

# THE COALDALE COAL FIELD, ESMERALDA COUNTY, NEVADA.

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By J. H. HANCE.

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## INTRODUCTION.

The occurrence of a marketable grade of coal in Nevada is of considerable economic interest. Freight rates are high throughout the State, and the nearest supply at present is in California and Utah. For this reason the presence of bituminous coal north of the Silver Peak district is of immediate importance to the people of the State.

As may be seen by glancing at the index map (Pl. XXIII), Coaldale is in the southwestern part of Nevada, near the California boundary. It is on the Tonopah & Goldfield Railroad, which connects Tonopah with a branch of the Southern Pacific Railroad at Mina, and this branch in turn reaches the transcontinental road at Hazen, about 50 miles east of Reno. Tonopah has direct railway communication with Los Angeles over the Tonopah & Tidewater Railroad, so that Coaldale is thus readily accessible to western Nevada and southeastern California.

A rapid examination of this field by the writer was confined to T. 2 N., R. 37 E., the township in which Coaldale is situated, as the coal seems to be limited to a part of the south-central and east-central portion of the township. Coal outcrops have been reported from other places within a radius of 15 miles, but these localities were not visited by the writer.

The writer wishes to acknowledge the cordial cooperation of Messrs. Rovnianek, Darms, and others, which was of material assistance during the field operations.

## LAND SURVEY.

The township was surveyed in 1884, the corners being marked by stone monuments without pits. Since then portions of the township in the Monte Cristo and Silver Peak ranges have been staked for placer, lode, and coal claims, and at the present time there is much confusion in distinguishing between these corners. Four Government corners were identified with little doubt, and three others were regarded as probably official.

### TOPOGRAPHY.

This township extends over the low pass between the Monte Cristo and Silver Peak ranges. As may be seen by reference to the map (Pl. XXIII), there is a region of sharp relief in the southwestern part of the township and one of lesser relief in the northeast, whereas the greater portion slopes gently to the west. In the northeast corner there are lava-capped hills, outliers of the Monte Cristo Range. West of this range and adjacent to the township is Columbus Salt Marsh.

The accentuated topography in the southern part of the area is mainly due to a series of block faults at the north end of Silver Peak Range. These tilted blocks have surface gradients on the northeast equal to the dip slope, but on the southwest or south they present abrupt scarps. On the faces of some of these scarps the coal is exposed in outcrop. The maximum relief is about 2,000 feet.

There are several springs in the southern tier of sections, but the drainage channels carry no water save after exceptionally heavy rains. Vegetation is confined to the usual desert plants.

### GENERAL GEOLOGY.

#### STRATIGRAPHY.

No fossils were obtained by the writer, but previous field work<sup>1</sup> indicates that the lowest formation here exposed is probably either Eocene or Miocene. This formation, consisting of tuffs, sandstones, and coal beds, is capped by late Tertiary lavas, ranging from rhyolite to basalt. The geologic section shown in figure 10, which is based on measurements made in sections 28, 29, and 33, probably represents an average for the southern portion of the township.

On account of the numerous displacements, accurate measurements of formations are almost impossible, but the section shown in figure 10 is probably nearly correct for the country adjacent to the north end of Silver Peak Range. To the north and west the formations may be thinner and may lack the coarser gravel and probably the coal. The more nearly level portions of the area to the west and north are covered with Quaternary gravel and alluvium.

The strata above the coal beds are made up largely of tuffs, conglomerates, and unsorted gravel capped by acidic and basic lavas. The gravel contains pebbles of basalt, granite, rhyolite, and quartz. In some places the tuffs are indurated and resemble quartzite. The total section represented above the coal is about 370 feet thick, but the broken condition of the beds renders accurate measurements impossible.

<sup>1</sup> Spurr, J. E., Coal deposits between Silver Peak and Candelaria, Nevada: Bull. U. S. Geol. Survey No. 225, 1904. Ball, S. H., A geologic reconnaissance in southwestern Nevada and eastern California: Bull. U. S. Geol. Survey No. 308, 1907. Spurr, J. E., Ore deposits of the Silver Peak quadrangle, Nevada: Prof. Paper U. S. Geol. Survey No. 55, 1906.

North of the fault block a large area is probably underlain by one or more coal beds, but as no coal outcrops were found north of the center of this township, the presence and depth of coal in that portion of the valley are problematical. This land is valuable only for the minerals it may contain, as the surface is not suited for agriculture.

North of this township there are limestones, probably of Pennsylvanian age, surrounded and in places covered with Tertiary tuffs and lavas. In this vicinity the later lavas are andesites and basalts.

The same beds seem to outcrop in the northeast and the southwest corners of the township, but in the former locality the coal is apparently absent, or at least is not exposed. Although coal outcrops have been reported from this vicinity, none were found by the writer, and if present they are probably on the edge of Big Smoky Valley to the east. Coal has been reported from Fish Valley, which lies west of Silver Peak Range, but the time available was not sufficient for a trip to this locality.

The coal beds now being prospected and developed outcrop along the south side of this township and apparently are four in number.

**STRUCTURE.**

Faulting has occurred in both ranges, the result being that the strata dip toward the low pass between them.

The structure at the north end of the Silver Peak Range is characteristic of a type very common throughout the Great Basin. Parallel faults have been accompanied by relative elevation of long, narrow blocks and a corresponding depression of adjacent portions of the crust. A

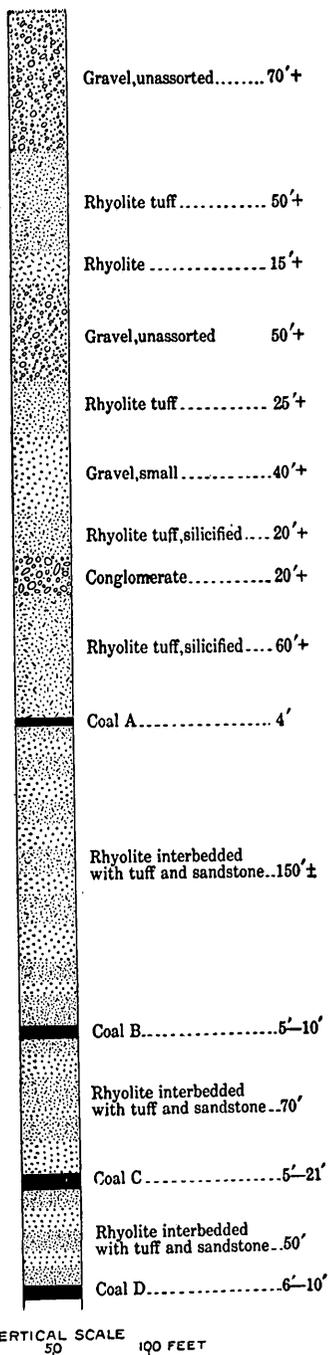


FIGURE 10.—Generalized section of strata exposed in secs. 28, 29, and 33, T. 2 N., R. 37 E., Coaldale coal field, Nev.

huge block, which extends across the range and is half a mile wide at its western end, has been depressed, leaving a bold scarp over 1,000 feet high on the south side of the fault. Accompanying the subsidence of this block a considerable thrust was developed along a line east of north and west of south, which has resulted in a series of fractures roughly parallel to the main fault plane. The section here exposed does not show any sedimentary beds, however, except some rhyolitic tuffs. The greater portion consists of sheets of rhyolite with some basalt. North of the block the sedimentary rocks are exposed and dip to the northeast. Near the fault these sedimentary beds show a reverse dip, probably due to the drag of the downthrown block. Step faults are numerous along the north edge of the displaced block and are generally parallel to it, the downthrown portion lying to the north. A few transverse faults extending north and northeast were also noted. The strata in these tilted blocks dip to the northeast at angles ranging from  $6^{\circ}$  to  $77^{\circ}$ , the dip lessening as the valley or pass is approached.

The south end of Monte Cristo Range shows step faults in which the downthrown side is to the south. The sedimentary beds are exposed in outcrop here and dip to the southwest.

A drill hole has been put down in sec. 28, near the west quarter corner, and another near the southeast corner, but the records are not available. In both of these localities the strata are folded and broken and a shallow hole would yield results of little value. The fact that these results did not stimulate the parties to further development indicates that no encouraging data were obtained.

#### THE COAL.

The material in the coal beds shows all gradations from black shale to coal having a brilliant luster. There is considerable bone and sandstone parting, especially in the two younger beds, and the ash in the best coal is rather high. Local variations are pronounced and lenses of good coal are usually of small extent. The aggregate coal in an exposed section may amount to 2 or 3 feet, but it is usually made up of thin streaks. On the other hand, the coal does not slack rapidly and is reported to be a fairly good steaming coal, an excellent gas coal, and to coke well.

#### BED A.

This coal bed outcrops near the north line of sec. 29 and strikes south of east across secs. 27, 28, 33, and 34. Faulting has caused this bed and the next lower one to outcrop in parallel ridges, so that in places identification of the coal bed is extremely difficult.

In some localities in sec. 29 this bed is nearly 4 feet thick, but it contains many partings of rhyolitic sandstone and bone, and although opened by prospect slopes on the outcrop does not seem to contain

clean coal except in thin streaks ranging from a fraction of an inch to 3 inches in thickness. Apparently the only exception to this general condition is near the east quarter corner of the section at the oldest coal prospect in the district (location No. 1,<sup>1</sup> in section 29), which consists of a slope about 380 feet long at an angle of 22°. The strike is S. 27° E. At the outcrop the coal bed is 42 inches thick with many small partings and some shaly coal. Some distance below the outcrop the quality improves and good coal is reported to have been taken out, but the bed thins to less than 3 feet at a distance of 150 feet. The lower part of the slope was not accessible at the time of this examination, but it is reported that the bed is thinner and the coal is of a poorer quality at the end of the slope than at the surface. Work on this prospect has long been discontinued.

From an examination of the coal in the upper 150 feet of slope it is believed that deposition took place under varying conditions. Quiet swamp periods, favorable to the accumulation of vegetable mold and peat, were occasionally interrupted by arid seasons or floods which covered the organic material with thin layers of sand or silt. Near the outcrop the rocks are badly weathered and this condition gives the impression that there is little or no good coal in the bed. Lenses of coal are present but can not be depended on, and render an estimate of available coal very uncertain.

Near the north quarter corner of this section another prospect slope (location 2) was sunk on what seems to be the same bed but was abandoned because of the poor quality of the coal. This opening was drifted up with sand and could not be entered. The coal dips N. 27° and strikes S. 8° E.

In secs. 26, 27, 35, and 36 this bed has been opened in several places (locations 3, 4, 5, and 6) but shows very little coal, less than 1 foot in a 3½-foot section.

#### BED B.

The next lower or second bed is about 150 feet below the top coal and seems to indicate more stable conditions of deposition but not uniform enough to produce good coal. The coaly streaks are thicker, as is the bed itself, but so are the partings, which are more numerous.

Northeast of the center of sec. 29 a prospect (location 7) has been opened on this bed where the dip is 26° NE. and the strike N. 25° W. The opening is about 5 feet square and extends 150 feet down the dip but, owing to numerous breaks in the roof, was not carefully examined. As far as could be noted from the mouth of the opening the bed contains very little clean coal, but there are numerous partings of sandstone and bone, ranging in thickness from less than

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<sup>1</sup> Numbers refer to locations on Pl. XXIII.

an inch to more than 6 inches. The roof, which was originally a rhyolitic tuff, has been silicified until it now resembles a quartzite.

Northwest of the east quarter corner of sec. 29 the same bed is exposed in outcrop and has been prospected (location 8). The coal dips  $22^{\circ}$  E. and strikes N.  $2^{\circ}$  W. Folding and faulting have disturbed the strata in this vicinity, and a given dip or strike is not ordinarily continuous for more than a short distance. At this place the bed is nearly 6 feet thick but contains less than 2 feet of coal. The thin streaks of coal that are present are bony and probably have a high ash content.

Near the center of the NE.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  of this section, and close to the oldest prospect, previously mentioned, this bed is exposed in outcrop (location 9). Although the bed is nearly 7 feet in thickness, about one-third of it consists of bone and no good coal was noted in the remaining portion.

About one-fourth mile south of this point the same bed has been prospected on an outcrop that strikes N.  $65^{\circ}$  W. (location 10). The dip at the mouth of the prospect pit is  $36^{\circ}$  N., but lessens to  $20^{\circ}$  at a distance of about 100 feet from the outcrop, where the strike is N.  $68^{\circ}$  W. The opening on the coal has exposed an overthrust fault diagonally across the section, in which there has been a displacement of 2 feet. At the end of the slope, about 100 feet from the outcrop, the coal is apparently of good quality and the bed is nearly 10 feet thick. At the time of examination no work was being done on this prospect, although the coal is of good quality and easily mined.

On the opposite side of the draw, about 350 feet south of west of this opening, is an outcrop apparently on the same bed. It is in a large displaced block, and the coal is broken and badly weathered. The bed has been prospected (location 11) by a slope about 60 feet in length, but although the bed is 6 feet thick there is only about 1 foot of good coal.

Northwest of this location, in the NW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  of this section, is a shallow prospect pit (location 12) on the same bed. At this point the dip is  $9^{\circ}$  W. and the strike is N.  $9^{\circ}$  E. The slope is 20 feet long and reveals a bed 8 feet thick which contains little good coal. The coal occurs in thin benches, the thickest measuring 6 inches, which aggregate nearly 2 feet of coal in the entire section.

Just east of the west quarter corner of sec. 28 there is a prospect slope (location 13) driven on this bed, but, owing to the bad condition of the roof and the old timbering, the slope was not entered. The dip is  $31^{\circ}$  E. and the strike is N.  $5^{\circ}$  W.

The bed outcrops along the south line of sec. 28 and in sec. 33. Pits at various places (locations 14 and 15) along this outcrop show very little clean coal. The thickness of the bed is fairly uniform,

averaging from  $5\frac{1}{2}$  to 6 feet, but numerous partings ranging from thin streaks to more than 1 foot in thickness make up most of the section, and what little coal is present is dirty and bony.

#### BED C.

About 70 feet below the second bed is another, which is exposed in outcrop at most of the places where bed B was noted. In general, the conditions attending the deposition of this bed seem to have been somewhat more stable than those which determined the character of the other two beds. The partings are fewer and are mostly bone rather than sandstone.

Near the center of the SE.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 29 bed C has been prospected. Owing to a roll in the bed, probably near a fault, the dip changes from  $12^\circ$  to  $31^\circ$  E. and the strike from east of north to west of north. There are two abandoned slopes (location 16), each about 60 feet long. Some good coal is present in each, but the quality varies in short horizontal distances. In one slope there is a large "horse" of rhyolitic tuff containing carbon particles, the largest being one-fourth inch in length. This bed is exposed in outcrop in several places (locations 17 and 18) in the SE.  $\frac{1}{4}$  sec. 29 but has not seemed to warrant careful prospecting, because of the large percentage of bone and sandstone partings. Its outcrop extends across the south side of sec. 28 and into sec. 33 (location 21), where the bed is being developed by Mr. H. A. Darms.

#### BED D.

A coal bed which seems to be lower, but which may be equivalent to the one just described, is exposed in outcrop near the center of the SE.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 29, where it is being developed by the Nevada Coal & Fuel Co. (location 19). In this vicinity the strata have been folded and displaced to such an extent that it is difficult to determine exactly where the coal bed belongs, but underground development indicates that this is a fourth bed, lying about 50 feet below bed C.

The exposed outcrop is at the crest of a fold and shows the coal to be crushed and faulted. At the mouth of the present working the bed measures 6 feet in thickness, but there are numerous partings and the coal is badly shattered. This mine is about 300 feet north-east of the edge of a huge downthrown block which marks the northern end of the Silver Peak Range. The coal bed dips toward the fault at an angle of  $39^\circ$  and strikes N.  $26^\circ$  E. Locally the coal appears to be good, but shearing and folding have so crushed the bed that it is difficult to estimate its original thickness or to determine its quality in undisturbed portions. Little is known of this bed, as but one other exposure has been found (location 20), near the north line of sec. 33, and several prospect pits have failed to reach it, but this failure is probably due to the presence of many faults.

## DEVELOPMENT.

*Nevada Coal & Fuel Co.'s mine.*—The mine of the Nevada Coal & Fuel Co. (location 19) is situated in the S.  $\frac{1}{2}$  SE.  $\frac{1}{4}$  sec. 29.

An entry was first driven S.  $17^{\circ}$  W. on bed D and turned to a more southerly direction about 30 feet from the mouth. The bed at this place measures 6 feet and contains between 2 and 3 feet of good coal. About 200 feet from the mouth of the mine the bed is cut off by a fault in which the south side is downthrown, and the entry continues in another coal bed, probably bed C, of better quality, containing about 4 feet of good coal, which is reported to be the best coal on the property. Its southward dip is due to the drag of the fault block a short distance to the south. The south end of the entry was full of water at the time of the writer's visit, and could not be examined.

In October, 1911, the company began work on the property and started a slope on bed D at the mouth of the old entry but in a direction S.  $26^{\circ}$  E., where the dip is  $39^{\circ}$ . Thirty-five feet down the slope this bed dips under the incline, and 15 feet farther a steeply dipping coal bed, probably bed C, was intersected and the incline continues on this bed. At a slope depth of 75 feet the dip lessens to  $6^{\circ}$ . A crosscut from this slope to the older entry lies in coal the entire distance and strengthens the impression that the coal bed encountered south of the fault in the older entry is bed C.

In its southern portion the newer entry has reached a fault zone where the coal is cut off by a wall of altered rhyolite or monzonite. Slickensides are abundant along this fault plane. Here the bed is nearly 10 feet thick and contains about 6 feet of good coal. Since the writer's visit the bed has been crosscut to the north and the coal is reported to be of better quality. Two samples for analysis were taken in this mine in bed C.

Sample 13980, in the table of coal analyses, was secured at a place about 100 feet from the mouth of the slope. It was taken by making a cut across the entire coal bed, which is here about 8 feet thick.

Sample 13979 was taken at a point 150 feet from the mouth of the slope and represents the entire bed, which is here 9 feet thick.

Sample 14409 was taken from a block of coal representing a bench 12 inches thick in this mine. The block was sent by freight to Washington and the sample was cut a month or more after the block was shipped. It shows the nonslacking property of the coal, but the ash is only half that in an average sample.

One car of coal was shipped to Tonopah and Goldfield during the winter of 1911-12 for free distribution, but the high ash content offsets to a considerable extent its value as a domestic fuel. Arrangements have been completed for shipping one car a day to those places

and the possible successful use of this coal is a matter of considerable interest.

This mine employs 12 men. At present a 15-horsepower gasoline engine using distillate supplies power.

There does not seem to be any gas in the mine and acetylene lamps are used. One small dust explosion occurred on February 27, 1912, but no damage was done.

*Darms mine.*—The Darms mine (location 21) is situated in the NE.  $\frac{1}{4}$  sec. 33 and is on bed C. At the outcrop the bed dips  $60^\circ$  NE. At a distance of 200 feet down the slope the bed measures 21 feet in thickness and contains 6 feet of fair coal just above the middle of the bed. The lower portion of the bed is composed of bone with some thin coaly streaks and the upper portion is principally bone. At this depth the dip is  $70^\circ$  and the strike is N.  $53^\circ$  W. The dip increases below this until at 245 feet it is  $77^\circ$  and lessens again at 250 feet to  $70^\circ$ . At this depth the bed is 8 feet thick but is badly broken and crushed from movement. At 265 feet the dip is  $52^\circ$  and at 280 feet the dip lessens to about  $10^\circ$ . A small drift 21 feet northeast from the slope at this depth passes into a rhyolitic tuff containing carbon particles.

At 320 feet the slope enters coal again, probably bed D. Here a flow of water amounting to 800 gallons a day was encountered, but is easily controlled by a small dam. At 330 feet the dip lessens to  $13^\circ$  and the bed is 3 feet thick. The present workings are 370 feet deep and at that depth the coal is very bony, shaly, and poor. A sample for analysis (No. 13978) was taken from bed C in the drift at a depth of 280 feet and 20 feet from the slope. The sample was obtained by cutting a channel across the bed and consequently represents the entire bed.

A small amount of white damp has been noted at the 280-foot depth, but it has not caused any trouble.

Power is at present supplied from a 25-horsepower steam engine, and hoisting is done with a skip of 400 pounds capacity. Two shifts are worked.

#### CHARACTER OF COAL.

As noted in previous writings<sup>1</sup> the coal in the upper two beds is dull, whereas that in the lower beds is brighter and some has a brilliant luster. A fresh fracture shows a number of streaks of bright vitreous luster alternating with dull layers. Some joints are present, but faults and folds have obscured this phenomenon in most of the exposures. In some of the workings, gypsum, alum, and iron salts are conspicuous along fractures and joint planes. Picked samples

<sup>1</sup> Stoneham, W. J., A Nevada coal field: Eng. and Min. Jour., June 23, 1904, p. 1009. Spurr, J. E., Coal deposits between Silver Peak and Candolara, Esmeralda County, Nev.: Bull. U. S. Geol. Survey No. 225, 1904, pp. 280-292.

from the coal burn with a long flame and leave a moderate amount of clean gray ash. Most of the coal, however, is so intimately mixed with bone and with other impurities that even hand sorting would be but moderately successful in obtaining a marketable product.

Some jiggling tests made on this coal at the Mackay School of Mines<sup>1</sup> bring out an important characteristic. The ash content in the jiggled sample is as high as that in the unwashed product. This indicates a uniform distribution of the impurities. Picked samples have a high fuel value and the coal is reported to yield a very good coke.

Analyses of the coal are given in the following table:

*Analyses of coal samples from T. 2 N., R. 37 E., Esmeralda County, Nev.*

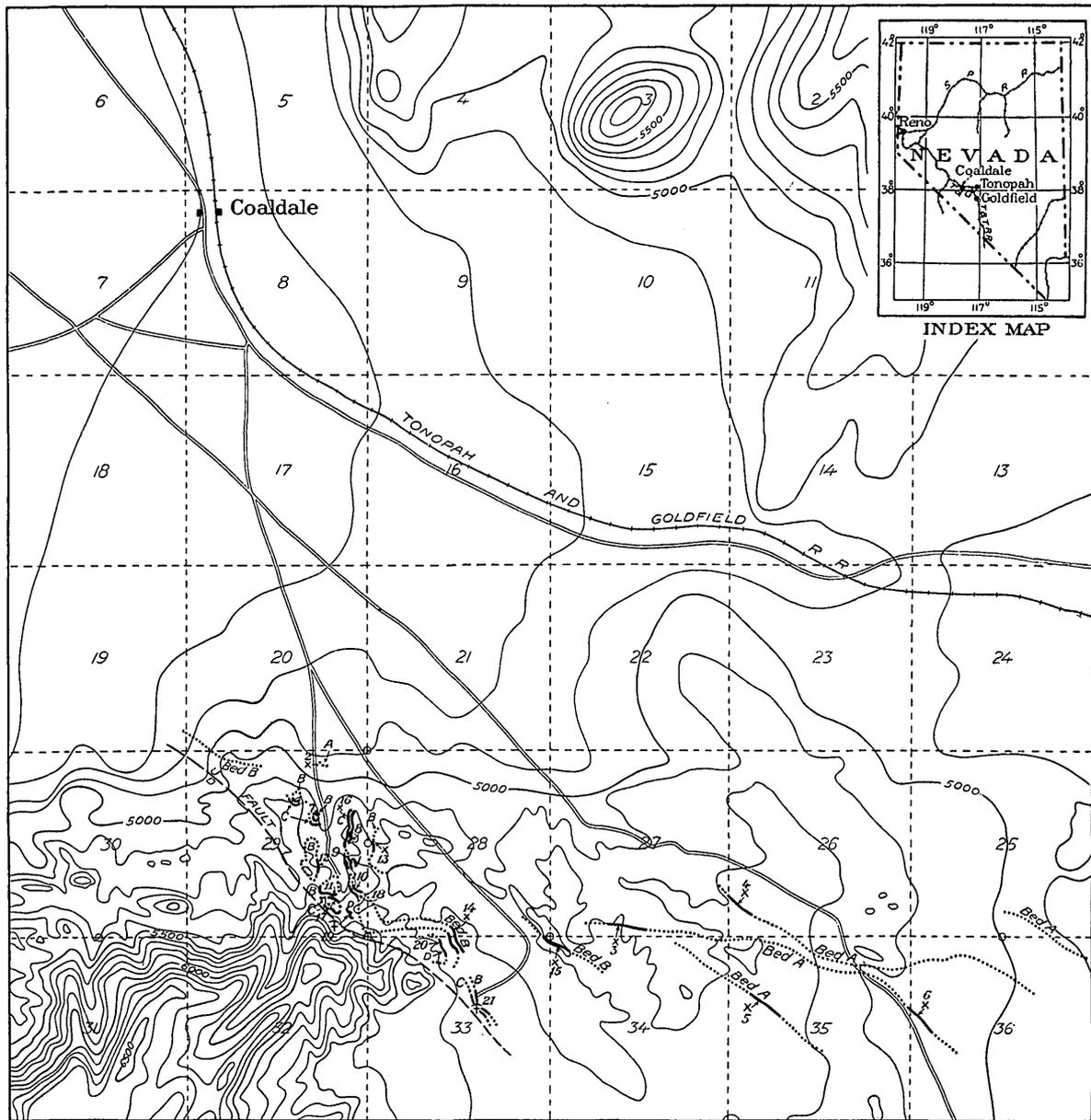
[Made at the Pittsburgh Laboratory of the Bureau of Mines. A. C. Fieldner, chemist in charge.]

Laboratory No.	Land section.	No. on Plate XXIII.	Air drying loss.	Form of analysis. <sup>a</sup>	Proximate.			Ultimate.		Heating value.		
					Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Calories.	British thermal units.	
13978	Mine of H. A. Darns (coal bed C).	33	21	0.6	A	2.1	33.7	33.7	30.5	7.18	5,330	9,590
					B	1.5	33.9	33.9	30.7	7.22	5,360	9,650
					C	.....	34.4	34.4	31.2	7.33	5,440	9,800
					D	.....	49.9	50.1	.....	10.65	7,905	14,230
13979	Mine of Nevada Coal & Fuel Co. (coal bed C).	29	19	.7	A	1.9	26.7	27.4	44.0	.60	4,500	8,100
					B	1.2	26.9	27.6	44.3	.60	4,530	8,160
					C	.....	27.3	27.9	44.8	.61	4,585	8,260
					D	.....	49.4	50.6	.....	1.11	8,310	14,950
13980	.....do.....	29	19	.2	A	1.6	31.3	35.5	31.6	7.42	5,330	9,600
					B	1.4	31.4	35.6	31.6	7.43	5,340	9,620
					C	.....	31.8	36.1	32.1	7.54	5,420	9,760
					D	.....	46.9	53.1	.....	11.10	7,980	14,370
14409	.....do.....	29	19	.1	A	1.6	39.2	43.8	15.4	6.64	6,765	12,180
					B	1.5	39.2	43.8	15.5	6.65	6,775	12,190
					C	.....	39.8	44.5	15.7	6.75	6,875	12,380
					D	.....	47.2	52.8	.....	8.00	8,155	14,680

<sup>a</sup> A, Sample as received; B, air-dried sample; C, moisture-free sample; D, moisture and ash free sample.

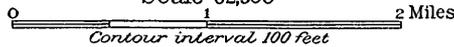
The analyses show that the coal has a high heat value and is bituminous, but this desirable feature is partly offset by a high percentage of ash-making constituents. The coal keeps well, slacks very little, and may meet an economical and efficient use in the gas producer. By using it as a gas coal, a power plant might be established at the mines and the neighboring towns and camps supplied with electric power more cheaply than under present conditions. However, it probably will not bear heavy transportation charges, such as prevail in this State, and can scarcely hope to have extensive use as a domestic fuel.

<sup>1</sup> Oral communication from Director G. J. Young.



Topography from Tonopah and Silver Peak sheets, U.S. Geological Survey

Scale  $\frac{1}{62,500}$



Contour interval 100 feet

LEGEND

- |   |   |   |                                    |   |                                     |  |                   |   |                   |
|---|---|---|------------------------------------|---|-------------------------------------|--|-------------------|---|-------------------|
|  | <i>Lines show elevation above sea level</i> |  | <i>Outcrop of coal bed exposed</i> |  | <i>Outcrop of coal bed inferred</i> |   | <i>Local mine</i> |  | <i>Wagon road</i> |
|   |   |   |                                    |   |                                     |  | <i>Prospect</i>   |   |                   |

MAP OF THE COALDALE COAL FIELD, ESMERALDA COUNTY, NEV.