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THE ESKA CREEK COAL DEPOSITS MATANUSKA VALLEY, ALASKA

BY

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THE ESKA CREEK COAL DEPOSITS, MATANUSKA VALLEY, ALASKA

By Ralph Tuck

ABSTRACT

The coal deposits in the vicinity of Eska Creek, a small tributary from the north to the Matanuska River, are a part of the Matanuska coal field. One of the two commercial coal-producing districts in Alaska, this field is in the south-central part of the Territory, at the head of Cook Inlet. It is 170 miles from Seward, the ocean terminus of the Government-owned and -operated Alaska Railroad, and is served by a branch line of that railroad.

A high-volatile bituminous coal has been produced in the vicinity of Eska Creek since 1917. The coal occurs in the Chickaloon formation (Eocene), which, in this area, is composed of over 2,000 feet of sandstone, shale, and interbedded coal seams. The Eska conglomerate, more than 1,100 feet thick, overlies the Chickaloon formation. Both the coal beds and the intervening sandstone and shale, comprising the Chickaloon formation, vary in thickness and composition within short distances. Over 20 coal beds having a thickness of more than 3 feet are known to occur. Most of the coal beds are from 3 to 5 feet thick.

The underlying rock structure is expressed by much of the topography. Wishbone Hill, the dominant topographic feature, reflects the major structural feature, which is a southwestward-plunging syncline. Strike and transverse faults are numerous. The transverse faults are usually normal and have the greater displacement, some of them more than 300 feet. The structure has strongly affected mining operations: it has increased the cost of development and mining and has decreased the quantity of recoverable coal and the production of lump coal.

Most of the coal reserves are west of Eska Creek, on the north side of Wishbone Hill. In spite of the detrimental effect of faulting, there are reserves of many million tons of recoverable coal above the present tunnel levels and an equal if not greater amount below.

INTRODUCTION

Location.—The Matanuska Valley, which separates the Chugach Mountains on the south from the Talkeetna Mountains on the north, is in south-central Alaska, at the head of Cook Inlet. Here is one of the two commercial coal-producing fields of Alaska. Eska Creek is 6 miles east of Moose Creek; both are tributaries from the north to the Matanuska River, and their courses are roughly parallel. All the coal now produced from the Matanuska field comes from an area in the valleys of these streams. The part of the coal field described in this report is about 3 square miles in area and extends westward from Eska Creek.

Both the Moose Creek and Eska Creek coal fields are served by branch lines of the Government-owned and -operated Alaska Railroad. Anchorage, the headquarters of the railroad, is 60 miles distant, and Seward, its ocean terminus, about 170 miles.

Present investigation and acknowledgments.—The present investigation is a continuation of the cooperative work of the Alaska Railroad and the United States Geological Survey, made possible through an appropriation in 1931 for the investigation of mineral resources in the area tributary to the railroad. In the spring of 1934 the Alaska Railroad requested the writer to report on the condition of its coal-leasing unit 7, which is held for the emergency production of coal. It has been the general policy of the Government, strictly adhered to by the Alaska Railroad, to encourage the development of the coal fields through private initiative; but in 1933 one of the producing mines was accidentally flooded, and in 1934 another producer ceased operations because of financial difficulties. This created a situation in which the railroad was dependent upon one mine, and in the event of a mine disaster its fuel supply would have been jeopardized. To forestall such a situation unit 7 was mapped geologically and topographically on a scale of 200 feet to the inch, with a 10-foot contour interval, and a program of putting the property into a stand-by condition was begun.

In 1935 development work on the railroad's coal lease was continued. To determine the extent of the coal reserves and to aid mine development, the Geological Survey recommended continuation of the mapping of the coal beds on a detailed scale. Upon the approval of this recommendation by the railroad, the larger part of unit 6 was mapped in the summer and fall of 1935. Eventually the survey will be extended to Moose Creek to embrace what is now the entire producing area of the Matanuska coal field. A scale of 400 feet to the inch with a 20-foot contour interval was used in mapping unit 6, and the topography of unit 7 has been reduced to that scale on plate 11.

The writer has been materially aided by the earlier published reports of Martin [1] and Chapin [2] and by unpublished reports of Capt. W. P. T. Hill, of the United States Marine Corps; B. W. Dyer, former Territorial mine inspector; Sumner S. Smith, former superintendent of the Eska mine; B. D. Stewart, now Commissioner of Mines for the Territory of Alaska; and J. J. Corey, former Bureau of Mines and United States Geological Survey coal-mining engineer. Most of the

[1] Martin, G. C., and Katz, F. J., Geology and coal fields of the lower Matanuska Valley; U. S. Geol. Survey Bull. 500, 1912. Martin, G. C., Geologic problems at the Matanuska coal mines: U. S. Geol. Survey Bull. 692, pp. 269–282, 1919.

[2] Chapin, Theodore, Mining developments in the Matanuska coal field: U. S. Geol. Survey Bull. 712, pp. 131–167, 1920; U. S. Geol. Survey Bull. 714, pp. 197–199, 1921.

coal analyses and some of the measurements of the coal sections were furnished by M. L. Sharp, of the Bureau of Mines, Anchorage, Alaska. Through the cooperation of Oscar Anderson, president and superintendent of the Evan Jones Coal Co., free access to the company's mine workings was readily granted. Considerable information was furnished by Evan Jones, former mine foreman of the Eska mine, long identified with the development of most of the coal mines in this region. T. N. Scott assisted in the topographic mapping. The fullest cooperation was given by Col. O. F. Ohlson, general manager of the Alaska Railroad, and other officials.

TOPOGRAPHY AND DRAINAGE

The dominant topographic feature of the area is Wishbone Hill, whose name is truly descriptive (pl. 11). The hill lies midway between Moose and Eska Creeks and is elongate in a northeast-southwest direction. On the north, east, and southeast sides, it is encircled by cliffs 50 to 300 feet high, scalable in only a few places, which make it an impressive landmark in the lower Matanuska Valley. Westward it slopes gently to Moose Creek. Most of the minor ridges have trends parallel to that of Wishbone Hill. There are many unusual topographic features, such as smooth, uniform slopes, terminated on one or more sides by cliffs; asymmetric ridges, many of them with steep north slopes and gentle south slopes; and curving ridges. All these land forms reflect the underlying rock structure.

The drainage of the western part of the mapped area flows southwestward into swamps and lakes, which have no surface outlet. The several small creeks in the NE¼ sec. 18 flow northward into a swamp that separates Wishbone Hill from the Talkeetna Mountains and ultimately drains into Moose Creek. The eastern part of the area, including Slipper Lake, is drained into Eska Creek.

Eska Creek has its source in a number of small tributaries which head against the southern flank of the Talkeetna Mountains, several miles to the north. The headwaters of the creek, although small in area, are often subject to torrential rainfalls, whose destructive influence is usually most severe in the portion of Eska Creek shown on plate 11. Here the flood plain of Eska Creek is only about 200 feet wide, with steep walls on both sides. During early mining operations some of the camp and mine buildings were constructed on this flood plain, but high water has destroyed most of those so situated. The greater part of the high water comes from the west fork of Eska Creek, which drains a part of the area on the north side of Wishbone Hill but has its source in a large spring high on the south side of the Talkeetna Mountains. Generally, August is the period of high water, although the destructive floods usually occur only every 3 or 4 years.

GENERAL GEOLOGIC FEATURES OF THE MATANUSKA VALLEY

The formations of the Matanuska Valley are predominantly Upper Cretaceous shale and sandstone; Tertiary arkose, conglomerate, sandstone, and shale, with interbedded coal seams; and Quaternary glacial and alluvial deposits of gravel, sand, clay, and boulders. Older and more complex igneous and sedimentary rocks are exposed in the valley walls, which are from 4 to 6 miles apart. In the eastern part of the valley numerous dioritic sills and dikes intrude the Cretaceous and Tertiary sedimentary rocks, but to the west they are progressively less abundant until in the vicinity of Eska and Moose Creeks they are entirely absent.

The valley is in part structural as well as erosional, having been an area of faulting and folding since the Cretaceous period. Most of the folds and a part of the faults trend east, paralleling the trend of the valley. A major fault bounds the north side of the valley and brings the younger formations into contact with an older granodiorite batholith, which forms the main mass of the Talkeetna Mountains. It is probable that a major fault bounds also the south side of the valley, because there the valley formations lie against the older and more highly deformed slate, graywacke, greenstone, and diorite that comprise the bulk of the Chugach Mountains. Thus, lying between these two major faults, the valley is essentially a graben of folded and faulted Upper Cretaceous and Tertiary sedimentary rocks. Both strike and transverse faults are numerous, and they have caused most of the difficulties of mining.

Most of the Tertiary coal-bearing rocks occur in irregular-shaped areas, many of which are entirely surrounded by Cretaceous rocks. The coal-bearing formation is much less resistant to weathering and erosion than the Cretaceous rocks, and its preservation is commonly due to downfaulting into the more resistant rocks or to the presence of a capping rock. The major part of the Moose Creek-Eska Creek coal field is of the latter type, Wishbone Hill being composed of a well-cemented conglomerate that overlies and protects the coal-bearing rocks. The coal mines of this area are located around the eroded margins of this conglomerate.

The coal of the Matanuska Valley increases progressively in rank from the western to the eastern part of the valley. In the lowland of the Susitna Valley, beyond the western limits of the Matanuska Valley, only lignite is found; 10 miles to the east of that locality, in the vicinity of Wishbone Hill, the coals are bituminous; in the eastern part of the valley, on Anthracite Ridge, there are beds that approach anthracite in composition. Increased folding and dike intrusion have contributed to this progressive devolatilization, which has occurred within a distance of 40 miles in the same formation.

STRATIGRAPHY

PRINCIPAL FEATURES

The stratigraphy—determination of the character, sequence, and thickness of the individual beds that make up the rock formations—is of great practical value in the development of the coal mines in this field. If it were fully known, any outcrop would give information, within limitations, regarding the location of the coal beds that may lie above or below any recognized bed. The practical limitations are numerous faults; the similarity of many of the rocks, which prevents them from being easily distinguished; and the lenticular nature, or rapid change in thickness, of the individual beds. Field work, however, will often show the presence or absence of faults; surface stripping will increase the visible section so that it can be recognized; and, in spite of the lenticular nature of the formations, approximations as to the position of individual beds can be estimated. Underground work and surface stripping and trenching are constantly adding to the completeness of knowledge of the stratigraphy.

The formations in the vicinity of Eska Creek have been mapped as three separate units—Chickaloon formation (coal-bearing), Eska conglomerate, and Quaternary slide rock. (See pl. 11.) Natural exposures of the coal-bearing rocks are not numerous, as they are easily eroded into smooth slopes, which are usually covered with vegetation, glacial and alluvial boulders, gravel, and sand. The Eska conglomerate, because of its resistance to erosion, is well exposed, usually as cliffs. The distribution of the glacial and alluvial deposits has not been shown on plate 11, as to do so would almost entirely obscure the underlying coal-bearing rocks. The nearest occurrence of Cretaceous rock is in the extreme southeast corner of sec. 16, on the bank of Eska Creek.

CHICKALOON FORMATION

The coal-bearing Chickaloon formation is the oldest rock unit shown on plate 11, and the nature of the flora it contains indicates that it is Eocene. These rocks underlie the entire area, but only those in the eastern part are shown on plate 11, as in the western part they are overlain by the Eska conglomerate. The total thickness of the coal-bearing formation in this area is over 2,000 feet.

Sandstone, shale, and interbedded coal seams make up the major part of the formation; shale has the greatest aggregate thickness. The shale and sandstone, of varying texture, are gray, drab, and cream-colored. When fresh, these rocks are coherent, but only a few of the sandstones offer much resistance to weathering. Concretions cemented with iron carbonate are common in the shale but usually are noticeable only in the weathered rock. The lower part of the formation contains more sandstone than the upper part. The following section was measured from the breast toward the portal in the new crosscut tunnel that is shown on the map near the south-central part of the NE¼ sec. 16. In this tunnel the beds dip northwest, so that the section as given starts with the uppermost members and the last-mentioned units are the lowest. The lowermost beds are among those that are stratigraphically the lowest exposed in this area.

Section in the new Eska crosscut tunnel, SW¼NE¼ sec. 16

	Ft.	in.
Bone	5	
Coaly shale	2	6
Hard bright coal	1	4
Coaly shale	5	
Shale	8	
Sandstone	3	8
Shale		4
Upper Shaw coal bed	4	5
Coaly shale	3	6
Lower Shaw coal bed	4	2
Coaly shale	1	2
Fine-grained sandstone	3	8
Coaly shale	7	
Martin coal bed:		
Coal	2	6
Coaly shale	1	5
Coal	1	6
Bone	2	6
Coal	2	4
Coaly shale	4	8
Fine-grained sandstone with coal veinlets	8	6
Coal and bone	2	2
Coaly shale	8	
Gray shale	5	6
Coaly shale	3	
Concretionary gray shale	6	
Nodular and banded shale	5	
Shale with thin coal seams	8	6
Shale	3	
Sandstone	6	6
Shale	5	
Coaly shale with 1- to 3-inch seams	4	8
Coal	2	4
Well-cemented sandstone	7	
Gouge; small strike fault		2
Gray shale	2	2
Coal	1	8
Gray shale	4	
Coaly shale	8	
Gray massive shale	8	8
Coaly shale	7	3
Shale and sandy shale	12	

Section in the new Eska crosscut tunnel, SW¼NE¼ sec. 16—Continued

	Ft.	in.
Brown shale	1	6
Coaly shale	1	8
Massive shale	7	
Fine-grained sandstone	5	
Gray shale	2	
Brown shale	1	
Coaly shale		6
Brown shale		8
Coaly shale		8
Brown shale	2	4
Coaly shale	2	6
Finely laminated sandstone	3	6
Coaly shale and a few carbonized logs	4	
Massive gray shale	16	6
Fine-grained sandstone and fragments of carbonized wood	43	
Laminated gray shale	18	
Coal and shale	1	7
Sandstone	1	2
Gouge; small strike fault		1
Coaly shale with a few thin coal seams	4	
Gray massive shale	11	
Coaly shale and a few carbonized logs	3	
Laminated sandy shale with leaf impressions	53	6
Coaly shale		5
Coal		6
Coaly shale		6
Sandstone	1	8
Coal and shale	3	6
Coal and bone	3	
Coaly shale		9
Shale	2	1
Coaly shale	1	1
Sandy shale	1	1
Coal	1	9
Shale	2	
Coal and shale	1	2
Shale		10
Gray shale	1	9
Coaly shale	1	4
Sandstone and some carbonized wood	70	
Gray massive sandy shale	15	
Sheared shale and gouge; small fault		10
Carbonaceous shale	4	11
Massive medium-grained shale	14	
Fine-grained sandstone with carbonized wood and small coal lenses	34	3
Medium- to coarse-grained sandstone	63	9
Laminated sandy shale with leaf impressions	12	4
Total thickness	606	5

The beds of shale and sandstone are not persistent but vary in thickness within short distances. Some of the sandstones, such as the one over the portal of the Eska West tunnel, are cross-bedded. The rapid change in thickness is well illustrated by the interval between the Eska and Emery coal beds. On Eska Creek 286 feet of sedimentary rocks intervene between these coal beds, but this sequence thins so quickly that about half a mile west, in the northeast corner of the NE¼NW¼ sec. 16, the interval between the two beds is only 125 feet. The sandstone overlying the Maitland bed shows a similar variation. On the west side of the creek it is 47 feet thick; on the east side, only 25 feet. These apparent changes in thickness are not all the result of depositional thickening and thinning; strike faults causing elimination or repetition of the strata are also present in the field. However, in general, there appears to be a thinning of the coal-bearing zones toward the southwest.

Coal beds are numerous; over 20 having a thickness of 3 feet or more are known. These beds are all in the upper 1,500 feet of the Chickaloon formation, and they extend within a few hundred feet of the base of the overlying Eska conglomerate. Like the sandstone and shale, the coal beds vary in thickness, so that correlation is difficult. Some of the coal beds have persistent shale markers, but these markers cannot always be relied upon to identify the bed. The position of the markers and the changes in thickness of coal are graphically illustrated by the sections of the coal beds on plate 13.

Two well-known groups of coal beds crop out on Eska Creek: The lower, known as the Eska coal group, consists of the Eska, Shaw, and Martin beds; the upper, known as the Maitland coal group, consists of the Maitland, David, and Emery beds. These are stratigraphically the lowest beds that have been mined; all other minable beds lie between them and the base of the Eska conglomerate.

Generalized section of the coal measures on Eska Creek

	Feet
Shale	10
Chapin bed	2–7
Sandstone	25–47
Maitland bed	10
Shale with a little sandstone	38
David bed	3½
Shale, largely nodular	52
Emery bed	5½
Sandstone and shale	125–286
Eska bed	3
Shale	29
Shaw bed	10
Shale and ironstone	4–11
Martin bed	4½
Shale with thin coal seams.	

Beds locally known as beds 5, 6, 7, 7A, 7B, and 8 were intersected on the north limb of the syncline by the crosscut tunnel of the Evan Jones mine. This section of coal beds overlies the Eska coal group and probably also the Maitland, as it has not been intersected by the new Eska crosscut tunnel and is not exposed on the banks of Eska Creek. Furthermore, structural considerations and the tentative correlation of the two coal beds on the eastern edge of the NE¼NE¼ sec. 17 as the Eska and Shaw beds suggest that the beds on the north limb of the syncline at the Evan Jones mine are stratigraphically above the Eska and Maitland groups.

Section in crosscut tunnel on north limb of syncline, Evan Jones mine

	Feet
Jonesville fault.	
Shale and fine-grained sandstone	30
Bed 5	5
Shale and shaly sandstone	36
Bed 6	4
Shale and fine-grained sandstone	50
Coal, bone, and coaly shale	5
Shale	14
Bed 7	3½
Shale and fine-grained sandstone	24
Bed 7A	6
Gray shale	18
Bed 7B	4
Shale and fine-grained sandstone	30
Bed 8	6
Shale and fine-grained sandstone with a few thin seams of coal	75

The coal beds on the south limb of the syncline in the Evan Jones mine are stratigraphically the highest known in this area, with the possible exception of the little-known exposures in the NE¼ sec. 18. Both of these groups of beds are within a few hundred feet of the base of the Eska conglomerate, and they may be at the same horizon. In the face of the cliff above the Evan Jones tunnel no coal beds are exposed between bed 4 and the base of the conglomerate; therefore, the beds that crop out in the western part of the SE¼NW¼ sec. 16 must be lower in the sequence. These beds are graphically represented by section 48, plate 13, and lie between the north and south limb sections of the Evan Jones mine, but they are not visible, as they are cut out by the Jonesville fault. The following is an approximate section of the coal beds on the south limb of the syncline in the Evan Jones mine. A part of the crosscut tunnel is timbered, and exact measurements could not be obtained at all points.

Section in crosscut tunnel on south limb of syncline, Evan Jones mine

	Feet
Axis of syncline; sandstone and shale broken by many minor faults.	
Shale, sandstone, and fine-grained conglomerate	190
Bed 4	3½
Shale and fine-grained sandstone	35
Bed 3	8
Coaly shale	8
Bed 2	3
Fault with small displacement.	
Sandstone and shale	12
Bed 1, coaly shale	7
Sandstone and shale with a few small faults	105
Bed 0	6
Coaly shale and a small fault	6
Bed 00	5
Crushed shale; fault	1
Shale and sandstone	30

A stratigraphic column of the total assemblage of coal-bearing rocks in this area can only be generalized, because of rapid change in thickness of individual members and the doubtfulness of some of the correlations that have been made. The following sequence of rocks and their thicknesses is suggested, although revisions will undoubtedly be made as more information is gained from development work.

Generalized section of coal-bearing Chickaloon formation in the vicinity of Eska Creek

	Feet
Eska conglomerate.	
Shale, sandstone, and fine-grained conglomerate	200–250
Coal beds 4, 3, 2, 1, 0, 00, and intervening sandstone and shale	200
Shale and sandstone	30
Unknown interval	100±
Coal bed (SE¼NW¼ sec. 16)	10
Sandstone (SE¼NW¼ sec. 16)	25
Coal bed (SE¼NW¼ sec. 16)	15
Unknown interval	200±
Shale and fine-grained sandstone	30
Coal beds 5, 6, 7, 7A, 7B, 8, and intervening sandstone and shale	205
Shale and fine-grained sandstone	75
Unknown interval	25±
Shale	10
Chapin coal bed	7
Sandstone	25–47
Maitland group of coal beds	110
Sandstone and shale	125–286
Eska group of coal beds	52
Shale and sandstone with a few thin coal beds	550

ESKA CONGLOMERATE

The Eska conglomerate overlies the coal-bearing formations and is exposed in the western half of the area. It crops out on the ridge immediately north of Jonesville and forms the main mass of Wishbone Hill. Because of its resistance to weathering, it forms extensive cliffs on the north, east, and southeast sides of Wishbone Hill. The conglomerate is indurated and is composed of well-rounded pebbles and boulders as much as 6 inches in diameter in a matrix of sand. It is usually massive, and the bedding is visible only in large exposures, although in the more sandy portions cross-bedding is common. Lenses of shale and sandstone are interbedded with the conglomerate, and, although they form only a small part of the total thickness, some of them attain an individual thickness of 40 feet, as in the south-central part of the SW¼NE¼ sec. 17. Here the small but pronounced southward-facing dip slope, just east of the top of Wishbone Hill and at an elevation of 2,080 feet, owes its origin to a soft bed of sandy shale that lies in the conglomerate formation. The total thickness of conglomerate is over 1,100 feet, as illustrated by section A–A′, plate 12. It is greatest in the western part of this area, because of the westerly plunge of the syncline.

The conglomerate is conformable in structure with the underlying Chickaloon formation, but the ridge north of Jonesville is the only locality where the contact between the two formations is exposed. This outcrop shows the coal-bearing rocks grading into the conglomerate.

QUATERNARY DEPOSITS

Slide rock.—The slide rock, because of its thickness and areal extent, has been mapped as a separate unit; it is present at the base of all the conglomerate cliffs and is very extensive on the southeast and south sides of Wishbone Hill, around Jonesville.

The formation is composed predominantly of a chaotic mass of irregular-shaped blocks of Eska conglomerate, some of which are 40 feet in diameter. In places, such as the portal of the Evan Jones mine, the slide rock is over 150 feet thick (pl. 12); it commonly lies directly on the coal-bearing rocks and on their contact with the Eska conglomerate. Its origin is due to the relative difference in resistance to weathering of the Eska conglomerate and the Chickaloon formation. The conglomerate is resistant, weathering to sheer cliffs, whereas the underlying coal formation is easily eroded, so that the conglomerate is continually being undermined.

A part of the slide rock is so recent that it is not covered with vegetation, and the nature and origin of the material are apparent; other parts are covered with a mantle of soil and a heavy growth of vegetation, so that their origin is not evident, except by the presence of numerous depressions, characteristic of formations of slide rock. Some of the depressions southwest of Jonesville and immediately south of the area mapped are 100 feet deep and 400 feet long. Although most of the slide rock is of recent origin, some may be doubtfully regarded as preglacial.

Glacial and alluvial deposits.—Glacial boulders, gravel, sand, and silt mantle all but the steepest slopes. The greatest thickness of glacial material is east of Eska Creek, where 50 feet is indicated by the drill logs (pl. 14). West of Eska Creek the covering is thinner, 20 feet being the greatest thickness encountered in drill holes and test pits; the average is 3 to 5 feet. Glacial boulders are found on the top of Wishbone Hill, indicating that it was overridden by the Matanuska Valley glacier. Recent alluvial deposits are confined almost entirely to Eska Creek, where they form a narrow flood plain.

STRUCTURE

PRINCIPAL FEATURES

The dominant structural feature is an open syncline, striking S. 55° to 80° W. and plunging southwest. In a few places along the axis of the syncline the plunge is as much as 25°, but the average is about 10°. (See section E–E′, pl. 12.) Because of this southwest plunge, formations higher in the coal series crop out progressively to the west, until the overlying Eska conglomerate caps the hill, so that the coal beds occur only at considerable depth or around the margins of the syncline.

East of Eska Creek the syncline is asymmetric: the north limb dips 10° to 20°, and the south limb, 45°. In the W½NE¼ sec. 16 the average dip is 28° on the north limb and 45° on the south limb (section D–D′, pl. 12). Farther west the syncline is steeper on the north side than on the south, which is largely eroded.

On the north side of Wishbone Hill, on the line between secs. 17 and 18, there is a gentle depression in the otherwise steep northward-facing cliffs (pl. 11). The conglomerate shows no evidence of faulting, and the change in direction of dip suggests a minor flexure on the north limb of the fold at this locality. The approximate position of the synclinal axis is indicated on plate 11; it is faulted more than shown on the map, however, and many of the sharp curves may be offsets due to faulting.

Both transverse and strike faults are common in the syncline. Many of the minor faults and flexures in the coal-bearing rocks do not appear in the Eska conglomerate, because of its greater competence, or resistance to deformation.

Many of the structural details are reflected by the topography, and Wishbone Hill derives its name from the topographic expression of the southwestward-plunging syncline. In the W½ sec. 16 this synclinal plunge is reflected in the curving ridges of resistant sandstone. Minor details, such as the southwest trend of ridges and depressions, reflect the strike of the beds. Some of the slopes, like the hill on the line between secs. 16 and 17 and the top of Wishbone Hill, are dip slopes further indicative of the structure.

The dip of the formations ranges from a few degrees at the axis of the syncline to nearly 90° in some of the faulted blocks. West of Eska Creek the average dip of the syncline and minable beds of coal is from 18° to 50°.

FAULTS

Very few of the coal beds in this field, when followed more than 1,000 feet along the strike, are not found to be faulted. The largest known virtually unfaulted coal seam is that being mined by the Evan Jones Coal Co. On bed 8 of that company is a block of coal over 2,200 feet long and 1,300 feet on the dip, which is broken only by a few minor faults that have not seriously interfered with mining operations. The practical importance of the study of faulting in this field cannot be overemphasized. The cost of prospecting, development, and mining has been increased and the amount of recoverable coal and the percentage of lump coal that can be produced have been decreased by the faulting of the beds. Surface prospecting, with a preliminary study of the faulting, would eliminate many areas that could not be mined economically, and development costs would be materially lowered.

The faults have displacements ranging from a few inches to several hundred feet. The transverse faults show the greater amount of movement and have predominantly southeast dips. Most of the faults are of the normal type, so that the southeast block has moved down relative to the northwest block. Plate 11 shows some of the more prominent faults.

One of the best-known faults on the Eska leasing unit is the Eska fault, which is well exposed on the south side of Eska Creek in the southern part of the SW¼SE¼ sec. 9. This fault cuts the Eska, Shaw, and Martin beds in the old Eska West workings. Surface prospecting had disclosed the Eska group of coal beds west of the downthrown block, and they were picked up again after the tunnel had been driven 600 feet through the massive sandstone that overlies the Eska coal beds. The continuation of this fault on the north side of the creek is indicated by a massive sandstone lying against soft coaly shales. How far it continues to the southwest is not known, but coal outcrops in the eastern part of the NE¼NW¼ sec. 16 are faulted; it is probable that the axis of the syncline is cut by the same fault. Near the portal of the old Eska West workings are two transverse faults; one brings the Shaw and Eska coal beds together, and the other the Shaw and Martin beds. Both of these faults are exposed at the surface on the steep south wall of Eska Creek. There are also several faults of minor displacement in the Eska West workings.

In the old underground workings, on the east side of Eska Creek, are two transverse faults. The northeast fault brings the Emery and Martin beds together; and the other, which is farther to the southeast, brings the David and Maitland beds together. The northeast fault strikes across the west bank of Eska Creek near the axis of the syncline; farther to the southwest it offsets the Eska bed on the south limb of the syncline, having topographic expression in the small gully in the western part of the SE¼NE¼ sec. 16. On the east side of Eska Creek it dips 72° SE., and probably it has a similar inclination on the west side. It is a normal fault, the southeast block having been downthrown from 300 to 400 feet.

The fault that has moved the Maitland East bed into continuity with the David East bed is normal, with small displacement. Because of the low dip of the coal beds, only a small vertical displacement (30 to 50 feet) is necessary to account for the apparent 300 feet horizontal displacement shown on plate 11. This fault has not been found on the west side of the creek, although it may be present under the Emery bed on the south limb of the syncline.

In the underground workings on the west bank of Eska Creek the Maitland, David, and Emery beds on the south limb of the syncline have been cut off by faults that may be continuations of those in the Eska West tunnel. The Eska bed on the south limb, in the central part of the SE¼NE¼ sec. 16, is also offset by what may be one of the same faults.

On the west bank of Eska Creek, just north of the axis of the syncline, the steep dip and crushed condition of the David and Maitland beds, as well as the absence of the Emery bed, indicate that they lie in a fault block.

A small amount of surface prospecting has failed to disclose the westward continuation of the Eska coal bed in the northern part of the SW¼NE¼ sec. 16: perhaps a fault occurs at this locality. Major faulting between the Eska bed of the south limb of the syncline and bed 4 of the Evan Jones mine is evident, as the eastward prolongation of bed 4 and the westward extension of the Eska coal group would bring the stratigraphically highest and lowest known coal beds almost into continuity. The curve of the axis of the syncline, as shown on plate 11, in the S½NW¼ sec. 16, may be a fault. Perhaps the Eska fault is continuous to the southwest and causes a part of this apparent displacement. The abrupt termination of the ridges at the east boundary of the NW¼NW¼ sec. 16 is also suggestive of faulting.

The faults shown on the south-limb workings of the Evan Jones mine (pl. 11) have been compiled from the old mine maps, as these workings are now inaccessible. The magnitude of the fault that terminates beds 3 and 4 on the east is not known, but the displacement may be expressed at the surface by the lower elevation of the east end of the ridge of Eska conglomerate.

The Jonesville fault is another northeastward-striking transverse fault and is well exposed in the crosscut tunnel of the Evan Jones mine about 150 feet south of bed 5. Here it dips 80° S. 60° E. and has about 3 feet of gouge and crushed rock between the walls. The drag of the beds indicates that at this location the fault is normal. Old mine maps show that beds 5 and 8, east of the crosscut tunnel, and beds 3 and 4, on the west, were cut off by the same fault; all these workings, however, are now abandoned and caved.

At the surface the Jonesville fault is expressed by a well-defined valley in the SE¼NE¼ sec. 17. As a result of the displacement, the base of the conglomerate on the southward-sloping hill, east of the fault and on the line between secs. 16 and 17, is 300 feet lower than the base of the conglomerate west of the fault and on the east end of Wishbone Hill, so that there is that much vertical displacement at this locality. On account of the slide rock, which obscures all exposures, the fault has no further surface expression to the southwest. The ridge to the northeast, in the southern part of the NE¼NE¼ sec. 17, does not show any topographic expression of the fault except on the north side, where the course of a small creek may be determined by it. Proof of the fault here is dependent on the correlation of the coal beds uncovered on the west edge of the NW¼NW¼ sec. 16. In general, they agree with beds 7, 7A, 7B, and 8 of the Evan Jones mine, and the apparent horizontal displacement is about 300 feet. The Evan Jones crosscut tunnel has been driven 150 feet north of bed 8 without intersecting any coal; if the fault were not present, the most southerly of the four coal beds in the western part of the NW¼NW¼ sec. 16 should have been encountered.

The coal beds on the east side of the NE¼NE¼ sec. 17 appear to be the Shaw and Eska beds, an inference which would further substantiate this interpretation. If the correlations are correct, however, the thickness between bed 7 and the base of the conglomerate east of the fault is inadequate as compared with the thickness between the same beds west of the fault. (Compare sections B–B′ and C–C′, pl. 12.) Therefore a fault is suspected on the north side of the conglomerate hill on the line between secs. 16 and 17 (section C–C′, pl. 12). A small amount of surface work in the NE¼NE¼ sec. 17 would readily determine the situation and would give information of value for future development at the Evan Jones mine.

So far as can be learned, no records have been kept regarding formations encountered at the fault in the extreme west end of the gangways of beds 3 and 4. Reports that conglomerate occurs west of the fault would seem to be true, to judge from the projected position of the base of the conglomerate at the surface in the northern part of sec. 20 (pl. 11). If this is true, the southeast side of the Jonesville fault must have moved northeastward relative to the block on the northwest side, so that the horizontal component was much greater than the vertical.

The Evans Jones crosscut tunnel intersects an area of broken ground south of the Jonesville fault, at the axis of the syncline. Numerous small faults are known, but as this part of the tunnel is timbered, it is impossible to detect the presence of any major dislocations.

Bed 8, west of the crosscut tunnel, has been cut by several small faults, of which only the largest, about 1,400 feet west of the crosscut, is indicated on plate 11, and in section B–B′, plate 12. It is a low-angle normal fault causing a 20-foot displacement of the beds exposed in the gangway. The present face of the gangway is in a small fault, which has not yet been driven through. The topography of the coal-bearing formation above the face of the gangway, in the southern part of the NW¼NE¼ sec. 17, is irregular.

The geologic time at which the deformation took place cannot be closely determined. The Eocene formations were first folded, and it may be that the strike faults, which preceded the transverse faults, were formed at this time. The transverse faults, most of which stand at a high angle, are later than the folding. The period of faulting preceded the glacial epoch and may have been late Tertiary.

COAL DEPOSITS

GENERAL OCCURRENCE

The aggregate thickness of coal in the known 2,000 feet of sedimentary rocks making up the Chickaloon formation is over 80 feet, which is a ratio of coal to noncombustible rock between 1 to 20 and 1 to 25, similar to that in many other coal fields. The coal beds usually occur in groups or zones, separated from each other by 100 feet or more of rock. Part of a coal zone is composed of bone (coal with over 50 percent ash) and coaly and carbonaceous shales. The hanging wall of the coal beds has more commonly a sharper contact than the footwall. The footwall is commonly composed of bone, which, like the coal, changes rapidly in composition as well as thickness and in places within a short distance changes to coal.

Present information indicates that there are at least five coal-bearing zones or groups of beds. The lowest, the Eska coal group, is composed of three beds within a thickness of 55 feet of strata; this whole zone, however, with the underlying thin coal seams, is about 100 feet thick. The Maitland group consists of three coal beds in a stratigraphic thickness of 110 feet. The beds on the north limb of the syncline in the Evan Jones mine form another such group: here there are seven beds in 212 feet of strata. The complete section of the formation in the western part of the SE¼NW¼ sec. 16 is not known, but there are at least two large coal beds within 55 feet. On the south limb of the syncline in the Evan Jones mine there are four beds within 85 feet. Beds 0 and 00 may be a part of the coal-bearing zone in the western part of the SE¼NW¼ sec. 16 or a separate zone. Most of these zones are separated by sandstone, signifying a definite change in sedimentation during the deposition of the Chickaloon formation.

CHARACTER OF THE COAL

The coal in this part of the Matanuska Valley is a high-volatile bituminous coal. When fresh it has a bright luster, which it loses upon exposure to weather, although it does not check quickly. The coal has well-developed prismatic cleavage and is friable, so that it is difficult to obtain a large percent of lump. Calcite is common on cleavage surfaces in the vicinity of faults. Some beds, such as the Eska and Chapin, contain petrified logs.

Most of the coal beds in this part of the field have an ash content ranging from 10 to 25 percent, and even the few beds of low ash content are difficult to keep clean because of the condition of the hanging wall. The specifications of the Alaska Railroad, the chief consumer of the coal produced in this field, call for a penalty on coal containing 14 percent or more ash on a moisture-free basis, so that washing plants are almost essential.

The available analyses of the principal coal beds are given in the following table; wherever possible, analyses with cross sections of the beds have been selected. The sections are referred to in the table and are given on plate 13. The analyses are placed in the order of stratigraphic sequence of the beds from which the samples were taken; a stratigraphic range of over 2,000 feet is represented, but the fuel ratios (ratios of volatile matter to fixed carbon) do not increase in the beds at lower horizons, as is the case in some fields. For comparison four analyses of bed 8 are given—two from the gangway, 1,300 feet apart; one composite analysis of 8,270 tons of washed coal produced in 1935; and a composite analysis of a shipment of 200 tons of picked nut-lump coal produced in 1935. A composite analysis of 12,800 tons of run-of-mine coal produced in 1923 from the Eska and Shaw beds of the Eska mine is also included. The Maitland and Chapin beds are highly regarded for domestic consumption, although the approximate analyses do not indicate any exceptional qualities. The David bed is the best blacksmithing coal in this part of the field and has the highest heating value, as is shown by analysis 15.

Analyses of coal from the vicinity of Eska Creek

Analysis no.	Air-drying loss	Form of analysis [1]	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Heating value: Calories	Heating value: British thermal units	Thickness of coal sampled: Ft.	Thickness of coal sampled: in.	Remarks
1	1.83	A	4.39	38.80	40.72	16.09	0.27	6,277	11,298	3	4	
		B	2.61	39.52	41.48	16.39	.27	6,394	11,509			
		C	----	40.58	42.59	16.83	.28	6,565	11,817			
		D	----	48.79	51.21	----	.34	7,893	14,207			
2	1.2	A	3.5	37.3	40.2	19.0	.3	6,106	10,990	7	8½	Sample taken from section 31, plate 13.
		B	2.3	37.8	40.7	19.2	.3	6,178	11,120			
		C	----	38.7	41.6	19.7	.3	6,322	11,380			
		D	----	48.2	51.8	----	----	7,872	14,170			
3	2.01	A	4.43	36.25	38.28	21.04	.32	5,947	10,704	2	8	
		B	2.47	36.99	39.07	21.47	.32	6,069	10,924			
		C	----	37.93	40.04	22.03	.34	6,116	11,009			
		D	----	48.64	51.36	----	.43	7,979	14,362			
4	1.4	A	3.5	35.4	37.4	23.7	.4	5,717	10,290	6	1	Sample taken from section 30, plate 13.
		B	2.1	35.9	38.0	24.0	.4	5,794	10,430			
		C	----	36.7	38.8	24.5	.4	5,917	10,650			
		D	----	48.6	51.4	----	.5	7,844	14,120			
5	1.3	A	3.6	35.5	39.3	21.6	.5	5,800	10,440	4	11	Sample taken from section 29, plate 13.
		B	2.3	36.0	39.8	21.9	.5	5,878	10,580			
		C	----	36.8	40.7	22.5	.5	6,017	10,830			
		D	----	47.5	52.5	----	.6	7,761	13,970			
6	1.2	A	3.5	36.8	38.4	21.3	.2	5,806	10,450	4	2¾	Sample taken from section 32, plate 13.
		B	2.3	37.2	39.0	21.5	.3	5,878	10,580			
		C	----	38.1	39.8	22.1	.3	6,017	10,830			
		D	----	48.9	51.1	----	.3	7,722	13,900			
7	1.4	A	3.8	37.9	43.3	15.0	.3	6,411	11,540	3	7½	Sample taken from section 33, plate 13.
		B	2.4	38.4	44.0	15.2	.3	6,506	11,710			
		C	----	39.4	45.0	15.6	.3	6,667	12,000			
		D	----	46.6	53.4	----	.3	7,900	14,220			
8	5.2	A	7.0	35.1	39.1	18.8	.3	5,771	10,390	4	11¼	Sample taken from section 41, plate 13, without 14 inches of coal and shale at top.
		B	1.9	37.0	41.3	19.8	.3	6,088	10,960			
		C	----	37.7	42.0	20.3	.3	6,205	11,170			
		D	----	47.3	52.7	----	.3	7,778	14,000			
9	1.5	A	5.2	34.7	41.4	18.7	.4	6,033	10,860	5	4	Sample taken from section 40, plate 13.
		B	3.8	35.2	42.0	19.0	.5	6,128	11,030			
		C	----	36.6	43.6	19.8	.5	6,367	11,460			
		D	----	45.7	54.3	----	.6	7,933	14,280			
10	2.4	A	4.7	41.2	45.8	8.3	.3	6,919	12,455			Composite sample of 200 tons of picked nut-lump shipped in 1935.
		B	2.4	42.2	46.9	8.5	.3	7,089	12,760			
		C	----	43.3	48.0	8.7	.3	7,259	13,065			
		D	----	47.3	52.7	----	.4	7,951	14,310			
11	4.4	A	6.6	38.4	43.1	11.9	.3	6,469	11,645			Composite sample of 8,270 tons of washed steam coal, 1935.
		B	2.3	40.1	45.1	12.5	.3	6,767	12,180			
		C	----	41.1	46.2	12.7	.3	6,928	12,470			
		D	----	47.0	53.0	----	.4	7,937	14,285			
12	4.5	A	6.7	37.0	40.5	15.8	.3	6,143	11,060	2	9½	Sample taken from section 28, plate 13, lower bench.
		B	2.3	38.8	42.4	16.5	.3	6,432	11,580			
		C	----	39.7	43.4	16.9	.3	6,585	11,855			
		D	----	47.8	52.2	----	.4	7,924	14,265			
13	2.2	A	4.84	41.64	46.58	6.94	.54	7,162	12,892			From U. S. Geological Survey Bull. 712, p. 137.
		B	2.74	42.56	47.61	7.09	.55	7,320	13,176			
		C	----	43.75	48.95	7.29	.57	7,527	13,549			
		D	----	47.20	52.80	----	.61	8,119	14,614			
14	2.5	A	5.13	42.01	44.08	8.78	.40	6,860	12,348			Do.
		B	2.69	43.09	45.21	9.01	.41	7,037	12,667			
		C	----	44.28	46.47	9.25	.42	7,231	13,016			
		D	----	48.79	51.21	----	.46	7,622	13,720			

[1] A, as received; B, air dried; C, moisture free; D, moisture and ash free.

Analyses of coal from the vicinity of Eska Creek—Continued

Analysis no.	Air-drying loss	Form of analysis	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Heating value		Thickness of coal sampled	Remarks
								Calories	British thermal units	Ft. in.	
15	2.0	A	4.90	41.55	48.04	5.51	.52	7,141	13,194		From U. S. Geological Survey Bull. 712, p. 137.
		B	3.60	42.38	48.40	5.62	.53	7,226	13,295		
		C	----	43.69	50.52	5.79	.55	7,614	13,705		
		D	----	46.38	53.62	-----	.58	8,582	15,448		
16	2.2	A	5.43	39.13	45.74	9.70	.33	6,873	12,371		Do.
		B	3.33	40.00	46.75	9.92	.34	7,025	12,645		
		C	----	41.38	48.36	10.26	.35	7,268	13,082		
		D	----	46.11	53.89	-----	.39	8,099	14,578		
17	2.1	A	4.94	38.03	39.55	17.48	.37	6,192	11,146		Do.
		B	2.87	38.86	40.41	17.86	.38	6,327	11,389		
		C	----	40.01	41.60	18.39	.39	6,514	11,725		
		D	----	49.92	50.98	-----	.48	7,982	14,368		
18	2.7	A	4.85	34.56	37.12	23.47	.32	5,605	10,090		Composite analysis of 12,800 tons of run of mine coal, 1923.
		C	----	36.32	39.01	24.67	.34	5,891	10,604		
		D	----	48.21	51.79	-----	.45	7,819	14,076		
19	3.0	A	4.3	41.4	41.8	12.5	.4	6,637	11,945	4 5	Sample taken from section 14, plate 13.
		B	1.3	42.7	43.1	12.9	.4	6,842	12,315		
		C	----	43.3	43.6	13.1	.4	6,936	12,485		
		D	----	49.8	50.2	-----	.5	8,078	14,540		
20	3.3	A	4.6	40.3	43.8	11.3	.5	6,846	12,325	4 1½	Sample taken from section 7, plate 13, with the three shale markers excluded.
		B	1.3	41.7	45.3	11.7	.5	7,080	12,745		
		C	----	42.3	45.9	11.8	.5	7,175	12,915		
		D	----	47.9	52.1	-----	.6	8,140	14,650		
21	4.5	A	5.6	39.3	40.7	14.4	.3	6,477	11,660	4 4	Sample taken from section 1, plate 13, with the 1 foot 4 inches of shale excluded.
		B	1.2	41.1	42.6	15.1	.3	6,782	12,210		
		C	----	41.7	43.1	15.2	.3	6,859	12,345		
		D	----	49.1	50.9	-----	.4	8,096	14,575		
22	2.8	A	4.1	44.9	47.0	4.0	.4	7,588	13,660	1 8	
		B	1.3	46.1	48.5	4.1	.4	7,807	14,055		
		C	----	46.8	49.0	4.2	.4	7,914	14,245		
		D	----	48.9	51.1	-----	.4	8,256	14,860		
23	3.5	A	5.8	40.9	43.9	9.4	.6	6,771	12,190	3	Sample taken from section 44, plate 13, upper bench.
		B	2.4	42.4	45.5	9.7	.6	7,017	12,630		
		C	----	43.4	46.6	10.0	.6	7,191	12,945		
		D	----	48.2	51.8	-----	.7	7,986	14,375		
24	7.0	A	8.9	39.7	35.2	16.2	.5	5,879	10,585	1 8	Sample taken from section 44, plate 13, lower bench.
		B	2.0	42.7	37.9	17.4	.5	6,322	11,380		
		C	----	43.4	38.8	17.8	.6	6,455	11,620		
		D	----	53.0	47.0	-----	.7	7,848	14,125		

1. Bed 4, Evan Jones mine; sampled by Capt. W. P. T. Hill; analyzed by M. L. Sharp.
2. Bed 3, Evan Jones mine; sampled and analyzed by M. L. Sharp.
3. Bed 2, Evan Jones mine; sampled by Capt. W. P. T. Hill; analyzed by M. L. Sharp.
4. Bed 0, Evan Jones mine; sampled by M. L. Sharp; analyzed by H. M. Cooper.
5. Bed 00, Evan Jones mine; sampled by M. L. Sharp; analyzed by H. M. Cooper.
6. Bed 5, Evan Jones mine; sampled by M. L. Sharp; analyzed by H. M. Cooper.
7. Bed 6, Evan Jones mine; sampled by M. L. Sharp; analyzed by H. M. Cooper.
8. Bed 8, Evan Jones mine; sampled by Ralph Tuck; analyzed by M. L. Sharp.
9. Bed 8, Evan Jones mine; sampled by H. I. Smith and B. D. Stewart; analyzed by H. M. Cooper.
10, 11. Bed 8, Evan Jones mine; sampled and analyzed by M. L. Sharp.
12. Chapin bed, Eska mine; sampled by Ralph Tuck; analyzed by M. L. Sharp.
13. Upper Maitland bed, west side of Eska Creek.
14. Lower Maitland bed, west side of Eska Creek.
15. David bed.
16. Emery bed.
17. Eska bed.
18. Mixture of Eska and Shaw beds.
19. Upper Shaw bed, new Eska crosscut tunnel; sampled by Ralph Tuck; analyzed by M. L. Sharp.
20. Lower Shaw bed, new Eska crosscut tunnel; sampled by Ralph Tuck; analyzed by M. L. Sharp.
21. Martin bed, new Eska crosscut tunnel; sampled by Ralph Tuck; analyzed by M. L. Sharp.
22. Coal bed in new Eska crosscut tunnel, 840 feet from portal; sampled by Ralph Tuck; analyzed by M. L. Sharp.
23. Coal bed in new Eska crosscut tunnel, 360 feet from portal; sampled by Ralph Tuck; analyzed by M. L. Sharp.
24. Coal bed in new Eska crosscut tunnel, 345 feet from portal, sampled by Ralph Tuck; analyzed by M. L. Sharp.

MINING OPERATIONS

Eska mine.—The original application for coal-leasing unit 7, known as the Eska mine, was made in 1916 by William Martin and associates. Mining operations began in January 1917, and during the following spring a railroad spur was constructed. In the early underground work several faults were encountered; the operators did not have sufficient capital for the necessary exploration, and in June 1917 the Alaska Railroad, wishing to be assured of a reliable fuel supply, purchased their equities in the lease. A modern camp was constructed and coal was mined. Operations stopped in October 1921, as private operators were then able to produce coal in sufficient quantity for all railroad and local purposes. Late in 1922 the Eska mine was reopened, the railroad's fuel supply being endangered by a fire at one of the producing mines, but it was shut down again in June 1923. No shipments of coal from this mine have been made since 1923, but some maintenance work was done in the old openings west of Eska Creek. According to the files of the Alaska Railroad, the total amount of coal produced from the Eska mine to date is 215,000 tons, of which 6,000 tons was mined prior to its purchase by the railroad.

In 1932 a flood on Eska Creek did much damage to the old plant. This disaster and the caved conditions of the old underground workings made advisable a new opening to maintain the property in a condition for emergency production. This development was undertaken during the summer of 1934; a new spur from the Jonesville branch of the Alaska Railroad was constructed; and a new crosscut tunnel was started in the southeast corner of the SW¼NE¼ sec. 16, to open up coal beds on the south limb of the syncline and later, in the event of continuous production, to extend the workings to the north limb.

Evan Jones mine.—Coal-leasing unit 6 is held by the Evan Jones Coal Co. Underground operations were first started in October 1920, and coal was sledded to the Eska spur during that winter. In 1921 a spur was constructed to the mine from the Eska branch of the Alaska Railroad. The early mining operations, through an upper tunnel on beds 2, 3, and 4, were on the south limb of the syncline. In 1925 a new tunnel was driven at a lower elevation to crosscut to the north limb of the syncline, and beds 5, 6, 7, 7A, 7B, and 8 were found. (See pls. 11 and 12.) The upper tunnel and the southern workings have been abandoned, and all the coal now mined comes from bed 8 in the lower tunnel. Because of a fire, the mine was shut down for several months in 1922 and 1923, but since then operations have been practically continuous.

In 1928 the equity of W. A. Vinal in leasing unit 5, which adjoins the original Evan Jones lease on the west, was purchased, and in 1933 this lease was included with unit 6.

The property, the largest coal producer in the Matanuska field, is fully equipped, including a screening and washing plant. The maximum daily capacity is over 200 tons.

COAL EXPOSURES

The following descriptions of coal beds that are exposed or have been located by prospecting supplement the coal sections shown on plate 13. In order to make this information as complete as possible, descriptions and sections are included from published reports of Martin[3] and Chapin,[4] and from unpublished reports by Sumner Smith, B. D. Stewart, W. P. T. Hill, B. W. Dyer, J. J. Corey, and M. L. Sharp. Most of these sections are now concealed because of the abandonment of old workings. As far as possible, the coal sections of individual beds on plate 13 have been so placed that they are in sequence from southwest to northeast, and the intervening distances are given; the changes in thickness of coal and the position of shale markers can be easily seen.

COAL BEDS IN THE ESKA MINE

The following description includes all the coal beds encountered in both the old and new underground workings at Eska. The coal beds that have been mined are stratigraphically the lowest in this district. The Martin, Shaw, Eska, Emery, David, and Maitland beds were mined from 1917 to 1923; the greater part of the production came from the Eska and upper Shaw beds. The Chapin bed, the highest of this group, has been mined only during the last 2 years to supply coal for camp use. The beds are described in stratigraphic sequence, the lowest first.

In the new Eska crosscut tunnel, 350 feet from its portal, are two small coal beds that are stratigraphically the lowest known in this area. The lower bed is 21 inches thick, and the upper one 36 inches. Both are graphically shown by section 44, plate 13. Analyses 23 and 24 were made from samples taken across these sections.

Sample 22 was taken from a coal bed 20 inches thick, occurring 840 feet from the portal of the new tunnel. About 20 feet farther north is a 28-inch bed of dirty coal, which was not analyzed.

The Martin bed is the lowest that has been mined. In the old Eska workings it consists of about 3 feet 5 inches of coal, which occurs in two benches separated by a 13-inch parting of shale (section 2, pl. 13); in the new Eska tunnel it is somewhat thicker (section 1, pl. 13). A small coal bed that closely underlies the Martin bed was not analyzed. The Martin bed was mined on both the east and west sides of Eska Creek, on the north limb of the syncline.

[3] Martin, G. C., op. cit. (Bulls. 500 and 692).
[4] Chapin, Theodore, op. cit. (Bulls. 712 and 714).

The Shaw bed has two benches of coal separated by 3 to 8 feet of shale. The lower Shaw bed, which is high in ash because of numerous shale partings, was mined on the east side of Eska Creek up to the northeast fault; on the west side it was mined for a distance of about 600 feet from the portal. Sections 3 to 9, plate 13, indicate that it thins to the south and west. The correlation of the bed on the east edge of the NE¼NE¼ sec. 17 as the lower Shaw is based largely on its association with two other beds that would be the equivalent of the Eska and upper Shaw.

The upper Shaw bed is present in the workings on the east side of the creek as a coaly shale, which changes rapidly to the west and south (sections 10 to 14, pl. 13) and was mined in the Shaw West workings. This bed is thickest and cleanest on the south limb of the syncline in the new Eska tunnel (section 14, pl. 13).

The Eska bed is 2½ to 3½ feet thick and has been mined on both the east and west sides of Eska Creek. Above the coal there is about 6 inches of coaly shale with a characteristic and persistent shale marker. The bed has not yet been cut by the new Eska crosscut tunnel, but surface exposures show that it is present on the south limb of the syncline (sections 18 and 19, pl. 13).

At present the Emery bed is not exposed in the new tunnel, but it is represented by sections 23 and 24, plate 13. There is a possibility that the northernmost exposure of coal in the NW¼NW¼ sec. 16 is the Emery bed, which is mentioned in the discussion of bed 8 of the Evan Jones mine.

The David bed is 2½ to 3 feet thick and, where mined on the west side of Eska Creek, has a persistent parting of yellow shale (section 25, pl. 13). It has a higher heating value than any other coal in the field and was mined on both sides of Eska Creek until cut off by faults.

The Maitland bed has two benches of coal, separated by 4 to 7 feet of coaly shale (section 27, pl. 13), and is one of the best-burning coals in the field. It was mined in the old workings on both sides of Eska Creek until cut off by faults.

The exposure of the Chapin bed at the axis of the syncline on the west bank of Eska Creek is now concealed, but the same bed has been opened up on the east side of the creek by a short tunnel. On the east side of the creek there are two benches of coal separated by 3 feet of shale (section 28, pl. 13), but only one on the west side is mentioned by Chapin.[5]

COAL BEDS IN THE EVAN JONES MINE

Underground work at the mine of the Evan Jones Coal Co. has disclosed several coal beds, and the numerical designations here used are those in common usage at the mine. Beds 1, 2, 3, and 4 were

[5] Chapin, Theodore, op. cit. (Bull. 712) p. 154.

discovered by the upper tunnel in the SE¼SE¼ sec. 17. The lower tunnel, the portal of which is in the SW¼SW¼ sec. 16, intersected the same beds and, in addition, the underlying beds 0 and 00, which are also on the same side of the syncline. Upon the extension of the tunnel across the syncline, beds 5, 6, 7, 7A, 7B, and 8 were discovered. Beds 0, 00, 1, 2, 3, and 4 are not exposed in the crosscut tunnel on the north limb of the syncline, as they have been cut out by the Jonesville fault. In the following description the coal beds are described in their stratigraphic sequence, the oldest first. The numbered sections are shown on plate 13, and the analyses are given in the table on pages 202–203.

A greater tonnage has been extracted from bed 8, which is now being mined, than from any other in this area. Measurements of sections 40 and 41 and samples for analysis were taken from the gangway. Analysis 8 does not include the 8 inches of coal and 6 inches of shale shown at the top of section 41. Tentatively correlated as bed 8 is the northernmost coal bed in the NW¼NW¼ sec. 16, which is represented by sections 42 and 43. The correlation is based on the similarity of sections 40 and 41 to sections 42 and 43 and on the sequence of overlying beds. The northernmost coal bed in the NW¼NW¼ sec. 16 is offset from bed 8 (see pl. 11), and the amount and direction of displacement as shown are approximately correct if the Jonesville fault strikes between them. If this correlation is incorrect sections 42 and 43 may be the Emery bed, as the sequence of overlying beds is somewhat the same.

Bed 7B is graphically shown by section 38; a correlation with the coal bed illustrated by section 39 is suggested.

Bed 7A (section 36) may be correlated with the coal bed illustrated by section 37. This bed has two benches of coal; if sections 42 and 43 should prove to be the Emery bed, section 37 would then represent the Maitland bed.

Bed 7 has 3½ feet of coal and is represented by the lower part of section 34. The section overlying the bed is partly obscured by timbering, and only the part that could be measured is shown. The southernmost coal exposure in the NW¼NW¼ sec. 16, represented by section 35, may be bed 7. Sections 34 and 35 do not have much similarity, and the suggested correlation is made on the basis of the sequence of the underlying beds at both localities.

Bed 6, sometimes known as the Guidone bed, is 3½ feet thick; analysis 7 represents a sample that was cut from a section of the bed shown by section 33.

Bed 5 is sometimes known as the Loussac bed; analysis 6 represents a sample of the coal that was cut from section 32. This section does not represent the entire bed, as there is coal and bone both above and below it.

Bed 00 is the lowest bed on the southern limb of the syncline. It overlies bed 5, but the exact thickness of intervening sediments is not known. It is graphically represented by section 29, and analysis 5 was made on a sample cut from this section.

Bed 0 is represented by section 30 and analysis 4.

Bed 1 has never been mined and is properly not a coal bed. This designation, on the old mine maps, was given to a 7-foot zone of coaly shale.

Bed 2 has an average thickness of 32 inches, and analysis 3 was made from such a section.

Bed 3 is represented graphically by section 31 and chemically by analysis 2. Because of the shale parting, this bed was mined in two benches.

Bed 4 is stratigraphically the highest known coal bed in this area. Analysis 1 represents a thickness of 40 inches of coal, including a 1½-inch shale parting. The average thickness of this bed is 3½ feet.

COAL BEDS LOCATED BY DRILLING

In 1917 the Alaskan Engineering Commission, whose functions were later taken over by the Alaska Railroad, drilled 47 holes in prospecting the coal beds immediately adjacent to Eska Creek. The location of these drill holes is shown by plate 11. Holes 1 to 35 were drilled on the east side of Eska Creek, and holes 36 to 47 on the west side; records of their logs, obtained from the files of the Alaska Railroad, are shown graphically on plate 14.

Drill holes 46 and 47 cut a coal bed at a depth of 60 feet. This bed has also been uncovered on the surface, where it is believed to be the Eska. The Shaw and Martin beds, which should underlie it, were not encountered by the drill holes, although hole 46 was drilled to a sufficient depth to intersect them if the usual interval of sedimentary beds had been present. The coal bed cut by hole 42 may be the Emery. Holes 36 to 41 probably are in faulted and broken ground.

A part of the area that was drilled on the east side of the creek has since been mined; in the remainder, so far as is known, there is little coal above the level of Eska Creek.

COAL BEDS EXPOSED BY SURFACE PROSPECTING

A coal bed was found in the extreme northwest corner of the SW¼NE¼ sec. 16, but it has not been sufficiently uncovered to expose the entire section. The dip of the bed indicates that it is near the axis of the syncline. It may be one of the upper Maitland group of beds or one of the coal beds found on the north limb of the syncline in the Evan Jones mine.

In the central part of the NW¼NE¼ sec. 16 a coal bed has been exposed. The complete section is not known, but this outcrop may be one of the Maitland group of beds, as the stratigraphic interval between it and the Eska coal bed in the old Eska West tunnel is about the same as the usual distance between these beds. (See section D–D′, pl. 12.)

In the eastern part of the NE¼NW¼ sec. 16 several coal outcrops have been uncovered on the bank of a small creek. One of these is regular in strike and dip, but the remainder have varied inclinations, showing evidence of faulting. They may lie within the Eska fault block encountered in the old Eska West tunnel. The northernmost coal bed, exposed on both sides of the small creek, is the only one that appears unfaulted. Section 46, plate 13, was determined from these exposures. On both sides of the creek, 90 feet to the south, is 30 inches of coal with some crushed shale and gouge, all in a vertical position. About 50 feet farther east, on the east side of the creek, there is 3 feet of coal; the top and bottom of the section are concealed. At 80 feet farther south, on the west side of the creek, is 3 feet of coal; this bed strikes N. 8° W. and thus is not in accord with the regional strike.

Several thin coal beds have been found on the north bank of a creek in the southwest corner of the SW¼NE¼ sec. 16. Section 45, plate 13, was measured at that locality. These beds have been traced southwest for 600 feet. The strike is practically continuous with that of the small coal beds that were cut in the new Eska crosscut tunnel 350 feet from the portal; the sections are somewhat similar, but a fault may occur between these two exposures. The presence of coal blossom indicates the probability of several coal beds on the bank of the creek in the southern part of the SE¼NW¼ sec. 16.

Two large coal beds are exposed on the sides of a deep gully in the W½SE¼NW¼ sec. 16. These beds are on or near the axis of the syncline, which here plunges steeply to the west. Section 48, plate 13, was measured on the west side of the gully.

In the northeast corner of the SW¼NW¼ sec. 16 is the coal bed represented by section 47, plate 13. It is not known whether this bed is above, below, or a part of the beds represented by section 48.

The coal beds uncovered in the NW¼NW¼ sec. 16 have been tentatively correlated with the beds on the north limb of the syncline in the Evan Jones mine, and those in the NE¼NE¼ sec. 17 with the Shaw and Eska beds.

In 1931 the Evan Jones Coal Co. prospected the two gullies on the north side of Wishbone Hill, in the northern part of sec. 18 (pl. 11). The trenches and tunnels have caved so that accurate sections of the beds exposed in them cannot be measured. A short report by the Evan Jones Coal Co. states that the prospecting exposed a 700-foot thickness of coal-bearing rocks, extending from the base of the Eska conglomerate to the swamp on the north side of Wishbone Hill. In this thickness nine coal beds were exposed, several of which were within a short distance of the base of the conglomerate. Similar sections were exposed in both gullies.

FUTURE MINING OPERATIONS

The total coal reserves of this area are not known, as the stratigraphic column is not complete. An estimate of the amount of coal would give but little accurate information of the tonnage that could be recovered, because numerous faults, particularly in unit 7, would prohibit the mining of many blocks of coal. Many of the coal beds are close together, and beds freer of ash or of better quality closely underlie less desirable beds, so that the overlying coal may be lost by the extraction of the underlying one first.

Because of the topography, the amount of coal above the natural drainage level on the east side of Eska Creek is small. Some coal could be extracted from the Chapin bed; the present opening would soon strike the same fault that brings the Maitland and David beds together, but in all probability the continuation of the Chapin bed could easily be found on the southeast side of the fault, as the approximate amount of displacement is known. On the south limb of the syncline the Maitland and Eska groups of coal beds may be present. These beds would also have to be developed from slope workings, because of the topography. Little is known of this area, however, as the overburden is thick, and the few holes that have been drilled were shallow.

On the west side of Eska Creek the new crosscut tunnel has made available coal sufficient for emergency purposes for the railroad. When this area is mined out, which would take several years at the present rate of railroad consumption, the new tunnel can be extended into the NW¼ sec. 16. Here the Eska, Maitland, and Jonesville groups on the north limb of the syncline and possibly several overlying coal beds will be intersected. This constitutes the largest reserve on unit 7; in some places there will be 1,400 feet of coal on the dip of the bed, above the tunnel level.

The largest known reserve in the Matanuska coal field, consisting of several million tons, lies in unit 6 and its western addition, formerly unit 5. So far as is known, the coal beds on the north side of Wishbone Hill are practically continuous for 2 miles. Bed 8, where first mined, had 1,500 feet of coal on the dip of the bed above the level of the gangway; where mined at present it has 1,300 feet, and because of the topography the thickness will continue to decrease to the west. Other coal beds occur stratigraphically above and below bed 8; those above will have a greater distance above the tunnel level than bed 8, whereas those below will have less. Theoretical considerations indicate that the Eska and probably the Maitland groups of coal beds will be intersected by the extension of the Jonesville crosscut tunnel; and that the Jonesville fault has eliminated from the crosscut tunnel all the beds overlying bed 5 on the north limb of the syncline. These beds, however, could be intersected northwest of the fault at the present tunnel level, as to the west the overlying coal beds are carried down by the southwest plunge of the syncline. (See sections B–B′ and E–E′, pl. 12). Valuable prospecting work that should be done on unit 6 would be to obtain, by surface trenching and stripping, a cross section of the formations downward from the base of the Eska conglomerate, on the north side of Wishbone Hill, which would yield information regarding the location, thickness, and quality of coal.

Besides the reserves on the north side of Wishbone Hill, there are equal if not greater reserves below the present tunnel level, along the axis of the syncline and on the uneroded remnant of the south limb. Some of the coal along the axis may be crushed and faulted, but undoubtedly there are large minable blocks.

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