COAL.

THE COALVILLE COAL FIELD, UTAH.

By Carroll H. Wegemann.

INTRODUCTION.

One of the oldest coal-mining districts in Utah is situated about 30 miles northeast of Salt Lake City, in the vicinity of the little town of Coalville, which lies in the valley of Weber River. High-grade subbituminous coal has been mined in this district for over 50 years, and the mines now operating are large and well equipped. The coal beds, however, are involved in extensive rock folding and are broken by faults of considerable magnitude. The extent and limits of the coal-bearing area have therefore been in some doubt, and the present study was undertaken with the view not only of making a general geologic study of the area but of working out in detail the rock structure, correlating so far as possible the coal beds exposed at the several localities, outlining the probable productive area, and making estimates as to the depths of the coal beds within it.

The Coalville field as here defined is situated in Tps. 2 and 3 N., Rs. 5 and 6 E. Salt Lake principal meridian. The coal-bearing rocks of Colorado age have been brought to the surface by folding, which took place for the most part prior to the deposition of the great mantle of Tertiary conglomerate belonging to the Wasatch formation that covers much of this region. Later erosion has removed the Wasatch over part of the fold and exposed the underlying coal-bearing rocks, which, so far as surface exposures are concerned, are separated from all others of the same age.

The field work for this report was done by the writer late in September and early in October, 1911, and in September, 1912. Previous geologic work in the field and its mention in literature are briefly summarized below.

In 1859 Capt. J. H. Simpson made a reconnaissance of a broad territory including the Coalville field, and his results were published by the Engineer Department, United States Army, in a volume entitled "Explorations across the Great Basin of the Territory of Utah," containing a chapter on geology by Henry Engleman. A summary of his results also appeared in the Proceedings of the Academy of Natural

Sciences of Philadelphia for 1860. Clarence King discusses the stratigraphy and gives a description of the Coalville field and mining operations in the report of the United States Geological Exploration of the Fortieth Parallel, volume 1, chapter 4, section 3, and volume 3, chapter 7. Hayden describes the Coalville area briefly in his fourth annual report. Mention is made of mining operations near Coalville in a book entitled "Resources of Utah, 1879," published by the Utah Board of Trade, and in certain of the reports of the coal-mine inspectors of the State of Utah. In 1890 the stratigraphy of the region was worked out in detail by T. W. Stanton and published in Bulletin 106 of the United States Geological Survey. The economic resources of the area were examined by J. A. Taff and briefly summarized in a report on the "Weber coal field," published in Survey Bulletin 285. A. C. Veatch, in "Geography and geology of a portion of southwestern Wyoming" (United States Geological Survey Professional Paper 56), gives a short description of the Coalville section for comparison with the section in Wyoming. His report contains also a very complete bibliography, which should be consulted by anyone interested in the study of this general region.

TOPOGRAPHY.

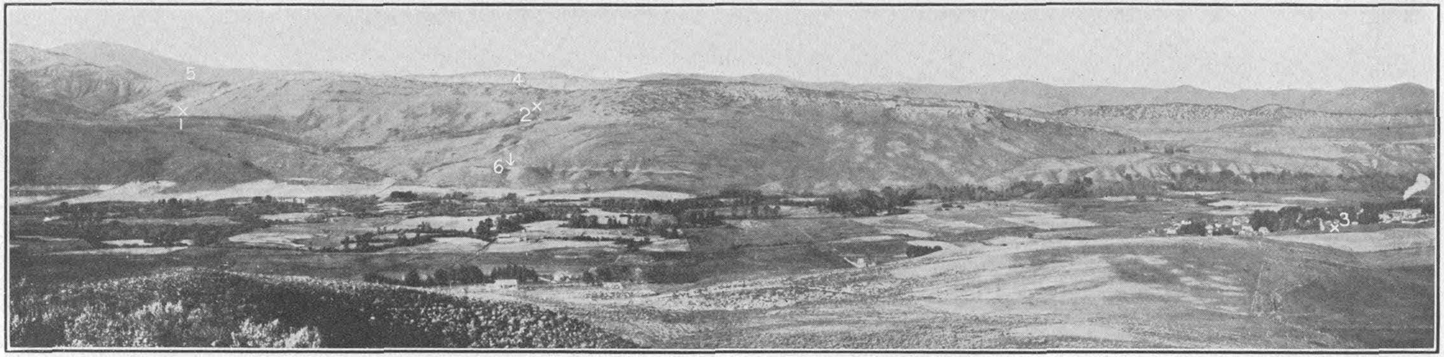
The difference in altitude from the flood plain of Weber River to the crests of the high divides which shut in the valley of that stream is about 2,000 feet. These divides are composed of strata of the Wasatch formation, and in the vicinity of Coalville there are several escarpments of considerable height formed by sandstone beds of Cretaceous age, which are here brought to the surface on the crest of the fold already mentioned. (See Pl. VI.)

The principal stream of the area is Weber River, which flows from south to north past the town of Coalville, where it is joined from the east by Chalk Creek. Two miles north of Coalville a smaller tributary, known as Grass Creek, comes in from the northeast; and at Echo City, 5 miles northwest of Coalville, the Weber is joined by the stream of Echo Canyon, which flows southwest. The main line of the Union Pacific Railroad runs through Echo Canyon, and the Park City branch follows the Weber from Echo City to Park City. Spurs run to the mines on Grass Creek and Chalk Creek, in the Coalville field.

GEOLOGY.

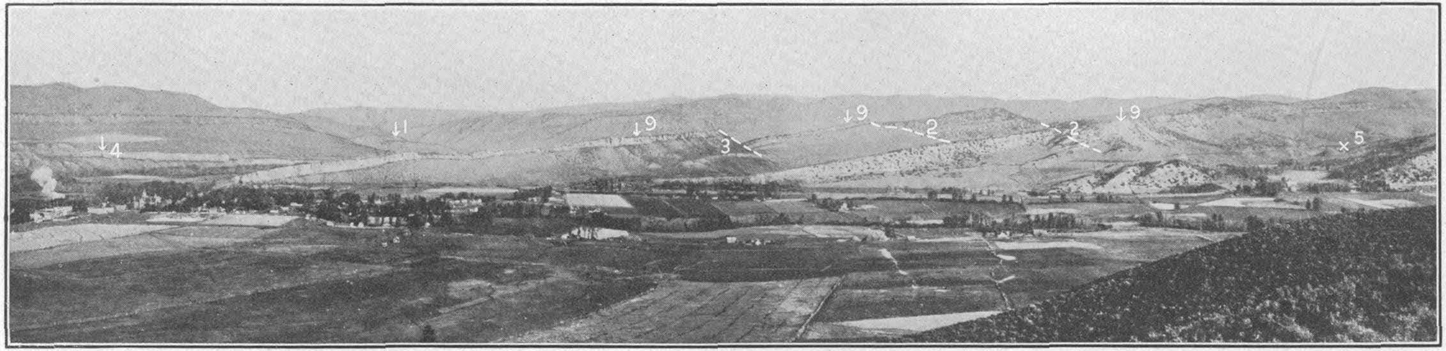
STRATIGRAPHY.

The rocks exposed at Coalville comprise a stratigraphic section about 9,000 feet in thickness, but, although the area has been studied by several geologists, the formation boundaries are by no means definitely determined. A composite section, the parts of which were



A. VALLEY OF WEBER RIVER, UTAH, FROM THE EAST.

Town of Coalville on right. 1, Carleton mine; 2, Sargent mine; 3, Buell & Bateman mine; 4, sandstone (No. 4 of section, p. 163); 5, Wasatch formation unconformable on Cretaceous beds; 6, Cretaceous conglomerate. (See p. 177.)



B. VALLEY OF CHALK CREEK, UTAH.

Looking north from same viewpoint as that from which Plate VI, *A* was taken. Town of Coalville on left. 1, Location of Echo City; 2, fault (see top of p. 169); 3, minor fault; 4, outcrop of sandstone (No. 4 of section, p. 163); 5, Wasatch mine; 9, outcrop of sandstone (No. 9 of section).

measured at various places in the vicinity of Coalville, is presented below:

Stratigraphic section at Coalville, Utah.

	Feet.
1. Top. Conglomerate of Wasatch formation; as exposed in Echo Canyon over 1,000 feet thick but probably reaching much greater thicknesses in other localities; color, various shades of red; contains bowlders 1 foot or less in diameter. Unconformable on all older formations...	1,000+
2. Soft beds, prevailingly sandy, usually concealed in grassy slopes; fossil leaves and fresh-water shells and thin beds of conglomerate occur at intervals...........	2,500
3. Beds prevailingly sandy but not well exposed; contain marine shells..	1,650
4. Sandstone, white, coarse, forming the prominent ridge west of the town of Coalville and also north of Dry Hollow..	200
5. Shale and thin beds of sandstone; at the base a coal bed, usually in two benches, formerly mined in Dry Hollow and at the Carleton mine............................	90
6. Shale..	880
7. Conglomerate, brown; pebbles principally of limestone and sandstone, the largest 6 inches in diameter........	40–100
8. Shale (lacking in some sections, the conglomerate resting directly on the underlying sandstone)................	180
9. Sandstone, forming the pronounced cliff just northeast of the town of Coalville, probably equivalent to the Oyster Ridge sandstone member of the Frontier formation of southwestern Wyoming......................	100–200
10. Shale, pink at base....................................	750
11. Sandstone, in places conglomeratic....................	30–130
12. Coal bed, locally known as the "Wasatch" bed, mined at Coalville..	5–12
13. Sandstone, in some sections very shaly................	40–80
14. Shale and sandstone alternating, white and gray, with numerous beds of pink shale, especially toward the base.	750
15. Coal beds, thin, three or four exposed in Spring Canyon, associated with carbonaceous shale	30
16. Shale, terra cotta in color, with three thin beds of white or gray sandstone..	850
	9,250±

Stanton,[1] in his discussion of the formations of the area, states that fossils collected from the strata ranging from a horizon 100 feet below the thick bed of coal mined at Coalville to the bed of conglomerate about 1,000 feet above that coal belong to a single fauna, which is of Colorado age. This part of the section resembles faunally and lithologically the Frontier formation of southwestern Wyoming, later described by Veatch, and doubtless represents at least a part of that

[1] Stanton, T. W., The Colorado formation and its invertebrate fauna: U. S. Geol. Survey Bull. 106, p. 40, 1893.

formation. Whether or not the beds for 1,000 feet above the conglomerate are also of Colorado age Stanton was uncertain at the time of the publication of his paper. Since then, however, he has come to believe that possibly the thin coal bed which lies about 2,000 feet above the thick bed at Coalville, together with the next higher sandstone bed (No. 4), should also be classed as Colorado. This belief is strengthened by some collections made by Veatch [1] in southwestern Wyoming, where the fossil *Inoceramus exogyroides*, which is characteristic of the Colorado group, was found at a horizon 3,000 feet above that of bed No. 4 of the Coalville section. Evidence against the Colorado age of this coal and associated beds is furnished by a collection of fossil leaves which Stanton obtained about 45 feet above the highest coal in the Coalville area. These leaves were at first assigned by Knowlton [2] to the Laramie but are now believed by him to be of Montana age. The later determination accords with Stanton's original statement that the top of the beds of Colorado age may be marked by the bed of conglomerate (No. 7) 1,000 feet above the thick coal bed at Coalville. The age of Nos. 2 and 3 of the section is also in doubt. The fossil collections indicate that No. 3 is marine. No. 2, up to the base of the conglomerate exposed on the Echo Canyon-Grass Creek divide, contains fossil leaves and fresh-water shells. Veatch describes a formation of shales and sandstones in southwestern Wyoming which he terms the Hilliard formation and which overlies the Frontier formation and is from 5,500 to 6,800 feet thick. This formation is marine, as indicated by the invertebrate fossils found at several horizons in it. It is probable that the coarseness of the materials, apparently occupying the same position at Coalville, is due to the fact that they were deposited nearer the shore line of the ancient land mass from which they were derived than the beds of southwestern Wyoming. This conclusion is supported by the sandy nature of the beds at Coalville that occupy the stratigraphic position of the Hilliard formation, and by the presence at Coalville of the conglomerate bed (No. 7) which is lacking in the Wyoming area, unless it is represented, together with the sandstone of No. 9, by the Oyster Ridge sandstone member of the Frontier formation, which is in some places conglomeratic. If the above-stated hypothesis is correct exact correspondence between the beds at Coalville, deposited in shallow water, and those in Wyoming, laid down farther from the ancient shore line, is not to be expected.

The conglomerate of Echo Canyon (Pl. VII, *B*) has been correlated by Veatch [3] with the Almy formation of southwestern Wyoming, which appears to be conformable in that area on the underlying

[1] Veatch, A. C., Geography and geology of a portion of southwestern Wyoming, with special reference to coal and oil: U. S. Geol. Survey Prof. Paper 56, p. 69, 1907.

[2] Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 8, 1900.

[3] Op. cit., p. 89.

Evanston formation. The Evanston is separated by a great unconformity from the underlying Adaville, which overlies the Hilliard. If divisions made in southwestern Wyoming could be applied to the Coalville section, there should be between the highest marine beds and the conglomerate of Echo Cañyon two fresh-water formations, the Adaville and the Evanston, separated by a great unconformity. Unfortunately the base of the conglomerate in Echo Canyon is not well exposed on the Echo Canyon and Grass Creek divide and the fossils obtained from the beds underlying it are too few to serve as a basis of correlation.

The age of the 1,700 feet of strata below the thick coal bed mined at Coalville is also doubtful, as fossils are rarely found in them. A small collection obtained near the group of thin coal beds of No. 15 is said by Stanton to suggest Bear River, but from the statigraphic relations exhibited in the field these beds seem to be several thousand feet higher in the section than the Bear River.

From Stanton's observations near Rockport, Utah, 12 miles south of Coalville, there appear to be 4,700 feet of beds between the Coalville coal and the horizon that corresponds with the top of the Aspen formation in southwestern Wyoming, which in turn overlies the Bear River where that formation is present.[1] In view of this fact, the occurrence of fossils suggesting the Bear River only 850 feet below the Coalville coal is worthy of note. In southwestern Wyoming the lower beds of the Frontier do not have the pink and red tints which are exhibited by the lowest beds exposed in the Coalville area.

From such evidence as is given above it is perhaps unsafe to draw any conclusions, but it seems probable that the beds exposed at Coalville from the base of the section at least to the conglomerate 1,000 feet above the "Wasatch" coal bed mined at Coalville are of Colorado age and belong to the Frontier formation. From the evidence of the plants collected by Stanton above the upper coal at Coalville it seems necessary to infer that the strata above No. 6 are not older than the Montana group and probably include the equivalent of part at least of the Hilliard formation described by Veatch. If, however, the evidence of the invertebrates is considered without reference to that furnished by the fossil plants, the line between the Colorado and Montana should probably be drawn considerably higher in the section, as suggested by Veatch—somewhere in the strata above the sandstone of No. 4. If it were drawn 1,200 feet above this sandstone it would mark the transition from marine to fresh-water deposits.

The following list of fossils with determinations and notes by T. W. Stanton, F. H. Knowlton, and W. H. Dall is given as bearing on the

[1] Op. cit., p. 44.

age of the rocks exposed at Coalville. For a full discussion of the paleontology of the region reference should be made to Stanton's work, already cited.[1]

Four miles north of Coalville, in sec. 21, T. 3 N., R. 5 E., about 630 feet below the base of the conglomerate in Echo Canyon:

Quercus sp.

Ficus pseudo-populus Lesquereux. A form regarded by Knowlton as post-Laramie, described originally from specimens obtained at Evanston and Green River, Wyo.

Ficus planicostata Lesquereux. Occurs in beds at Black Buttes, Wyo., regarded by Knowlton as of post-Laramie age.

Seven miles northeast of Coalville, in the SW. ¼ sec. 33, T. 3 N., R. 6 E., 210 feet above base of No. 2 of the section on page 163:

Small narrow leaves not well preserved, probably Salix or Sapindus.

About 1½ miles south of Coalville, in the NW. ¼ sec. 21, T. 2 N., R. 5 E., near the base of the Wasatch formation:

Land snail of the genus Polygyra, undescribed. Much more like the recent Polygyras than any of the Eocene species heretofore described from the western Tertiary.

In Clark's Canyon, 8 miles northeast of Coalville, upper surface of sandstone of No. 4:

Ostrea soleniscus Meek. This species has a great vertical range.

Fewkes Canyon, 7 miles northeast of Coalville, from No. 4 sandstone:

Ostrea coalvillensis Meek?

Inoceramus sp., possibly I. erectus Meek.

Judd Canyon, 7 miles northeast of Coalville, about the horizon of sandstone of No. 3:

Ostrea coalvillensis Meek.

Avicula sp.

Barbatia sp.

Corbicula sp.

Cardium sp.

Mactra arenaria Meek.

Corbula sp.

Chemnitzia sp.

Melania sp.

East of Huff Creek, 3 miles north of Upton, from 20-foot bed of oysters above coal bed:

Ostrea coalvillensis Meek. This species is associated with the coal bed of No. 5 and is probably confined in the Coalville field to that part of the section.

Three miles east of Upton, in Judd Canyon, about 400 feet above the base of No. 3:

Ostrea sp.

Inoceramus erectus Meek.

About 2½ miles above the mouth of South Fork of Chalk Creek, in the SW. ¼ sec. 11, T. 2 N., R. 6 E., from an isolated exposure of Cretaceous rocks on the north side of the creek:

Inoceramus labiatus Schlotheim.

Tellina modesta Meek?

Mactra emmonsi Meek?

Probably from a horizon higher than that of the "Wasatch" coal bed (No. 12). This collection has a bearing on the probable position of the "Wasatch" coal in this area, which is for the most part covered by Wasatch.

[1] The Colorado formation and its invertebrate fauna: U. S. Geol. Survey Bull. 106, 1893.

Half a mile south of Coalville, about 30 feet below the "Wasatch" coal bed (No. 12):

Ostrea soleniscus Meek.
Tellina modesta Meek.
Glauconia coalvillensis Meek.

These species belong to the fauna of the Colorado group and indicate a zone included in the Frontier formation in western Wyoming.

Three miles east of Coalville, in the NE. ¼ sec. 11, T. 2 N., R. 5 E., from strata apparently just below coal beds of No. 15:

Ostrea soleniscus Meek.
Modiola multilinigera Meek.
Barbatia micronema (Meek).

Horizon in the Colorado group, probably below the "Wasatch" coal bed (No. 12).

A quarter of a mile northeast of the last collection, in the SW. ¼ sec. 1, T. 2 N., R. 5 E., from strata between coal beds of No. 15:

Ostrea sp.
Corbicula durkeei Meek?
Pachymelania? sp.
Pyrgulifera sp.

This little collection is strongly suggestive of the Bear River fauna, but none of the fossils can be identified as typical specimens of Bear River species, and the collection is too meager to justify any positive statements about it. With the possible exception of the Ostrea it shows nothing in common with the preceding collection.

Two miles up Spring Canyon, in the NW. ¼ sec. 26, T. 2 N., R. 5 E., from sandstone ledge below coal beds supposed to belong to No. 15:

Ostrea sp.
Anomia sp.
Modiola multilinigera Meek?
Cardium? sp.
Cyrena? sp.

So far as can be determined from these fossils the horizon might be either near the local base of the Cretaceous or in No. 5.

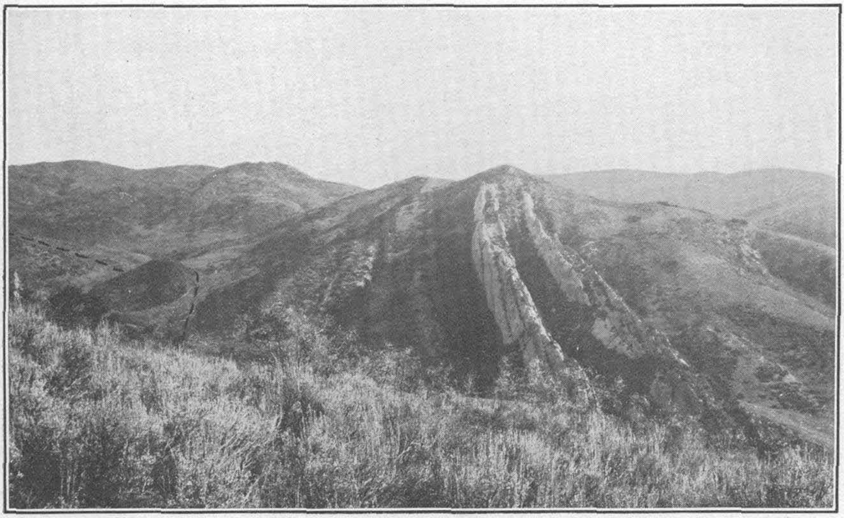
STRUCTURE.

The structure of the rocks in the Coalville area is that of a slightly overturned anticline. (See Pls. VIII, *A*, and XI.) On the northwest limb of this anticline the beds rise toward the southeast with dips of 15° to 30° and strike of N. 47° E., flatten rather abruptly on the broad, flat top of the fold, and descend precipitously on the southeast side with a strike of about N. 20° E. The whole thickness exposed at the surface, or about 9,000 feet, is involved in the fold, the coal descending in the syncline on the southeast from a surface altitude of 6,500 feet to approximately 500 feet below sea level and rising again to the surface about 4 miles east of the anticline, on the northwest flank of a second fold which is probably connected on the north with the folds southwest of Evanston, Wyo. The south end of the Coalville anticline is obscured by the overlying Wasatch formation.

Several miles northwest of the Coalville anticline another and more abrupt fold brings the Cretaceous rocks to the surface in the valley of Weber River, 2 or 3 miles below Echo City. The fold is very narrow and apparently parallels that at Coalville. Whether or not this is the continuation of a fold which appears on Lost Creek, 15 miles northwest of the Coalville field, is uncertain. Lost Creek flows in what is apparently an anticlinal valley, the coal-bearing Cretaceous rocks being exposed well up in the hills on each side. Between the Lost Creek and Coalville anticlines lies the syncline of Echo Canyon, which involves to some extent the strata of the Wasatch and is probably much more pronounced in the underlying Cretaceous formations. (See Pl. VII, *B*.)

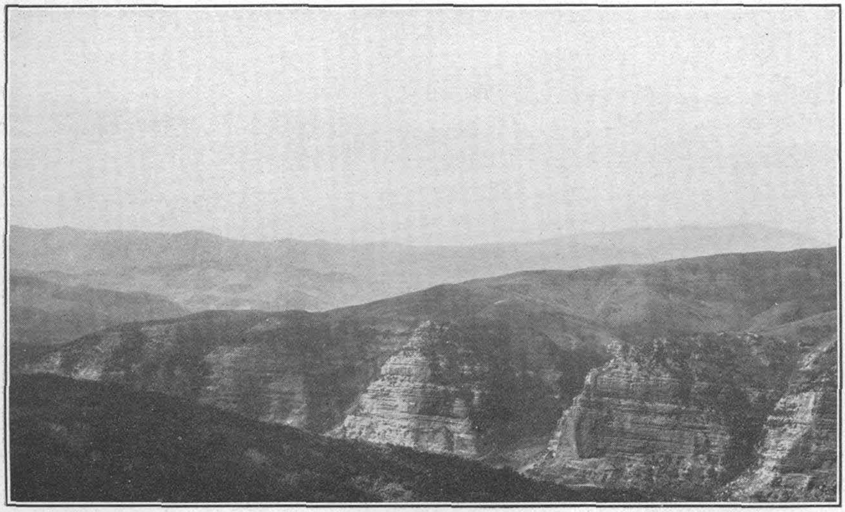
In the Coalville anticline, north of the town of Coalville, the beds strike about N. 35° E. Near the town, however, the strike changes, so that in the vicinity of the Sargent mine, on the west side of the Weber, it is N. 19° E. The upper beds hold the same strike for about a mile farther south to the point where they are covered by the overlying Wasatch deposits. (See Pl. VI, *A*.) They give no indication of a minor fold which involves the lower beds just southeast of the town of Coalville. The outcrop of the principal bed of coal, the "Wasatch" bed, formerly mined at the town, takes a direction approximately north and south at the old Buell & Bateman mine and, swinging to the southeast, is opened at the mine of the Superior Fuel & Briquette Co. From this place it swings to the northeast and east, thus outlining the small fold above mentioned, and is opened on the north end of the adjoining syncline at the old Howard mine in the NW. ¼ sec. 15. From this opening it can be traced a short distance to the southeast but is soon lost under the cover of Wasatch. It probably turns again in a south or southwest direction to conform with the strike of the coal beds exposed in Spring Canyon, but how far south it may extend before connecting with the outcrop marking the southeast side of the fold it is impossible to determine. The coal beds in Spring Canyon (Pl. VIII, *B*) appear from their position and the character of the associated strata to represent those north of The Narrows at Chalk Creek, which lie 850 feet below the "Wasatch" coal bed exposed at the Hoffman mine. (See Pl. VIII, *A*.) If the coal in Spring Canyon really belongs to this lowest coal group the anticline probably continues for a considerable distance farther south and may be directly connected with the anticline which crosses Weber River 1½ miles south of Wanship.

A little north and east of Coalville, at about the middle of the fold, a block of strata 2 miles in width from northeast to southwest has been dropped by faulting with reference to the adjacent beds. The faults bounding this block on the northeast and southwest are by no means simple ones. On the southwest four distinct faults may be observed distributed through a distance of 1¼ miles, the downward movement of the central block being thus distributed along four



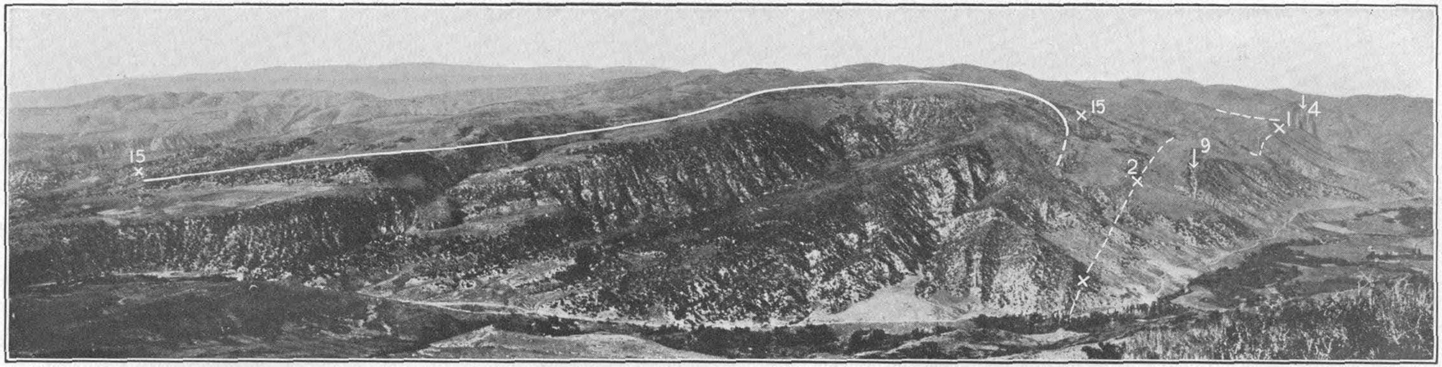
A. VIEW LOOKING NORTHEAST IN SEC. 28, T. 3 N., R. 6 E., UTAH.

Sandstone (No. 4 of section, p. 163) in vertical position. Abrupt turn of "Wasatch" coal bed (No. 12 of section) at northeast end of anticline shown by dotted line on left.



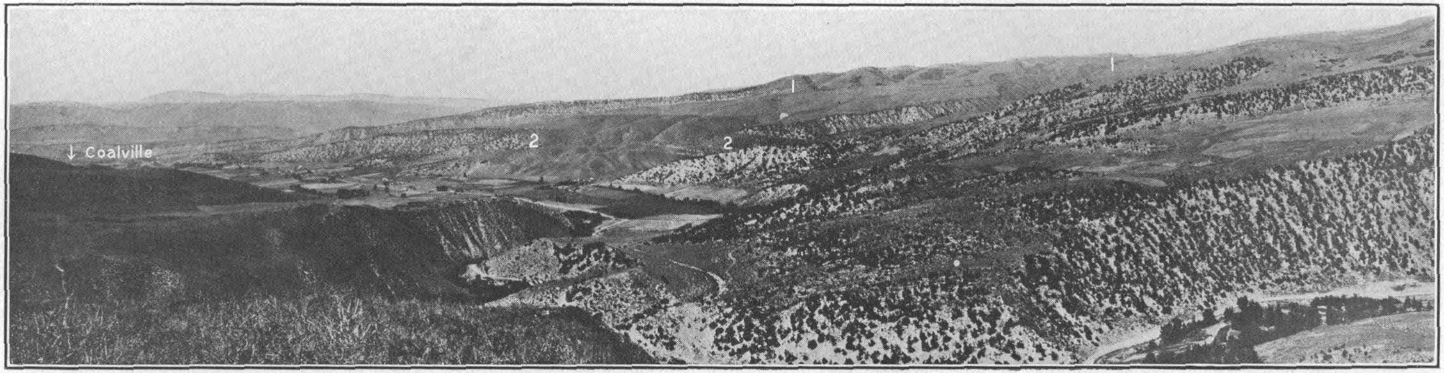
B. VIEW LOOKING WEST ACROSS ECHO CANYON, UTAH, NEAR ITS MOUTH.

Cliffs of conglomerate of Wasatch formation, the strata of which dip northwest into a syncline which adjoins the Coalville anticline.



A. LOOKING NORTH ACROSS CREEK FROM HILL IN SEC. 18, T. 2 N., R. 6 E.

Heavy line drawn on sandstone bed below coal (No. 15 of section, p. 163) outlines in cross section the crest of the anticline. Broken lines show position of "Wasatch" coal bed. In the distance its course with low dip around pitching end of anticline is indicated. (See p. 181.) 1, Clark prospect; 2, Hoffman mine; 4, sandstone (No. 4 of section, p. 163); 9, sandstone (No. 9 of section) in vertical position; 15, coal bed (No. 15 of section).



B. LOOKING NORTHWEST FROM THE NARROWS.

1–1, 2–2, Wasatch formation filling a pre-Wasatch stream valley and bounded on either side by lighter-colored strata of Colorado age. (See p. 171.)

VALLEY OF CHALK CREEK, UTAH.

different lines of fracture, although greatest along that shown in Plate VI, *B*. The fault bounding the displaced block on the northeast is apparently a simple fracture where it crosses Grass Creek, but a short distance to the south it breaks up into a number of faults, as is shown by an isolated mass of coal set off on each side by faults in the middle of sec. 27, T. 3 N., R. 5 E. (See Pls. VIII, *B*, and XI.) Numerous small faults have been noted in the northeastern workings of the Wasatch mine in the NE. ¼ sec. 3, T. 2 N., R. 5 E., and it is probable that these faults will be found to increase in size as the great fault is approached. The flattening of the rocks on the crest of the fold, which is approximately 3 miles in width, accounts for the fact that whereas the upper coal on Grass Creek is displaced less than half a mile by the great fault which crosses secs. 23, 26, and 35, T. 3 N., R. 5 E., the lower bed outcropping farther to the southeast and thus nearer to the top of the fold is displaced by the same fault a horizontal distance of over 2 miles. (See Pl. XI.) The movement was probably vertical, the block southwest of the fault being dropped, and the horizontal displacement may thus be accounted for by a movement of only a few hundred feet in the gently dipping beds near the crest of the fold. The trace of the fault to the south is somewhat uncertain. It is possible that the abrupt change in dip at The Narrows, in the SW. ¼ sec. 12, T. 2 N., R. 5 E., is in line with it, but whether or not it passes between the coal exposures in the SW. ¼ sec. 1 and the NE. ¼ sec. 11 of the same township is undetermined.

The abrupt change in strike of the rocks at the northeast end of the fold is noteworthy. The beds on Grass Creek strike approximately N. 50° E., and this strike changes abruptly near the mine of the Union Fuel Co. to S. 52° E. Holding this direction for about 2 miles across the northeast end of the field, it again changes abruptly at the old prospects in Fewkes Canyon to S. 36° W., the two bends thus produced being almost right angles. (See Pls. VIII, *A*, and XI.)

The periods of folding and faulting in this region can be fairly well determined. Except for the unconformity marked by the conglomerate 1,000 feet above the principal Coalville coal, the series of strata 9,000 feet thick exposed in this area appears to be conformable. It is evident from the comparative regularity of the beds underlying the conglomerate that the deposition of these beds was not preceded by any great amount of erosion or any period of folding. The unconformity at the base of the Wasatch, which overlies the other formations exposed in this area, is great and is probably to be correlated in part at least with the great unconformity at the base of the Evanston formation in southwestern Wyoming, which is said by Veatch[1] to denote "a long period of folding, faulting, and erosion," indicating in the Wyoming area an unconformity of over 20,000 feet. It seems fair to assume, therefore, that the folding and faulting that are apparent in all the rocks exposed at Coalville below the conglomerate of the Wasatch formation took place during the period denoted by this unconformity. Certainly they took place after the deposition of the lower part of No. 2 in the stratigraphic section given on page 163 (the upper part is not well exposed) inasmuch as these beds were involved in the movement, and they took place for the most part before the deposition of the conglomerate, for the Wasatch strata are but little disturbed in comparison with the strata on which they rest.

It is true that a certain amount of movement took place after the deposition of the Wasatch, and this movement appears to have been in the main, though not invariably, along the same lines of weakness as that which preceded the deposition. For example, the syncline of Echo Canyon, into which the Cretaceous strata on the northwest flank of the Coalville anticline dip at an angle of 29° is indicated in the overlying Wasatch by a comparatively gentle structure. (See Pl. VII, *B*.) Southeast of Coalville, in sec. 22, T. 2 N., R. 5 E., just north of Spring Canyon, strata of the Wasatch formation dip 7° NW. The strike exactly parallels the strike of the older beds which outcrop three-quarters of a mile farther up the canyon and dip at an angle of 26°. (See Pl. VIII, *B*, and XI.) Wasatch beds exposed in sec. 25, T. 2 N., R. 4 E., dip 7° S. and strike east, whereas the older rocks exposed 1 mile to the north dip 10°–15° NW. and strike approximately N. 20° E. (See Pl. VI, *A*, and XI.) If an east-west fault with downthrow on the south had broken the strata at this place prior to the deposition of the Wasatch beds, and if movement along the same fault plane had taken place subsequent to the deposition, just such conditions might have resulted. The same dip might, however, have resulted from a post-Wasatch uplift of the major part of the dome without faulting, so that the presence or absence of a fault here is undetermined. In the NE. ¼ sec. 2, T. 2 N., R. 5 E., near the line of the great fault which crosses that section, Wasatch beds dip at an angle of 20°, which is unusually great in comparison to the dip of these beds in other parts of the field. It seems probable that post-Wasatch movement along the line of the great fault has produced the unusual dip, but it is also probable that the major movement along this fault plane took place prior to the Wasatch deposition, as, except for the increase in dip at this one locality, there is no surface evidence in the Wasatch formation of the presence of this fault, although the underlying Cretaceous beds give abundant

[1] Veatch, A. C., Geography and geology of a portion of southwestern Wyoming, with special reference to coal and oil: U. S. Geol. Survey Prof. Paper 56, p. 75, 1907.

proof of its existence. In sec. 36, T. 3 N., R. 6 E., the coal bed at the Boyer mine dips 12° W., and the overlying beds of the Wasatch are practically horizontal. About a mile above the south fork of Chalk Creek beds near the top of the Cretaceous section stand on edge, although just south of the stream the beds of the Wasatch formation are horizontal.

It seems evident, therefore, that two periods of movement are represented in the Coalville region. The first or more extreme deformation took place after the deposition of the topmost Cretaceous strata exposed in this area and before the deposition of the conglomerate of the Wasatch formation, and the second and lesser deformation occurred some time after the deposition of the Wasatch, the movement as a rule merely accentuating the folds and faults already formed in the older rocks.

That considerable erosion took place before the deposition of the conglomerate of the Wasatch formation is shown by the fact that undisturbed strata of the Wasatch may be found in some of the larger river valleys much below Cretaceous beds that outcrop on adjacent highlands. As the conglomerate of the Wasatch is more resistant to erosion than the Cretaceous strata, it forms many of the highest eminences in the region and not uncommonly the Wasatch filling of a pre-Wasatch river valley forms a line of hills. Such a condition seems to exist 2 miles northeast of Coalville, along the series of faults above mentioned, which cross the divide from Chalk Creek to Grass Creek. Along the zone of weakness formed by these faults a valley was excavated by erosion in pre-Wasatch time. This valley was afterward filled by gravel and bowlders, subsequently consolidated into the conglomerate of the Wasatch formation which may at the present time be observed outcropping at many points lower than the Cretaceous strata. (See Pl. VIII, *B*.) The fact that the Dry Hollow coal bed does not outcrop south of the old Carleton mine is probably due, in part at least, to erosion prior to the deposition of the Wasatch sediments, and the same may be said of the principal bed south of the old Howard mine.

THE COAL.

GENERAL CHARACTER.

Three beds of coal are present in the Coalville field. The principal one is that mined on Grass Creek and at the Wasatch mine of the Weber Coal Co. and the mine of the Superior Fuel & Briquette Co. It is usually referred to as the "Wasatch" bed. The second in importance, the Dry Hollow bed, occurs about 2,000 feet above the principal bed and was formerly worked along Dry Hollow north of Coalville and at the old Carleton mine, in sec. 19. The lowest bed or group of beds is that which is exposed in the prospects in Spring Canyon, in sec. 26, and will be termed for convenience the Spring Canyon bed. It is doubtfully correlated with the coal exposed in the same township north of Chalk Creek, in the SW. ¼ sec. 1, which is 850 feet below the "Wasatch" bed.

At the time of this examination it was possible to obtain fresh material for analysis only from the "Wasatch" bed. Three analyses of this coal are given in the following table, together with one analysis of bituminous coal of Frontier age from Cumberland, Wyo., and two of sub bituminous coals, one from the Evanston formation of southwestern Wyoming and one from the Fort Union formation of the Sheridan field, in north-central Wyoming.

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 variable local conditions, 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 for general comparison. Analysis C represents the theoretical condition of the coal after all the moisture has been eliminated. Analysis D represents the coal after all the moisture and ash have been theoretically removed. This is supposed to represent the true coal substance, free from the most abundant impurities. Forms C and D, which are obtained from the others by recalculation, represent theoretical conditions that do not 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 heat values are given to the nearest five units, and in the column headed "British thermal units" they are given to the nearest tens, as the value of a British thermal unit is about one-half that of a calorie.

Analyses of coal samples from the "Wasatch" bed, Coalville field, Utah, and of Wyoming coal from various fields.

[Made by U. S. Geological Survey and the Bureau of Mines.]

Laboratory No.	Name and location of mine.	Collector.	Coal bed and kind of coal.	Location.				Thickness.		Air-drying loss.	Form of analysis.	Proximate.				Ultimate.					Heating value.	
				Quarter.	Section.	Township.	Range.	Coal bed.	Part sampled.			Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Calories.	British thermal units.
								Ft. in.	*Ft. in.*													
13216	Mine operated by Tom Reese-Grass Creek Coal Co., 6 miles northeast of Coalville, Utah.	Carroll H. Wegemann.	"Wasatch" coal bed, subbituminous.	NW.	24	3 N.	5 E.	8 6½	8 6½	4.50	A	12.2	42.2	42.2	3.39	1.90	5.80	63.77	1.27	23.87	6,255	11,260
											B	8.0	44.2	44.2	3.55	1.99	5.55	66.77	1.33	20.81	6,550	11,790
											C	.....	48.0	48.1	3.86	2.16	5.07	72.61	1.45	14.85	7,120	12,820
											D	.....	50.0	50.0	.....	2.25	5.27	75.52	1.52	15.45	7,405	13,330
13217	Mine operated by Superior Fuel & Briquette Co., 1 mile southeast of Coalville, Utah.	....do......	....do.......	SW.	16	2 N.	5 E.	7 6	7 6	7.80	A	17.1	36.9	41.2	4.8	1.53	.....	.....	.....	.....	5,655	10,179
											B	10.1	40.1	44.7	5.1	1.66	.....	.....	.....	.....	6,135	11,040
											C	.....	44.6	49.7	5.7	1.85	.....	.....	.....	.....	6,820	12,280
											D	.....	47.3	52.7	.....	1.96	.....	.....	.....	.....	7,235	13,020
13218	Mine operated by Weber Coal Co., 1½ miles northeast of Coalville, Utah.	....do......	....do.......	SW.	3	2 N.	5 E.	10 6	10 6	5.30	A	13.6	41.3	41.0	4.08	1.37	5.84	62.11	1.06	25.54	6,100	10,980
											B	8.8	43.6	43.3	4.31	1.45	5.54	65.59	1.12	21.99	6,440	11,590
											C	.....	47.8	47.5	4.72	1.59	5.01	71.89	1.23	15.56	7,060	12,710
											D	.....	50.2	49.8	.....	1.67	5.26	75.45	1.29	16.33	7,410	13,340
2245	Cumberland mine No. 1, Union Pacific Coal Co., 1 mile west of Cumberland, Lincoln County, Wyo.	A. C. Veatch.	Main Kemmerer coal bed, bituminous.	SW.	31	19 N.	116 W	8 0	.....	2.6	A	6.8	39.8	47.4	6.00	.43	5.56	69.01	1.12	17.88	6,815	12,270
											B	4.3	40.8	48.7	6.16	.44	5.41	70.85	1.15	15.99	6,995	12,590
											C	.....	42.7	50.9	6.44	.46	5.16	74.03	1.20	12.71	7,310	13,160
											D	.....	45.6	54.4	.....	.49	5.51	79.12	1.28	13.60	7,815	14,060
2325	Mine No. 5, Rocky Mountain Coal & Iron Co., near Almy, Uinta County, Wyo.	....do......	Main Almy coal bed, subbituminous.	SE.	30	16 N	120 W	24 0	8 0	6.7	A	14.4	36.8	41.6	7.22	.21	5.37	59.97	1.15	26.08	5,805	10,450
											B	8.3	39.5	44.5	7.74	.22	4.96	64.28	1.23	21.57	6,220	11,200
											C	.....	43.0	48.5	8.44	.25	4.41	70.08	1.34	15.48	6,785	12,210
											D	.....	47.0	53.0	.....	.27	4.81	76.54	1.47	16.91	7,410	13,330
12685	Mine operated by Monarch Coal Co., Monarch, Sheridan County, Wyo.	O. B. Hopkins.	Monarch coal bed, subbituminous.	.....	.....	.....	.....	.....	.....	8.1	A	23.9	34.3	38.4	3.35	.38	6.29	54.07	1.14	34.77	5,185	9,335
											B	17.2	37.4	41.8	3.65	.41	5.87	58.84	1.24	29.99	5,645	10,160
											C	.....	45.1	50.5	4.40	.50	4.78	71.03	1.50	17.79	6,815	12,260
											D	.....	47.2	52.8	.....	.52	5.00	74.30	1.57	18.61	7,125	12,830

It will be seen from the above analyses that although the coal is high in heating value, ranging from 11,039 to 11,788 British thermal units, it is also high in moisture content. It crumbles or slacks on exposure to the air and sunlight, and is therefore to be classed as a subbituminous coal. It is interesting to note that coal of the same age near Cumberland, in southwestern Wyoming, 75 miles northeast of Coalville, is bituminous in grade, differing from that of Coalville in its lower percentage of moisture and in its ability to withstand exposure without crumbling. The Coalville coal is dense and brittle and is generally black in color but has in certain lights a somewhat brownish cast. It is low in ash and its luster is vitreous. The powder is black. The bedding is massive, but when mined the coal breaks with a fairly good cleavage in two planes almost at right angles to each other.

THE COAL BEDS BY TOWNSHIPS.[1]

T. 3 N., R. 5 E.

"Wasatch" coal bed.—The northernmost mine on the "Wasatch" bed in T. 3 N., R. 5 E., is the Tom Reese-Grass Creek mine, in the SW. ¼ NW. ¼ sec. 12. The coal is here from 7 to 10 feet thick, without partings of any kind. At the mouth of the slope the sandstone which overlies the coal dips 34° NW., contains numerous conglomeratic layers, and is from 25 to 30 feet thick. In the mine there are places where shale appears to come in between the coal and the overlying sandstone, so that the roof of the coal is at these localities formed by shale. Considerable difficulty is encountered by the "heaving" of the shale floor, which in some places amounts to as much as 5 feet. The capacity of the mine is from 150 to 200 tons a day. The method of mining is in general that employed by all the mines in this area, a slope being run down the dip of the coal bed and the entries being driven along the strike of the bed with just enough inclination toward the slope to allow free drainage. The rooms are turned up the slope from the entries.

Three-quarters of a mile southwest of the Tom Reese mine are some abandoned mines formerly worked by the Union Pacific Co. In sec. 14 the "Wasatch" bed is broken by a normal fault trending a little east of south. Although the vertical displacement of this fault may not be great, the outcrop of the coal, because of the flattening of the anticline near its crest, is displaced horizontally more than 2 miles, the bed reappearing in the NW. ¼ sec. 2, T. 2 N., R. 5 E. Where the fault cuts the sandstone ledges in the southern part of sec. 23, T. 3 N., R. 5 E., it appears as a simple break, but south of this point it apparently divides, the movement being distributed

[1] In the following descriptions frequent reference should be made to the general map, Pl. XI.

along several planes approximately parallel to one another. This division is shown by the isolated mass of coal outcropping in Bull Hollow, near the center of sec. 26 of this township, which is separated by a fault from the outcrop of the main bed on the northeast and by a second fault from the outcrop of the main bed on the southwest. This isolated mass was formerly worked and yielded considerable coal.

Dry Hollow coal bed.—The Dry Hollow bed, occurring about 2,000 feet stratigraphically above the "Wasatch" bed, has been prospected at several places just north of the road in secs. 26 and 27, but no extensive mining has been done. The bed is reported to lie in two benches, the thicker of which is from 2 to 2½ feet thick. Because of the caving of the old prospects it was impossible to obtain an accurate measurement. In the southern part of sec. 27 the coal outcrop may be traced across the road and southward up the slope into Dry Hollow, the change in direction of the outcrop being due in some degree to a bend or slight fold in the strata, but for the most part to the difference in altitude on the Grass Creek and Dry Hollow divide. Along Dry Hollow the bed was formerly mined to a slight extent in several places, and a partial section of the bed measured at an old prospect in sec. 33 is as follows:

Section of coal bed in Dry Hollow.

	Ft.	in.
Shale, carbonaceous.		
Coal	2	2
Shale		1½
Coal		5
Shale, brown, with streaks of coal	1	0
Shale, gray	3	0
Coal, thickness undetermined, probably not over 20 inches.		
	6	8½

The bed in Dry Hollow dips 23° NW. and in the SE. ¼ sec. 33 is broken by a small fault, the downthrow being on the northeast side. A similar fault occurs in the SW. ¼ of the same section, near the township line.

Northeast of the great fault in the eastern part of the township already described, the Dry Hollow coal has not been found, although the sandstone which occurs about 100 feet above the bed can be followed along the slope northwest of the Tom Reese mine. The bed probably occurs in this locality, but it may perhaps have thinned or been replaced to some extent by carbonaceous shale, so that its outcrop is not easily observed. A bed believed to lie approximately at the same horizon outcrops 8 miles to the east, in the NE. ¼ sec. 13, T. 3 N., R. 6 E., where it is about 2 feet thick. The bed has not been found in the interval between these exposures, unless the coal bed 18 to 24 inches thick in the SE. ¼ sec. 16, T. 3 N., R. 6 E., is at this horizon, which seems rather doubtful as it is immediately overlain by a bed of sandstone which forms a rather pronounced escarpment.

T. 2 N., R. 5 E.

"Wasatch" coal bed.—The northernmost opening of the "Wasatch" bed in T. 2 N., R. 5 E., is at the old Wilson mine, in the NW. ¼ sec. 2, which is now abandoned. The Wasatch mine, the most extensive and the oldest working mine in the field, is situated in the SW. ¼ sec. 3. The coal ranges from 9 to 13 feet in thickness and is without shale or bone partings. The dip of the bed is about 10° WNW. A number of minor faults having an upthrow on the northeast are encountered in the mine, especially in its northeast entries, and the coal adjacent to them is shattered to some extent, increasing the percentage of slack, which is separated by screening. The capacity of the mine is about 500 tons a day. The outcrop of the "Wasatch" bed extends from the Wasatch mine south-southwestward into the NW. ¼ sec. 10, where it is broken by a fault with a downthrow on the northeast, the outcrop being displaced half a mile horizontally and reappearing in the SE. ¼ sec. 4, where it was formerly worked in the Allen Hollow mines, now abandoned. It is reported that considerable faulting was encountered in these mines, the principal movement having taken place along a comparatively narrow fault zone and being the equivalent of that which was distributed among the four faults which break the Dry Hollow coal to the northwest at intervals of about half a mile.

The outcrop of the "Wasatch" bed is concealed across the flood plain of Chalk Creek but is exposed in the town of Coalville, where the bed was formerly worked at the Buell & Bateman mine in the NW. ¼ sec. 16, which is probably the same as the Sprague mine described by Clarence King[1] as having been worked in 1869. King states that at the Sprague mine the coal "averages 11 to 14 feet in thickness, resting on a cream-colored sandstone and roofed by thin strata of the same material, which passing upward alternate with bands of shale and sandstone." The mine was overburdened with water at a depth of 50 feet, which marked the lowest workings. The bed dipped 14° W. A report is current in Coalville to the effect that the "Wasatch" bed was found to thin abruptly to the west in the Buell & Bateman mine, the coal being cut out by a "sand roll" or deposit of coarse sand and gravel in the roof of the bed. Considering the swiftness of the water currents by which the sandstone above the coal was deposited, as shown by the coarseness of the material,

[1] U. S. Geol. Expl. 40th Par., vol. 3, chap. 7, 1870.

it is not unlikely that the coal was eroded to some extent in certain localities before the deposition of the overlying sandstone and conglomerate. It is not probable, however, that such erosion was extensive or that the character of the coal bed was affected by it over any considerable area.

The depth of the coal below the surface on the west side of the river has been variously estimated. In the NE. ¼ SW. ¼ sec. 17 a bed of conglomerate is exposed, which may represent the conglomerate of No. 7. (See Pl. VI, *A*.) It appears to be, however, 1,300 feet below the coal at the Sargent mine, whereas on Grass Creek the base of conglomerate No. 7 is only 950 feet below the Dry Hollow coal, which is taken to be the same bed as that exposed at the Sargent mine. If the structure between the exposure of conglomerate in sec. 17 and the Sargent mine is regular and the measurement of 1,300 feet therefore correct, it must be supposed either that the thickness of the shale of No. 6 is much greater on the west side of the river than on Grass Creek, or that the conglomerate exposed in sec. 17 is lower than No. 7, being perhaps a conglomeratic phase of sandstone No. 9. In the latter case the "Wasatch" coal bed is only about 750 feet below the surface at the outcrop of the conglomerate. If the conglomerate is in reality that of No. 7, the coal is probably 1,100 feet below its base. The drill alone can solve the problem. At the Sargent and Carleton mines, as well as at all outcrops of the Dry Hollow coal, the "Wasatch" bed is a little more than 2,000 feet below the surface, as the stratigraphic interval between the two beds is approximately that amount.

A short distance south of the Buell & Bateman opening and west of the road a shaft, now filled with water, has been sunk to the coal. From this place to the mine of the Superior Fuel & Briquette Co., a distance of three-fourths of a mile, the coal outcrop is concealed in the flood plain of Weber River. From dip and strike readings taken on thin beds of calcareous sandstone known as the "Diamond rock," which underlie the "Wasatch" bed at a distance of about 30 feet, it is evident that the outcrop of the coal swings somewhat sharply to the east in the SE. ¼ SW. ¼ sec. 16. At the Superior Fuel & Briquette Co.'s mine the coal bed strikes N. 48° E. and dips to the south. The bed here ranges from 7 to 9½ feet in thickness, but the percentage of slack in the coal is considerably increased by numerous small faults that are encountered at several places in the mine. The capacity of the mine is about 150 tons a day. The coal is overlain by 2 feet of shaly sandstone, 6 inches of shale containing numerous shells, and 10 inches of calcareous sandstone, overlying which is a bed of conglomeratic sandstone 30 or 40 feet thick. From the Superior Fuel & Briquette Co.'s mine the outcrop of the coal swings northeastward for a distance of half a mile to the old Dexter mine, in the NE. ¼ SE. ¼ sec. 16. The strike is here about north and the dip 21° E. The Dexter mine, which is now abandoned, is one of the old mines of the field and from it, to judge by the size of the slack piles, a considerable amount of coal was removed. North of this mine the outcrop is concealed, but it apparently extends north and then east, outlining the syncline described on page 168, to the old Howard mine, in the NW. ¼ NW. ¼ sec. 15, where it strikes N. 69° W. and dips 16° SSW. Only a small amount of coal was removed at the Howard mine, which has long since been abandoned. From this place the outcrop probably swings to the southeast and then south, but its exact location is uncertain. An outcrop of white sandstone, believed to be the bed overlying the coal, appears 800 feet southeast of the old mine opening, but to the southeast the coal-bearing rocks are concealed by the cover of conglomerate of the Wasatch formation. Whether or not the coal in the syncline in the western part of sec. 15 and the eastern part of sec. 16 is broken by faulting, it is impossible to say. The Union Pacific Coal Co. has put down a number of drill holes in this area, but no definite information could be obtained concerning them. It is reported at Coalville that coal was struck in all these holes. It seems probable that south of sec. 15 the coal-bearing formation was eroded in a pre-Wasatch valley before the deposition of the Wasatch formation. The depth of the coal below the surface does not, in all probability, exceed a few hundred feet. If the structure of the coal-bearing formation in general conforms to the less marked structure of the overlying Wasatch, it is probable that the coal outcrop swings somewhat to the west to conform to the strike of the Wasatch beds in the SW. ¼ sec. 22. The strike of these beds conforms to that of the coal-bearing formation exposed in Spring Canyon, and this makes it more probable that the strike of the coal bed in this locality follows the same direction. In that case the concealed outcrop of the "Wasatch" coal would underlie the valley of the Weber somewhere near the site of the little town of Hoytsville. If, however, an extensive fault which is concealed by the overlying mantle of Wasatch strata has broken the outcrop of the coal south of the area in which surface exposures occur, it is of course impossible to make any predictions concerning the probable location of the coal bed.

Dry Hollow bed.—The Dry Hollow bed has been prospected in the NW. ¼ sec. 4, near the township line. A quarter of a mile southwest of this place the bed is broken by a fault which is apparent in the overlying sandstone, the outcrop of the coal being obscured. Near the middle of sec. 5 the bed is broken by a second fault having a downthrow on the north, as shown by the relation of the sandstone ledges, the coal itself not being exposed. Two small faults break the bed in the NW. ¼ sec. 8, the downthrow in each being to the north. The coal bed has been prospected in the SW. ¼ sec. 8 but is entirely concealed between this place and the exposures in Dry Hollow. The coal has also been opened at the Sargent mine, in the SE. ¼ SE. ¼ sec. 18, where it is reported by one of the owners to be 31 inches thick and to be overlain by 2 feet of black shale with sandstone above. A report is current in Coalville to the effect that the Dry Hollow bed wherever it has been opened consists of two benches separated by 18 inches of shale. The Sargent mine was so caved at the time of the examination that an exact measurement could not be obtained. The correlation of the coal at the Sargent mine with the Dry Hollow bed is somewhat doubtful, because of the increased thickness of shale between the coal and the prominent sandstone ledge, the top of which, at the Sargent mine, is 450 feet above the coal. In Dry Hollow and on Grass Creek the top of this sandstone is only about 280 feet above the Dry Hollow coal. Mr. Stanton is of the opinion, from the fossil evidence, that the two coal beds occupy approximately the same horizon, and it seems more reasonable to assume that the beds at the Sargent mine and in Dry Hollow are the same, the difference in thickness of the overlying strata being due to differences in deposition in waters adjacent to the shore of a considerable land mass rather than to assume that there are two distinct coal lenses. In this connection it may be noted that the thickness of the shale between the coal at the Sargent mine and the conglomerate doubtfully correlated with that of No. 7 (see p. 177) as exposed on Grass Creek is 1,300 feet (see p. 163), as compared with 880 feet on Grass Creek. It is possible that all the shale members of the section are thicker toward the west.

One mile south of the Sargent mine the Dry Hollow coal has been opened at what is known as the old Carleton mine, one of the oldest mines in the field and long since abandoned. The section of the bed is reported to be as follows:

Section of Dry Hollow coal at Carleton mine.

	Feet.
Sandstone roof.	
Coal	1
Shale	1
Coal	3

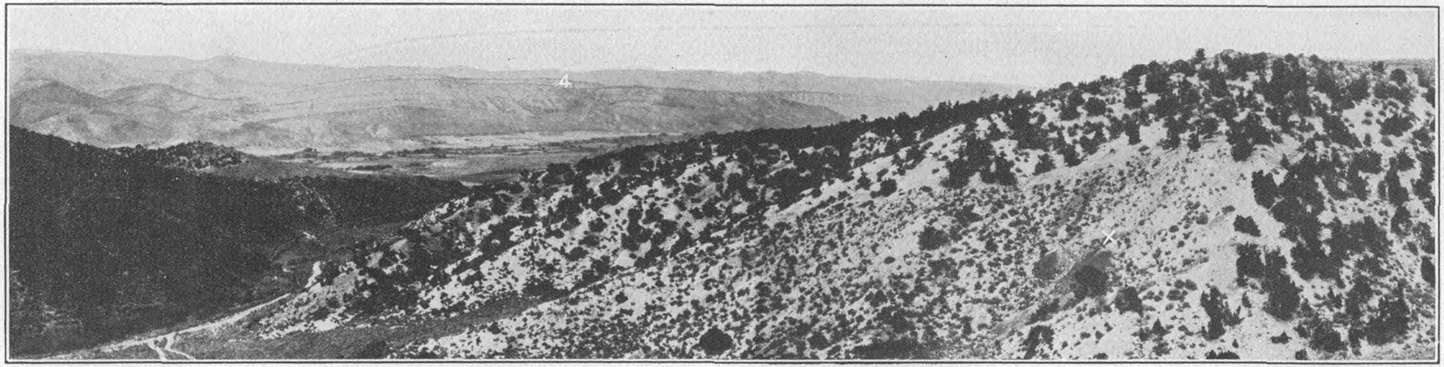
The coal is not exposed south of the Carleton mine. The overlying sandstone can be traced for about a quarter of a mile to a valley which crosses the outcrop at this point. South of the valley the surface rocks consist of the conglomerate of the Wasatch formation. It has been believed by some observers that the coal-bearing beds are here cut off by a fault which crosses the outcrop almost at right angles, and this belief is to some extent borne out by the dip in the Wasatch beds south of the valley. (See p. 170.) The existing conditions can be adequately accounted for, however, by the presence of a pre-Wasatch valley eroded in the coal and the overlying sandstone, the valley being afterwards filled by Wasatch deposits.

Spring Canyon bed.—In the NW. ¼ sec. 26 two coal beds of rather doubtful value have been prospected on the north side of Spring Canyon. (See Pl. IX, *A*.) At 100 feet below the lowest bed is a white sandstone about 35 feet thick, which forms a prominent escarpment on each side of the valley. The strike is N. 30° E. and the dip 26° NW. About 18 feet below the base of this sandstone a bed of carbonaceous shale has been prospected, apparently without results. The section of the two coal beds 100 feet above the sandstone is as follows:

Section of coal beds in Spring Canyon.

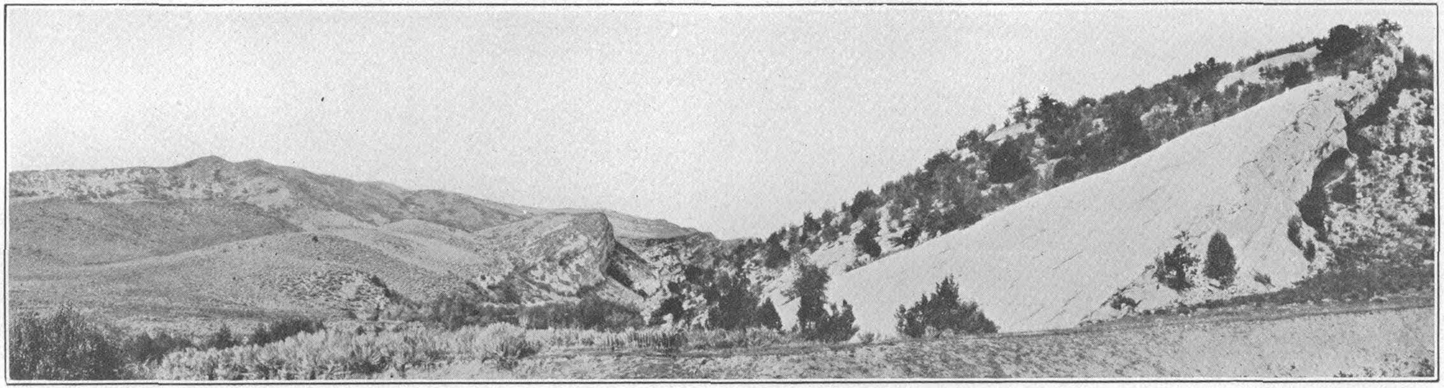
	Ft.	in.
Coal, broken by several thin partings of shale	3	6
Shale	25	0
Coal	1	0
Shale		2
Coal		6
Shale		¾
Coal	1	5¼
Shale		2
Coal	1	2

These beds are said to have been opened by the Buell & Bateman Co., but the coal was too dirty to compete with that of the Wasatch bed. The outcrop of these two beds, together with that of the underlying sandstone, is concealed both north and south of Spring Canyon by the cover of Wasatch deposits. The exact position of these coal beds with reference to the Wasatch bed is unknown. They are apparently a considerable distance below it and are rather doubtfully correlated with two beds which have been prospected on the north side of Chalk Creek, in the NW. ¼ sec. 11 and the SW. ¼ sec. 1. The beds at the last-named locality lie about 50 feet above a cliff-forming sandstone, and the several thin beds which constitute the coal group are distributed through a thickness of about 75 feet of carbonaceous shale. A good measurement of the beds could not be obtained, but the thickest probably contains about 2 feet of rather bony coal. The underlying sandstone ledge may be traced northeastward across sec. 1 and thence eastward across the crest of the anticline to the SW. ¼ sec. 32, T. 3 N., R. 6 E., where a showing of coal appears above it at the crest of a hill. (See Pl. VIII, *A*.) The outcrop of the sandstone over part of this distance is rather obscured and the tracing difficult. From the SW. ¼ sec. 32 the bed may be traced southward across the western part of sec. 5, T. 2 N., R. 6 E., where it dips 90° on the vertical eastern limb of the anticline. From a measurement between the sandstone and the coal of the Wasatch bed, exposed at the Hoffman mine in the SW. ¼ sec. 5, it appears that the coal group is approximately 850 feet below the



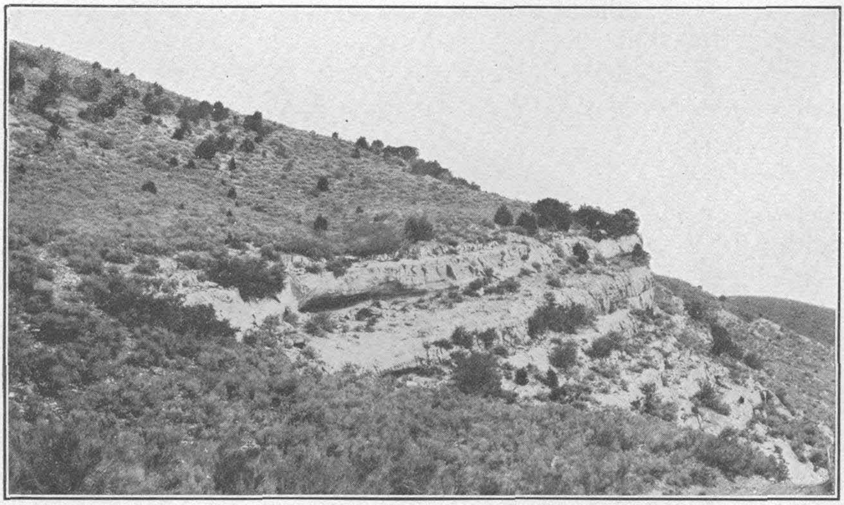
A. VIEW LOOKING WEST DOWN SPRING CANYON, UTAH.

Prospects on coal bed (No. 15 (?) of section, p. 163) in foreground on right, Weber Valley and escarpment of sandstone (No. 4 of section) in middle distance.



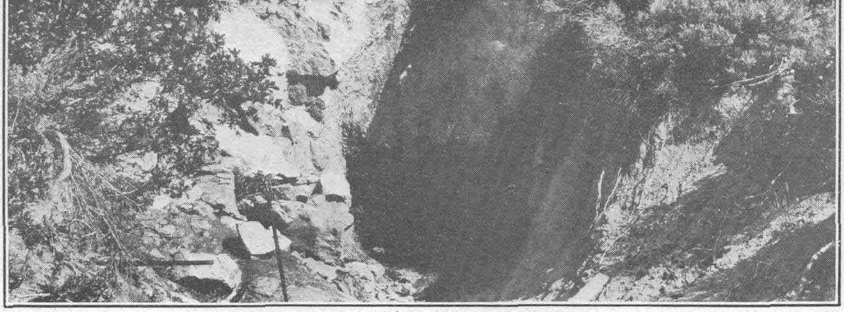
B. VIEW LOOKING NORTH UP HUFF CREEK IN SEC. 13, T. 3 N., R. 6 E., UTAH.

Sandstone (No. 4 of section, p. 163) on right. (See p. 182.)



A. VIEW NEAR BOYER MINE, SEC. 36, T. 3 N., R. 6 E., UTAH.

Looking northeast. Sandstone (No. 11 of section, p. 163) overlying coal bed.



B. HOFFMAN MINE, SEC. 5, T. 2 N., R. 6 E., UTAH.

"Wasatch" coal bed (No. 12 of section, p. 163), 10 feet thick, dips 78° W. on limb of overturned anticline. Sandstone floor on left, shale roof on right.

Wasatch bed. As stated above, the tracing of the sandstone ledge across the crest of the anticline is by no means positive. Should a strike fault exist near the crest or on the eastern limb of the incline, it would be very difficult to detect. It is believed, however, that the relations of the beds have been correctly determined. Fossils collected near the coal group in the SW. ¼ sec. 1, T. 2 N., R. 5 E., have been discussed on page 165.

T. 3 N., R. 6 E.

"Wasatch" coal bed.—The "Wasatch" bed is worked at the Union Fuel Co.'s mine, in the SW. ¼ sec. 18, T. 3 N., R. 6 E. Considerable faulting has been encountered in the mine and the coal has apparently been affected by slipping along the bed. Its thickness ranges from 5 to 13 feet. The strike of the bed changes rather abruptly east of this mine, taking a direction of S. 50° E.

A quarter of a mile southeast of the mine of the Union Fuel Co. is the opening of the old Church mine, from which a large amount of coal was taken some 40 years ago. Southeast of this mine the outcrop of the coal and of the conglomeratic sandstone which immediately overlies it is concealed across the crest of the Grass Creek and Chalk Creek divide. A little over half a mile southeast of the old Church mine is a small sandstone knob, which is probably formed by either the sandstone bed which underlies the coal or that which overlies it. From this place across the divide for three-quarters of a mile there is no exposure of the coal-bearing formation, but in the NW. ¼ SW. ¼ sec. 21 the sandstone ledge which underlies the coal appears at the surface, dipping 8° NE. The ledge may be traced for a quarter of a mile southeastward, where in the SW. ¼ SW. ¼ sec. 21 the coal bed just above it has been prospected. The strike is here N. 31° W. and the dip 25° NE. One thousand feet to the southeast the coal is also exposed, the strike changing abruptly to S. 35° W. (See Pl. VII, *A*.) The bed may be traced for a quarter of a mile to the southwest and has been opened in three different places with a reported thickness of 11 feet. The bed here dips 70° SE., but the dip increases rapidly to the southwest until the beds are vertical. For 2½ miles southwest of these prospects, to the openings in the SW. ¼ sec. 5, T. 2 N., R. 6 E., the coal is concealed, and the location of the bed can be determined only from its relation to the overlying sandstones, which are exposed east of it. Only an approximate estimate can be made of the depth below the surface, reached by the coal bed along the axis of the syncline, which lies west of the anticline above described. It is probably about 6,500 feet. For 1 mile east of the coal outcrop the overlying beds are vertical, but farther eastward they rise gradually at angles of 16° to 21°. The axis of the syncline is apparently a very sharp fold, the dip at the surface changing in a few rods from 90° to 14° W. Whether or not there is faulting along the axis of the syncline it is impossible to tell from surface exposures. If faulting exists, it is probably not great, as what are taken to be the same sandstone ledges appear within a few rods on each side of the synclinal axis. From the axis of the syncline the beds rise steadily toward the east for a little over 3 miles, the "Wasatch" coal bed appearing at the surface in the NE. ¼ NE. ¼ sec. 36, at what is known as the Boyer mine. This mine is not worked at present, but the coal is reported to be 8 feet in thickness. About 22 feet above it is the base of a sandstone 130 feet thick, which forms a prominent ridge on the north side of Chalk Creek. (See Pl. X, *A*.) The dip is here 12° W. and the strike north. On the crest of the hill north of this place the coal-bearing rocks are entirely concealed by the cover of Wasatch deposits, and, so far as known, the coal does not appear at the surface for a distance of 4 miles to the north. In the NE. ¼ sec. 13, however, a bed of coal reported to be 5 feet thick was formerly worked at an old mine near a spring on the west side of the Huff Creek road. This coal is 470 feet stratigraphically below the base of a prominent sandstone ledge and is possibly the "Wasatch" bed, but this correlation is by no means positive.

Dry Hollow bed.—In the NE. ¼ sec. 13, T. 3 N., R. 6 E., about 2 feet of coal is exposed on the north side of a draw. Above the coal is a bed 20 feet thick composed of oyster shells. These shells were formerly burned for lime, and the ruins of the old kiln are still standing. Specimens of these oysters were examined by T. W. Stanton, who states that they are a species usually associated with the Dry Hollow coal. Above the shell bed is a 10-foot bed of sandstone, and above that several hundred feet of shale, overlying which are two sandstone ledges separated by shale or soft sandstone. The two ledges together are perhaps 200 or 250 feet thick. On the surface of the upper ledge (Pl. IX, *B*) were found specimens of Inoceramus, believed to be *Inoceramus erectus*, a species which in this field is characteristic of the sandstone above the Dry Hollow coal. On the evidence of this Inoceramus and the species of oyster, the coal associated with the shell bed is provisionally correlated with the Dry Hollow coal. The outcrop of the "Wasatch" bed (No. 12) should come to the surface about a mile to the east but is probably concealed by the strata of the Tertiary conglomerate. If the old mine in the NE. ¼ sec. 12 is on the "Wasatch" bed there must be either a sharp fold or a fault between it and the outcrop of the coal and shell bed just described. There is some evidence of such a fault near the north line of sec. 13. Opportunity was not afforded for more than a hasty examination of this locality.

In the SE. ¼ sec. 16 a bed of coal reported to be from 18 to 24 inches thick outcrops between two sandstone ledges, the upper of which is 40 feet thick and has embedded in its upper surface great numbers of large shells of *Ostrea soleniscus*. Below the coal is about 100 feet of soft sandstone, and below that a second ridge-forming sandstone. These sandstone beds appear to be the same as those which appear near Coalville above the Dry Hollow coal. The coal just described as occurring between the two sandstone ledges is probably a somewhat higher bed than the Dry Hollow. Its outcrop was not observed at any other locality, though coal is reported at about the same horizon in what is known as the Middle Canyon, 2½ miles to the southwest.

T. 2 N., R. 6 E.

"Wasatch" coal bed.—The "Wasatch" bed has been opened in two places in the SW. ¼ sec. 5, T. 2 N., R. 6 E., at what are known as the Hoffman mines, which are worked only to supply local demand. One of these mines is now on fire. The coal here occurs on the steeply dipping limb of the anticline, which appears to be slightly overturned, the strata dipping 78° W. (See Pl. X, *B*.) The bed is 10 feet thick, but contains several small lenses of shale which apparently represent a shale parting in the bed, the shale having been formed into lenses by the compression to which the bed has been subjected. Half a mile south of the Hoffman mine the coal is exposed on the east face of the hill just north of the Chalk Creek road, in the NW. ¼ sec. 8. Below the bed is a sandstone ledge 79 feet thick, which forms the abrupt cliff known as Halfway Rock, on the north side of the road. It is reported that the "Wasatch" bed was opened just south of Chalk Creek, a few rods south of this locality. A low ridge of sandstone, which probably underlies the coal, may be observed trending in a direction a little west of south on the north slope of Elkhorn Mountain and extending to the SW. ¼ sec. 18, but south of this place the coal-bearing formation is concealed by the overlying Wasatch strata. An estimate of the depth of the "Wasatch" coal bed in the syncline, the axis of which lies a little over half a mile east of the outcrop of the bed, can be only approximate. If the structure is regular and can therefore be inferred from the surface outcrops, it is probable that the coal descends to a depth somewhat below sea level, or, in other words, 6,500 feet below its surface altitude in this township. If the overturn of the beds is more than a local feature of the structure and extends far below the surface, the axis of the syncline at the great depth which it attains must lie almost three-quarters of a mile west of the axis as it appears at the surface. Exposures of the pre-Wasatch rocks may be seen along South Fork of Chalk Creek for 2 miles above its mouth, but near the head of that stream all exposures are concealed by the strata of the overlying Wasatch.

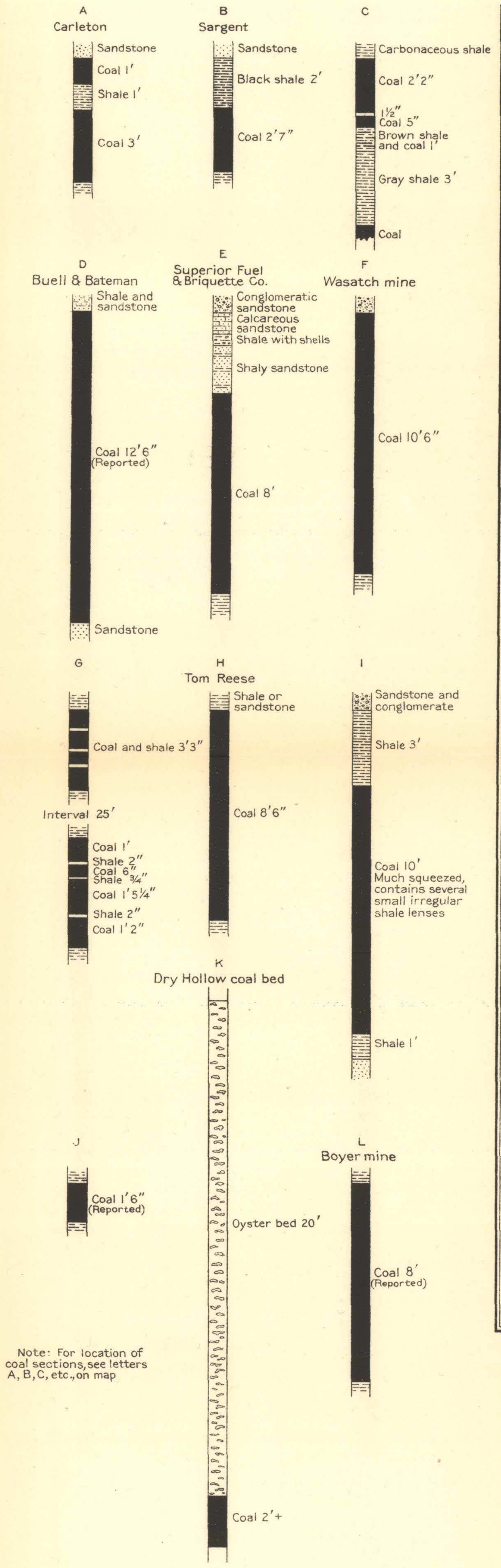
No outcrops of the Spring Canyon or Dry Hollow coal beds were observed in T. 2 N., R. 6 E.

THE MAP.

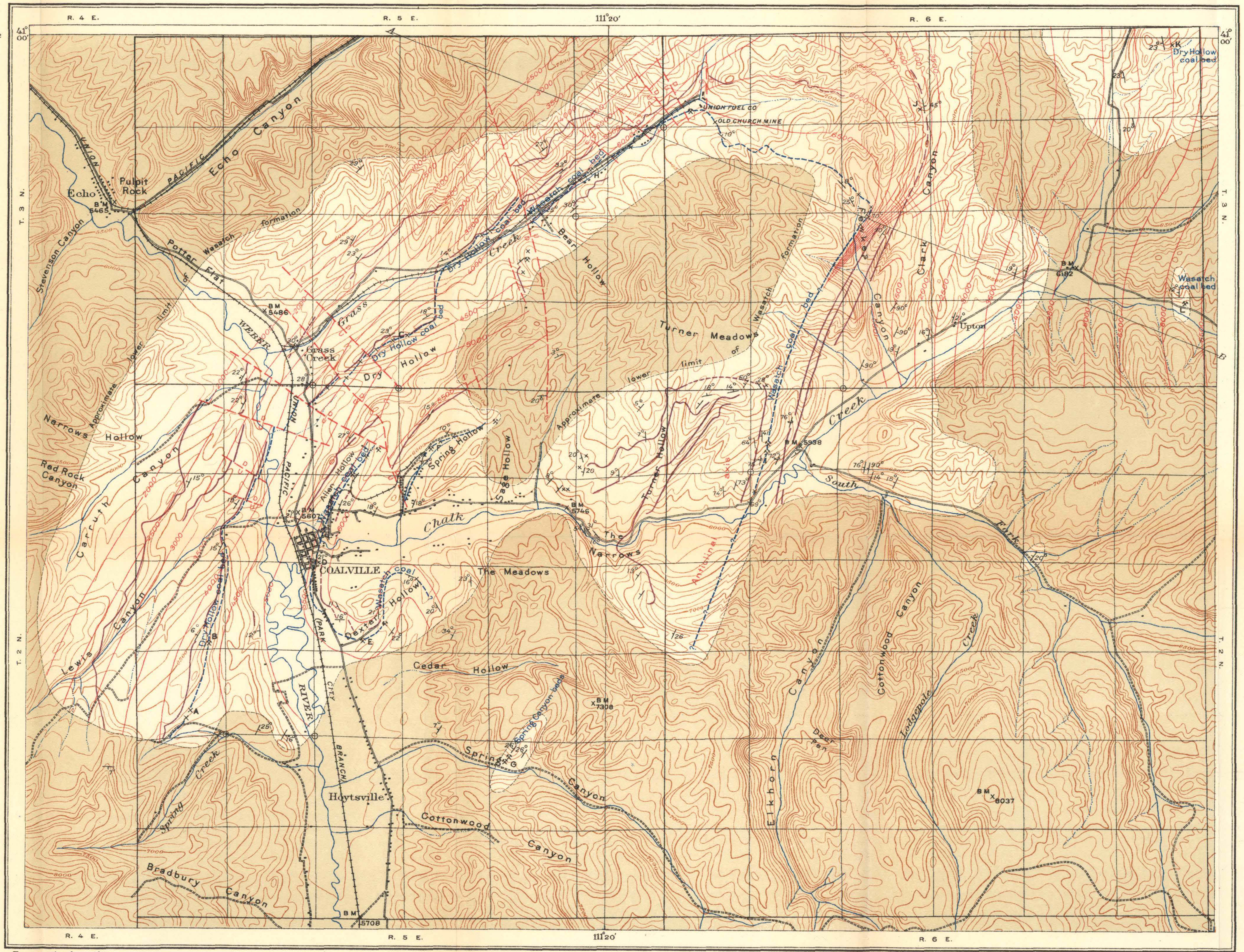
Topography and geology.—The topography shown on the accompanying map was surveyed by H. L. Baldwin and Jeremiah Ahern in 1899 and 1900. The geologic mapping in Tps. 2 and 3 N., R. 6 E., was done directly on the topographic map, a plane table being used in obtaining locations. The geologic mapping in Tps. 2 and 3 N., R. 5 E., was done with a plane table and telescopic alidade independently of the former topographic mapping, the two maps being afterward combined in the office. In the work a base line 5,610 feet was measured from a point on the road near the schoolhouse just north of Coalville to a flag established near the east quarter corner of sec. 4, T. 2 N., R. 5 E. From this base line control was expanded over the township. Elevations were calculated by vertical-angle readings, the United States Geological Survey benchmark 5607 near the road just north of town being used as a starting point. All locations were made by triangulation, no traverse work being done. Control was carried over T. 3 N., R. 5 E., from a base line, the ends of which were the flag in the SE. ¼ sec. 34 and the sandstone point in the NW. ¼ sec. 5, these points having been established in the work on T. 2 N., R. 5 E.

Land lines.—The land lines as shown do not altogether agree with those as given on the topographic map. Section corners wherever found were located by triangulation, and the land lines were projected from the known corners according to the plats of the General Land Office. Where corners are shown on the map as found, the land lines may be considered as accurate in location. Where no corners were found, the lines are to be considered as more or less hypothetical. The original land survey of the area, part of which was made as early as 1869, appears to have been conscientiously made.

Structure contours.—The structure contours as given on the map are drawn on the principal or "Wasatch" coal bed and represent absolute elevations above sea level. They are drawn from actual elevations taken along the outcrop of the coal bed, from elevations taken on various sandstone ledges between which and the "Wasatch" bed the intervals were known, and from dip readings. Where outcrops are few, and consequently the data on which the structure contours are based are meager, the contours are to be understood as representing more the general structure of the region than the absolute depth at which the coal bed lies. The approximate depth of the "Wasatch" coal below the surface can be calculated at any point in the area by subtracting the elevation as given by the structure contour on the coal at that point from the surface elevation. The depth of the Dry Hollow coal bed can be easily calculated from this result, as the stratigraphic interval between the "Wasatch" bed and the Dry Hollow bed is 2,000 feet.

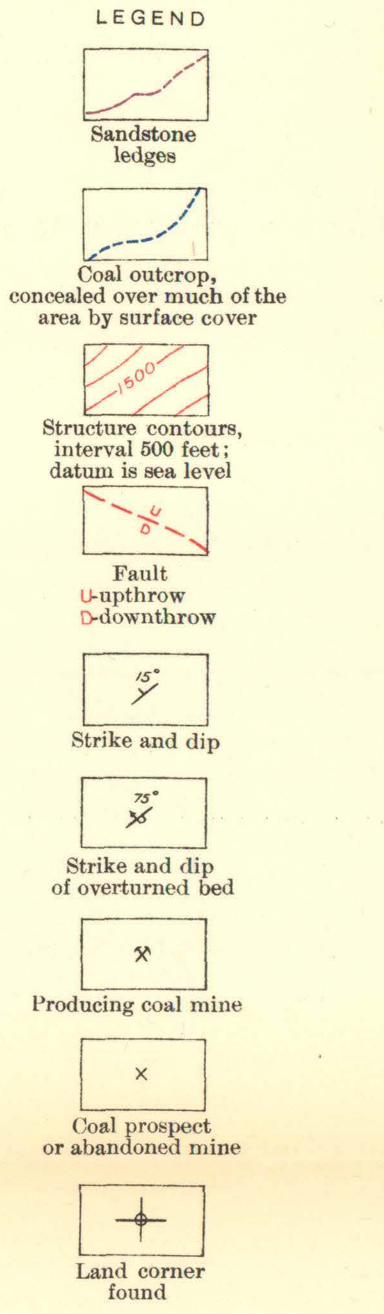


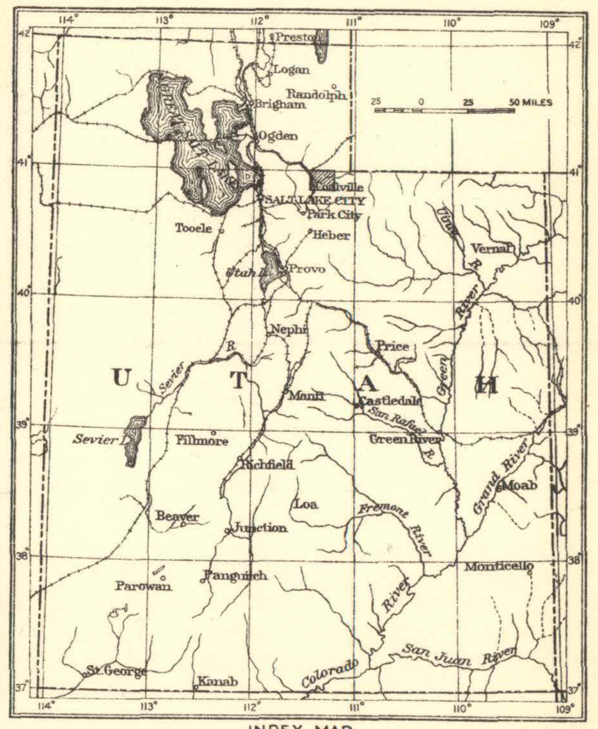
Note: For location of coal sections, see letters A, B, C, etc., on map

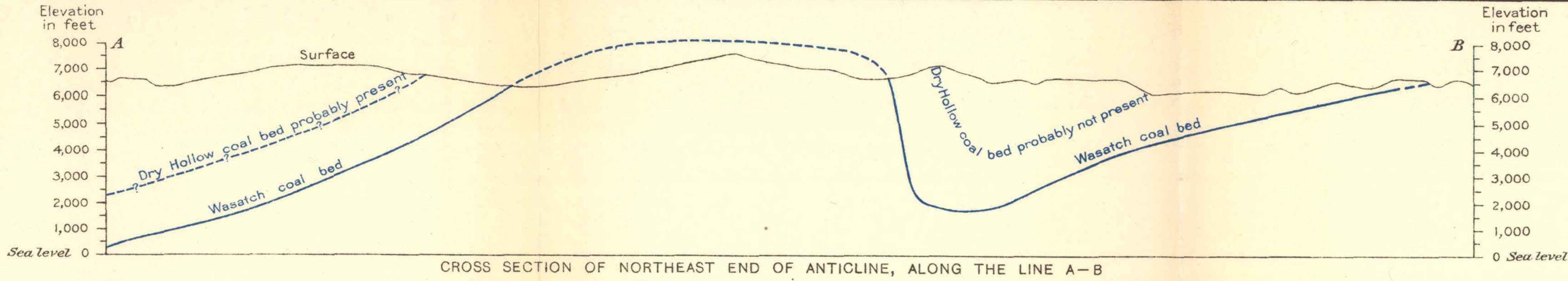


Topography from the Coalville atlas sheet. U.S. Geological Survey

A. Hoen & Co. Lith. Baltimore, Md.







CROSS SECTION OF NORTHEAST END OF ANTICLINE, ALONG THE LINE A—B
Horizontal and vertical scales the same

MAP OF THE COALVILLE COAL FIELD, UTAH

SHOWING ANTICLINE OF PRE-WASATCH STRATA (UNCOLORED AREA), SURROUNDED AND PARTLY COVERED BY WASATCH FORMATION (COLORED AREAS)

By Carroll H. Wegemann

Scale $\frac{1}{62500}$

1 0 1 2 3 Miles

Contour interval 100 feet
Datum is mean sea level

1915

INDEX.

O