers in the text refer to sections and their corresponding locations on Pl. LX.

In a surface prospect just west of Deep Creek, in the SW. ¼ SE. ¼ sec. 27, T. 3 S., R. 19 E., Salt Lake meridian, a section (No. 4) was measured on a bed that corresponds quite closely to that showing at location 5. The coal is practically of the same thickness as at location 5, but a parting of shale 1 inch thick 7 inches from the top separates the bed into two benches. The roof is shaly sandstone and the floor is hard resistant sandstone.

About a mile to the west there are three abandoned mines formerly operated by the Government to obtain fuel for use at Fort Duchesne and the Indian agency at Whiterocks. The easternmost mine (No. 3), in the NW. ¼ SW. ¼ sec. 33, T. 2 N., R. 2 E., Uinta special meridian, is little more than a large prospect and shows a total thickness of 3 feet of coal separated into two benches by 1½ inches of bone 9 inches from the top. The next entry to the west is 200 feet long. Both roof and floor consist of sandy shale.

The largest of the Government mines (No. 2) is located about one-fourth of a mile slightly north of west from No. 3. It contains a total of 5 feet 6½ inches of coal separated into three benches by bone partings. The uppermost parting is 3½ inches thick and is 1 foot 7 inches from the top of the bed. The lower parting is bone 5 inches thick, 1 foot 7½ inches above the base of the bed. The roof is sandstone and the floor is brown to drab shale. It was impracticable to explore all of the old workings of this mine on account of caving. The entry is 100 feet long to the first room and is fitted with an iron track. A wooden car was used in removing the coal. The entry has been driven with a slight dip and a horsepower whim installed to bring the coal to the surface. The other Government mine is situated between Nos. 2 and 3 at a point where the rocks dip 31° S. and strike N. 60° to 70° E., and was so much caved that it was impossible to obtain a reliable section of the coal bed. Westward for about 2 miles from No. 2 the coal is covered with alluvium and gravel.

The Reynolds mine (No. 1) is located in the NW. ¼ SW. ¼ sec. 20, T. 3 S., R. 19 E., Salt Lake meridian, at which place the only sample for analysis (laboratory No. 10812) was taken in this district. In this mine two sections of the coal bed were measured at points about 100 feet apart, which show a slight difference in the character of the bed in this distance.

Sections of Reynolds coal bed in the Reynolds mine, in the NW. ¼ SW. ¼ sec. 20, T. 3 S., R. 19 E. of the Salt Lake meridian.

Section at back end of entry.	Ft.	in.
Shale, purple (roof)	4	
Clay, brown, shaly, contains coal streaks near bottom		7½
Coal, bright		2
Clay shale, brown, soft		2½
Coal,[1] solid, very much fractured in upper part	2	1¼
Clay shale, brown, contains thin lenses of coal		2
Coal,[1] solid		6
Bone, very carbonaceous, containing laminæ of coal		4
Coal,[1] solid, bright	1	2¾
Clay shale, brown		1½
Shale, hard, sandy		1
Total coal	4	

Section about 160 feet from mouth of entry.	Ft.	in.
Shale, purple (roof)	4	
Bone, containing thin lenses of coal		7
Shale, soft, weathered		1
Coal, dull, bony		9½
Shale, black, carbonaceous		¾
Coal, dull, fair quality		6
Shale, black, carbonaceous		¾
Coal, dull, fair quality		6
Clay, gray		3
Coal, bright	1	4
Clay, gray		½
Coal, bright		3
Shale, black, sandy.		
Total coal	3	4½

This mine was opened by Bob Reynolds several years ago and has been recently operated. It is well timbered; the entry bears S. 35° W. and is 250 feet long. A whim is used to hoist the cars from the mine. The rocks at this locality dip 21° S. and strike N. 70° to 75° W.

The westernmost place in this district at which a bed containing any coal was noted is in the SE. ¼ sec. 19, T. 3 S., R. 19 E., Salt Lake meridian, about one-fourth mile northwest of the Reynolds mine. The bed has been prospected near the west line of sec. 20, but does not show coal of economic importance, as the section given below indicates:

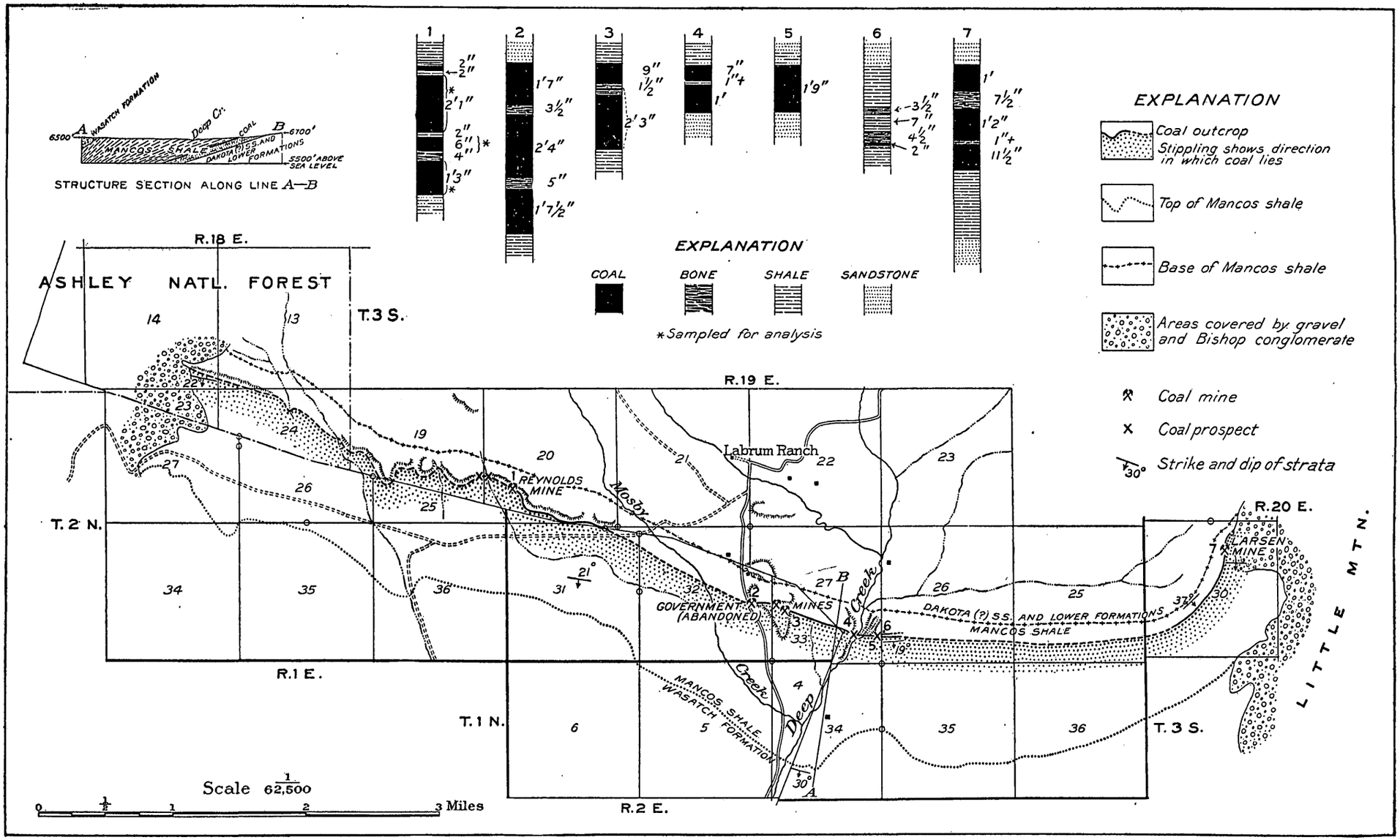
Section of coal zone in NW. ¼ SW. ¼ sec. 20, T. 3 S., R. 19 E. of the Salt Lake meridian.

	Feet.
Sandstone, gray, thick bedded	4+
Shale, purple, contains a few lenses of coal up to 1 inch thick; the lenses are usually about 6 feet in length	3
Sandstone, gray	2
Shale, black, carbonaceous, contains a few lenses of coal near top one-half inch thick	5
Covered.	
	14+

It is possible that the coal bed represented by the section given above corresponds to coal section No. 6, near Deep Creek, and is not the main coal bed, which probably is covered with talus and hill wash at this place.

Westward from the last-mentioned locality the coal-bearing rocks are exposed for a distance of about 2½ miles, but a representative section could not be obtained anywhere along the outcrop of these beds.

[1] Sampled for analysis, laboratory No. 10812.



MAP OF THE DEEP CREEK DISTRICT OF THE VERNAL COAL FIELD, UINTA COUNTY, UTAH.

By C. T. Lupton.

Near the west line of the SE. ¼ SE. ¼ sec. 14, T. 3 S., R. 18 E., Salt Lake meridian, the coal-bearing rocks are concealed under a cover of gravel and hill wash; westward these rocks are covered by Tertiary and post-Tertiary deposits for 35 miles, or to a point 2 to 3 miles east of Rock Creek, in the southwestern part of T. 1 N., R. 5 W., Uinta special meridian. (See Pl. LXII, p. 622.)

CHARACTER OF THE COAL.

PHYSICAL PROPERTIES.

The coal of this district is low-grade bituminous. Fresh surfaces are pitch-black, but faces of joints and weathered surfaces are dull black. The coal is hard and brittle and jointing is cubical. Its luster is vitreous, and its fracture ranges from uneven to regular. The coal when pulverized gives a very dark brown powder and the streak made by rubbing the coal on unglazed porcelain has a slightly brownish tint. Its structure is bedded but not prominently.

CHEMICAL COMPOSITION.

One sample for chemical analysis was taken at the Reynolds mine (No. 1) in the NW. ¼ SW. ¼ sec. 20, T. 3 S., R. 19 E., Salt Lake meridian, about 250 feet from the mouth of the entry and under about 90 feet of cover. The mine had not been operated for several months before sampling, therefore about 1 foot of the outer coal was removed to obtain unweathered coal. The three lower benches are included in the sample. The analysis of the coal is as follows:

Analysis of coal from the Deep Creek district of the Vernal coal field, Utah.

[Bureau of Mines laboratory, A. C. Fieldner, chemist in charge Laboratory No. 10812. Air-drying loss, 4.5 per cent.]

	As received.	Air dried.	Dry coal.	Ash and moisture free coal.
Moisture	11.3	7.1	.....	.....
Volatile matter	35.6	37.3	40.1	43.4
Fixed carbon	46.4	48.6	52.3	56.6
Ash	6.7	7.0	7.6	.....
Sulphur	.95	.99	1.07	1.16
Calories	6,325	6,620	7,125	7,710
British thermal units	11,380	11,920	12,830	13,880

TONNAGE.

The following table gives the estimated tonnage of coal in beds more than 14 inches thick underlying the townships included in the Deep Creek district of the Vernal coal field. In this estimate 1,800 tons is taken as the amount of coal contained in an acre-foot, and coal more than 3,000 feet below the surface is not considered.

Estimated tonnage of coal in the Deep Creek district of the Vernal coal field.

	Tons.
Salt Lake meridian:	
T. 3 S., R. 18 E.	699,000
T. 3 S., R. 19 E.	8,925,000
T. 3 S., R. 20 E.	8,062,000
T. 4 S., R. 19 E.	913,000
Uinta special meridian:	
T. 1 N., R. 1 E.	1,901,000
T. 1 N., R. 2 E.	11,293,000
T. 2 N., R. 2 E.	10,128,000
T. 2 N., R. 1 E.	7,540,000
	49,461,000

By careful mining at least 60 to 75 per cent of this amount of coal, or approximately 35,000,000 tons, can be recovered.

THE BLACKTAIL (TABBY) MOUNTAIN COAL FIELD, WASATCH COUNTY, UTAH.

By CHARLES T. LUPTON.

INTRODUCTION.

The Blacktail (locally known as Tabby) Mountain coal field, Utah, occupies a portion of the northern margin of that immense syncline in northwestern Colorado and northeastern Utah known as the Uinta Basin (fig. 15, p. 579). The coal-bearing rocks are well exposed along the greater part of the southern, southeastern, eastern, and northeastern edges of this large structural trough, but throughout extensive areas along the northern margin, which lie on the flank of the Uinta Mountains, the upturned edges of the coal-bearing formations are covered by Tertiary and later rocks. This overlap or encroachment comes in gradually from the east, obscuring more and more of the coal beds until finally a few miles west of Vernal the highest coal-bearing formation—the Mesaverde—is concealed by the overlap of the Tertiary, and a little farther west the lower coal-bearing formation also is covered by the great sheet of coarse material washed down in Tertiary time from the mountains on the north. This condition exists nearly to Rock Creek, but beyond that stream for a distance of 5 miles the lower coal-bearing formation is exposed here and there. On the west slope of Farm Creek Peak both formations are partially exposed, but the coal-bearing portion of the Mesaverde is not exposed east of the west slope of Blacktail Mountain. Just north of Current Creek, near the south line of T. 1 S., R. 10 W., the coal-bearing rocks are again concealed by the Tertiary formations. Faults, overlaps, and igneous rocks conceal the outcrop to a great extent along the western margin of the basin. The Blacktail Mountain coal field includes the outcrops of the coal-bearing formations on Duchesne River and in that vicinity.

The primary object of the investigation of the field in 1910 was to obtain accurate knowledge regarding the coal resources in order that the public land might be classified and valued and that information concerning the commercial value of the fuel might be more complete.

EARLIER COAL INVESTIGATIONS IN THE UINTA REGION, COLORADO AND UTAH.

Whitman Cross and G. H. Eldridge[1] in 1884 to 1888 examined the Anthracite and Crested Butte quadrangles, Colo., which include a small part of the southeastern end of the Uinta region.

In 1905 J. A. Taff[2] made a reconnaissance survey of that portion of the Book Cliffs northwest from Sunnyside to Castlegate and south and southwest along the eastern margin of the Wasatch Plateau from Castlegate to Ivie Creek and Mount Hilgard, where the coal-bearing rocks are covered by basalt.

Taff[3] made a more detailed survey of the coal-bearing rocks in the vicinity of Price, Castlegate, Clear Creek, and Huntington during the season of 1906. In the same year G. B. Richardson[4] examined the coal-bearing rocks along the Book Cliffs between Grand River, Colo., and Sunnyside, Utah, and H. S. Gale[5] investigated the coal resources of the Danforth Hills and Grand Hogback in northwestern Colorado.

In 1907 W. T. Lee[6] examined and mapped a region 10 to 20 miles in width along the outcrop of the coal-bearing rocks southeast from Grand River, Colo., for a distance of about 50 miles. During the same field season Gale[7] completed his investigations along the northeastern flank of the Uinta Basin as far west as Little Mountain on the west side of Ashley Valley, Utah, connecting with the Danforth Hills and Grand Hogback fields in Colorado.

In 1909 A. L. Beekly examined and mapped a portion of the northeastern edge of the Uinta Basin south from Glenwood Springs, Colo., a distance of about 25 miles. The report on the Glenwood Springs field will be published soon.

EARLIER GEOLOGIC WORK IN THE BLACKTAIL MOUNTAIN FIELD.

The earliest known published record of explorations in this field is given in Frémont's travels.[8] With his party, he camped, on the night of May 30, 1844, probably near the present site of Tabby post office. J. H. Simpson[9] in 1859, accompanied by Henry Engleman, traveled

[1] Anthracite-Crested Butte folio (No. 9), Geol. Atlas U. S., U. S. Geol. Survey, 1894, pp. 6-10.

[2] Book Cliffs coal field, Utah, west of Green River; Bull. U. S. Geol. Survey No. 285, 1905, pp. 289-302.

[3] The Pleasant Valley coal district, Carbon and Emery counties, Utah: Bull. U. S. Geol. Survey No. 316, 1906, pp. 338-358.

[4] The Book Cliffs coal field between Grand River, Colo., and Sunnyside, Utah: Bull. U. S. Geol. Survey No. 316, 1906, pp. 302-320.

[5] Coal fields of the Danforth Hills and Grand Hogback in northwestern Colorado: Bull. U. S. Geol. Survey No. 316, 1906, pp. 264-301.

[6] The Grand Mesa coal field, Colo.: Bull. U. S. Geol. Survey No. 341, 1907, pp. 316-334.

[7] Coal fields of northwestern Colorado and northeastern Utah: Bull. U. S. Geol. Survey No. 341, 1907, pp. 283-315.

[8] Frémont's first and second expeditions, 1842-43-44, pp. 277-280.

[9] Explorations across the Great Basin of Utah in 1859, 1876, pp. 296-298.

down the west fork and then the main valley of Duchesne River as far as the present site of Duchesne (formerly Theodore). They recorded the character of the rocks over which they passed and attempted to correlate them with others they had observed in the general region. The geologists of the Fortieth Parallel Survey[1] in 1869 and 1871 mapped the geology of this region in a reconnaissance way. They recorded the presence of coal west and northwest of Blacktail Mountain, but did not attempt to examine it in detail. Eldridge,[2] during his investigation of the uintaite (gilsonite) deposits of Utah, probably visited some part of the area under discussion, although he does not make reference to it. C. P. Berkey[3] visited the Duchesne Valley in 1903. The greater part of his investigations were made a few miles north of the Blacktail Mountain coal field. On his map he shows the Cretaceous rocks and coal outcropping west of Blacktail Mountain, but in his text he confines himself to the discussion of older rocks. In 1906 S. F. Emmons,[4] who examined this area for the Fortieth Parallel Survey, in 1869 and 1871 revisited certain places in the Duchesne Valley. F. B. Weeks[5] encircled the Uinta Mountains in 1906. He published with his paper a revised geologic map of the mountains in which he differentiates a larger number of formations than had been included on former geologic maps. Atwood[6] studied the glaciation of the Uinta and Wasatch mountains in 1902 and 1903. The moraines and outwash plains that he noted do not enter the mapped area in the valley of Duchesne River, but they do extend almost across it in Rock Creek valley.

LAND SURVEY.

The field under discussion was subdivided by the General Land Office in 1903 and 1904. The Uinta special base line, with relation to which the entire Uinta Indian Reservation was sectionized, crosses the northeastern part of the field. Practically all the land corners searched for were found to be well marked and properly located. In the valley of Duchesne River, where many of the Ute Indians selected allotments when the reservation was opened to public entry, August 28, 1905, most of the corners of 40-acre tracts are in place. These auxiliary cornerstones are of great value to settlers, because they make it possible to locate land accurately without the aid of a surveyor.

[1] King, Clarence, Hague, Arnold, and Emmons, S. F., U. S. Geol. Expl. 40th Par., vol. 2, Descriptive geology, 1877, pp. 303-315, Atlas map II, west half, and map III, east half.

[2] The uintaite (gilsonite) deposits of Utah: Seventeenth Ann. Rept. U. S. Geol. Survey, pt. 1, 1896, pp. 909-949.

[3] Bull. Geol. Soc. America, vol. 16, 1905, pp. 517-530.

[4] Idem, vol. 18, 1907, pp. 287-302.

[5] Idem, vol. 18, 1907, pp. 427-448.

[6] Atwood, W. W., Glaciation of the Uinta and Wasatch mountains: Prof. Paper U. S. Geol Survey No. 61, 1909.

FIELD WORK.

The field work upon which this report is based extended from August 24 to October 15, 1910. It consisted in making a topographic map, locating the various geologic features by planetable methods, and carefully examining the coal resources of the field. Coal beds were examined in natural outcrop wherever such exposures could be found and were prospected in every locality in which prospecting could be done without too great an expenditure of time and money. The sections presented under the discussion of stratigraphic geology were measured at the points indicated, and coal samples were taken at the places shown in the table of analyses (pp. 625–626). The topographic map, Plate LXII (p. 622), is not intended to show minute detail but represents features much more accurately than reconnaissance maps. It was made by triangulation from a base line 1½ miles long carefully measured between points E and F in the valley of Duchesne River southeast of Hanna post office, and from altitudes determined by the United States Geological Survey in the valley of Duchesne River and on the Strawberry Valley quadrangle of the same survey. An aneroid barometer was used as an accessory in determining altitudes, though in general the altitude of a point was found by computation of vertical angles and distances from known points. Especial care was taken to determine the location of outcrops of coal beds in relation to land corners. In general such locations were made by stadia traverse or intersections on the planetable, though some positions were fixed by compass observations to determine direction and foot pacing to obtain the distance.

PERSONNEL AND ACKNOWLEDGMENTS.

The field work for this report was done with the assistance of A. E. Fath and W. L. Mielke. Thomas Birchell and Millard Massey served as camp hands and rendered valuable aid in various ways. The settlers in the coal field promoted the work by their hospitality and courtesy.

GEOGRAPHY.

POSITION AND EXTENT.

The Blacktail Mountain coal field is in Wasatch County, Utah, on the south flank and near the west end of the Uinta Mountains. Its eastern boundary is 30 to 35 miles west of the Deep Creek district of the Vernal coal field, described in the preceding paper in this report. Blacktail Mountain, from which the coal field takes its name, is near the center of the area mapped and is the most prominent topographic feature in the area. The field extends from the eastern line of T. 1 N., R. 6 W. (being terminated by the overlap of the Tertiary formations and outwash from glacial deposits), slightly south of west

to Currant Creek in the southwest corner of T. 1 S., R. 10 W., where conditions similar to those in the east terminate the field. As shown by these limits its length is about 32 miles, its width from 2½ to 7 miles, and its area about 150 square miles.

ACCESSIBILITY.

The field is remote from lines of railroad and similar means of travel and transportation. It can best be reached by way of Provo, on the main line of the Denver & Rio Grande Railroad, and over a branch of that line to Heber. A fairly good wagon road extends from Heber up the valley of Lake Creek over a low divide and down Currant Creek to the outcrop of the coal beds, a distance of 25 miles

Another route is overland from Park City, the terminus of a branch of the Union Pacific Railroad which joins the main line at Echo City, Utah. The journey can be made on horseback or wagon up the south fork of Provo River through Woodland, over the divide, and down Wolf Creek and the west fork of Duchesne River, through Stockmore to Blacktail Mountain, a distance from Park City of about 50 miles.

The coal field can be approached from the south by two routes. A daily mail stage carrying passengers and express from Price to Vernal may be used as far as Myton, on Duchesne River, where a private conveyance can be obtained for the remainder of the journey up that river, a distance of about 60 miles. The other southern approach is from Colton, on the Denver & Rio Grande, by mail stage to Duchesne (Theodore), and private conveyance from there to the coal field by following up Duchesne River, a distance of 35 miles.

To enter the coal field from the east one should leave the Denver & Rio Grande Railroad at Mack, Colo., and take the Uintah Railway to Dragon, Utah, from which place an automobile stage runs to Fort Duchesne, where private conveyance can be obtained for the remainder of the journey up Duchesne River, a distance of about 75 miles.

SETTLEMENTS AND POST OFFICES.

The area under discussion is very sparsely settled. Practically all of the 200 inhabitants, about one-third of whom are Indians, live in Duchesne Valley east of Blacktail Mountain. Wanroads, an Indian farmer in Rock Creek valley, in the SW. ¼ sec. 27, T. 1 N., R. 6 W., is the only settler in the mapped area living outside of Duchesne Valley. Hanna and Tabby post offices on Duchesne River at the north and south sides of the field, respectively, are ranch houses to which mail is delivered twice each week. Mail to Hanna passes through Park City and Woodland and to Tabby by way of Myton

and Duchesne (Theodore). About midway between the post offices there is a small store. The settlers obtain their supplies mainly from stores in Heber, Kamas, Woodland, and Duchesne.

ROADS AND TRAILS.

The best roads are in the valleys of the main streams. One of the main routes of travel between the upper Provo and Weber valleys and the settlements to the east and southeast at Duchesne (Theodore), Myton, Fort Duchesne, and Vernal is through this area along the north side of Duchesne River. A road shown on the south side of the river on the map (Pl. LXII) swings abruptly to the southwest a short distance south of the mapped area and leads through Strawberry Valley and Daniels Canyon to Heber. The wagon route to Heber most frequently used by the settlers near Blacktail Mountain extends up the river as far as the old site of Stockmore, thence up the west fork of the Duchesne to the mouth of Wolf Creek, up that creek, over the mountains, and down the south fork of Provo River. One traveling on horseback or with buggy or light wagon can follow up the west fork of the Duchesne and down Lake Creek to Heber, thus shortening the distance one-third. The old Indian trail extending from Whiterocks Indian Agency to Heber is shown on the map by a single broken line west of Duchesne River and as a secondary road east of the river, leading up Farm Creek, through Farm Creek Pass, crossing Rock Creek, and continuing to the east. No wagon road leads into the main part of the coal field between Currant Creek and the Duchesne Valley. The coal exposures in Red Creek valley can be visited from the east most easily by following the Indian trail shown on the map.

DRAINAGE AND WATER RESOURCES.

Duchesne River, the principal stream of the region, flows in a southeasterly direction across the Blacktail Mountain coal field a short distance east of its center. Currant, Red, and Rock creeks have courses similar in direction to that of the main stream. Rock Creek empties into the Duchesne about 10 miles downstream from Tabby post office. Currant and Red creeks empty into Strawberry River, which joins the Duchesne at Duchesne (Theodore), 10 or 12 miles below the mouth of Rock Creek. Duchesne River and Rock Creek contain considerable water the year around, but generally the volume is greatest during the months of May, June, and July and the low-water stage is from November to March. The following table, compiled from records of observations[1] made by the United States Geological Survey, shows approximately the amount of water carried

[1] Surface water supply of the Colorado River basin, 1907–8: Water-Supply Paper U. S. Geol. Survey No. 249, 1910, pp. 54–73.

by Duchesne River and Rock Creek through the area under discussion during the months when irrigation is necessary.

Approximate amount of water flowing in Duchesne River above the mouth of Strawberry River from June to September, inclusive, 1908.

Months.	(1) Discharge of Duchesne River at Myton, Utah, in 1908.		(2) Discharge of Lake Creek 3 miles above Myton, Utah, in 1908.		(3) Discharge of Strawberry River at Duchesne (Theodore), Utah, 1908.		(4) Discharge of Duchesne River above mouth of Strawberry River, 1908, determined by deducting the sum of (2) and (3) from (1).	
	Mean second-feet.[a]	Acre-feet.[b]	Mean second-feet.	Acre-feet.	Mean second-feet.	Acre-feet.	Mean second-feet.	Acre-feet.
June	2,400	143,000	1,260	75,000	386	15,300	754	52,700
July	1,230	75,600	476	29,300	179	11,000	575	35,300
August	869	53,400	328	20,200	153	9,411	388	23,789
September	539	32,100	208	12,400	123	7,320	208	12,380

[a] Second-foot=unit for rate of discharge of water flowing in a stream 1 foot wide and 1 foot deep at a rate of 1 foot a second.
[b] Acre-foot=43,560 cubic feet, or the quantity required to cover an acre of land to the depth of 1 foot.

The amount of water carried by Duchesne River indicated in column 4 of the table includes the flow of Rock Creek.

CLIMATE AND VEGETATION.

The climate of the district is that of high mountains of the Temperate Zone. Winters are rather severe with much snow and ice four to five months of the year. Summers are pleasant, with warm days and cool nights. The average rainfall is about 10 inches per year. The region furnishes an excellent summer range for stock. That part of Duchesne Valley which lies in this field is irrigated for the most part and produces good crops of grain, potatoes, and vegetables. Irrigation is carried on largely by cooperative effort. Very little farming is done in Rock Creek valley, no part of which is known to be irrigated. Considerable timber grows on the uplands and mountain slopes away from the valley bottoms. Scrub cedar is common on the "breaks" just back from the alluvium-covered bottom lands. A little higher up on the mountain slopes small aspen, maple, and scrub oak are fairly plentiful. The upper parts of mountain slopes usually bear considerable pine valuable for lumber, but in many places forest fires have destroyed much of it. Scrub oak, boxelder, cottonwood, and willow trees fringe the banks of the streams.

TOPOGRAPHY.

The general surface features of the area are shown on the map, Plate LXII (p. 622). As the contour interval is 100 feet, minor irregularities are not shown. For the most part the surface is rough. It ranges in altitude from 6,400 feet at the lowest point along Duchesne River to about 10,600 feet at the summit of Blacktail Mountain. It

is cut into five separate topographic districts by Duchesne River and Rock, Red, and Currant creeks. The three central districts are dominated by Blacktail Mountain, Red Creek Peak, and Farm Creek Peak. These peaks probably owe their preservation to a thick coating of resistant conglomerate (Bishop conglomerate), which has withstood erosion better than the rocks lying beneath. The slopes of these highlands are sharply dissected by small valleys. Though the peaks are the dominant features of the landscape they are not the prevailing ones. Generally the surface consists of ridges or "hogbacks" produced by the unequal erosion of upturned alternating beds of hard sandstone and soft shale. The ridges are noticeable features at various places but especially south of Farm Creek and east of the "narrows" near the center of the field. Valleys eroded in the shale are occupied by the upper courses of Red and Currant creeks. Farm Creek valley, which joins Duchesne River valley 2 miles below Hanna post office, is carved in soft shale for the greater part of its length. The larger streams, however, flow across the upturned edges of the strata.

GEOLOGY.

STRATIGRAPHY.

SUMMARY.

The surface rocks of the Blacktail Mountain coal field comprise a series of formations ranging in age from Jurassic to Recent. Their age is determined in part by fossils collected in the Blacktail Mountain field and in part by their similarity in lithology and stratigraphic position to the formations studied by Gale [1] in northwestern Colorado and northeastern Utah. The rocks in the two fields were deposited in near-by parts of the same great interior sea. Gale [2] describes the conditions under which deposition occurred as follows:

> The deposits in which the coal was originally formed are a part of a great series of sedimentary strata that were laid down at a time when this part of the continent was largely submerged. The submergence probably ranged from deep sea to shallow water and swampy conditions, as well as from salt water or marine to brackish and fresh water stages. These strata are deposited in an approximately horizontal position. Subsequent movements of the earth's crust have folded or even broken the originally continuous deposits, so that it is now necessary to study their attitude and order of superposition in order to explain the relation of one set of beds to another. Their position in the stratigraphic section indicates in a general way their relative geologic age, although there are also evidences that great time intervals have elapsed in which no deposits were being formed, or in which material was being laid down that was subsequently removed, leaving little or no record of its existence.

The following table gives the sequence and description of geologic formations observed in the Blacktail Mountain coal field from the Flaming Gorge formation of the Jurassic to the most recent deposits:

[1] Gale, H. S., Coal fields of northwestern Colorado and northeastern Utah: Bull. U. S. Geol. Survey No. 415, 1910, pp. 41–94.

[2] Idem, p. 41.

Geologic formations of the Blacktail Mountain coal field, Utah.

System.	Series.	Formation.	Thickness (feet).	Description.	Economic value.
Quaternary.	Recent.	Alluvium.	0–50±	Sand, gravel, and clay, in present flood plains.	
		—Unconformity.—			
	Pleistocene.	Terrace gravel.	0–20	Sand and gravel 200–300 feet above valley floor.	
		Glacial material.	0–50±	Sand, clay, pebbles, and bowlders unstratified and deposited as terminal, lateral, and recessional moraines.	Water bearing.
		—Unconformity.—			
Tertiary (?).	Pliocene (?).	Bishop conglomerate.	0–500+	Conglomerate composed of waterworn and subangular quartzitic pebbles and bowlders, many of them 1 to 6 feet in diameter, embedded in finer gravel and sand.	Good water-bearing formation, supplies many of the springs of the field.
		—Unconformity.—			
Tertiary.	Eocene.	Bridger and Uinta (?) formations.	0–600+	Coarse massive red and yellowish-gray sandstone alternating with thin beds of red, gray, and green sandy shales.	Water bearing. Fair building stone. Contains hydrocarbons in vicinity of Fort Duchesne and to the southeast.
		Green River formation.	0–2,000+	Greenish-gray sandy shale with thin beds of sandstone of same color. Bridger overlaps this formation.	Contains valuable hydrocarbons (uintaite, elaterite, ozokerite, etc.).
		Wasatch formation.	10,000±	Reddish, yellowish, grayish, and brownish sandstone, sandy shale and conglomerate, poorly consolidated.	Carries some placer gold on Currant Creek.
		—Unconformity.—			
Cretaceous.		Mesaverde formation.	0–1,650±	Beds of gray sandstone, shale, and coal, alternating. Fossil leaves were found at different horizons.	Water bearing. Twenty-one coal beds are known.
			0–1,600±	Consists mainly of sandstone, with a few unexposed zones which probably are soft sandstone or sandy shale.	Water bearing.
		Mancos shale.	800–2,000	Yellowish-gray soft shale, with a few thin beds of sandstone near top and bottom.	
			200–1,100	White to yellowish-gray resistant sandstone, which becomes shaly near the base. In the lower part of this formation a shale 50 to 100 feet thick occupies the stratigraphic position of the Mowry shale member of eastern and central Wyoming.	Water bearing. Contains four coal beds in places near the top.
		Dakota (?) sandstone.[a]	200±	Poorly consolidated gray sandstone. Not a "hogback" maker in this region. Some difficulty encountered in locating the lower boundary.	
		—Unconformity.—			
Jurassic.		Flaming Gorge formation.[a]	(b)	Varicolored sandstone, clay, shale, and fine conglomerate. Poorly consolidated.	

[a] Shown on map as pre-Mancos

[b] Thickness not determined.

QUATERNARY SYSTEM.

RECENT SERIES.

The valley bottoms are covered to an unknown depth with alluvium, which includes sand, gravel, and clay in various combinations. Much of the material brought in by the main streams has been derived from formations outcropping farther up. The material from adjacent formations deposited as alluvial fans at the mouths of tributaries and small gulches ultimately becomes incorporated into the river flood plain. Alluvium is present in all the valleys, but it is too narrow to be mapped except along Duchesne River and Rock Creek.

PLEISTOCENE SERIES.

Terrace gravel.—Remnants of a terrace probably of Pleistocene age exist along Duchesne River about 200 to 300 feet above the present flood plain, which is much better preserved on the north than on the south side of the valley. It is covered with 10 to 20 feet of sand and gravel derived for the most part from the quartzitic rocks forming the core of Uinta Mountains.

Glacial material.—A small area in the vicinity of Red Creek Peak shows evidences of glaciation. Glacial moraines extend eastward from the above-mentioned peak in the north-central part of T. 1 S., R. 10 W., almost to the east side of the township. They are mainly terminal or recessional moraines and head in two well-developed cirques on the east side of the peak. West of this peak there are no cirques, though material extending down the slopes toward Currant Creek is probably of glacial origin. North and west of Currant Creek glacial moraines extend down the slopes almost to the stream course.

At Farm Creek Pass, near the northeast corner of T. 1 S., R. 7 W., there are small areas of glacial material on each side of the divide near the top. In Rock Creek valley moraines and outwash from "glaciers of earlier epoch," as mapped and described by Atwood,[1] extend almost across the field. The remainder of the area is unglaciated.

TERTIARY SYSTEM.

PLIOCENE (?) SERIES.

Bishop conglomerate.—A conglomerate in places 500 feet or more thick, and dipping 1° to 3° S., caps the high ridges and the peaks in this area. On account of the large amount of talus on the sides of the mountains the line shown on the map (Pl. LXII) as representing the base of the formation is only approximately located.

[1] Atwood, W. W., Glaciation of the Uinta and Wasatch mountains: Prof. Paper U. S. Geol. Survey No. 61, 1909, pp. 54-56, Pl. IV.

This conglomerate was first mapped and described by Powell,[1] in the vicinity of Bishop Mountain, in southern Wyoming, from which it takes its name. Later the geologists of the Fortieth Parallel Survey,[2] extended the mapping of this formation under the name Wyoming conglomerate, a term that has often been applied to it by later writers but is now obsolete. The quartzitic pebbles and bowlders that constitute the greater part of the material range in size from coarse sand grains up to bowlders 5 or 6 feet in diameter. Sand is intermixed with the waterworn pebbles and bowlders and the formation as a whole is fairly well consolidated.

Undoubtedly this conglomerate was deposited at about the same time and under the same conditions as that on the north flank of the Uinta Mountains described by Rich.[3] According to his investigations the Bishop conglomerate on the north side of the range is subaerial in origin, was deposited as a desert-fan extending far out over the plains adjacent to the mountains, and is probably of Pliocene age.

EOCENE SERIES.

Bridger and Uinta (?) formations.—The rocks of these formations, the outcrop of which does not extend far into the Blacktail Mountain coal field, consist for the most part of beds of coarse massive sandstone, red to yellowish gray in color, separated by thin layers of red, gray, and green sandy shales. In places flakes or specks of a white mineral, probably calcite, are plentiful in the coarse sandstone. Joints in the sandstone are prominent and strike almost north and south. These rocks near the eastern end of the field, in T. 1 N., R. 5 W., and T. 1 S., R. 5 W., are redder and less consolidated than in the vicinity of Tabby post office. The rocks at the former locality are higher stratigraphically than at the latter and probably are equivalent to the Uinta formation as defined by Osborn.[4] The beds in the mapped area dip from 1° to 10° S. and overlie the Wasatch formation unconformably, there being marked discordance in dip near the south side of sec. 34, T. 1 S., R. 7 W. The Bridger overlaps the Green River formation a short distance south of this area. An unconformity between the Bridger and Uinta (?) is shown by the fact that the red upper portion of the beds (Uinta?) overlaps the lower, less strikingly colored part (Bridger) at the east side of the field east of Rock Creek. Near Utahn post office, which is about 15 miles down Duchesne River from Tabby post office and

[1] Powell, J. W., Report on the geology of the Uinta Mountains and a region of country adjacent thereto, U. S. Geol. and Geog. Survey Terr., 2d div., 1876, pp. 169, 170, atlas map B.

[2] King, Clarence, Hague, Arnold, and Emmons, S. F., U. S. Geol. Expl. 40th Par., vol. 2, Descriptive geology, 1877, pp. 205, 226, and 258.

[3] Rich, J. L., The physiography of the Bishop conglomerate, southwestern Wyoming: Jour. Geology, vol. 18, 1910, pp. 601–632.

[4] Osborn, H. F., Bull. U. S. Geol. Survey No. 361, 1909, pp. 54–57.

about 6 miles north of Duchesne (Theodore), the Green River formation is present, apparently conformably overlain by Bridger. The former is not known to outcrop at any place along the south flank of the mountain between the exposures of the Wasatch and Bridger formations, which is its normal position, hence the inference that Bridger rocks overlap those of Green River age. The following section of a part of this formation gives the minor details:

Section of part of the Bridger and Uinta (?) formations in sec. 6, T. 1 S., R. 5 W.

	Feet.
Sandstone, yellowish and brick-red, soft, coarse grained, in places conglomeratic; some beds are resistant; near top sandstone beds are thin and alternate with brick-red and yellow-gray sandy shale	250
Sandstone, brick-red, gray, purple, and yellow	11
Sandstone, yellow and brick-red, massive, coarse grained, friable; contains some iron concretions	10
Sandstone, brick-red, drab, yellowish gray, and white alternating, soft	7
Sandstone, yellowish gray, coarse grained, massive, ledge maker	5
Sandstone, yellowish brown, with beds of yellow, gray, brick-red, and maroon alternating (brick-red predominates)	50
Clay, sandy, for the most part brick-red, part gray to white, fine grained	10
Sandstone, gray, with a tinge of red, rather coarse grained and friable (base of vertical cliff)	2½
Sandstone, brick-red alternating with a little grayish-green color; a lens of conglomerate 18 inches thick exposed near the middle of the section	48
Clay, sandy, grayish green	9
Sandstone, argillaceous, brick-red	6
Conglomerate, fine grained; pebbles consist mainly of limestone and gray quartzitic sandstone; matrix apparently lime	2½
Clay, sandy, brick-red, with a few streaks and lenses of gray fine conglomerate similar to that described above	68
Clay, slightly sandy, pinkish gray	25
Sandstone and sandy clay, for the most part brick-red, with four or five streaks of similar material gray in color	100
Alluvium.	
	604

The section given above probably contains a part or all of the Uinta formation as defined by Osborn.[1]

Green River formation.—This formation, although it does not outcrop in the area under discussion, was observed near Utahn post office on Duchesne River, 6 miles north of Duchesne (Theodore), where it disappears under the Bridger. There the beds dip 2° to 3° N. and consist of yellowish-gray sandy shale and thin resistant sandstone beds intercalated. Locally the beds have a slightly greenish tint. It seems quite probable that the Bridger is conformable on the

[1] Loc. cit.

Green River formation at the above locality. Northward the Bridger overlaps the edge of the Green River beds, and wherever observed rests directly on the Wasatch and older rocks.

Wasatch formation.—The Wasatch formation, which outcrops almost the entire length of the field, consists of beds of varicolored sandstone, sandy shale, and conglomerate dipping 20° to 40° S. The base of the formation in general is composed of a thick bed of conglomerate, the pebbles of which range from sand grains up to bowlders 1 foot or more in diameter. This conglomerate is made up mainly of well-polished and somewhat flattened pebbles of gray and red quartzitic sandstone and quartzite, blue and gray limestone, and black cherty limestone set in an iron-stained calcareous matrix. The Wasatch is unconformable upon the underlying formations wherever it has been studied in this field. In places along the south flank of the Uinta Mountains it rests upon the Mancos shale. (See report on the Deep Creek district of the Vernal coal field, Utah, in this bulletin.) In other localities it was deposited upon the lower non-coal-bearing part of the Mesaverde, and elsewhere it rests on the top of the coal-bearing portion of the Mesaverde formation. In Duchesne Valley east of the river, in T. 1 S., R. 7 E., the Wasatch is fairly well exposed. Conservative calculations, based on dips measured at the top and base of the formation and the width of outcrop, which is about 4 miles, give a thickness of about 10,000 feet, which is greater than has been noted elsewhere. The possibility of repetition due to faulting has been considered.

The following section measured at the base of the Wasatch formation on Red Creek in sec. 26, T. 1 S., R. 9 W., is fairly typical of this part of the formation on the south side of the Uinta Mountains.

Section of lower part of the Wasatch formation in sec. 26, T. 1 S., R. 9 W.

	Feet.
Conglomerate, yellowish gray, coarse, estimated thickness	400+
Sandstone, yellow and drab, thin bedded, with beds of pink and yellow shale alternating; top part very conglomeratic	80
Shale and clay, pink	10
Sandstone, yellow, massive, fine grained	8
Poor exposure, mainly yellow and drab shale	50
Sandstone, gray, conglomeratic, very coarse grained, rather massive, contains thin beds of drab shale	25
Unexposed, probably contains shale and soft sandstone	55
Conglomerate; pebbles gray and black, range up to 1 inch in diameter; contains thin beds of sandstone and shale brown, gray, yellow, drab, and red in color	65
Bottom of formation (determined entirely on lithologic character).	
	693+

The upper part of the formation is prevailingly sandy and has a reddish tinge. As a whole, the rocks are poorly consolidated. With

the exception of the "Red Beds," from which the Wasatch probably derived its color, this formation is the most striking in appearance of those outcropping along the mountain flanks.

CRETACEOUS SYSTEM.

Mesaverde formation.—The Mesaverde formation consists of a sequence of sandstone and sandy shale, with coal beds in its upper part. The correlation of these rocks with the formation recognized as the Mesaverde in the Vernal coal field to the east is justified by their stratigraphic position, lithology, and the fossils collected, which were examined by T. W. Stanton. In both localities the formation is characterized by two parts, the lower consisting mainly of sandstone with little or no coal, whereas the upper part contains alternating beds of sandstone and sandy shale, with beds of coal. At the outcrop it presents a greater variation in thickness than any of the other formations that are exposed in the Blacktail Mountain coal field. The variation is due apparently to the overlapping of the Wasatch formation. From the west part of the area described and mapped by Gale [1] in the vicinity of Vernal, Utah, westward to the east side of T. 1 S., R. 7 W., near Duchesne River, about 50 miles, the Mesaverde does not show in outcrop. In the Deep Creek district of the Vernal coal field, 10 to 15 miles west of the westernmost exposure of the Mesaverde in the area mapped by Gale, the Wasatch rests directly on an eroded surface of the Mancos shale. The Tertiary and Quaternary formations overlap the Cretaceous rocks and parts of the older formations westward from the west line of the Deep Creek district of the Vernal coal field (Pl. LX) to the east edge of the Blacktail Mountain coal field (Pl. LXII). In the eastern part of this field the Mesaverde formation is not exposed. West of Farm Creek Peak, near the east end of the prominent "hogback" which forms the south boundary of Farm Creek valley, the easternmost outcrop of this formation was observed. Here thin-bedded sandstone, alternating with sandy shale, which forms the transition beds between the Mancos shale and the Mesaverde, is reduced to a feather edge by the overlapping of the lower beds of the Wasatch, which are very conglomeratic. The exposed part of the Mesaverde formation thickens in a short distance westward to about 600 feet, a thickness which it maintains for 10 miles. In sec. 24, T. 1 S., R. 9 W., where the outcrop of the Mesaverde rocks broadens, the thickness increases to about 3,250 feet. A detailed section of the formation measured in Red Creek valley is given below. The lower 1,600 feet, presumably of marine origin, consists mainly of massive yellowish-gray, rather resistant sandstone. The upper 1,650 feet consists of sandstone,

[1] Gale, H. S., Coal fields of northwestern Colorado and northeastern Utah: Bull. U. S. Geol. Survey No. 415, 1910, pp. 204-219, Pl. XXI.

andy shale, shale, clay, and numerous coal beds. The section given herewith shows fewer coal beds than are known to be present in this part of the formation. The coal beds are represented probably by the "unexposed" parts of the section, where springs are numerous.

Section of Mesaverde formation along Red Creek, in secs. 22, 23, and 26, T. 1 S., R. 9 W.

	Feet.
Conglomerate, Wasatch.	
Sandstone, gray, massive in places, slightly conglomeratic, with thin layers of sandy shale	40
Unexposed, mainly shale, with some sandstone and probably some coal	100
Sandstone, yellowish gray, coarse grained, contains carbonaceous material (spring)	30
Unexposed, probably for the most part shale and thin-bedded sandstone	100
Coal (Fraughton No. 44)	20+
Unexposed, mostly gray and yellow sandstone, with probably some shale and coal	215
Sandstone, gray, part massive	40
Shale, drab and brown, part sandy	40
Coal bed (No. 42)	6+
Shale, brown and gray	10
Sandstone, thin bedded, and sandy shale	25
Shale, drab, sandy	15
Coal bed (Nos. 39 and 43)	2½
Unexposed, probably contains shale and some coal	110
Sandstone, gray, massive, cross-bedded, medium fine grained, with some drab and brown shale alternating; three or four unexposed portions near the top may contain coal; a spring issues at a point 50 feet below the top of the sandstone	375
Unexposed, probably contains shale and some coal (spring)	50
Sandstone, gray, massive	160
Unexposed, probably contains shale and some coal (spring)	70
Sandstone, yellow and gray, alternating with shale and probably coal	85
Unexposed, probably contains shale and some coal	40
Sandstone, partly massive, and shale, gray and yellow	70
Unexposed, probably contains shale and some coal (spring)	25+
Sandstone, yellow and gray, in places iron-stained, having a reddish-brown color, also containing a few thin beds of sandy shale; limonite and marl observed at top	110
Unexposed, probably contains shale, sandstone, and some coal (spring)	85
Sandstone, yellowish gray, mainly massive, lower part thin bedded (in places sandstone is soft and forms a depression)	280
Unexposed, probably contains shale, soft sandstone, and some coal	65
Sandstone, gray and yellow alternating, very hard, thin bedded; in places alternating with sandy shale; some limestone beds near the top 1 to 2 feet thick (in these and in the adjacent sandstones marine fossils were collected)	100
Poorly exposed, probably shale and thin-bedded sandstone	25

	Feet.
Sandstone, gray, yellowish, in places green, mainly massive, mostly fine grained; upper part somewhat thin bedded; two or three very soft zones in the sandstone, resulting in depressions in the outcrop	205
Shale, sandy, and sandstone, soft, poorly exposed (a few prospects for coal have been opened but no coal found)	45
Sandstone, yellow, gray, mainly massive, in places rather soft near the center	470
Unexposed, probably sandy shale and thin-bedded soft sandstone	200
Sandstone, yellow and gray, poorly exposed, resistant, fine grained	50±
Shale, Mancos.	
	3,263½±

Mancos shale.—The Mancos shale, like the Mesaverde formation, can not be traced continuously into this field from the areas of known Mancos to the east, but judging from the lithology, stratigraphic position, and fossils, which T. W. Stanton states "belong to the Benton fauna, which is characteristic of the lower part of the Mancos shale," there is but little doubt as to the correctness of the correlation. The upper part of the Mancos shale consists of soft drab to yellowish-gray shale and the lower part is made up of sandstone, coal beds, and shale. A marked difference in the thickness of the parts was noted at different places. The shaly upper part thickens eastward. Near the mouth of Farm Creek it is 2,000 feet thick; at the forks of Red Creek, 1,450 feet; 3½ miles farther west, 1,000 feet; and on Currant Creek, near the Cummings mine, it is 800 feet thick. The lower sandy part becomes thinner eastward, whereas the upper shaly portion becomes thicker toward the east, so that the total thickness of the formation is about the same in various parts of the field. While the lower member was being deposited, offshore, shore, and marsh conditions alternately prevailed. The offshore conditions are shown by the presence of a certain fine-grained shale. The shore conditions are represented by coarse sandstone containing shells of Ostrea sp. Beds of coal, of which there are at least four, represent the swamp or marsh conditions. Following is a section of the Mancos shale measured on the west branch of Red Creek in secs. 16 and 21, T. 1 S., R. 9 W. Details of the upper part could not be obtained, owing to poor exposures. The lower part was measured in great detail.

Section of the Mancos shale along Red Creek in secs. 16 and 21, T. 1 S., R. 9 W.

Mesaverde formation.	Feet.
Shale, drab to yellowish gray	1,450±
Sandstone, light gray, weathers yellow to brown, massive, ledge maker	15
Sandstone, light gray, weathers yellow and brown, moderately thin bedded (4 to 18 inches thick), contains Ostrea sp	10
Covered, probably thin-bedded sandstone	10
Sandstone, light gray, weathers from yellow to brown, fairly massive, ledge maker	18
Coal bed (No. 38)	10
Covered, probably thin-bedded sandstone	20
Sandstone, yellow and brown	5
Covered	30
Sandstone, yellowish gray, weathers brown	8
Coal bed (No. 37)	11
Sandstone, yellowish gray, beds near top fairly massive	25
Shale, reddish gray and brown	4
Sandstone, light gray near top, weathering yellow and brown, yellow near bottom, ledge maker	25
Coal bed (No. 36)	3–
Sandstone, yellow and light gray, thin bedded	10
Coal bed (No. 35)	3–
Covered, probably thin-bedded sandstone	10
Sandstone, yellow, thin bedded	10
Covered, probably soft, thin-bedded sandstone	20
Sandstone, yellow, massive at top, thin bedded near bottom, ledge maker	15
Covered	20
Sandstone, yellow	10
Covered	30
Sandstone, light gray, weathers yellow, poorly exposed	5
Covered	10
Sandstone, light gray, weathers yellow, poorly exposed	10
Sandstone, brown, rather soft	3
Covered	10
Sandstone, brown, massive, ledge maker	6
Covered	20
Sandstone, light brown, massive, ledge maker	15
Covered	25
Sandstone, brown, massive ledge maker, contains Ostrea	25
Sandstone, brown, thin bedded near middle, fair ledge maker	25
Covered	159
Sandstone, contains great numbers of Ostrea	35
Covered	10
Sandstone, light brown at top, light gray near base, Ostrea near middle	15
Covered	57
Sandstone, gray, weathers brown, thin bedded	10
Covered	106
Shale, contains fish scales; from top of this shale to base of Mancos	325
Dakota (?) sandstone.	
	2,643±

Dakota (?) sandstone.—The Dakota (?) sandstone and underlying rocks were not studied in detail in this field. As mapped by Gale[1] in northwestern Colorado and northeastern Utah, the Dakota sandstone includes the upper portion of the Henrys Fork group, as described by Powell.[2] It is limited below "by varicolored clays, clay shales, and associated strata now supposed to belong to the Jurassic" (Flaming Gorge) according to Gale.[3]

PRE-CRETACEOUS ROCKS.

The varicolored rocks above referred to in their physical characteristics closely correspond to and probably represent the Flaming Gorge formation described by Powell,[4] along Green River on the north flank of the Uinta Mountains.

STRUCTURE.

The structure of the Blacktail Mountain field is shown by dip and strike symbols and by cross sections on Plate LXII. The field lies on the south flank of the Uinta Mountains in the belt of more steeply inclined strata which strike practically east and west parallel to the axis of the mountains. Both north and south of this zone the dip of the strata is less. At the eastern edge of the field the coal-bearing rocks dip about 20° S., but this inclination increases slightly toward the west to a point near sec. 10, T. 1 S., R. 7 W., where an abrupt increase was noted. From that point the dip gradually becomes greater westward to sec. 12, T. 1 S., R. 8 W., where the inclination is 45°. Westward from this place the dip is practically constant to a point near the forks of Red Creek in secs. 13 and 24, T. 1 S., R. 9 W., where again the dip in the Mesaverde increases and attains its maximum of 58° S. along the "narrows" of Red Creek, but this abrupt change in dip does not exist in the Mancos shale. The difference in dip noted in the two groups of coal-bearing rocks is possibly due to the greater resistance of the thick sandstone beds of the Mesaverde, in which adjustment to the stresses of uplift takes place less readily than in the underlying Mancos shale, which assumes its new position by flowage, minor slips, and possibly slight faults, inconspicuous on the surface. From the "narrows" of Red Creek the strata of the Mesaverde formation flatten gradually westward to 27° S. near Red Creek Peak. From this place to Currant Creek the strike swings from east-west to almost north-south, and the dip increases to 32° E. in the upper part of the formation and to

[1] Gale, H. S., Coal fields of northwestern Colorado and northeastern Utah: Bull. U. S. Geol. Survey No. 415, 1910, pp. 45, 59–60, and 89.

[2] Powell, J. W., Report on the geology of the eastern portion of the Uinta Mountains and a region of country adjacent thereto: U. S. Geol. and Geog. Survey Terr., 2d div., 1876, pp. 40, 50, 153, and 157.

[3] Op. cit., p. 45.

[4] Op. cit., p. 51.

54° in the lower part. The highest dip (57° SE.) in the Mancos coal-bearing rocks was noted in sec. 18, T. 1 S., R. 9 W., where the end of a slight lateral fold, the only one noted in this field, affects the regularity of this flank of the great anticline of the Uinta Mountains. However, the inclination of the Mancos shale is less toward Red Creek Peak, west and southwest of which the dip increases from 27° to 54° in a distance of about 4 miles. The structure south of Currant Creek is unknown, as the coal-bearing strata are covered deeply by rocks of Tertiary and later ages.

A slight variation from the regular southern dip was noted on the north slope of Blacktail Mountain near the west line of sec. 16, T. 1 S., R. 8 W. On the east side of an intermittent stream course Mesaverde rocks are well exposed, showing a thick sandstone ledge dipping slightly to the north. The crest of a slight anticline is exposed in the same outcrop.

There has been little or no faulting of the rocks in the area under discussion. Abrupt changes in strikes and dips as noted in and near sec. 18, T. 1 S., R. 9 W., suggest possibly the presence of minor faults, but the structure is more easily explained as a sharp fold. Considerable faulting has taken place in the older rocks to the west and southwest of the area mapped, and it is quite probable that the same disturbance has affected the deeply buried coal-bearing rocks south of Currant Creek.

THE COAL.

OCCURRENCE.

The coal of this field, judged by its physical characteristics and by analysis, is low-grade bituminous. Its calorific value, determined from an air-dried, practically unweathered sample, is about 12,000 British thermal units. The stocking quality is believed to be good. This opinion is based not on actual tests, but on considering the condition of the walls of prospects opened several years ago. Although the Mesaverde coal at Sunnyside in the southern margin of the Uinta Basin will coke, the Pishel coking test [1] indicates that the coal in the Blacktail Mountain field does not possess the property.

The coal beds occur in two groups. The higher is in the Mesaverde formation and contains at least 21 coal beds in a stratigraphic distance of 1,650 feet. The lower group is in the lower part of the Mancos shale about 3,500 feet below the upper group and consists of four known coal beds in a stratigraphic distance of 250 feet.

As shown on the geologic map (Pl. LXII) the Mesaverde group of coals is not exposed east of Red Creek. Owing to the great amount of talus and hillwash covering the outcrop of the group west of Red Creek, it was impossible to trace a single bed any great distance.

[1] Pishel, M. A., A practical test for coking coals: Econ. Geology, vol. 3, 1908, pp. 265–275.

Practically all the exposures noted are on the tops of narrow ridges, where the talus does not accumulate. The valley bottoms are composed of alluvium and afford no outcrops. It is probable that the Mesaverde formation in this region contains a greater number of coal beds than those observed. It may be noted on the geologic map that the outcrops of only a few of the main coal beds have been projected across the area. The basis for the probable correlation is the thickness of the coal beds and the constancy of the distance between them. At the south end of Red Creek Peak, in sec. 22, T. 1 S., R. 10 W., the Bishop conglomerate probably overlies several coal beds. That part of the field east of the south end of Red Creek Peak and west of sec. 20, T. 1 S., R. 9 W., contains very few outcrops, but the possibility of obtaining good measurements of the coal beds at such localities is very doubtful, owing to the great amount of slipping that has occurred and the rather thick deposit of talus and glacial drift on the surface. West of the south end of Red Creek Peak much of the surface is covered with talus from the Bishop conglomerate which caps the divide. South of the Cummings mine, along Currant Creek, the coal-bearing rocks are covered with talus, alluvium, and landslide.

The coals of Mancos age are approximately of the same quality as those of Mesaverde age. A sample was taken for analysis (laboratory No. 10997) from the Winchester prospect in sec. 8, T. 1 S., R. 7 W. The coal is considerably weathered, and the analysis shown on page 625 does not represent fresh coal. Coal beds belonging to this group have been prospected at other places, especially in the valley of Red Creek, but nowhere else was it possible to obtain even an approximately fresh sample. The geologic map shows all exposures of coal-bearing rocks visible at the time this field was examined. The easternmost exposures of coal beds in this field are in secs. 24 and 25, T. 1 N., R. 6 W. Only a few rather poor measurements could be obtained at this locality. Although the coal-bearing rocks are exposed here and there, it was impossible to measure any of the coal beds between Rock Creek and sec. 10, T. 1 S., R. 7 W., a distance of about 9 miles. At the latter locality a very thin coal bed outcrops. Westward from this place, for the most part on the north side of Farm Creek, the coal beds are fairly well exposed to a point in sec. 12, T. 1 S., R. 8 W., where the rocks are covered with alluvium. As noted in the discussion of the structure of this field the coal beds along Farm Creek have an average dip of 45° S. This posture and the presence of considerable water the year round in Farm Creek and Duchesne River probably would make coal mining somewhat difficult in the valleys of these streams on account of surface water. The coal beds are well exposed and have been fairly well prospected for 5 miles west of the divide, extending north from Blacktail Mountain to Duchesne River. Northwestward from sec. 16, T. 1 S.,

R. 9 W., for 2 miles the resistant sandstone which is found above and between the coal beds is well exposed. West of the last-mentioned locality the Mancos coal-bearing rocks pass under a cover of talus and a great thickness of Bishop conglomerate which caps Red Creek Peak. West and southwest from Red Creek Peak the outcrop of the Mancos makes an abrupt bend to the south. In this region the resistant sandstones are fairly well exposed, but at no place was it possible to obtain a measurement of the coal beds. It is not known definitely whether they are of any value here.

DETAILED DESCRIPTION OF COAL OUTCROPS.

MESAVERDE FORMATION.

The coal-bearing rocks of the Mesaverde formation are so nearly covered with talus and hillwash that it is impossible to follow a coal bed for any great distance, hence it is impossible to show the variation in thickness of coal beds in different parts of the field. As described above, the best exposures are on the crests of ridges, which for the most part cross the strike of the rocks at right angles, so that when a ridge top is prospected for coal the thickness of the coal beds and the distances between them can be easily ascertained. A bed containing 10 to 15 feet of coal may not show a "bloom" where the talus is thick, hence on the crests of many of the ridges it is necessary to make a trench 2 or 3 feet deep in order to be certain that no coal beds are overlooked. Where the ridges are one-eighth to one-fourth of a mile apart and the character of the strata between the coal beds is not unlike and beds of coal are approximately of the same thickness, it is impossible to trace the bed continuously or to make an absolute correlation. In the following description the coal beds noted at the various good exposures on ridge tops and elsewhere are discussed as units, with no attempt to correlate them other than that shown on Plate LXII. The solid and broken lines represent only a probable correlation of a few of the more important coal beds.

The easternmost exposure of the Mesaverde coal beds is in the "narrows" of Red Creek in secs. 23 and 26, T. 1 S., R. 9 W. Here six sections (Nos. 39, 40, 41, 42, 43, and 44)[1] were measured on five coal beds near the top of the coal group exposed in a distance of 400 feet. The topmost coal bed (No. 44) is the thickest and contains 20 feet 9 inches of coal broken by a ¼-inch parting 4 feet 3 inches above the base. This coal has an iridescent luster and contains some resin. A sample for analysis (laboratory No. 10998) was collected from this bed at the back end of a 100-foot prospect (Fraughton). This coal has been designated the Fraughton bed and can be traced a short distance to the east and about 1½ miles

[1] Numbers refer to locations on Pl. LXII and to the corresponding sections of coal beds on Pl. LXI.

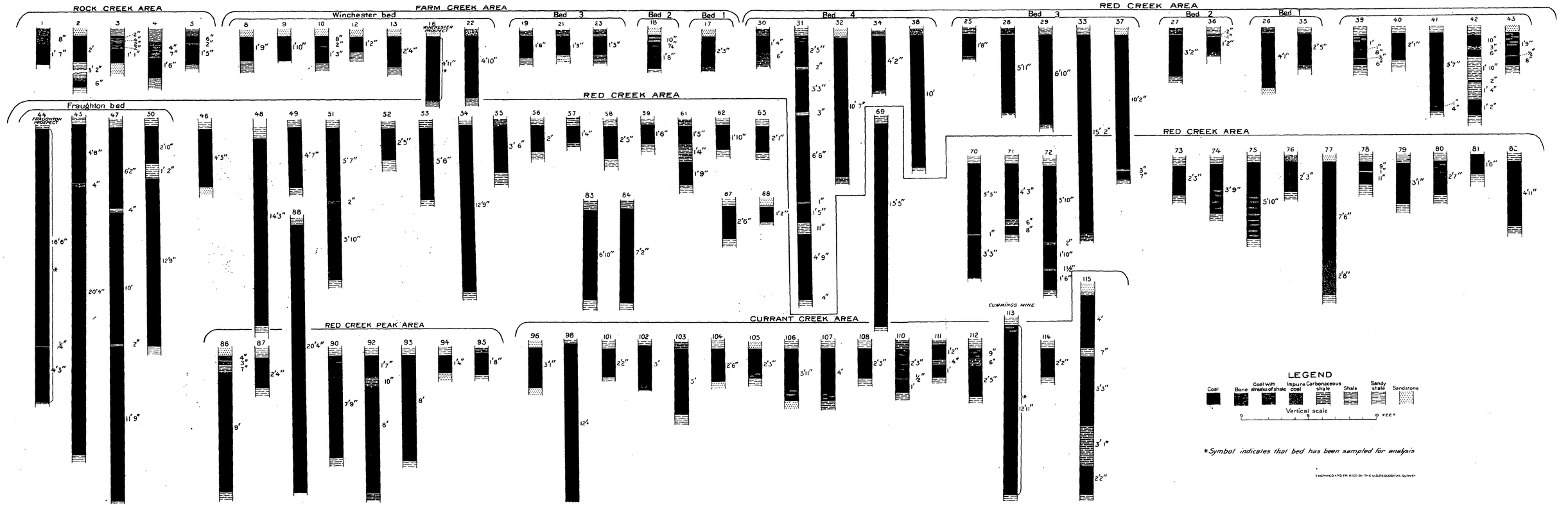
to the west, where its identity is questionable, its outcrop being obscured by talus and hillwash. Another coal bed measured in a small prospect represented by section No. 41, situated about 20 feet below the Fraughton bed, contains about 6 feet of fairly bright coal. A coal bed about 2 feet thick, 30 to 40 feet below the Fraughton, is exposed in a prospect (No. 40). Two coal beds are exposed on the east side of Red Creek 250 feet below this bed. A section (No. 42) of the uppermost bed, obtained in a prospect drift 40 feet in length, contains a total of 2 feet 8 inches of good coal, the bed being broken by three clay and shale partings, which render it of little value for mining. About 50 feet below this coal bed is another showing about 2 feet of coal at each place (Nos. 39 and 43) where it was measured. The coal in these beds is practically of the same quality.

Undoubtedly all the Mesaverde coal beds exposed in and to the west of the "narrows" of Red Creek extend at least a short distance to the east of Red Creek, but an excessive amount of talus in the depressions in the softer shaly rocks conceals any coal beds that may be present. The columnar section measured at the "narrows" (pp. 609–610) shows the actual conditions. As noted in that section, the places where springs issue probably represent coal beds. Some prospecting has been done in attempts to discover coal beds at various places along the "narrows" of Red Creek, but no coal has been uncovered other than that described above.

The Fraughton coal bed (No. 45), the same as that represented by section No. 44 on Red Creek, is well exposed at a shallow prospect on ridge No. 8, shown on the map in the SE. ¼ SE. ¼ sec. 21, T. 1 S., R. 9 W. It consists of 25 feet 2 inches of clean coal, with the exception of a 4-inch shale parting 4 feet 6 inches below the top. Two other sections (Nos. 47 and 50) were measured on this coal bed. No. 47 was obtained in a prospect on ridge No. 7, in the SW. ¼ SE. ¼ sec. 21 of the above township, where the coal is very much weathered. Section No. 50, also in a shallow prospect, probably is more nearly representative of this bed than are sections Nos. 45 and 47. The coal bed exposed in the Fraughton prospect was definitely traced a greater distance than any other coal bed of Mesaverde age.

On ridge No. 7, roughly 1,200 feet stratigraphically below the Fraughton coal bed, a shallow prospect exposes 4 feet 5 inches of fairly good coal (No. 46). This coal bed has a shale roof and sandstone floor.

Four coal beds, represented by Nos. 48 to 51, were measured on ridge No. 6 in the SE. ¼ sec. 21, T. 1 S., R. 9 W., in a stratigraphic distance of about 900 feet. Exposures are very poor at this place. The coal bed represented by No. 51 is about 250 feet above the Fraughton coal bed, which stratigraphically is the highest one exposed at the "narrows" on Red Creek. The roof of soft brown carbonaceous



SECTIONS OF COAL BEDS IN THE BLACKTAIL MOUNTAIN COAL FIELD, WASATCH COUNTY, UTAH

ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

shale would require considerable support during mining operations. The Fraughton coal bed represented on this ridge by No. 50 is discussed above. About 600 feet stratigraphically below it are two coal beds separated by 5 feet of sandstone and sandy shale. The upper bed (No. 49) contains 4 feet 7 inches of impure coal. Specks of resin were noted in the upper 2 feet 4 inches of this bed. The lower bed (No. 48) consists of 14 feet 3 inches of clean coal and has an excellent roof of sandstone 4 feet 2 inches thick separated from the top of the coal bed by 10 inches of brown and drab shale. The coal at this prospect is less weathered than at other places in this general locality.

Twenty-one coal beds (Nos. 52 to 72, inclusive) are exposed in a stratigraphic distance of 1,500 feet on a north-south ridge (No. 5) in the west half of sec. 21, T. 1 S., R. 9 W. These coal beds range from 7 inches up to 15 feet 5 inches in thickness and contain a total of 84 feet 2 inches of fairly good coal. Eight of the coal beds are more than 3 feet thick; four are between 2 and 3 feet thick; and nine are less than 2 feet thick. The character of the coal in these various beds is practically the same.

Four coal beds, represented by sections Nos. 60, 63, 64, and 66, are not shown on the plate of coal sections, but are given below:

Sections of coal beds on ridge No. 5, in NE. ¼ SW. ¼ sec. 21, T. 1 S., R. 9 W.

No. 60.

	Ft.	in.
Shale, brown, with thin coal streaks	1+	
Coal, dull, weathered		7
Shale, brown, carbonaceous		6
Coal, dull, weathered	1	1
Coal bed	2	2

No. 63.

	Ft.	in.
Shale, brown	1+	
Coal, dull, impure		8½
Shale, brown	1+	
Coal bed		8½

No. 64.

	Ft.	in.
Shale, brown, with thin coal streaks	1+	
Coal, dull, weathered		6½
Shale, brown, carbonaceous		2
Coal, dull, weathered		4
Shale, brown		6+
Coal bed	1	½

No. 66.

	Ft.	in.
Shale, brown	1	
Coal, dull, weathered		7
Shale, brown		6±
Coal bed		7

Section No. 69 may represent the Fraughton bed, but exact correlation can not be made.

Ten coal beds, represented by sections Nos. 73 to 82, inclusive, are well exposed on a north-south ridge (No. 3) just east of the center of sec. 20, T. 1 S., R. 9 W. They are included in a stratigraphic distance of approximately 1,000 feet and range in thickness from 1 foot 6 inches to 10 feet 2 inches, with a total of 38 feet of good coal. Probably the number of coal beds and the total thickness of coal on this ridge (No. 3) would be found to correspond closely with that on

ridge No. 5, less than one-half mile to the east, if a complete section of the rocks was exposed at this locality. The coal beds represented by Nos. 74 and 75 are separated by an 11-inch drab shale parting and can be mined as one bed. Above No. 75 is a stratigraphic distance of 400 feet so covered with hillwash that no coal beds could be found. They are fairly well exposed and rather evenly distributed throughout the 350 feet of strata which overlie the covered part.

The strata on ridge No. 2 are poorly exposed. In a stratigraphic distance of about 750 feet only two coal beds (Nos. 83 and 84) were noted. These beds are at the extremes of the group and both are of economic importance considering their thickness and the quality of the coal. Westward from ridge No. 2 to the ridge extending south from Red Creek Peak only one section (No. 85) was measured on an 8-inch coal bed on the north side of Red Creek in the NE. ¼ SE. ¼ sec. 24, T. 1 S., R. 10 W. It was practically impossible to obtain measurements of the coal in the region intervening between this locality and the south end of Red Creek Peak owing to the glacial débris, talus, and hill wash. The presence of underlying coal beds is assured, however, by "bloom" in landslides.

Ten coal beds (Nos. 86 to 95, inclusive) are exposed in a stratigraphic distance of 1,200 feet at the south end of Red Creek Peak in the S. ½ sec. 22 and NE. ¼ sec. 27, T. 1 S., R. 10 W. Eight of these coal beds are in the lower 600 feet of the section. The rocks in the upper half of the section are not well exposed and only here and there could they be observed. The 10 coal beds contain a total thickness of about 62 feet of good coal. Five of these beds average more than 7 feet of coal each. Two of the coal beds represented by sections No. 89 and 91, are not shown on Plate LXI, but are given in detail below.

Sections of coal beds in SE. ¼ SW. ¼ sec. 22, T. 1 S., R. 10 W.

No. 89.

	Inches.
Shale, brown, carbonaceous	4
Coal, bright, weathered; contains resin, blocky	8½
Shale, brown; contains thin streaks of coal	3
Coal bed	8½

No. 91.

	Inches.
Clay, drab	10
Coal	8
Clay, drab with gray and white sand	3+
Coal bed	8

A few claims have been staked and prospected on this divide.

Glacial débris and talus cover the surface for a distance of about 2 miles west and southwest from the coal exposures on the divide south of Red Creek Peak. The coal-bearing rocks are fairly well exposed, beginning in the S. ½ sec. 29, T. 1 S., R. 10 W., and extending in a southerly and southwesterly direction for 1½ miles to a line

coinciding approximately with the south boundary of the township in secs. 31 and 32. It was possible in this locality to correlate some of the beds for a distance of about a mile, but this correlation is rather uncertain, being based on the thickness of the beds and the distances between them. In this region there are 16 coal beds, represented by Nos. 96 to 115, inclusive. Nos. 104 and 105 represent the same coal bed. Nos. 96 and 102 are on a lower coal bed. Nos. 103, 107, and 108 are on an intermediate coal bed. The 16 coal beds show a total thickness of 65 feet 9 inches of good coal, with the possibility that some of the beds may be measured twice, but this is doubtful.

The lowest coal bed of Mesaverde age noted in the Blacktail Mountain coal field was observed just east of Currant Creek above a massive yellowish-gray sandstone, which probably marks the arbitrary boundary drawn between the coal-bearing and non-coal-bearing rocks. This coal bed (No. 101) shows 2 feet 2 inches of fair coal overlain and underlain by brown clay shale. Approximately 500 feet above this bed is another only 8 inches thick (No. 109). A mass of about 425 feet of alternating sandstone and shale lying directly above the last-mentioned coal bed is apparently barren of coal. Above this barren mass 14 coal beds are fairly evenly distributed throughout a stratigraphic distance of 1,050 feet. These beds range in thickness from 8 inches to 12 feet 11 inches. Five of the measured sections average 4 feet or more in thickness, five contain on the average 3 to 4 feet of coal, six sections show between 2 and 3 feet, and the remaining four less than 2 feet of fairly good coal. Four coal beds, represented by sections Nos. 97, 99, 100, and 109, are discussed below.

At location 97, in the NE. ¼ SW. ¼ sec. 29, T. 1 S., R. 10 W., 1 foot 1 inch of coal overlain and underlain by brown shale is exposed. A similar thickness was measured at location 99 in the SW. ¼ SE. ¼ of the same section. In the NW. ¼ NW. ¼ sec. 32, at location 100, 8 inches of coal and brown shale are exposed. At location 109, in the NW. ¼ SE. ¼ sec. 31 of the same township another 8-inch coal bed is exposed. The roof and floor at location 100 consist of clay and at location 109 of shale.

At the Cummings mine (No. 113) in the SW. ¼ SE. ¼ sec. 31, T. 1 S., R. 10 W., which is now caved and abandoned, a sample for analysis (laboratory No. 11058) was collected at a good surface exposure, where the coal is 12 feet 11 inches thick. The sample was undoubtedly weathered somewhat, but was the best that could be obtained in this part of the field.

In practically every place where the Mesaverde coal has been examined the beds are overlain by shale and considerable support

would be necessary in mining the coal, but fortunately the field is well supplied with suitable timber.

MANCOS SHALE.

Coal beds of Mancos age are much more readily correlated than the coal beds of Mesaverde age above described. It is possible to do this on account of the better and more continouus exposures along the Mancos sandstone "hogback," in the top of which the coal beds outcrop. The greatest exposure of the coal-bearing rocks of this formation is mainly along the headwaters of Red Creek extending almost east and west through T. 1 S., R. 9. W., and entering the west side of R. 8 W., slightly over a mile, a total distance of about 7 miles. It was not possible to obtain a good section of each of the four coal beds at every place where the coal zone was examined. A sufficient number of good measurements were secured, however, to afford a fair knowledge of the quantity and quality of the coal contained in this locality, and also along the north side of the lower course of Farm Creek in T. 1 S., Rs. 7 and 8 W.

The coal bed exposed on the east side of Rock Creek can not be definitely correlated with those shown on Farm and Red creeks, but it probably is the same as one of the lower beds. Five measurements (Nos. 1 to 5, inclusive) were obtained on this coal bed in secs. 24 and 25, T. 1 N., R. 6 W. A study of these shows that the coal bed is of little importance economically, the greatest thickness (2 feet) of available coal being shown at location No. 2 in the NE. ¼ NW. ¼ sec. 25, T. 1 N., R. 6 W. The other sections of the coal bed show that the lower bench ranges from 1 foot 1 inch to 1 foot 7 inches (No. 1) and that the upper part may be found in one or two thin benches. Sandstone directly overlies the coal bed at location 2, but at the other places a few inches of shale separate the coal from the sandstone.

The Mancos coal-bearing rocks are poorly exposed west of the above-mentioned locality for a distance of about 10 miles to a point near the center of sec. 10, T. 1 S., R. 7 W., and no measurements could be obtained. At the last-mentioned locality a coal bed 6½ inches thick (No. 6) outcrops. This bed is overlain by sandstone and shale and underlain by shale and may represent one of the four coal beds which outcrop to the west. At the east boundary of sec. 9, T. 1 S., R. 7 W., the coal-bearing rocks are fairly well exposed, and the coal beds can be traced westward continuously for a distance of almost 4 miles. In this distance 17 coal sections were measured. The greater number of these (Nos. 7 to 10, 12, 13, 16, 20, 22) were obtained from the stratigraphically highest coal bed (Winchester). From an examination of these sections it will be noted that the coal bed becomes thicker toward the west.

Two measurements (Nos. 7 and 20), presumably on the Winchester coal bed, are not shown graphically, but are discussed below. No. 7, in the SW. ¼ NE. ¼ sec. 9, T. 1 S., R. 7 W., shows 6 inches of bright coal overlain by sandstone and underlain by brown shale. No. 20, in the NE. ¼ SE. ¼ sec. 12, T. 1 S., R. 8 W., shows a total of 1 foot 9 inches of coal broken by partings of shale and may represent the Winchester coal bed, or that bed may be under cover and No. 20 may represent a lower bed, as it was measured on the outcrop between locations 16 and 22, where the average thickness is 4 feet 10 inches. On the other hand, it is possible that the Winchester coal bed is lenticular and that section No. 20 represents one of its measurements. It will be noted also that section No. 20, which is given in detail below, is very much broken by partings.

Section No. 20 of Winchester (?) coal bed in NE. ¼ SE. ¼ sec. 12, T. 1 S., R. 8 W.

	Ft.	in.
Sandstone, light gray	12	
Earth, dark gray, soft, carbonaceous		3½
Coal, bright		8
Shale, black, carbonaceous		4±
Coal, bright		11
Shale, dull, purplish gray		4
Coal, contains streaks of shale		2
Shale, dark, gray		6
Coal bed	2	5±

At the Winchester prospect (No. 16) in the NW. ¼ SW. ¼ sec. 8, T. 1 S., R. 7 W. a sample (laboratory No. 10997) was taken for analysis. This sample was somewhat weathered, because the prospect entry is only a short distance under cover and had not been worked recently. A foot or more of the weathered coal of the wall was removed in order to obtain fresher material, which would be more nearly representative of the unweathered coal.

Sections Nos. 19, 21, and 23 were measured on bed 3, which is 9 feet below the Winchester coal bed. They show that this bed ranges from 1 foot 5 inches to 1 foot 8 inches thick.

Six feet below the last-described coal bed is another, bed 2, represented by Nos. 15 and 18. It shows 2 feet 6 inches of fairly good coal (No. 18), with a quarter-inch parting of yellowish-gray clay 10 inches below the top, in the NE. ¼ SE. ¼ sec. 12, T. 1 S., R. 8 W.

The following section (No. 15) was measured near the Winchester prospect in the NW. ¼ SW. ¼ sec. 8, T. 1 S., R. 7 W.:

Section of bed 2 in NW. ¼ SW. ¼ sec. 8, T. 1 S., R. 7 W.

	Ft.	in.
Sandstone, brownish gray, weathers yellowish gray, somewhat shaly.		
Coal, dull		1½
Shale, brownish, with a few coal streaks		1
Coal, bright		2½
Shale, brown		1¼
Coal, bright		6
Shale, brown		¾
Coal, bright		2½
Shale, black, carbonaceous		6
Coal, bright		2
Shale, purplish	1	
Coal bed	1	11½

The lowest coal (bed 1) represented by sections Nos. 11, 14, and 17, is of no importance. These sections show that this coal bed ranges in thickness from 6 inches up to 2 feet 3 inches, the greatest thickness being toward the western end of the outcrop. This coal bed is 25 to 30 feet below the Winchester coal bed. Section No. 6 described above is probably on this bed. Two of the above sections (Nos. 11 and 14) are not shown graphically on Plate LXI, but are given in detail below:

Sections of coal bed 1.

Section No. 11, NW. ¼ SW. ¼ sec. 8, T. 1 S., R. 7 W.

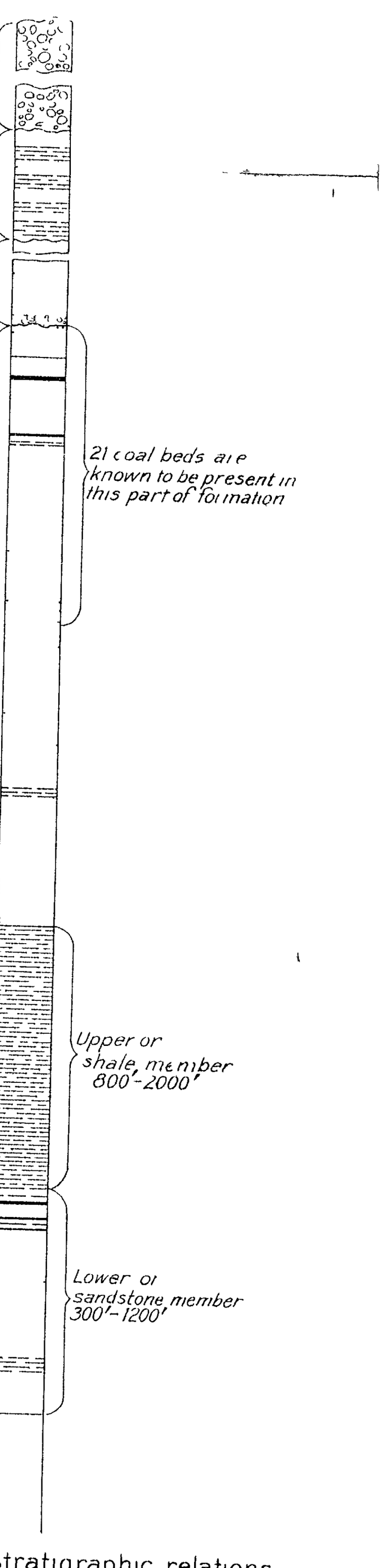
	Ft.	in.
Shale, gray	2	
Shale, and coal streaks intermixed.		6
Coal, dull, poor		6
Shale, dark gray, shows slickensided surfaces	1	5
Coal, dull, poor		4
Shale, dark gray	1	
Coal bed	2	3

Section No. 14, NW. ¼ SW. ¼ sec. 8, T. 1 S., R. 7 W.

	Ft.	in.
Sandstone.		
Shale	1±	
Coal, bright, variable		6
Shale, purplish, contains thin coal streaks		5
Shale, gray	1	
Coal bed		6

The topmost coal (bed 4) of Mancos age on the headwaters of Red Creek was measured at five places in T. 1 S., R. 9 W. These sections are represented by Nos. 30 to 32, 34, and 38. They show that the coal bed ranges in thickness from 1 foot 10 inches (No. 30) in the NW. ¼ SW. ¼ sec. 13 to 18 feet 8 inches (No. 31) measured in a prospect in the SE. ¼ SW. ¼ sec. 14, T. 1 S., R. 9 W. Westward from this locality the coal bed decreases in thickness to 10 feet 7 inches (No. 32), then suddenly drops to 4 feet 2 inches (No. 34), one-fourth mile west, where a section was measured in a short prospect entry on the south side of Red Creek. From this place the coal bed thickens toward the west to 10 feet (No. 38) in the SW. ¼ SW. ¼ sec. 16, T. 1 S., R. 9 W. Westward from this locality it was impossible to obtain measurements

TOPOGRAPHIC AND GEOLOGIC MAPS OF BLACKTAIL MOUNTAIN COAL FIELD, WASATCH COUNTY, UTAH



Section shows stratigraphic relations in the Blacktail Mtn coal field

on any of the coal beds owing to the fact that the coal-bearing rocks are deeply covered. The horizon of the coal could, however, be followed and mapped for 2½ miles by the sandstone beds which outcrop above and below the coal beds.

A second coal (bed 3), 63 feet below the bed just described, is fairly well exposed and was measured at six different places. These sections, Nos. 24, 25, 28, 29, 33, and 37, show that the coal bed increases in thickness very abruptly toward the west. At location No. 24, in the NW. ¼ NW. ¼ sec. 17, T. 1 S., R. 8 W., the coal bed shows 1 foot of coal; at the westernmost exposure of this bed (No. 37), in the SW. ¼ SW. ¼ sec. 16, T. 1 S., R. 9 W., 10 feet 8½ inches; and in the SE. ¼ SE. ¼ of the same section, the greatest thickness (No. 33), 15 feet 2 inches. The above measurements suggest that this coal bed is a lens, with its thickest portion at the last-mentioned locality. All the coal sections measured on this bed are shown graphically on Plate LXI, with the exception of No. 24 in the NW. ¼ NW. ¼ sec. 17, T. 1 S., R. 8 W., which shows 12 inches of bright coal overlain by gray sandy shale.

The coal bed at this place is folded and somewhat broken, and the true thickness of the bed may not be so great as that represented.

The third coal from the top (bed 2) was examined at two places only, locations 27 and 36. The distance between bed 2 and bed 3 is 54 feet. This coal bed is 3 feet 2 inches thick (No. 27) in the SW. ¼ NE. ¼ sec. 18, T. 1 S., R. 8 W., and consists of 1 foot 3½ inches of fairly good coal (No. 36) in the SE. ¼ SW. ¼ sec. 16, T. 1 S., R. 9 W.

Ten feet below the coal bed last described is another coal (bed 1), which was examined at two places, locations 26 and 35. At location 26, in the SW. ¼ NE. ¼ sec. 18, T. 1 S., R. 8 W., the bed shows 4 feet 1 inch of fairly bright coal. The roof at this place is shale, and the floor is a fine-grained carbonaceous sandstone. About 4 miles west of this place in the SE. ¼ SW. ¼ sec. 16, T. 1 S., R. 9 W., is an old prospect entry (No. 35), 50 feet in length, on the north side of Red Creek, showing 2 feet 5 inches of medium bright coal.

The Mancos coal beds, like those of Mesaverde age, for the most part have shale overlying them which will need support during mining operations, but suitable timber is plentiful in this region.

CHARACTER OF THE COAL.

PHYSICAL PROPERTIES.

The coal of both Mesaverde and Mancos ages, as noted above, is a rather low-grade bituminous variety. The fresh coal is pitch black in color, but the faces of the joints and weathered surfaces are usually dull black. When fresh the coal is hard and brittle. The luster is generally vitreous, and the fracture ranges from uneven to regular.

When pulverized the coal is a dark-brown powder and its streak made by rubbing on unglazed porcelain is almost black, with a slightly brownish tint. The coal is bedded but not prominently and its jointing is cubical. It burns with a flame of medium length and gives off a bituminous odor. The quantity of ash remaining is not excessive.

CHEMICAL COMPOSITION.

Three samples, yielding the analyses given below, were collected in the Blacktail Mountain field. One of these samples (laboratory No. 10997) was taken from a Mancos coal bed (Winchester) east of Duchesne River, in the NW. ¼ SW. ¼ sec. 8, T. 1 S., R. 7 W. The other two samples (laboratory Nos. 10998 and 11058) were taken from Mesaverde coal beds near the center and western edge of the field, respectively. One sample (laboratory No. 10998) of Mesaverde coal was collected in the Fraughton prospect in the NW. ¼ NW. ¼ sec. 26, T. 1 S., R. 9 W., and the other (laboratory No. 11058) at the Cummings mine (abandoned) in the SW. ¼ SE. ¼ sec. 31, T. 1 S., R. 10 W.

In sampling, a fairly fresh surface of the coal was chosen. A channel was cut perpendicularly across the face of the coal bed from roof to floor, of such size as to yield not less than 5 pounds for each foot of coal in the bed. Partings more than three-eighths of an inch thick were discarded. An oilcloth was used to catch the coal as it fell from the channel and to exclude moisture and impurities. The coal was then crushed so that it would pass through a ¼-inch mesh sieve, thoroughly mixed, quartered, opposite quarters discarded, and the remainder remixed. This process was continued until the sample was reduced to 1 quart, which was sent in an air-tight can to the chemical laboratory of the Bureau of Mines at Pittsburgh, where it was analyzed.

On account of the undeveloped condition of the coal field fresh samples were difficult to obtain, but without doubt all of the coals when they are mined under thick cover will be found to rank as high in fuel value as that shown in laboratory No. 10998, from the Fraughton prospect on Red Creek. The effect of weathering is very noticeable in the accompanying table of analyses, when the heat value of the unweathered coal is compared with that of the weathered coal.

Analyses of coal samples from the Blacktail Mountain coal field.

[Made at the Pittsburgh laboratory of the Bureau of Mines, A. C. Fieldner, chemist in charge.]

Laboratory No.	No. on map and plate of sections.	Name of coal bed.	Location.				Air-drying loss.	Form of analysis.	Proximate analysis.					Heat value.	
			Qaurter.	Sec.	T. S.	R. W.			Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calories.	British thermal units.
10997	No. 16...	Winchester	SW.	8	1	7	19.0	A	27.4	32.1	37.9	2.6	0.60	4,125	7,430
								B	10.4	39.7	46.7	3.2	.74	5,095	9,170
								C	.....	44.3	52.2	3.5	.83	5,680	10,230
								D	.....	45.9	54.1	.....	.86	5,890	10,610
10998	No. 44...	Fraughton	NW.	26	1	9	9.0	A	14.6	38.5	41.0	5.9	.82	5,770	10,380
								B	6.1	42.3	45.1	6.5	.90	6,340	11,410
								C	.....	45.1	48.0	6.9	.96	6,755	12,160
								D	.....	48.4	51.6	.....	1.03	7,255	13,060
11058	No. 113..	Cummings	SE.	31	1	10	5.6	A	19.2	37.0	37.6	6.2	.69	4,845	8,720
								B	14.4	39.2	39.8	6.6	.73	5,135	9,240
								C	.....	45.8	46.5	7.7	.85	5,995	10,790
								D	.....	49.6	50.4	.....	.92	6,495	11,690

No. 10997.—From Winchester coal bed in Winchester prospect (No. 16), in the NW. ¼ SW. ¼ sec. 8, T. 1 S., R. 7 W., about 3½ miles east of Hanna post office on the north side of Farm Creek. Coal somewhat weathered.

No. 10998.—From the Fraughton coal bed in the Fraughton prospect entry (No. 44), in the NW. ¼ NW. ¼ sec. 26, T. 1 S., R. 9 W., on the west side of Red Creek, about 7 miles west and slightly south from Hanna post office. Coal very slightly weathered.

No. 11058.—From the Cummings mine (abandoned—No. 113), in the SW. ¼ SE. ¼ sec. 31, T. 1 S., R. 10 W., on the north side of Currant Creek, about 28 miles southeast from Heber, Utah. Sample, which was considerably weathered, was taken at a good surface exposure, the mine being caved.

In the table the analyses are given in four forms, marked A, B, C, and D. Analysis A represents the composition of the sample as it comes from the mine. This form is not well suited for comparisons, because the amount of moisture in the sample as it comes from the mine is largely a matter of accident, and consequently analyses of the same coal expressed in this form may vary widely. Analysis B represents the sample after it has been dried at a temperature a little above the normal until its weight becomes constant. This form of analysis is best adapted to general comparisons. Analysis C represents the theoretical condition of the coal after all the moisture has been eliminated. Analysis D represents the coal after all moisture and ash have been theoretically removed. This is supposed to represent the true coal substance free from the most significant impurities. Forms C and D are obtained from the others by recalculation. They should not be used in comparison, for they represent theoretical conditions that never exist.

In the analytical work it is not possible to determine the proximate constituents of coal or lignite with the same degree of accuracy as the ultimate constituents. Therefore the air-drying loss, moisture, volatile matter, fixed carbon, and ash are given to one decimal place only. The determination of the calorific value to individual units is not reliable. Hence in the column headed "Calories" the values are given to the nearest five units, and in the column headed "British thermal units" they are given to the nearest tens (the value of a British thermal unit being about one-half that of a calorie).

PRESENT DEVELOPMENT.

On account of the great abundance of cedar and pine in this region, the coal beds have not been developed. With a small amount of work the few ranchers living in the Duchesne Valley can obtain their fuel much more easily from the cedar forests than by uncovering the coal. At present practically no coal is being mined in this field. Possibly a few tons are removed each year from the Winchester prospect, sec. 8, T. 1 S., R. 7 W., on Farm Creek for local blacksmithing and domestic purposes.

Prospects have been made along Red Creek in both the Mesaverde and Mancos coal groups. One of these, the Fraughton prospect, situated in the NW. ¼ NW. ¼ sec. 26, T. 1 S., R. 9 W., is 100 feet in length and bears N. 80° W., which is the strike of the coal-bearing rocks at this locality. The strata dip 58° to 60° S. No work was being done at this prospect in 1910.

A short entry has been made on the uppermost of the Mancos coal beds on the north side of Red Creek in the SE. ¼ SE. ¼ sec. 16, T. 1 S., R. 9 W. No work has been done at this prospect recently.

Considerable coal has been mined at the Cummings mine in the SW. ¼ SE. ¼ sec. 31, T. 1 S., R. 10 W., in Currant Creek valley and hauled over the mountains to Heber, a distance of about 30 miles. During the fall of 1910, when this portion of the field was examined, the entry was so much caved that it was inaccessible. It was reported that considerable mining had been done here a few years before. One of the reasons for the abandonment of this mine is the lack of good roads over the mountains to a market. Those using the coal are reported to have objected to it on account of the large amount of ash it contains and the difficulty with which the coal is ignited. These faults of the mined coal are probably due to its weathered condition. The only coal mined in this field other than at the prospects described above has been taken from natural exposures.

FUTURE DEVELOPMENT.

The future development of this field will be governed for the most part by the settlement of the Uinta Basin country, by the exhaustion of the cedar and pine, and by the extension of railroads across the basin. One or more railroad routes have been surveyed from Colorado and Wyoming along the Duchesne Valley, with a probable terminus at Salt Lake City. One of these routes (Moffat road) follows the course of Yampa, Green, Duchesne, and Strawberry rivers, intending to cross Strawberry Valley and follow down Daniels Canyon through Heber Valley. Another route of the same road has been surveyed, leaving the line above described at Duchesne (Theodore) and following the main branch of Duchesne River northwestward to the West Fork, which it follows to its head, where a tunnel possibly may be made through to the headwaters of Lake Creek, thence down that stream, through Heber Valley to Salt Lake City. Whichever route is followed it seems quite probable that this railroad will obtain some of its fuel supply from the coal field about Blacktail Mountain. If the former route is followed, in order to reach this coal field it will be necessary to extend a spur up either Currant or Red Creek to reach the coal-bearing rocks. It seems to the writer that the most feasible route would be up the valley of Red Creek, because the Currant Creek route would tap only an end of the field,

whereas the Red Creek route leads into the center of both the Mesaverde and Mancos coal groups. Should the railroad be built up Duchesne River northwest from Duchesne (Theodore), only a small portion of the coal field could be reached easily. That portion of the Mancos coal-bearing rocks east of Duchesne River and north of Farm Creek would be most accessible. To reach the main portion of the field, which lies west of Blacktail Mountain it would be necessary to build a rather steep railroad spur from the Duchesne Valley possibly over the divide that extends from the north flank of Blacktail Mountain to Duchesne River, and then down the East Fork of Red Creek to reach the heart of the coal field.

The Uinta Indian Reservation, which was recently thrown open to entry, is receiving many new settlers. Any considerable population will eventually consume the wood supply, and it seems to the writer that in a few years these settlers must necessarily obtain fuel from some coal field. As the Blacktail Mountain field is the most accessible it seems quite probable that mines with a considerable output will be established here. The development of this coal field, as well as the development of other mineral and agricultural resources of the Uinta Basin, depends ultimately upon the completion of a railroad through this region.

TONNAGE.

The following table gives an estimated tonnage of the coal underlying the townships included in the Blacktail Mountain coal field, Utah. In making this estimate, 1,800 tons is taken as the amount of coal contained in an acre-foot, and coal more than 3,000 feet below the surface is not considered. Townships marked with an asterisk (*) contain coal in both the Mancos and Mesaverde formations.

Estimated tonnage of Blacktail Mountain coal field.

	Tons.
T. 1 N., R. 5 W.	8,211,000
T. 1 N., R. 6 W.	7,236,000
T. 1 S., R. 5 W.	1,628,000
T. 1 S., R. 6 W.	57,072,000
T. 1 S., R. 7 W.	70,839,000
T. 1 S., R. 8 W.*	142,893,000
T. 1 S., R. 9 W.*	599,576,000
T. 1 S., R. 10 W.*	850,133,000
T. 2 S., R. 10 W.*	117,894,000
T. 1 S., R. 11 W.*	2,118,000
	1,857,600,000