THE COAL RESOURCES OF GUNNISON VALLEY, MESA AND DELTA COUNTIES, COLORADO.

By E. G. WOODRUFF.

INTRODUCTION.

The following is a brief description of the coal resources of Gunnison Valley, between Grand Junction and Delta, in Mesa and Delta counties, Colo. The location and extent of the district are shown on the map, Plate LVIII. Few geologic reports of this region are available. The earliest is that of A. C. Peale,[1] who made a reconnaissance survey of the region, but gave no special attention to coal; later, W. T. Lee[2] studied the Grand Mesa coal field, and in connection with that work he made a hasty examination of the coal beds in the area described in this report. Mr. Lee found them so thin and the coal so poor that he considered them to be of no economic value under the conditions existing at that time. The recent regulations by the Secretary of the Interior regarding the classification of public land have made it necessary to examine the district in detail. This was done by the writer in the autumn of 1910, and the data obtained are presented in this paper to supply information on the supposed coal resources of this valley and also to correct any false impressions which may have arisen from previous publications.

LOCATION AND EXTENT.

The area described in this report occupies a narrow zone on the northeast side of Gunnison River, except in the vicinity of Whitewater, where an unusually large meander of the river to the northeast has left an area of coal-bearing rocks on the southwest side of the stream. In general, the line of outcrop is along the river cliffs, but it recedes to the northeast, where the walls of the canyon on that side have been dissected by small tributaries. There are also many small isolated outliers of coal-bearing rocks on the dip slope of the mountains southwest of the river, but commonly these remnants are small and of little economic value. Even where the outliers are a few

[1] Peale, A. C., Eighth Ann. Rept., U. S. Geol. and Geog. Survey Terr., 1874, p. 135.
[2] Lee, W. T., Bull. U. S. Geol. Survey No. 341, 1909, p. 316.

acres in extent, the cover over the coal is so thin as to have afforded little protection from weathering; therefore the coal has disintegrated badly and is practically valueless. Furthermore, the beds examined in these outliers are too thin to be of economic importance, even if the coal were of good quality and unweathered.

GEOLOGY.

STRATIGRAPHY.

The geologic age of the coal beds has not been definitely determined. The strata immediately below the group of beds containing coal include dicotyledonous leaves, which are referred to the Dakota sandstone; whereas the beds a short distance above contain marine fossils which are characteristic of the Mancos shale. The evidence obtained by previous investigators and by the writer shows that the stratigraphic line separating the Dakota from the Mancos is indistinct in this area. Certainly it is near the group of coal beds, but as yet the data at hand are not sufficient to fix the position of the line definitely. The following sections were measured at the points indicated:

Section of coal-bearing strata measured near the filtration plant, 1½ miles east of junction of Grand and Gunnison rivers.

	Feet.
Shale, sandy.	
Sandstone, yellowish brown, locally shaly	13
Shale, mostly carbonaceous, partly tan-colored and sandy, with a 10-inch bed of coal 3 feet below top	17
Shale, tan, sandy	3
Shale, mostly carbonaceous	9
Sandstone, tan, shaly	7
Shale, not well exposed, contains carbonaceous material, sandy	7
Conglomerate, gray, composed of a matrix of coarse angular grains of sand containing waterworn pebbles of black and gray quartz	12
Shale, sandy, green	34
Sandstone, shaly	28
Sandstone, massive, coarse grained, cross-bedded, locally conglomeratic	23
Base of Dakota.	
	153

Section of Dakota and Mancos formations (at locality 56, Pl. LVIII) in sec. 35, T. 4 S., R. 3 E. of the Ute principal meridian.

	Ft.	in.
Shale, sandy, yellow, merging upward into drab shale.		
Sandstone, hard ferruginous	2	
Shale, yellow	3	
Sandstone, hard, ferruginous, in several layers	8	
Shale, drab at base and tan, sandy above base	20	
Sandstone, shaly.		
Shale, tan, sandy, locally carbonaceous	17	
Sandstone, tan, massive	9	
Shale, drab	2	
Sandstone, tan, shaly	2	
Shale, carbonaceous		3
Coal		3
Shale, carbonaceous		8
Coal		3
Shale, tan, sandy, and drab in upper part	14	
Shale, carbonaceous	1	6
Coal	1	3
Shale, carbonaceous		11
Conglomerate, gray, composed of waterworn pebbles of gray and black chert	26	
Base of Dakota.		
	108	1

The coal occurs in a group of beds varying from 20 to 50 feet in thickness, comprising sandstone, sandy shale, carbonaceous shale, and coal beds. As will be seen by comparing the sections on Plate LVIII, the coal beds are neither thick nor continuous. The greatest thickness of coal exposed at any place in the area is along the cut of the railroad near the junction of Grand and Gunnison rivers, at a point shown by section No. 1, where a thickness of 59 inches of coal was measured in beds having a total thickness of 10 feet 10½ inches. At this place the coal occurs in six benches, the thickest with a maximum of 17 inches. In the entire area the thickest single bench of coal measured (20 inches) is in the Wells Gulch mine, location 47. In general, the beds are lenticular and are continuous throughout a comparatively limited area. Generally, the character of the bed varies from place to place, as will be seen by comparing the series of sections given on Plate LVIII. A bed may contain coal at one point and carbonaceous shale at another a short distance away, with a gradual transition between.

STRUCTURE.

The strata of the area discussed in this report are included in the monocline which extends from the Uncompahgre Plateau northeastward and continues under the broad structural basin of Grand Mesa. Along Gunnison River the strata dip gently to the northeast at angles varying from 4° to 5°; consequently they occupy an attitude favora-

ble for mining if a bed of coal of sufficient thickness and extent could be found. Neither faults nor abrupt undulations of the strata were observed which would interfere with the extension of underground workings. The exposures of the beds along the cliffs of the river and in the small canyons through which tributaries enter the main stream also afford favorable conditions for the examination and exploration of the coal beds.

THE COAL.

OCCURRENCE AND DEVELOPMENT.

As previously stated, the coal beds outcrop on the northeast side of the river, except a small area near Whitewater, and they also are present in small outliers on the southwest; but as the coal in these isolated areas is valueless they are not considered in this report. The line of outcrop and sections of the coal beds are presented on Plate LVIII. In general they are too thin to be mined, and hence detailed descriptions of the beds are omitted except at a few localities where mining has been undertaken.

At location 1, near the junction of Grand and Gunnison rivers, a prospect entry has been driven to a depth of about 150 feet, but the coal is too impure to warrant development under present conditions. The coal is hard, lusterless, and contains a high percentage of ash. The analysis of a sample taken at this place is shown by Nos. 11108 and 11109 in the table of analyses on page 571. Although this sample was taken at a point 125 feet from the opening, it was undoubtedly weathered, as the entry had stood open for some time. Furthermore, the coal is probably weathered because it lies under a terrace, where the covering is only about 30 feet thick. At the place where the samples were taken the following section was measured:

Section of coal bed near junction of Gunnison and Grand rivers.

Shale, carbonaceous.	Inches.
Coal (analysis No. 11108, p. 9)	23
Shale, drab	1
Coal? (analysis No. 11109, p. 9)	10
	34

This section is slightly different from the upper part of section No. 1 shown on the map. The difference is due to variation in the coal bed at the two places where the sections were obtained, No. 1 being measured along a cut bank near the railroad and the section given above in the entry.

To obtain a sample of the coal as fresh as possible a man was employed to work a day to remove coal from the point selected before the sample was taken. About one-fourth mile to the north on the

bank of Grand River is an old opening, but at the time of this investigation the entry was closed and no reliable information concerning it could be obtained.

At location 5 there is a prospect 10 feet deep, which encountered carbonaceous shale but no coal.

At location 11 a prospect has been opened to a depth of 100 feet, which reached unweathered coal at a point where the following section was measured:

Section of coal bed exposed in SW. ¼ sec. 5, T. 2 S., R. 1 E. of the Ute principal meridian (location No. 11).

	Ft.	in.
Sandstone.		
Coal (analysis No. 11104, p. 9)	1	3
Shale, gray		3
Coal (analysis No. 11105, p. 9)	1	0
Shale, carbonaceous.		
	2	6

The samples for analysis were taken at the end of the entry, where the coal is under ample cover to protect it from weathering prior to the opening of the mine. It is possible that the coal has altered slightly from exposure to the atmosphere since the mine was opened, but the face was cleaned before the sample was taken; consequently the analyses are believed to represent approximately fresh coal. There are several prospects between locations 11 and 47, but very little coal was found.

The most earnest attempt at mining in this field has been made in Wells Gulch, at location 47. The main entry has been driven about 200 feet, and at the end a room has been begun. Coal has been taken out for local consumption and for pumping water for irrigation, but the attempt to burn the product has not been successful because of the high percentage of ash. The character of the bed is different in different places in the mine. This is shown by the following two sections measured at points 100 feet apart.

Sections of coal bed in Wells Gulch mine, sec. 17, T. 4 S., R. 3 E. of the Ute principal meridian (location 47).

Section A, 100 feet from entrance.

	Ft.	in.
Sandstone.		
Coal		8
Shale		2
Coal		9
Shale, carbonaceous	3	1
Shale, drab		8
Total coal	1	5

Section B, at end of entry, 200 feet from entrance.

Sandstone.	Ft.	in.
Coal (analysis No. 11106, p. 571)	1	8
Shale, carbonaceous, or bone	2	3
(This bench contains a high percentage of ash and closely approaches bone. Its composition is shown by analysis No. 11107, p. 571).		
Total coal and bone	3	11

These samples were taken at the end of the entry where the surface covering is 50 feet thick. The face had stood exposed for several months prior to sampling; consequently the coal was slightly weathered. Before sampling the face was cleaned until comparatively unaltered coal was obtained.

The most eastward place in the field at which prospecting has been done is at location 59, where an entry has been opened to a depth of about 50 feet. At this place the coal is bright and of very good quality, but there are several partings in the bed which are not easily separated in mining. The conditions seem favorable for obtaining a small amount of low-grade fuel for local consumption, but the bed is too limited in area to warrant extensive development.

PHYSICAL PROPERTIES.

Locally there are thin beds of coal with a subvitreous luster, cubical joints, and considerable mineral charcoal. This seems to be bituminous coal, with a weak tendency to coke. Most of the coal, however, is very impure and closely resembles bone. It contains a large percentage of ash-forming material so intimately intermixed that it is impossible to free the coal by any washing process now devised. Generally it is resistant to the pick when mined, and is, therefore, taken out with difficulty. The impurities seem to give a firmer body to the coal which causes it to resist weathering more readily than pure coal, and consequently it has the appearance of high-grade coal. This appearance is deceptive and is readily detected by the high percentage of clinker and ash which remains when the coal is burned.

CHEMICAL COMPOSITION.

The chemical composition of the coal is shown by the analyses in the following table:

Analyses of coal samples from the Gunnison Valley coal field.

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

Laboratory No.	No. on plate.	Section of coal bed.	Location. Section.	T. S.	R. E.	Air-drying loss.	Form of analysis.	Proximate. Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Heat value. Calories.	British thermal units.
			Ft. in.											
11108	1	Shale.	26	1	1	1.9	A	5.1	27.9	38.8	28.2	1.14	5,145	9,270
		Coal [a] 1 11					B	3.3	28.5	39.5	28.7	1.16	5,245	9,450
		Shale 1+					C	.....	29.5	40.8	29.7	1.20	5,425	9,770
		Coal 10					D	.....	41.9	58.1	.....	1.72	7,720	13,890
11109	1	Shale.	26	1	1	2.1	A	5.7	26.3	34.2	33.8	.80	4,650	8,370
		Coal 1 11					B	3.7	26.9	34.9	34.5	.82	4,750	8,550
		Shale 1+					C	.....	27.9	36.3	35.8	.85	4,930	8,870
		Coal [a] 10					D	.....	43.5	56.5	.....	1.32	7,675	13,820
11104	11	Sandstone.	5	2	1	.7	A	3.5	39.2	51.3	6.0	1.67	7,250	13,050
		Coal [a] 1 3					B	2.8	39.5	51.7	6.0	1.68	7,300	13,140
		Shale 3					C	.....	40.6	53.2	6.2	1.73	7,515	13,530
		Coal 1					D	.....	43.3	56.7	.....	1.84	8,010	14,420
11105	11	Sandstone.	5	2	1	.7	A	3.2	29.1	45.3	22.4	1.19	5,840	10,510
		Coal 1 3					B	2.5	29.3	45.6	22.6	1.20	5,880	10,590
		Shale 3					C	.....	30.1	46.8	23.1	1.23	6,030	10,860
		Coal [a] 1					D	.....	39.1	60.9	.....	1.60	7,850	14,130
11106	47	Sandstone.	18	4	3	.5	A	3.5	38.8	51.7	6.0	.98	7,280	13,110
		Coal [a] 1 8					B	3.0	39.0	52.0	6.0	.98	7,320	13,170
		Shale 2 3					C	.....	40.2	53.6	6.2	1.01	7,540	13,570
							D	.....	42.9	57.1	.....	1.08	8,040	14,470
11107	47	Sandstone.	18	4	3	.5	A	3.1	31.2	48.4	17.3	1.89	6,260	11,270
		Coal 1 8					B	2.6	31.4	48.6	17.4	1.90	6,290	11,330
		Shale [a] 2 3					C	.....	32.2	49.9	17.9	1.95	6,460	11,630
							D	.....	39.3	60.7	.....	2.37	7,865	14,160

[a] Part sampled.

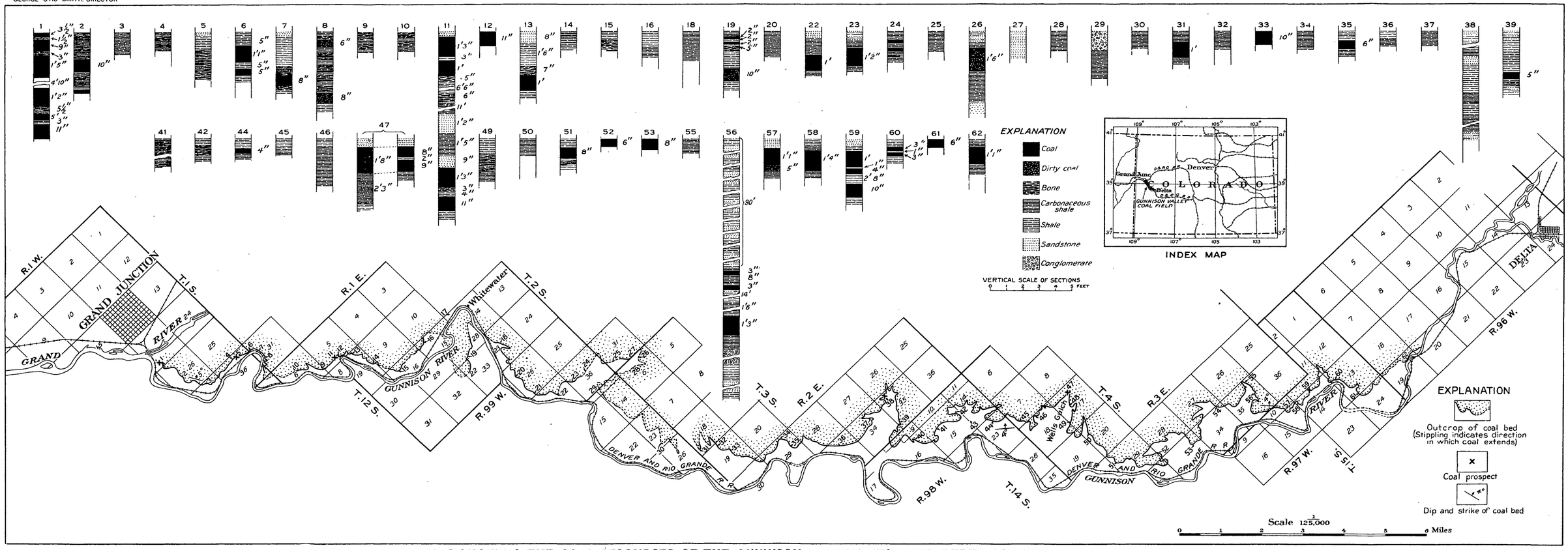
In the table the analyses are given in four forms, marked A, B, C, and D. Analysis A represents the composition of the sample as it comes from the mine. This form is not well suited for comparison because the amount of moisture in the sample, as it comes from the mine, is largely a matter of accident, 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 has 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, whereas the ash (in the ultimate analysis), sulphur, hydrogen, carbon, nitrogen, and oxygen are given to two decimal places. 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 the value of a calorie).

The samples whose analyses are given under Nos. 11108 and 11109 in the table on page 571 were taken in an abandoned entry near the junction of Gunnison and Grand rivers, at location 1 on the accompanying map, Plate LVIII. The face from which the samples were taken is about 125 feet from the mouth of the entry and under 30 feet of cover.

The moisture in the coal as received is probably slightly below normal, because the entry had been abandoned for some time and the surface covering was insufficient to protect the coal entirely from the action of weathering agencies.

The coal for analyses Nos. 11104 and 11105 was taken in an abandoned entry, 100 feet long, at location 11 on the accompanying map, where the coal bed has the structure shown by the upper part of section No. 11. The entry was dry and had stood open for some time previous to sampling, hence the moisture and volatile constituents of the coal may be slightly subnormal, but it is believed that this deficiency is practically negligible, because the face was



MAP SHOWING THE COAL RESOURCES OF THE GUNNISON VALLEY, MESA AND DELTA COUNTIES, COLORADO

By E. G. Woodruff
1912.

cleaned before sampling and the coal obtained seemed to be unaltered. Analysis No. 11104 is from the upper bench and No. 11105 from the lower.

FUTURE DEVELOPMENT.

It is doubtful if the future development of the field will ever be extensive. This opinion is based on the facts that the beds of coal are thin and limited in extent, and also that the coal is impure. Moreover, the impurities in the coal render it difficult to mine and interfere with ready combustion, which condition will prevent extensive development. On the other hand, the structure is favorable and local markets could be reached from almost any mine which might possibly be developed, owing to the ready shipping facilities obtainable over the railroad which traverses the river valley, but the coal will come in direct competition with better coal from the Book Cliffs and Grand Mesa fields.

THE TIJERAS COAL FIELD, BERNALILLO COUNTY, NEW MEXICO.

By W. T. Lee.

The Tijeras coal field is located in central New Mexico, about 20 miles east of Albuquerque, on the eastern slope of the Sandia Mountains. Obscure references to it are found in some early reports, but little has heretofore been known about it. The coal-bearing rocks occupy the center of a syncline of irregular outline about 5 miles long and 2 miles wide, lying between the Sandia uplift on the west, the South Mountain uplift on the northeast, and a broad but less well defined uplift on the southeast which manifests itself within the area mapped by a fault which brings Carboniferous rocks in contact with Mancos shale (Upper Cretaceous). The coal-bearing rocks are faulted, warped, and crushed but in general dip from all directions toward the center of the syncline. Along the western margin of the field the strata are upturned to a nearly vertical position. Across the edges of these upturned beds at San Antonio the part of the accompanying section below the coal beds was measured. In the central part of the syncline, although the rocks lie more or less horizontal, they are warped and faulted to such an extent that any measurement of their thickness is likely to be deceptive. The part of the section above the Mancos shale was measured in a canyon at Holmes mine near the center of the syncline, where the rocks seem to be disturbed less than they are in some other places. Nevertheless, the section is given with some hesitancy because the measured thicknesses may prove to be quite different from the thicknesses of the beds as originally laid down.

Section of rocks between Holmes mine and Tocco mine, in the Tijeras coal field, N. Mex.

	Ft.	in.
Sandstone, coarse grained, not continuously exposed, thickness estimated	400±	
Sandstone, gray, coarse grained, friable; contains fossil leaves	15	
Coal	1	6
Not exposed	25	
Coal	3 (?)	
Not exposed	(?)	

	Ft.	in.
Sandstone, coarse grained, hard, cliff-making, thickness estimated	50	
(Abrupt change in lithology.)		
Shale and yellow sandstone; the shale predominates in the lower part and the sandstone above, contains marine invertebrate fossils	440	
Shale with thin layers of yellow, flaggy sandstone	50	
Sandstone, massive, contains marine invertebrate fossils	55	
Coal	1±	
Shale	15	
Coal	2±	
Shale, not continuously exposed	15	
Sandstone, massive	30	
Shale	10	
Coal	1	8
Shale and sandstone with thin layers of coal	20	
Coal		2±
Sandstone, massive, cliff-making, contains marine invertebrate fossils	115	
Shale, dark colored, sandy at top	1,345	
Sandstone, hard, quartzose; contains worm borings and indefinite markings of various kinds	145	
Shale, dark colored, with limestone concretions	60	
Sandstone (Dakota)	65	
Sandstone and shale, variegated (Morrison).		
	2,864	4±

The rocks of the Morrison formation are not well exposed, but where seen, near San Antonio, do not differ in character from those referred to the Morrison at other localities in central New Mexico. They rest on the gypsiferous red beds of the Manzano group of the Pennsylvanian series[1] and are overlain by the Dakota sandstone. The rocks intervening between the Dakota sandstone and the base of the coal-bearing rocks are similar in thickness and character to the Mancos shale of neighboring fields.

The coal-bearing rocks of the Tijeras field belong, in part at least, to the Mesaverde formation. Marine invertebrates were found in the basal sandstone and also in rocks above the principal coal beds, which T. W. Stanton identifies as being indicative of Mesaverde age. There is a thick mass of sandstone and shale above the principal coal beds which contains marine invertebrates and which may be equivalent to the Lewis shale of the southern part of the San Juan Basin as described by Gardner.[2] It is somewhat thicker than the Lewis in the southeastern part of this basin, north of Cabezon, N. Mex., the locality nearest to the Tijeras field at which the Lewis is known to occur. However, these invertebrates are not different enough from

[1] Lee, W. T., and Girty, G. H., The Manzano group of the Rio Grande Valley, N. Mex.: Bull. U. S. Geol. Survey No. 389, 1909.

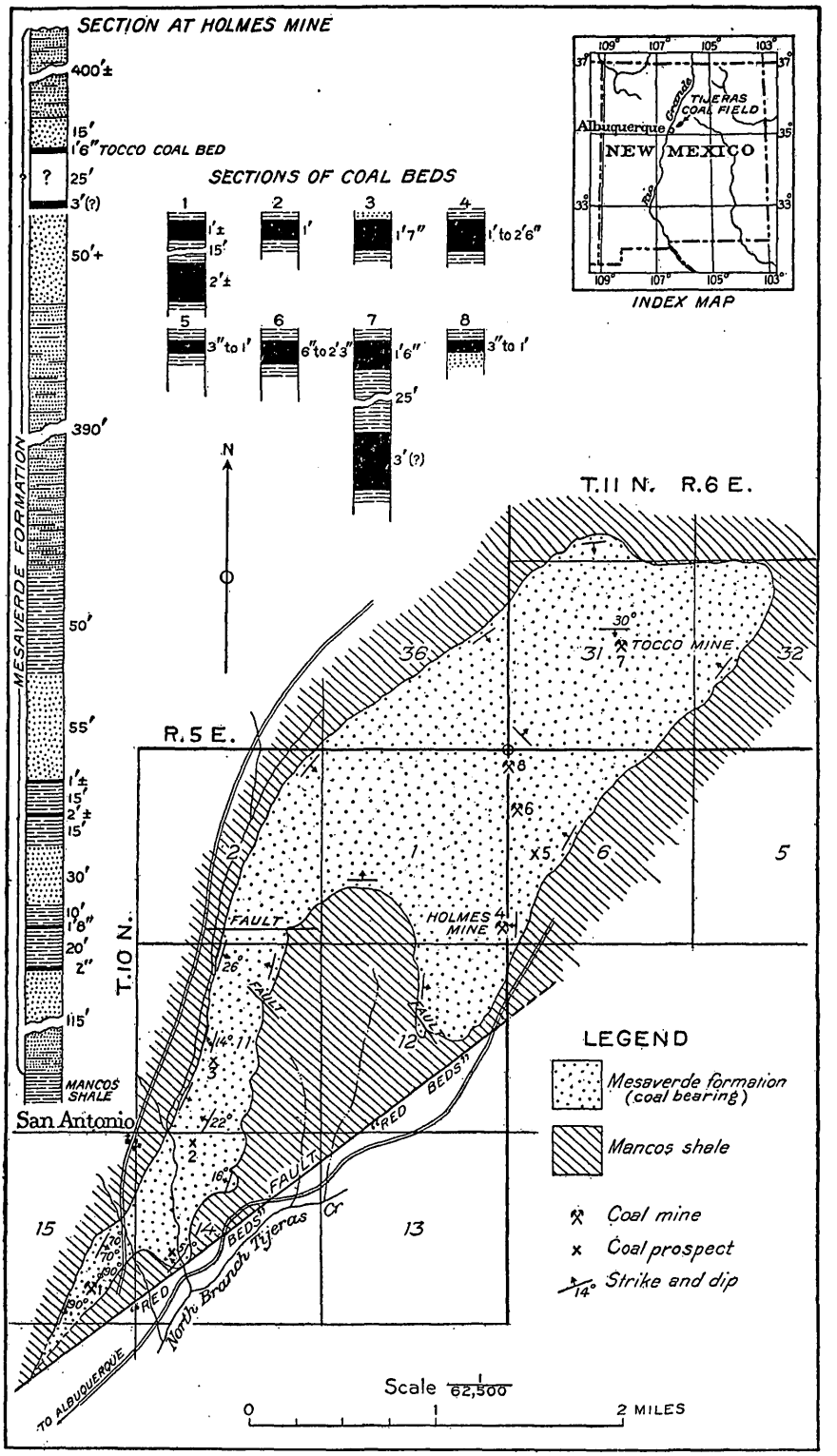
[2] Gardner, J. H., The coal field between San Mateo and Cuba, N. Mex.: Bull. U. S. Geol. Survey No. 381, 1910, pp. 461-473.

those of the rocks lower in the section to warrant the reference of this sandstone and shale to a separate formation.

Still higher in the section is a coarse-grained, hard, cliff-making sandstone which differs in character and appearance from the sandstones below to such an extent that it suggests the beginning of a new formation. This in turn is overlain by coal-bearing sandstone and shale. If the underlying beds containing the fossils of marine origin prove to be Lewis, these higher beds may be regarded as "Laramie." No fossils except a few poorly preserved leaves were found in them, and these proved insufficient for a determination of their age. However, the rocks consist principally of coarse-grained, friable sandstone, and, like the basal sandstone just described, are very different from any of the sandstones associated with the lower coal beds in this field or in the Mesaverde formation of neighboring fields. For these reasons the rocks are regarded as possibly younger than Mesaverde, but because there is no convincing evidence to this effect they are not in this paper separated from the Mesaverde. These younger coal-bearing rocks are confined to the trough in the center of the syncline and occupy an area of only a few acres. As exposed at the Tocco mine they contain two beds of coal separated by an interval of 25 feet. Below the coal beds, which are supposed to occur near the base of the formation, the rocks consist largely of soft friable sandstone and shale. Owing to the imperfect exposures the stratigraphic distance between the lowest coal bed and the cliff-making sandstone below could not be determined.

Many attempts have been made to find coal in the Tijeras field in beds thick enough to be worked with profit, but most of these attempts have proved futile. Many prospect openings have been made in the southern part of the field and some coal was mined years ago south of San Antonio at location 1 of the accompanying map (Pl. LIX). However, all of these mines and prospects have been practically abandoned. The measured thicknesses of the coal beds found in the old openings are shown on the map. The thicknesses vary greatly within short distances from the maximum shown down to a few inches. The coal beds are badly contorted and the coal crushed and impure. Probably no coal bed in the southern part of the field would average a foot thick for any considerable distance.

In the central parts of the field, north of the Holmes mine, the lower group of coal beds contains at least four beds that locally have considerable thickness, and several beds of carbonaceous shale were observed that may contain coal in some parts of the field. The principal coal beds have been opened and some coal has been marketed from the Holmes mine and from the mine at location 6, but here, as well as farther southwest, the beds are contorted and the coal crushed



MAP OF TIJERAS COAL FIELD, BERNALILLO COUNTY, N. MEX.

By W. T. Lee.

and impure. The observed thicknesses of the coal beds are indicated on the map and in the geologic section. The character of the coal beds is well indicated in the mine at location 6, where the coal varies in thickness from 6 inches to 2 feet 3 inches within a horizontal distance of a few feet. It is probable that the average of this bed is less than 1 foot.

A sample of the coal was taken by the writer, according to the methods of sampling prescribed by the Survey, at a point 300 feet from the mouth of the entry, where the coal was fresh and the bed locally thickened to its maximum. The analysis is given on page 578.

Though it is possible that in some place the coal beds of the lower group are undisturbed and the coal thick enough and clean enough to be mined with profit, no such place has been found, and the economic importance of these beds is yet to be demonstrated. The coal of the higher group seems to be better. The Tocco mine is developed on the higher bed, which is moderately uniform in thickness, ranging from 14 inches to 20 inches. For several years the mine has been worked intermittently and the coal has been sold for smithing. It is said to be in great demand and commands a high price.

The lower or 3-foot(?) bed near the Tocco mine was not seen by the writer and all that is known of it is the statement of the owner that such a bed exists. These beds underlie the small conical hill in the center of the syncline outcropping at its base on all sides and are said to underlie an area of about 60 acres. This mine was closed at the time the writer visited it, but later the owner, Mr. John Tocco, took a sample for analysis from the working face in the mine. In taking the sample Mr. Tocco followed the printed instructions of the Survey, sealed the coal in a can given him for this purpose, and sent it to the writer, who forwarded it for analysis to the laboratory of the Bureau of Mines at Pittsburgh.

Analyses of coal samples from the Tijeras coal field, N. Mex.

[A. C. Fieldner, chemist in charge.]

Laboratory No.	Name of mine.	Location.				Thickness.		Air-drying loss.	Form of analysis.	Proximate.					Heat value.	
		Quarter.	Section.	T. N.	R. E.	Coal bed.	Part sampled.			Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calories.	British thermal units.
						Ft. in.	*Ft. in.*									
12650	Holmes mine.....	SW.	6	10	6	2 3	2 3	0.5	A	1.6	31.1	36.2	31.1	3.24	5,580	10,050
									B	1.1	31.3	36.3	31.3	3.26	5,610	10,100
									C	.....	31.6	36.7	31.7	3.29	5,675	10,210
									D	.....	46.3	53.7	.....	4.81	8,300	14,940
13201	Tocco mine.....	NE.	31	11	6	1 2	1 2	.6	A	1.4	36.2	53.6	8.8	.87	7,725	13,900
									B	.8	36.4	53.9	8.9	.88	7,770	13,990
									C	.....	36.7	54.4	8.9	.88	7,830	14,090
									D	.....	40.3	59.7	.....	.97	8,600	15,480

NOTE.—For explanation of form of analysis, given in column 10, see page 572.