R. I. 3784 December 1944

UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

REPORT OF INVESTIGATIONS

MOOSE CREEK DISTRICT OF MATANUSKA COAL FIELDS, ALASKA

BY

G. A. APELL

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By G. A. Apell[2/]

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ILLUSTRATIONS

1/ The Bureau of Mines will welcome reprinting of this paper provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Report of Investigations 3784."

2/ Mining engineer, Bureau of Mines, Juneau, Alaska.

SUMMARY

The quality of Moose Creek coal is considered superior to that of any now being produced in the Matanuska field of Alaska. In rank it is classed as poor coking high-volatile B bituminous coal.

At present the Moose Creek mines are accessible from the Glenn highway by 6 miles of well-maintained gravel road. The nearest railroad loading point is Moose Creek siding, 7 miles by road from the Buffalo mine. Palmer, 12 miles south of Buffalo mine, is the nearest town. Anchorage is 50 miles south of Palmer by road and railroad.

Core drilling and trenching by the Bureau of Mines revealed 2,375,500 short tons of coal in the Buffalo series on the Buffalo Coal Co. leasehold. Of this, 514,200 tons is considered measured coal and 489,900 tons indicated coal. Existence of deeper beds over the same length increased the tonnage of coal of all categories to 3,259,300 tons. The property has an assumed life, of 16 to 22 years, depending on the number of beds mined, based on an output of 500 tons of coal a day and 100-percent recovery. Coal from some of the beds can be marketed without washing; however, a washery is necessary if all beds are mined. Beds in the Buffalo series not mined in the "first mining" will be irrecoverable at any later date.

The Bureau of Mines completed exploration of approximately one-third of the local coal-bearing areas during 1943. Knowledge gained from this work makes it possible to investigate the rest of the area by drilling an estimated additional 5,000 feet of hole.

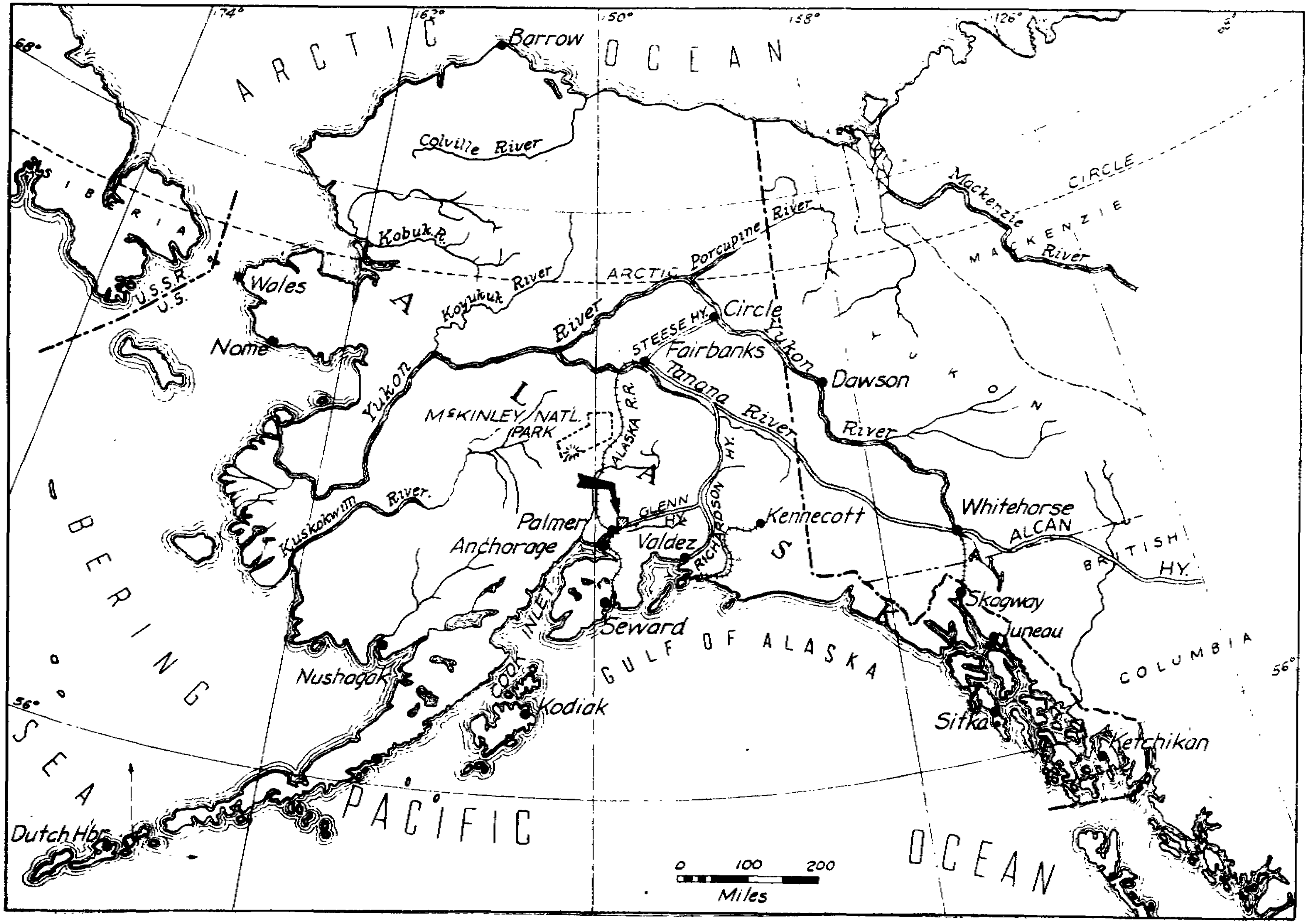

FIGURE 1.- Moose Creek area of Matanuska coal field.

INTRODUCTION

Coal occurrences are numerous and widely scattered throughout Alaska. It has been mined at various places for local consumption in the Territory and to a small extent for river steamers and ships plying the Bering Sea and the Arctic Ocean.

Outbreak of war in December 1941 caused Alaska to be designated a military combat area; consequently, there was a large influx of military men and material into the Territory. Urgent defense projects quickly absorbed all local labor and materials, and more were brought in. The resulting increase in demand for coal far exceeded the pre-war requirements.

The Bureau of Mines undertook to explore certain coal areas of Alaska and to encourage the production of Alaskan coals because of the high cost of importing coal, shortage of cargo space in ships en route to Alaska, delay in or prevention of shipments of other commodities needed by defense projects or by Government agencies aiding the war effort or by civilians, because of the use of cargo space for coal, the impending shortage of coal in the States, the known abundance of accessible coal of good quality, and the existing acute shortage in Alaska because of low normal production.

The Moose Creek district of the Matanuska coal field was selected for investigation because of the good grade of coal, proximity to market, available railroad transportation, and possibility of getting the deposit into production quickly. The physical and chemical properties of the coal are such that it can be stored without difficulty. Location of the Moose Creek district is shown in figure 1.

Alaska coals grade from lignite to anthracite; the most important commercially are subbituminous, bituminous and semibituminous. Lignite abounds in Alaska, but is not so desirable for fuel because of high moisture ash content and its tendency to disintegrate (slack) quickly on exposure to air. Anthracite is not much in demand at present because few fire boxes are designed to burn this kind of fuel.

Wood has been used for fuel for domestic purposes and small commercial enterprises to such an extent that areas contiguous to cities and towns have been denuded. Mining operations and portable sawmills have taken heavy toll of timber accessible to mines and towns. Spruce is the best local wood for fuel, mine timber, and lumber. The cost of long haul and handling has virtually removed spruce as fuel in the Anchorage-Palmer area.

The Territorial coal requirements for the 1943-44 season were estimated at 500,000 to 600,000 tons. Before the war the annual comsumption of Alaska was about 200,000 tons. The large increase is due mainly tp heavy demands for military purposes and expanded civilian activities attendant thereon.

To meet the increased demand in the shortest possible time and to safeguard the future it is apparent that new mines must be opened and brought into production quickly, even though some of them will be kept in stand by condition or be worked on curtailed production after the war. However, the normal annual increase in coal consumption has been steadily accelerated owing to increased population and the growing cost of wood fuel. Moreover, many of the recent expansions are permanent; the resumption of gold-mining activities after the war will require coal for the production of electric power, hydrogenation plants will use coal as raw material; and increasingly numerous products are derived from coal - all combining to assure Territorial demands for coal after the war that will exceed per-war consumption.

A military coal commission[3] was sent to Alaska in 1943 to investigate coal resources and initiate speedy production where conditions were most favorable. The commission visited the Moose Creek district and was favorably impressed with its possibilities as revealed by the Bureau of Mines work then in progress.[4]

The Bureau of Mines work had as its object the tracing and sampling of a sequence of coal beds, herein called the Buffalo series, by core drilling and trenching in the area shown in figure 2. Core drilling was started on the Buffalo Coal Co. property on November 1, 1942, and recessed on the Premier-Baxter ground of the Alaska Matanuska Coal Co. property on August 1, 1943. Field work, mapping, and cost accounting were completed at the end of September 1943. Progress of the work was delayed during cold weather owing to freezing of pumps and water lines, icing of equipment, and impassable roads caused by drifting snow and glaciering.

The Federal Geological Survey had a field party of four men in the Moose Creek district in the summer of 1943 under the supervision of George O. Gates, associate geologist. The purpose of its work was to complete the geological map of the Wishbone Hill area started by Ralph Tuck in 1934.[5] The geological party had free access to all data gathered by the Bureau of Mines in the Moose Creek district, such as surveys, maps, drill cores, logs of drill holes, etc.

Work on the Moose Creek project was expedited by the full cooperation, in every way possible, of B. D. Stewart, Territorial Commissioner of Mines; L. Saarela and C. Garrett, of the Territorial Department of Mines; M. L. Sharp, coal analyst for the Alaska Railroad; Col. O. F. Ohlson of the Alaska Railroad; the Alaska Road Commission; members of the field party of the Federal Geological Survey working at Moose Creek in 1943; Dr. Schooler, Missouri School of Mines; and the Matanuska Valley Farmers Cooperating Association. Many local men also gave information and assistance.

A study of the ground and local conditions indicated that results of greatest benefit to Moose Creek mines would obtain from starting the work on the Buffalo property. Accordingly, drilling was started on the Buffalo at hole 1 on November 1, 1942.

LOCATION AND ACCESSIBILITY

The Matanuska coal field lies along the valley of the Matanuska River between the Talkeetna and Chugach mountain ranges in south central Alaska. The coal field is 6 to 8 miles wide and about 40 miles long with a general trend approximately N. 70° E. The Moose Creek district, shown in figure 2, is in the western part of the Matanuska field, cutting across secs. 13, 14, 22, 23, 26,

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3/ Members: Lt. Col. C. W. Jeffers, Maj. D. L. Sibray, Maj. Chapman, Capt. J. M. Rasch. Headquarters of the Commission is at Fort Richardson, Anchorage, Alaska.

4/ Bureau of Mines work was under the direction of G. A. Apell, assisted by S. C. Bjorklund and A. W. Erickson, assistant engineers.

5/ Tuck, Ralph, The Eska Creek Coal Deposits, Matanuska Valley, Alaska: Geol. Survey Bull. 880-D, 1937, plate 11.

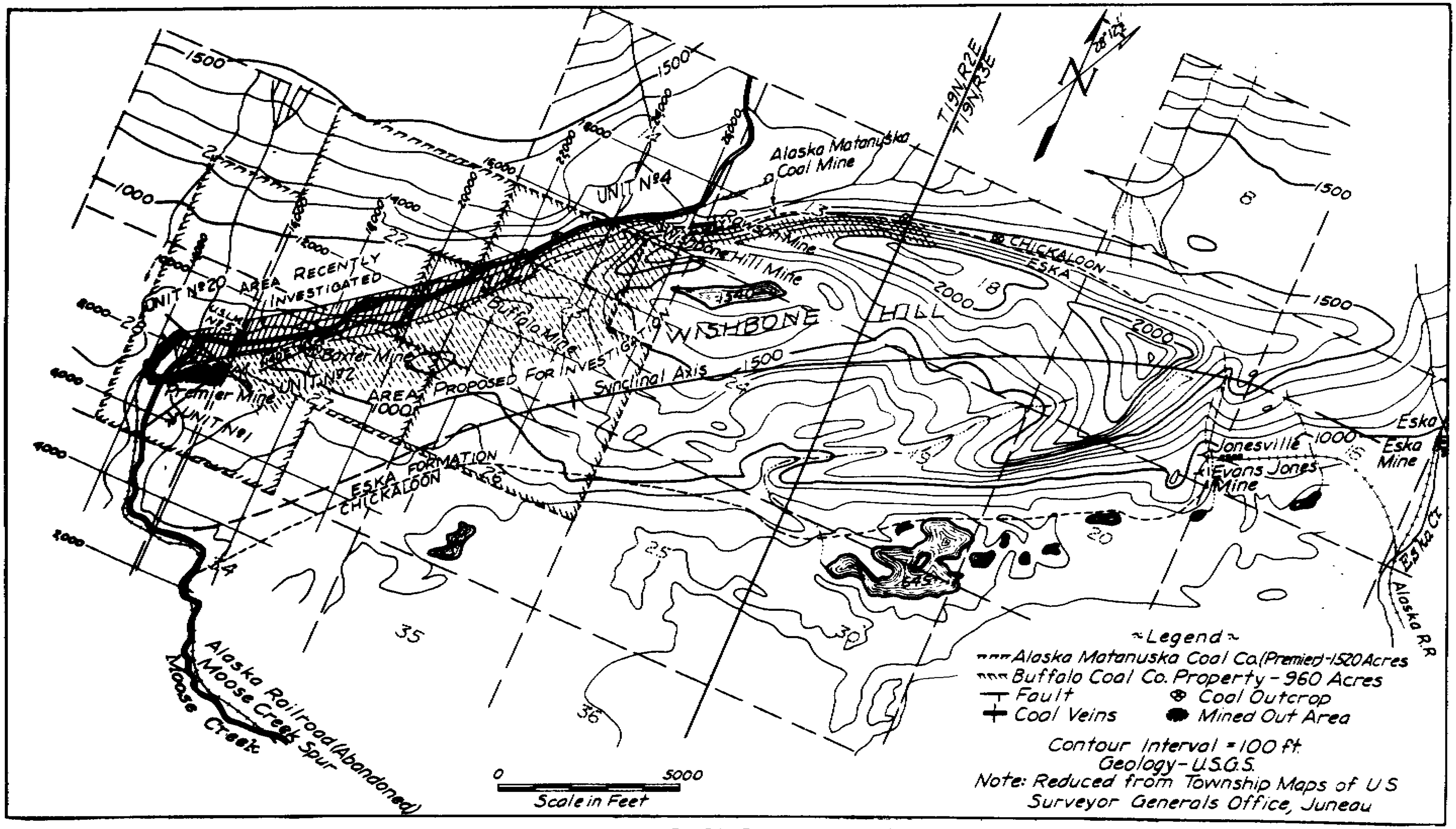

FIGURE 2.- Matanuska coal field, Moose Creek coal mines.

27, and 28 of T. 19 N., R. 2 E., Seward Meridian. Moose Creek heads in the Talkeetna Mountains and flows in a southerly direction to Wishbone Hill, where its course is southwesterly for a little more than 3 miles, to below the Premier mine camp, where it makes a sharp turn and flows southeasterly about 4 miles through a narrow canyon to its junction with the Matanuska River. The 3-mile stretch where Moose Creek flows southwesterly is the coal-bearing area under consideration.

Moose Creek is accessible via the Alaska Railroad from Seward or Anchorage to Matanuska Station, distances of 150 and 50 miles, respectively, and thence by branch line by way of Palmer to Moose Creek siding, a distance of about 15 miles. The branch railroad continues up the Matanuska Valley to Sutton station and the Evan Jones and Eska coal mines. At one time the standard-gage railroad extended 4 miles up Moose Creek to a short distance above the Premier mine and continued as narrow gage an additional 3 miles to the Wishbone Hill mine. In September 1942 a heavy flood in Moose Creek washed out large sections of track of both standard and narrow gage. The railroad has not been repaired and probably will not be because of the extent of the damage. Should coal production in the Moose Creek area justify railroad transportation, a new location will be chosen.

Six miles of good, graveled, automobile road, built and maintained by the Alaska Road Commission, connects the Buffalo and Premier mines with the Glenn highway 6 miles north of Palmer, the nearest railroad and supply point. Good, graveled roads connect Palmer with several points on the main line of the Alaska Railroad. The Glenn highway runs from Anchorage northward 50 miles to Palmer, thence eastward along the Matanuska River, and connects near Gulkana with the Richardson highway, which runs from Valdez to Fairbanks. For the most part, these roads are kept open all year by the Alaska Road Commission. However, the south end of the Richardson highway crosses a mountainous section near the coast in an area of heavy snowfall, therefore this portion of the highway is impassable during the winter months.

The Willow Creek bus line runs a daily round-trip stage between Palmer and Anchorage. The fare one way is $3.00, round trip $5.00. The O'Hara bus line of Anchorage runs frequent unscheduled bus trips between Palmer and Anchorage. There is passenger service between Anchorage and Palmer on Tuesdays, Thursdays, Fridays, and Saturdays on the Alaska Railroad. Air-line companies in Anchorage furnish plane transportation to and from Juneau and Fairbanks at $90.00 and $60.00, respectively. Charter plane service is available at Anchorage. Approximate fare by plane from Seattle to Juneau is $81.00, Seattle to Fairbanks is $175.00, and Juneau to Fairbanks $82.00 via Whitehorse, Y. T.

Mininum first-class passage by steamship from Seattle to Juneau is $57.60 and Juneau to Seward $85.00. Continuous passage from Seattle to Seward is $108.94. Railroad fare Seward to Anchorage is $9.45.

Cook Inlet is served by the Alaska Steamship Co., which has maintained once-a-month service to Seldovia since the entrance of the United States into the war. The basic freight rate on machinery from Seattle to Seldovia during the summer of 1942 was 41-1/4 cents a cubic foot or 82-1/2 cents a hundred pounds, whichever was greater, plus a 25/percent emergency surcharge. Rates on groceries and other supplies varied but were generally higher than those above.[6]

Telephone, telegraph, freight, and express service is available at Palmer. Freight rates from Juneau to Palmer are $2.89 a hundred pounds and Palmer to Fairbanks $2.46. Express is $6.35 a hundred from Juneau to Palmer.

HISTORY

Coal mining is steadily becoming a fixed and important industry in Alaska. When the point is reached where the supply is stable and deliveries can be assured there will be no reason to import coal. Abnormal conditions, such as now exist, are hastening the date when adequate storage and handling facilities will be available at Alaskan ports.

The Federal Geological Survey has covered by areal surveys most of the known Alaskan coal fields and portions of certain fields have been studied and mapped in detail.[7] In some instances the areas were drilled by the Federal Geological Survey, as at Anthracite Ridge[8] and Moose Creek[9] in the Matanuska field.

The Government owned and operated Alaska Railroad was the largest consumer of coal before the war. Coal from the Evan Jones mine and some from the Eska mine (owned and operated by the Alaska Railroad) in the Matanuska field is used for railroad operations from Seward, the southern terminus, to Healy, three-fifths of the total mileage. Fuel for the northern two-fifths, Healy to Fairbanks, is obtained from the mines in the Healy and Nenana districts producing lignite and subbituminous coal. The Northern Commercial Co. gets 50,000 tons of coal annually from the Healy area for its power plant in Fairbanks. This plant furnishes power to the city of Fairbanks, to the extensive gold-dredging operations of the Fairbanks Exploration Co. and other operators in the district.

The first coal mine in the Moose Creek district was the Doherty or Pioneer mine opened in 1916. It was situated on the west bank of Moose Creek about 3/4 mile from its mouth. A 3-foot bed was mined and the product sold to the Alaska Railroad and in Anchorage. The coal proved too dirty, so the mine was closed after 3 months' operation. The Baxter mine on Moose Creek, 4-1/2 miles above its mouth, produced coal from an 11-foot bed during the winter of 1917-18.

6/ Bureau of Mines, Claim Point Chromite Deposit, Kenai Peninsula, Alaska: War Minerals Report 253, June 1943, 34 pp. (Robert S. Sanford, district engineer).

7/ Tuck, Ralph, The Eska Creek Coal Deposits, Matanuska Valley, Alaska: Geol. Survey Bull. 880-D, 1937, pp. 185-214.

8/ Waring, G. A., Geology of Anthracite Ridge District, Alaska: Geol. Survey Bull. 861, 1936, 57 pp.

9/ Waring, G. A., Core Drilling for Coal, Moose Creek, Alaska: Geol. Survey Bull. 857-E, 1934, pp. 155-173.

Lack of capital and the faulted condition of the bed caused the mine to close. It was reopened in 1921 and produced a small tonnage of coal for the next few years, but was finally abandoned in 1925. At the Rawson and the Alaska Matanuska mines, about 2-1/4 miles above the Baxter, some coal was produced in development work. The Rawson mine stopped operations in 1926 and the Alaska Matanuska in 1929. Successful development was hindered by the faulted condition of the beds. In 1925 a narrow-gage railroad was extended up Moose Creek to these properties. In 1932 the Wishbone Hill Coal Co. produced a small quantity of coal from the Rawson. These workings were taken over in 1934 by the New Black Diamond Coal Co. The Premier mine of the Alaska Matanuska Coal Co., 3/4 mile below the Baxter, was opened in 1925. The railroad was made standard gage in 1926 to the Premier, and this mine became the principal producer in the Moose Creek district. Late in the summer of 1933 water broke in and flooded the workings. Since that time it produced a small tonnage daily from the beds above the flooded area. These reserves were worked out, and the mine closed in August 1943. The Anchorage Coal Co. was the operator at the time of shut-down. It is estimated that the Premier mine produced about 165,000 tons of coal. The Buffalo mine, about a mile above the Baxter, is in the prospect stage. Its gross production from development work was about 3,800 tons. The total tonnage produced by all the Moose Creek mines is estimated roughly at 250,000 tons.

Prospecting on the Buffalo property was started in 1939 by Frank Colobuffalo and Fred Spach. The latter soon withdrew, and his place was taken by Joe Colograssi, who stayed about 2 months. Joe Danich became a partner in December 1940, at which time the Powder House Tunnel had been driven 18 feet, and a small tunnel had been started at the present main entry. The property was incorporated as the Buffalo Coal Co. in June 1941, the incorporators and principal shareholders being Frank Colobuffalo, Joe Danich, Thomas Bevers, and Emil Pfeil, all of Anchorage, Alaska. At present the main entry has driven to the No. 3 bed and a short gangway (65 feet) on No. 1 bed.

PROPERTY AND OWNERSHIP

All coal lands in Alaska are owned by the Federal Government and are under the jurisdiction of the United States Department of the Interior. Coal-prospecting permits and mining leases may be granted to individuals or groups of individuals who are citizens of the United States.

A coal-prospecting permit grants to the applicant, for a period of 4 years, the exclusive right to prospect for coal on the described land. A royalty of 10 cents a ton is paid to the Government for all coal removed. A maximum of 2,560 acres can be held by an individual or group by permit or lease.

A mining lease on coal lands in Alaska is of indefinite duration, provided the provisions of the Coal Leasing Act of October 20, 1914 (38 Stat., 741), are fully observed by lessee. The Government exacts a minimum royalty of 2 cents a ton for all coal removed during the first 5 years of the lease and a minimum of 5 cents a ton for the following 20 years, after which royalties are adjusted from time to time but never exceed 5 percent of the selling price of the coal.

The area discussed in this report includes 960 acres held by coal prospecting permit by the Buffalo Coal Co., and 1,520 acres held by mining lease by the Alaska Matanuska Coal Co., Anchorage, Alaska, all in T. 19 N., R. 2 E., Seward Meridian. The Alaska Matanuska ground embraces the Baxter and Premier mines. Description of individual tracts is as follows:

Property and ownership

Owner: Buffalo Coal Co.; number of entry: 010214

T. 19 N., R. 2 E., sec. -	Part of section		Area, acres
22	E 1/2 SE 1/4		80
23	S 1/2 W 1/2 NE 1/4 NE 1/4 NW 1/4		440
	W 1/2 NW 1/4 SE 1/4 NW 1/4		120
26	N 1/2		320
		Total	960

Owner: Alaska Matanuska Coal Co.; number of entry: 09331

21	SE 1/4		160
22	N 1/2 SW 1/4 W 1/2 SE 1/4		560
27	N 1/2 SW 1/4		480
28	E 1/2		320
		Total	1,520

PHYSICAL FEATURES

The general trend of the Matanuska Valley from source to mouth is slightly south of west. The Matanuska River flows along the south side of the coal field against the Chugach Mountains, which rise steeply from the valley (see fig. 3). Many small streams and a number of glaciers head in the Chugach Mountains and flow northward into the Matanuska River. The Matanuska is a fast-moving, braided stream flowing westerly in a flat-bottomed, gravel-covered valley a half mile to a mile in width. Floods cause frequent changes in the branching channels of the river. North of the river the drainage is southward; it is noteworthy that the largest tributaries come from the north. The relief on the north side of the Matanuska in the Wishbone Hill area, which lies between Eska and Moose Creeks, is more moderate than that south of the river. Gravel-colored hills and bluffs (see fig. 4), rising from 200 to 400 feet, border the north side of the river. Thence the slope, going northward, is moderate and rather uniform in ascent to the southerly flank of Wishbone Hill, where there is an abrupt rise of 150 to 200 feet to the top of the ridge. The rise then is gradual to the northerly flank of the hill, followed by an abrupt drop-off into Moose Creek Valley. Beyond Moose Creek the ground again rises in a series of stream terraces for several hundred feet to the foothills of the Talkeetna Mountains.

The area south and southwest of Wishbone Hill to the Matanuska River and the lower part of Moose Creek is covered with a mantle of glacial till. The

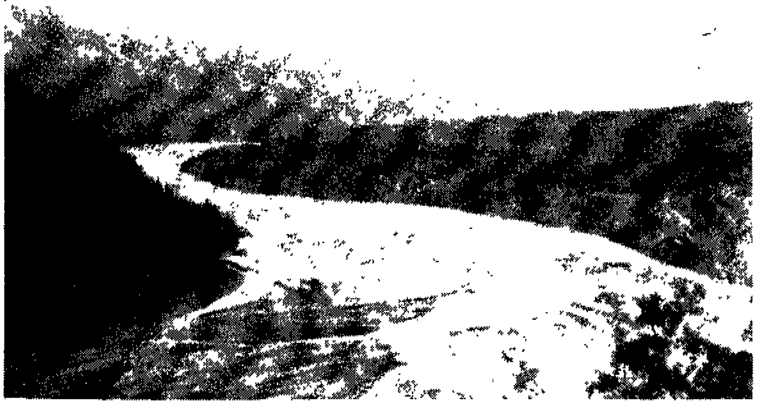

FIGURE 3.- Matanuska River approximately 40 miles from Palmer on Glenn highway.

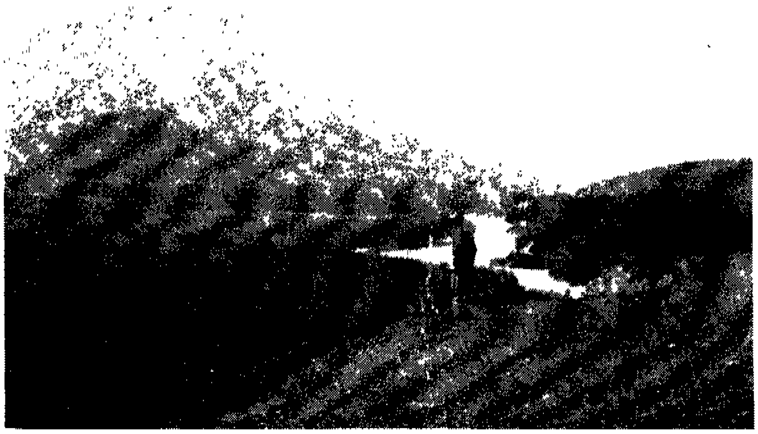

FIGURE 4.- Matanuska River approximately 50 miles from Palmer on Glenn highway.

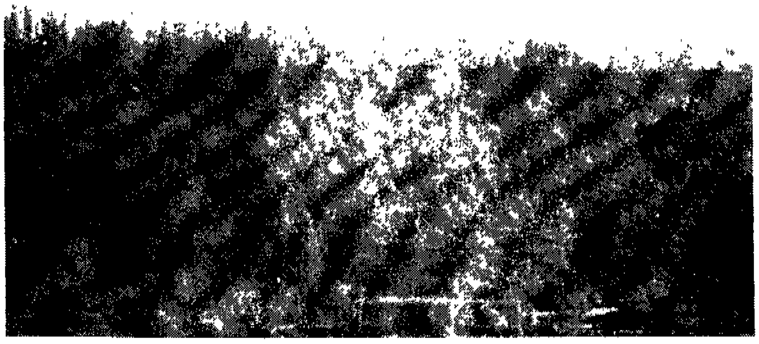

FIGURE 5.- North flank, Wishbone Hill, showing conglomerate capping; 1,000 feet upstream from the Baxter mine.

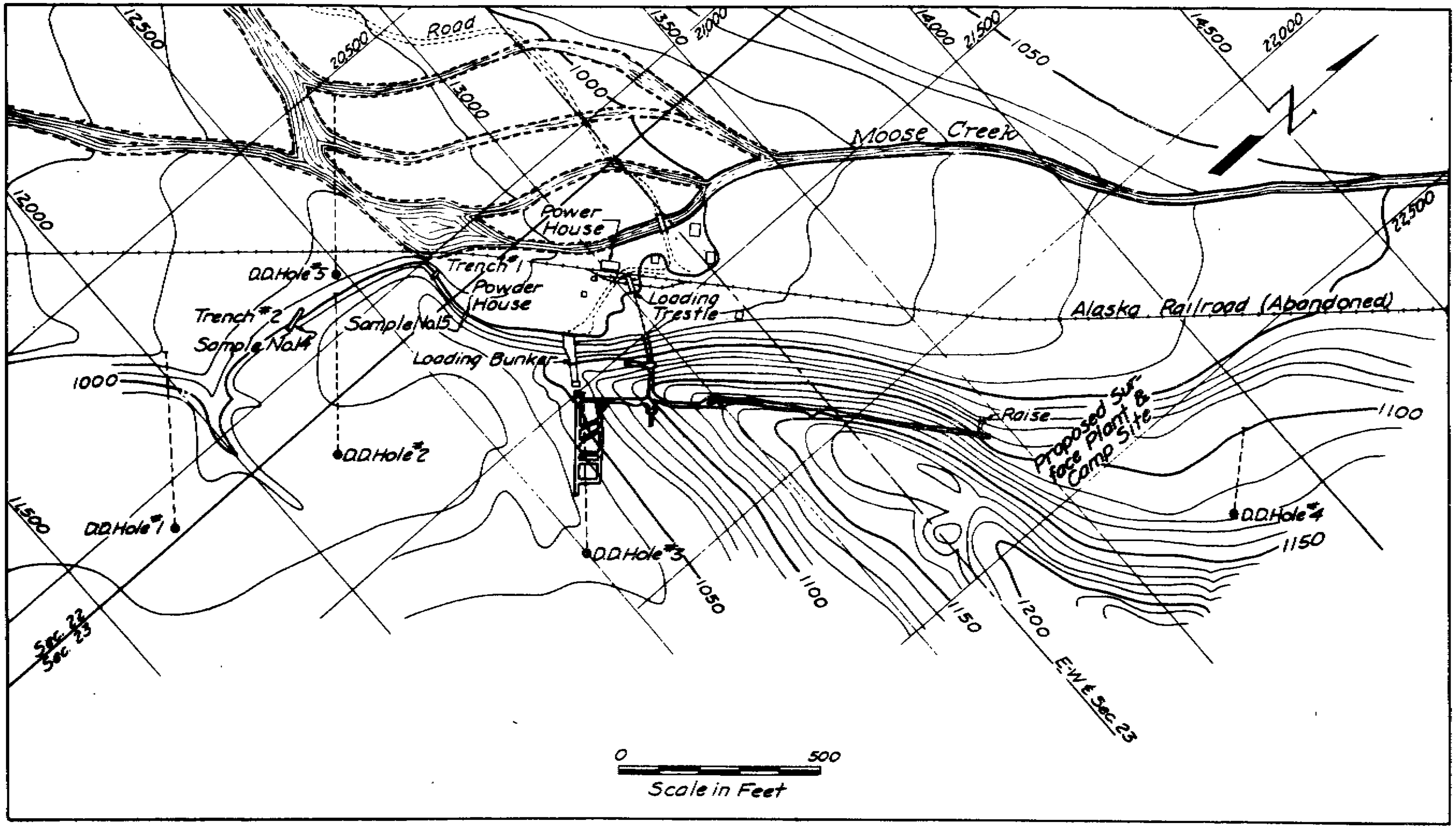

FIGURE 6.- Topographic map of Buffalo mine.

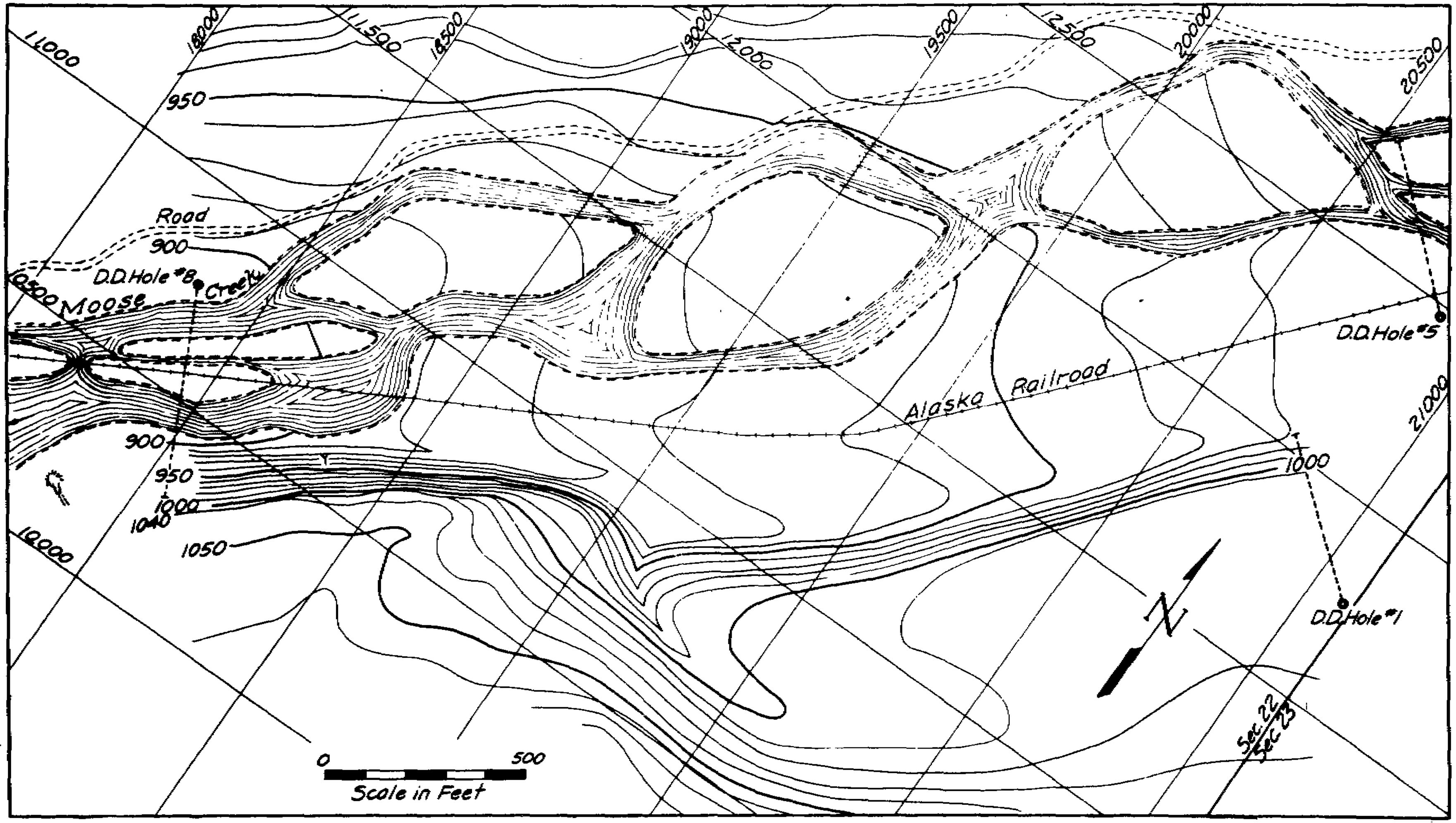

FIGURE 7.- Topographic map of region between Buffalo and Baxter mine areas.

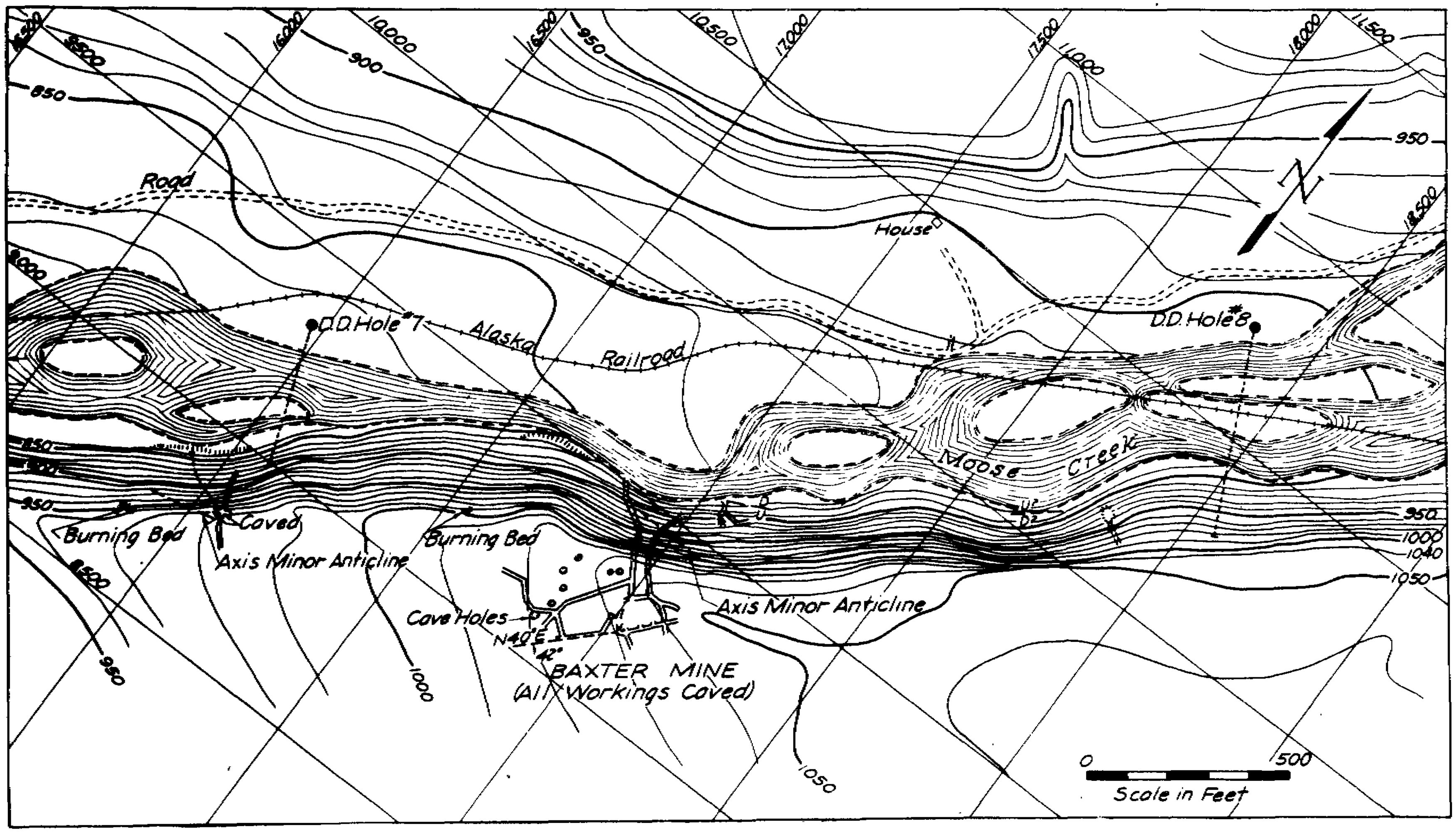

FIGURE 8.- Topographic map of Baxter mine area.

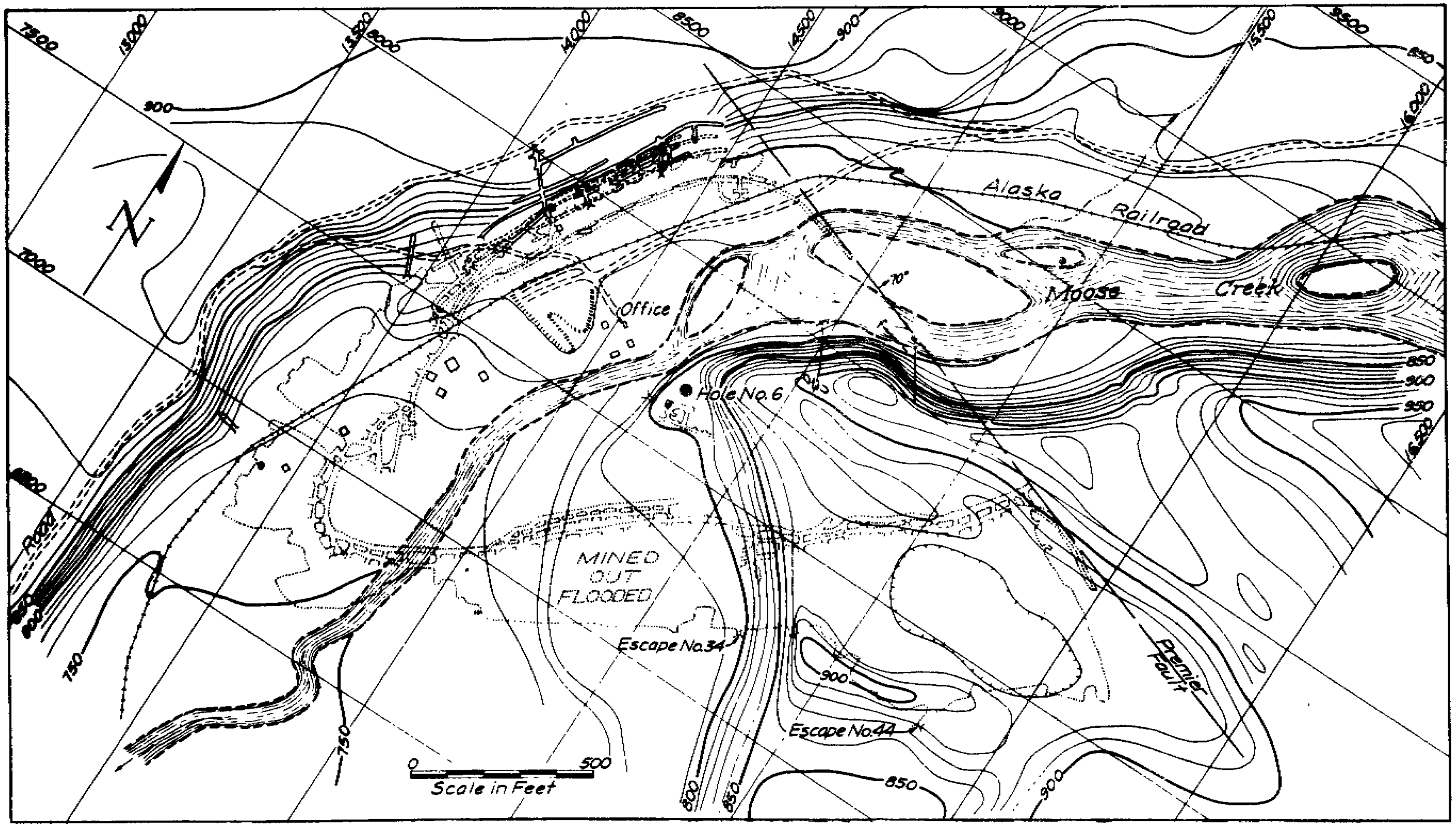

FIGURE 9.- Topographic map of Premier mine area.

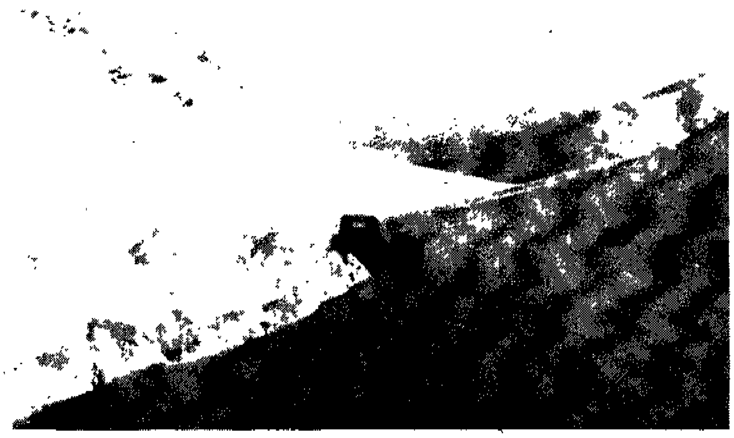

FIGURE 10.- Approaching Palmer, Alaska, winter of 1942-43.

FIGURE 11.- "Glaciering" of roads during cold weather near Premier coal mine.

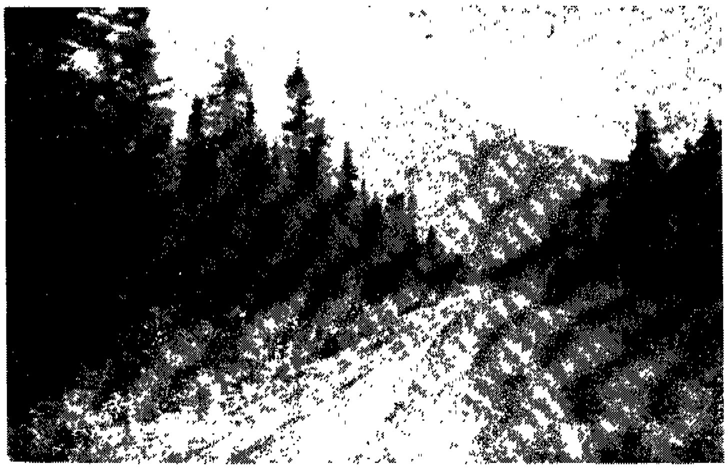

FIGURE 12.- Glenn highway near Knik River, showing typical forest land.

surface is undulating and contains some small lakes, many undrained depressions, and small intermittent creeks common to glaciated terrain. There are some rounded-off, curving ridges, which often indicate the topography of the rock surface underneath.

The Wishbone Hill area covers about 15 square miles; the hill itself covers about 6 square miles. It is the chief topographic feature and the dominant, well-known landmark of the area. Viewed from a distance it looks like an elevated and tilted, mesa-topped isolated fault block, with the high point at the eastern extremity and a general southwesterly slope (fig. 5). Its sedimentary structure is very apparent from all directions.

Moose Creek is a turbulent stream of rather steep gradient flowing southwesterly in a flat-bottomed, boulder- and gravel-strewn valley. At one time the valley was filled with glacial till for some distance north of the flank of Wishbone Hill. This glacial till has been reworked by the creek, leaving a series of terraces on the north side of Moose Creek, and the present flow is confined to a narrow valley, 200 feet to 1/2 mile wide, against the northerly flank of Wishbone Hill.

The Moose Creek coal district covers the area along Moose Creek and the north flank of Wishbone Hill from above the Alaska Matanuska mine to and including the Premier mine, a length of 3-1/2 miles and a width of about 1/4 mile each side of the creek, making an area of about 2 square miles. Future work probably will increase the width of the area southward.

Figures 6 to 9, inclusive, are topographic maps of adjoining areas between the Buffalo and Premier mines. Mine workings, drill-hole locations, and the more prominent geologic features are also shown on these figures.

The Moose Creek district is far enough inland to escape much of the fog and misty rain of the coastal region. The climate is pleasant in the summer, with temperatures up to 70° or 80°. The mean low temperature in winter is -20°, with an occasional drop to -40°. A 600-foot difference of elevation makes temperatures at Moose Creek about 10° colder than at Palmer. The average annual rainfall at Moose Creek is 25 to 30 inches; usually rain and snowstorms are light, amounting to drizzles and flurries, but occasional storms result in heavy precipitation, causing damaging floods when they occur during the warm months. Snow averages 1-1/2 to 2 feet deep on the level in the shelter of the woods; occasionally there is a winter with snow 3 feet deep (see fig. 10) and, in contrast, there are some with only a few inches of snow. Climate and precipitation vary greatly from year to year.

Winds during the summer are usually light and blow from the sea. In the winter they blow from the northeast, often with gale intensity, bringing in the severe weather of the interior. The high winds of winter cause much drifting of snow in the open country, on barren ridges, and along roads and highways. Springs, seepages and the freezing of culverts along the roads cause "glaciering" - that is, building up of flat cones and fans of ice which must be removed frequently to keep the road safe for traffic (fig. 11). Drifts are removed by snowplows or bulldozers. Glaciering is either chopped out or removed by steam supplied by a portable boiler. The Alaska Road Commission was not diligent in keeping the road open between Palmer and the Moose Creek mines. Windstorms in winter usually last 3 or 4 days, during which time snowdrifts build up as fast as they are removed. It is sunny or only partly cloudy about 60 percent of the time; on cloudy days, there are intermittent light misty drizzles of rain with an occasional heavy shower in the warm months, or snow flurries and snowstorms in the winter.

In summer the many hours of daylight tend to keep the daily variation of temperature to a minimum. Heavy frost and some snow come early in October; by the first of November winter has set in and stays until March or April. The spring break-up starts about the first of April and lasts 4 to 6 weeks, during which time automobile travel is hazardous because of bogholes.

Moose Creek Valley is rather well wooded with cottonwood, poplar, white birch, alder, and spruce (see fig. 12). Much of the spruce has been cut for mine timber, and some cottonwood has been used for camp buildings, foot bridges, etc. The uplands are, for the most part, barren of timber. Much of this area is covered with wild grasses, moss, fireweed, and high and low bush cranberry, with scattering birch and poplar bush. These areas are locally called "moose pastures." Destructive forest fires occurring from time to time have denuded much of the upland area of the timber. In the Moose Creek district spruce rarely attains a diameter at the butt greater than 12 inches; it is tall and of slight taper and has few limbs. White birch is used to some extent for fuel, but it rots quickly unless it is peeled or split. Cottonwood has little commercial value. Vegetation grows rapidly owing to the long daylight during the growing season.

Palmer, 12 miles south of Moose Creek district, is in the center of and is headquarters of the Government colonization project in Matanuska Valley started in 1935. The project has been successful to such an extent that the colonists have taken over under the name of Matanuska Valley Farmers Cooperating Association.

Wildlife in the Moose Creek district is not very abundant. Mining has been in progress in the district since 1916; hunting has been indulged in by the employees over a period of years, depleting the game; forest fires, particularly a large one in the summer of 1940, over the Wishbone Hill area have driven the wildlife to other haunts.

LABOR AND LIVING CONDITIONS

Competent mine labor is scarce in this part of Alaska. Most of the young men are in the military service; other labor, skilled and unskilled, has been taken over, at high wages, by firms executing Government contracts. The few men released by the closing down of gold-mining operations were quickly absorbed by contractors, permanent Government agencies such as the Alaska Road Commission, the Alaska Railroad, or private enterprise. The Moose Creek mines, Buffalo and Premier, operating during the fall and winter of 1942-43 and spring and summer of 1943, were often seriously handicapped by shortage of competent help. This was true also of the Evan Jones mine at the east end of Wishbone

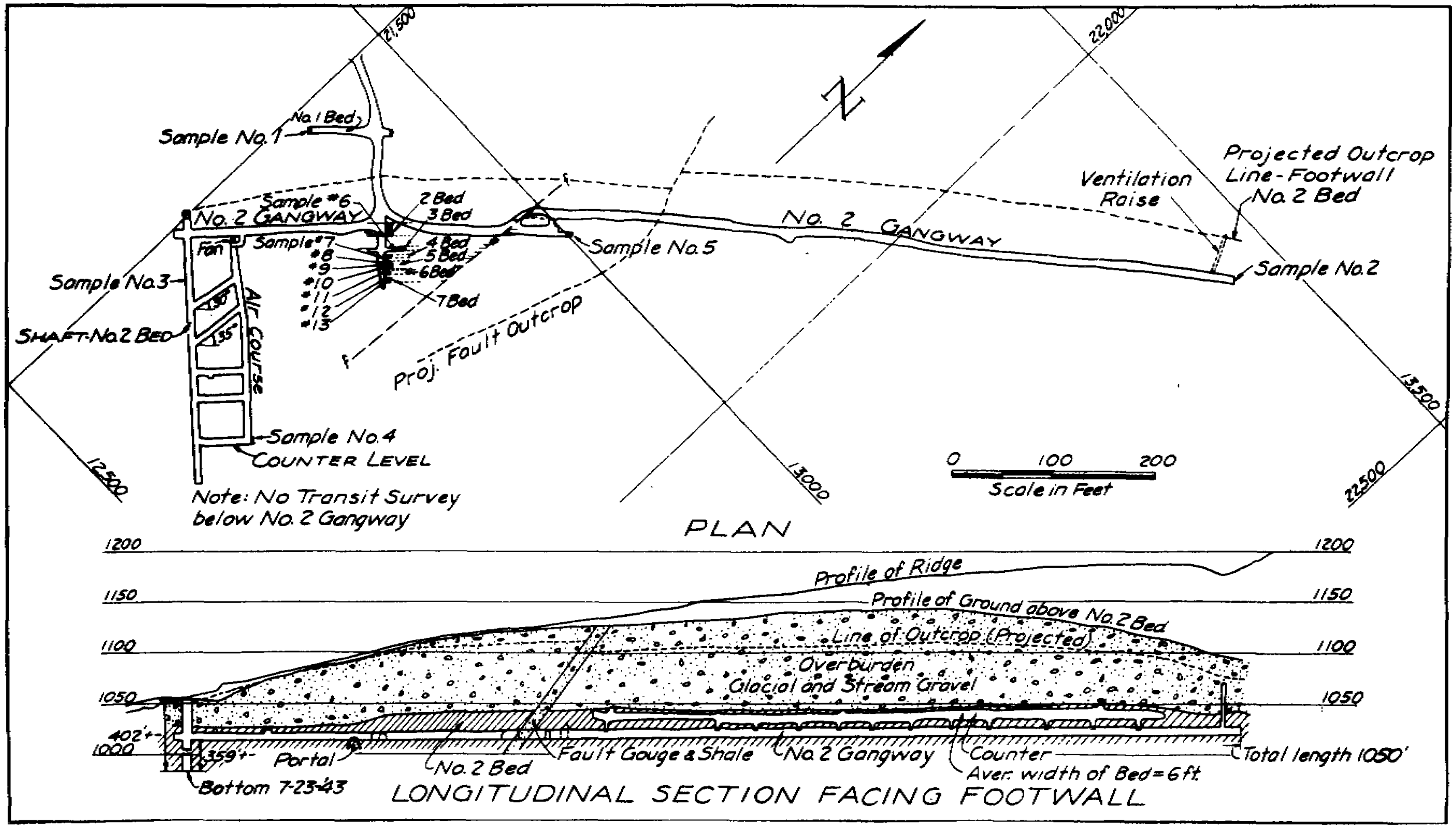

FIGURE 13.- Plan and section of Buffalo mine.

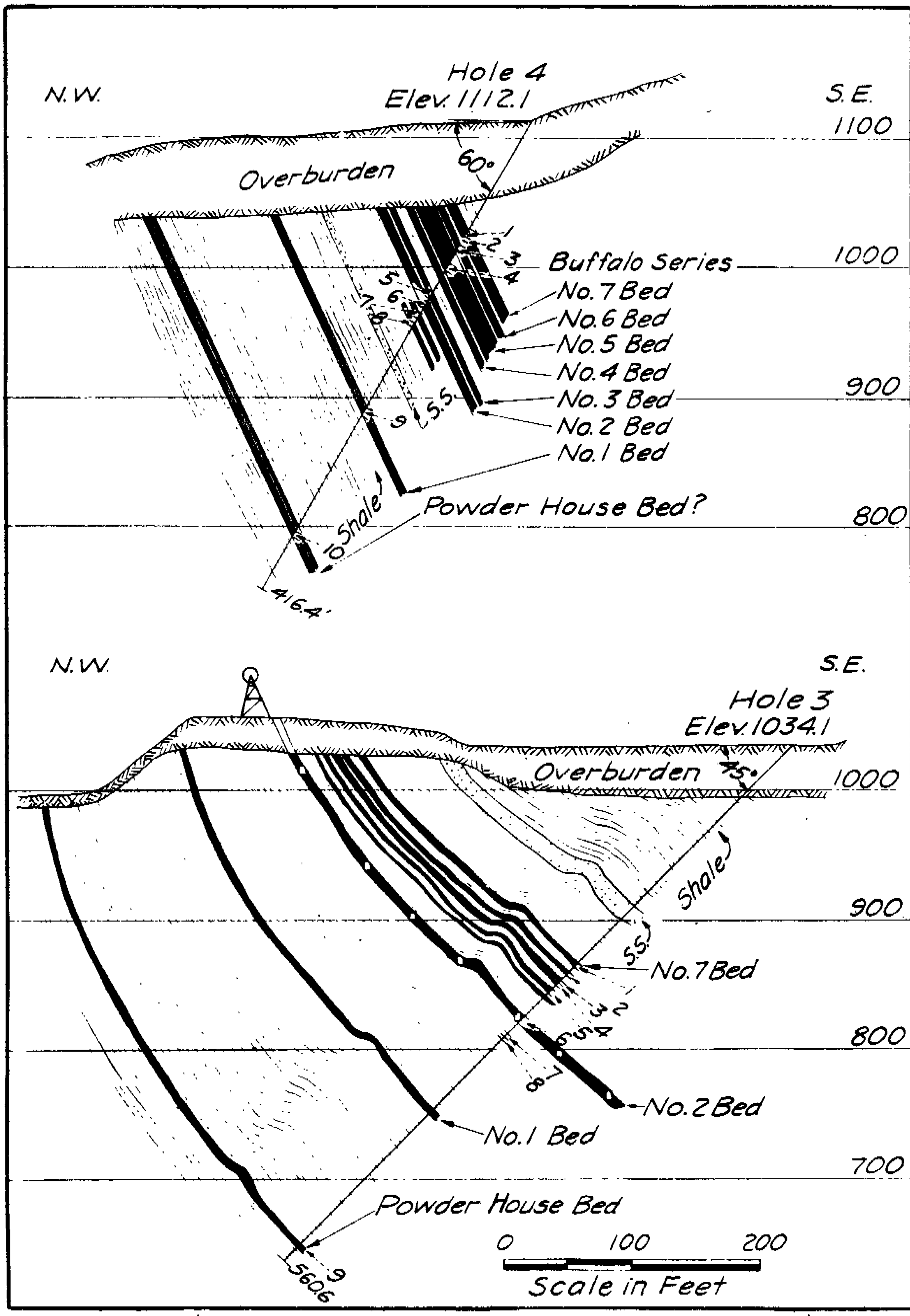

FIGURE 14.- Sections through diamond drill holes 3 and 4.

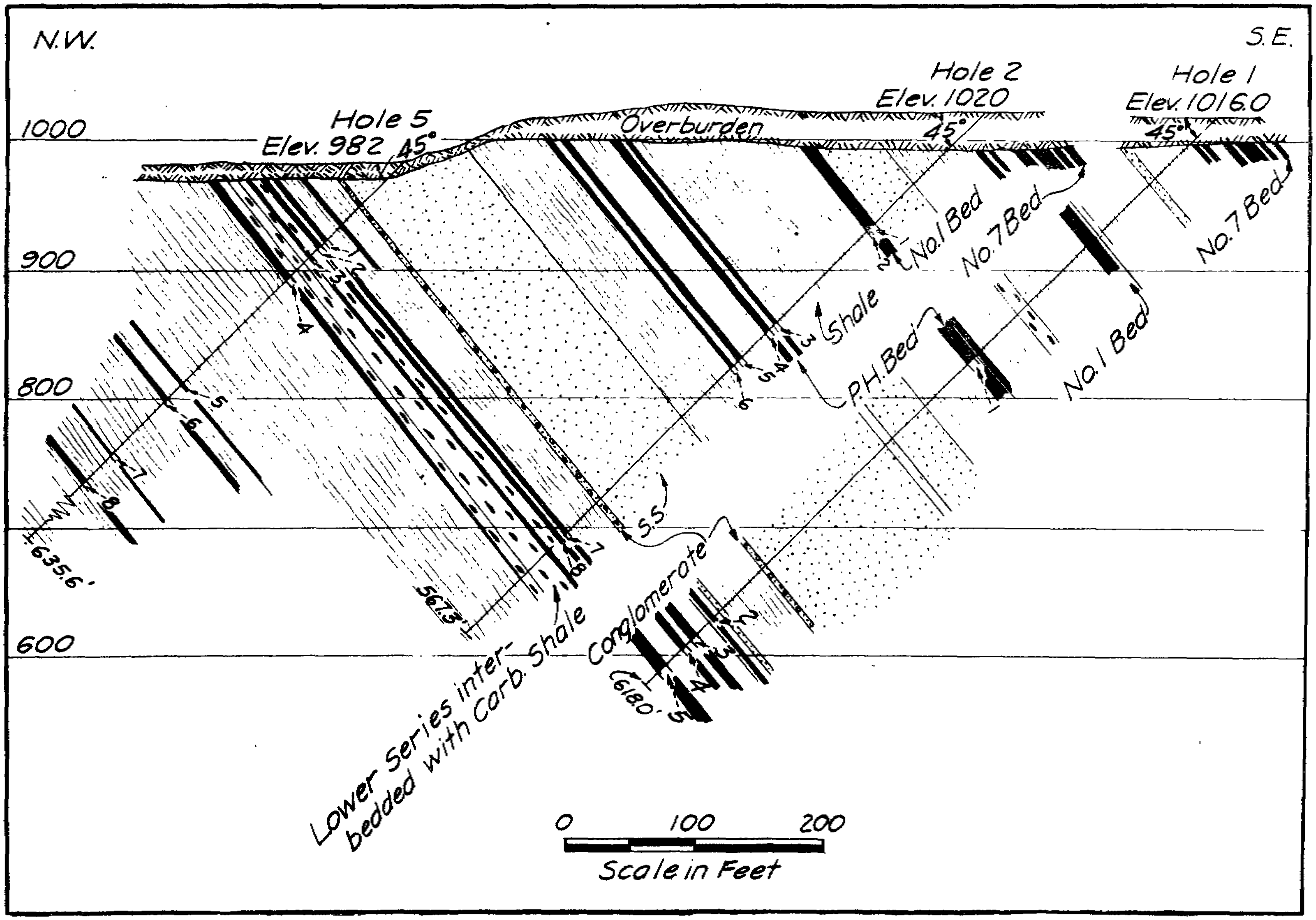

FIGURE 15.- Sections through diamond drill holes 1, 2, and 5.

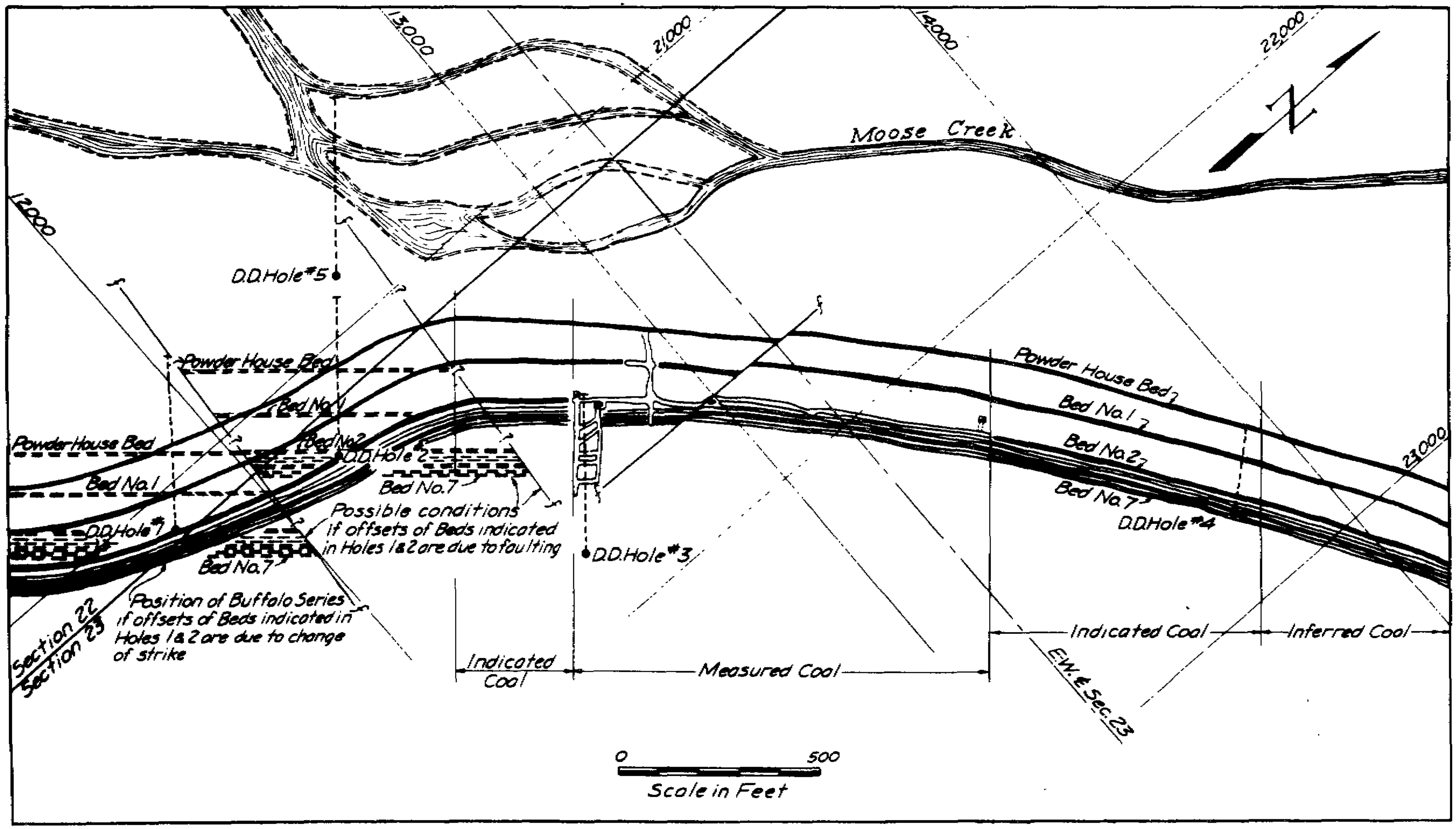

FIGURE 16.- Diagrammatic sketch, Buffalo series.

Hill. When the Government took over coal mines the Army supplied men to the Evan Jones mine to keep up production of coal needed by the Army at Fort Richardson and by the Alaska Railroad. The bulk of the Evan Jones production has been going to the railroad. The Eska mine, 1 mile east of Evan Jones, is owned and operated by the Alaska Railroad. Before the war it was kept in stand-by condition ready to produce quickly if the Evan Jones production should suddenly be cut off or greatly curtailed by some accident such as that in the fall of 1937, when a dust explosion killed 14 men and closed the mine several months. The Army depends upon the Alaska Railroad for transportation and other facilities and upon the Eska mine for some coal. Since both railroad and mine are Government-owned the Army has furnished labor to both as needed to safeguard itself. The Eska mine is being equipped for a 600-ton daily production.

Some competent labor for any large or medium-size coal-mining operation on Moose Creek would have to be brought into Alaska or furnished by the Army if the mine is Government-operated. The coal beds on Moose Creek are steeply pitching, similar to the Pennsylvania anthracites. As a matter of safety and efficiency, men should be hired who have been accustomed to working on "pitch" coal rather than "flat" coal.

There were no accommodations for men at the mines along Moose Creek during the Bureau of Mines drilling operations. Building materials for camp construction were not to be had; neither was it possible to rehabilitate any unused buildings, therefore the men resided in Palmer and were transported to and from the job each shift by motor truck furnished by the Bureau of Mines. The minimum daily cost for accommodations was approximately $2.75; the average was somewhat higher because not many low-priced accommodations were available. Comfortable quarters and good food could be had at $3.50 to $4.00 a day.

GEOLOGY

A plan and section of the Buffalo mine are shown in figure 13. Sections through drill holes 3 and 4 and 1, 2, and 5 are shown in figures 14 and 15. A diagrammatic sketch of the Buffalo coal series is shown in figure 16. These diagrams have been included herein to illustrate the following discussion more fully.

The coal-bearing Chickaloon formation of the Wishbone Hill area of the Matanuska coal field is of Cenozoic era, Tertiary period, Eocene epoch.[10] It is overlain by the Eska conglomerate, probably of Miocene age,[11] and underlain by the Matanuska formation of Upper Cretaceous.

The Chickaloon formation underlies the entire area and is estimated to be over 2,000 feet thick. It is composed, for the most part, of sandstone, shale, and interbedded coal seams, with shale predominating. The formation contains

10/ Martin, D. C., and Katz, F. J., Geology and Coal Fields of Lower Matanuska Valley, Alaska: Geol. Survey Bull. 500, 1912, 52 pp.
11/ Work cited in footnote 7.

over 20 coal beds 3 feet or more in thickness. The Moose Creek coal beds are the highest stratigraphically in the Chickaloon formation, followed by the Evan Jones and Eska beds. The thickness of shale, sandstone, and coal beds varies from place to place, often changing rather abruptly. No particular bed can be used as a marker for any distance, laterally or in elevation, because of dimensional and textural changes; sandstone grades into shale and vice versa. The number of coal beds plus the approximate thickness of the series or sequence can be used reliably over distances of 1,000 feet or more for purposes of correlation. The number and thickness of markers in a particular coal bed also vary from place to place.

The sandstone, when fresh, ranges in color from dark to light gray and in texture from very fine uniform-grained to conglomeratic. The shales range in color from black (carbonaceous) through brown to light gray and in texture from very smooth through sandy into fine-grained sandstone. The shales and sandstones are coherent when fresh, but disintegrate rapidly on exposure; however, vagrant bands of sandstone and shale have been impregnated with calcareous or siliceous material, making them harder and more resistant to disintegration and changing the color to buff or tan.

Structure of the Wishbone Hill area is a broad, shallow syncline plunging gently southwestward.[12] The Moose Creek district lies along the north limb of the syncline in which the beds, in general, strike northeast and dip southeast. The synclinal structure is indicated in the Buffalo shaft. At the surface the No. 2 bed dips 65° southeast and gradually flattens to a dip of 52° southeast at the bottom of the shaft, a depth of 400 feet. The plan map of the old workings in the Premier mine shows that the lower gangway on the No. 3 bed is roughly U-shaped, with the open end against a fault and all dips of the bed pointing toward a common center inside of and below the plane of the U, indicating a minor syncline with a northerly plunge.

Faults are numerous in the Moose Creek district. They strike and dip in all directions, with inclinations varying from vertical to almost flat. However, the transverse (east-west) faults and, next, the faults (northeast-southwest) paralleling the beds present the greatest obstacles to successful mining enterprises in the area. A north-south fault dipping 52° W. in the Buffalo mine caused a horizontal displacement of 15 feet. This is the only fault revealed in over 1,000 feet of gangway on the No. 2 bed.

A northeast-southwest fault dipping 42° southeast cut off the coal in the Baxter mine; transverse faults cut it off laterally.

The Premier beds were cut off by an east-west fault (the Premier fault) dipping 70° north. Although some prospecting has been done, the Premier series of beds has not been located north of the fault. Minor faults, caused by pressure and folding and varying widely in strike and dip, occur frequently throughout the Premier workings. In general, these faults did not seriously impede mining operations.

In the underground workings of the Moose Creek mines there has been considerable movement along the walls of some of the beds. This is indicated by

12/ Work cited in footnote 5, plate 12.

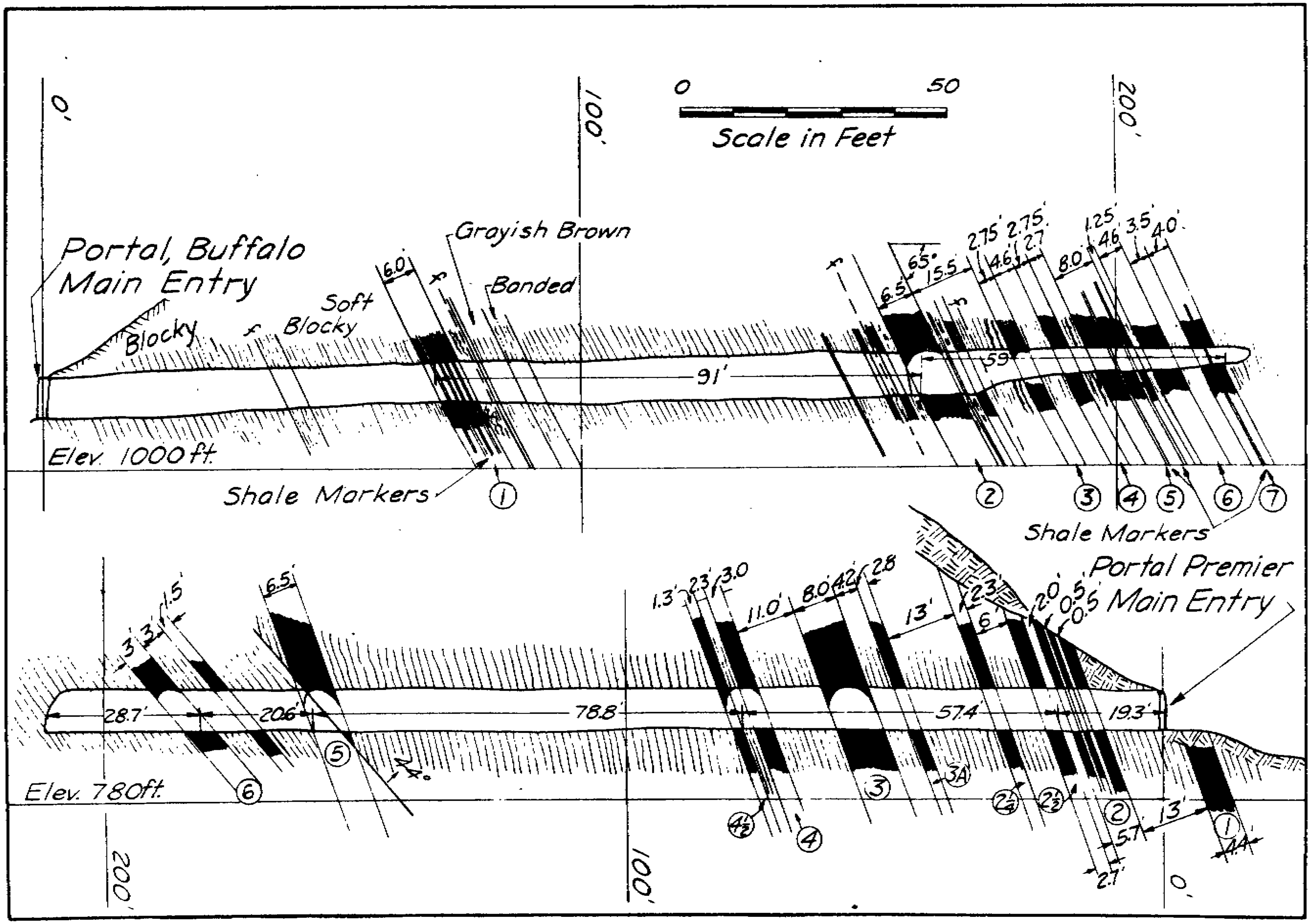

FIGURE 17.- Sections through Buffalo and Premier beds.

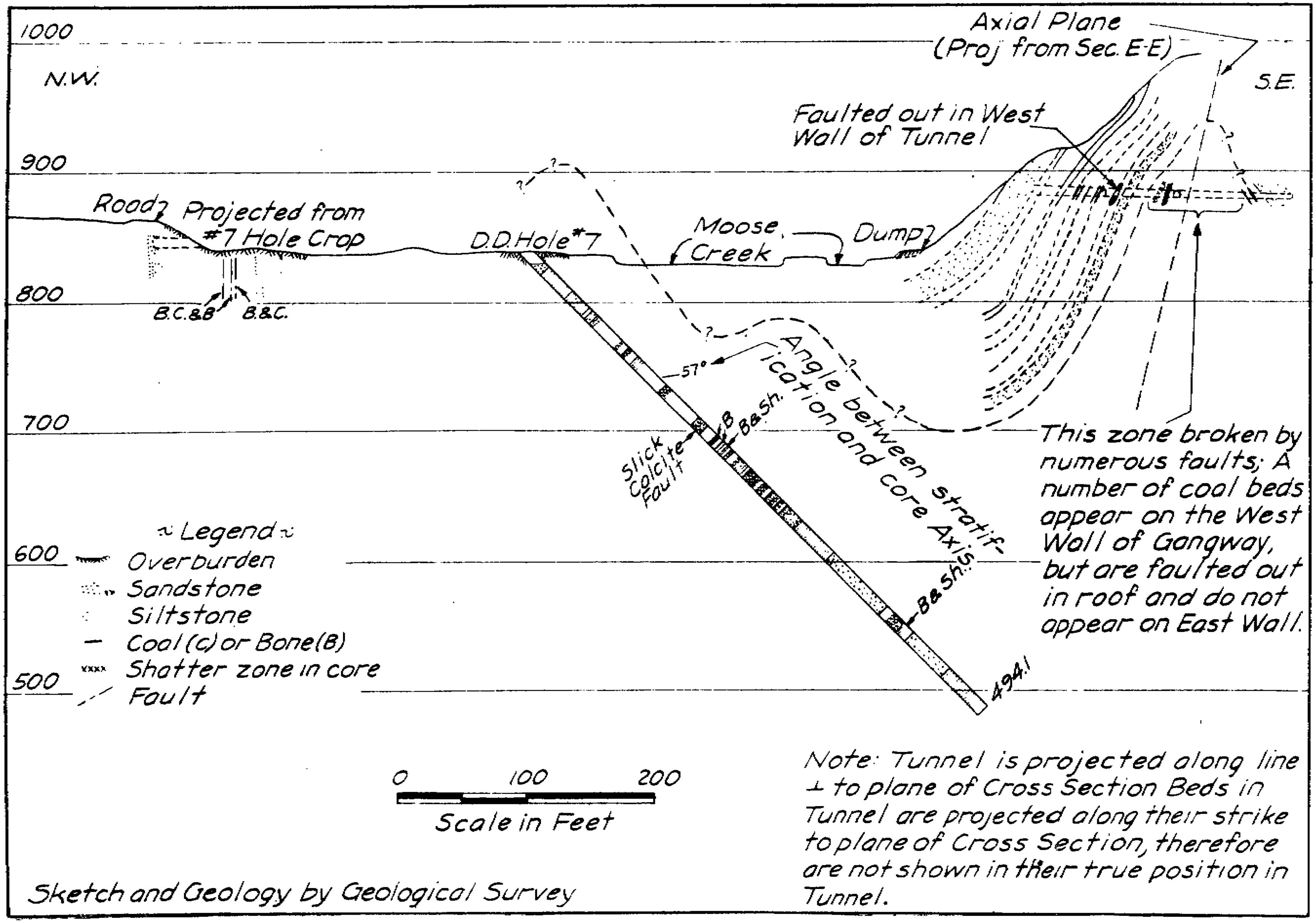

FIGURE 18.- Geologic section B-B through diamond drill hole 7.

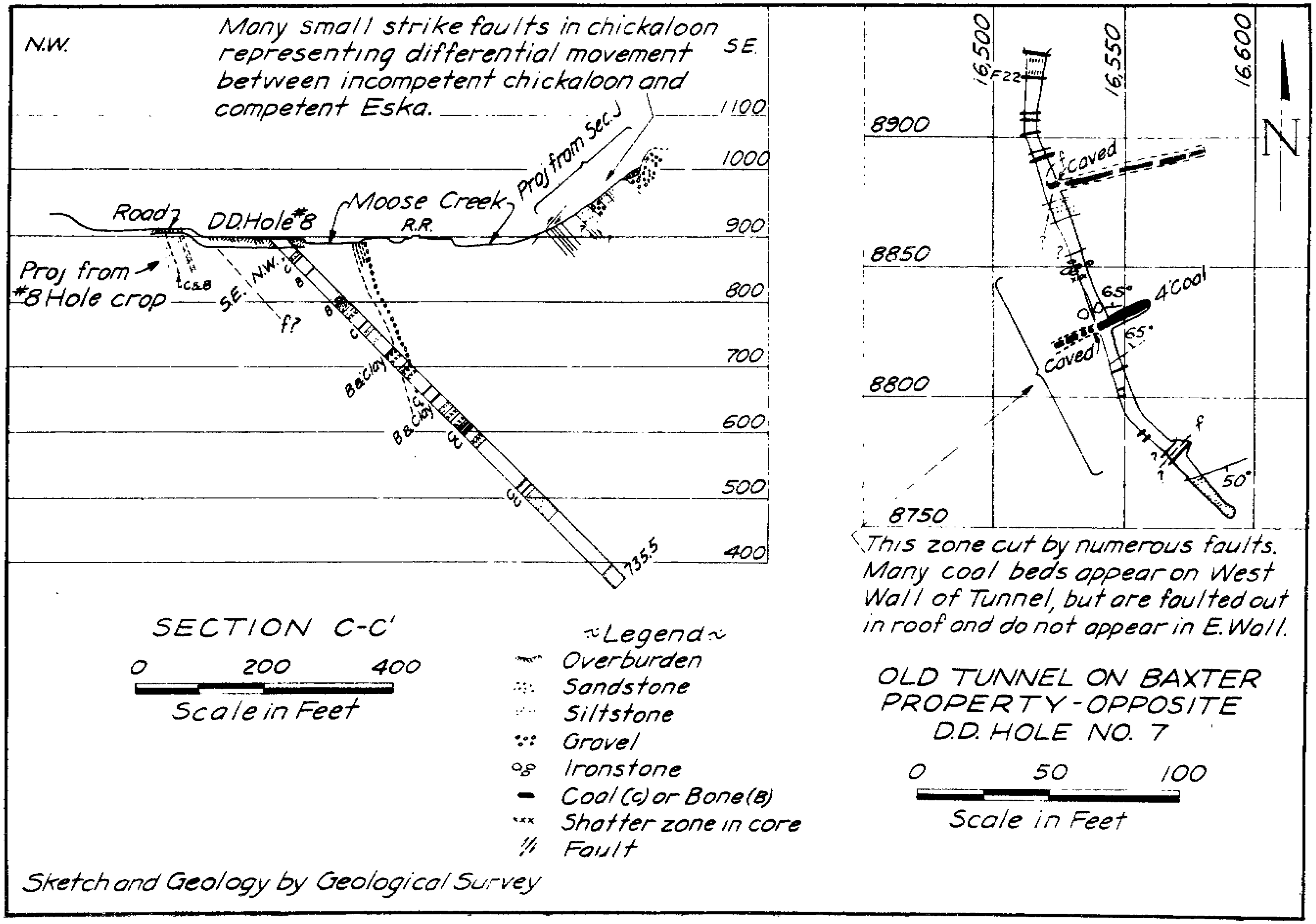

FIGURE 19.- Geologic section C-C through diamond drill hole 8, and plan of tunnel opposite hole 7.

slickensiding over large areas, foliation and lensing of the wall rock with shallow and deep grooves, and striations in these areas. The grooves and striations point in all directions in the plane of the wall, suggesting complex movements.

It is noteworthy that all mine portals and workings in the Moose Creek district are on the south side of the creek except at the Premier, that the beds in all instances dip steeply southeast, except at the Baxter, and that there is a marked similarity in appearance and sequence between the Buffalo and the Premier series of beds; this is illustrated in figure 17.

The Premier workings shown in figure 9 are in an isolated fault block. The underground surveys show pronounced veering of the beds as they approach the fault, the strikes becoming more and more easterly because of drag. The north flank of Wishbone Hill terminates in a low bluff on the south side of Moose Creek opposite the Premier mine portal. A conglomerate, said to be the Eska conglomerate, caps the bluff and continues along the ridge northeasterly to the Premier fault, a distance of about 500 feet. The conglomerate and underlying formations exposed along the north face of the ridge are rather flat-lying, with a slight dip into the ridge. The general trend of the ridge is northeast.

The Premier fault is a broken, brecciated zone 600 to 800 feet in width. Because of the shattered condition of this zone there is little likelihood of finding minable coal in it. Any openings in this broken ground below the creek level will be in heavy ground and will bring in a large flow of water. The conglomerate capping is absent on this section and does not occur again on the ridge for 3,000 feet.

Steeply pitching interbeded sandstones, shales, and occasional coal beds striking about N. 60° E. are exposed in a few places in the next 1,600-foot stretch to the Baxter mine. A number of old shallow pits and a tunnel, shown in figures 18 and 19, showed the coal to be faulted out and discontinuous. Drill hole 7 failed to encounter, at depth, coal beds exposed at the top of the ridge. The drill cores showed that the bedding planes gradually became parallel with the core axis, then diverged again, indicating folding of beds, as shown in figure 18. The Buffalo or Premier series was not encountered. A forest fire in 1940 set fire to two coal beds in the area between the Baxter and Premier; these beds are still burning. Owing to the faulted condition of the rocks in this area, the fires cannot assume large proportions; neither is there danger of spreading to other beds nor otherwise becoming a menace. The minable coal in these beds is too small in volume for profitable operations, hence the expense involved in quenching these fires is not justified.

Little information is available concerning actual conditions underground at the Baxter, other than that the coal occurred in an 11-foot bed which was cut off laterally and forward by faults. Unsuccessful efforts were made to find continuation of the bed. The fault delimiting the Baxter workings on the southeast side strikes N. 40° E. and dips 42° SE. There is no evidence of this fault on the surface, but its presence is known to many and is shown on old Baxter maps. Just below the Baxter portal a transverse fault dips about 60° NE., marking the southwesterly limit of the Baxter workings and a change in the attitude of the beds. On the downstream side of the fault the beds strike approximately N. 60° E. and dip steeply southeast; on the upstream side the beds strike N. 40° E. and dip 20° SE. The beds are again cut off about 400 feet from the portal fault by another transverse fault, which forms the northeasterly limit of the Baxter workings. Information as to the strike and dip of this fault is lacking.

On the upstream side of this fault are many strike and transverse faults; strikes and dips of the beds vary from place to place within short distances. The strikes are generally northeasterly, with dips varying from 40° NW. to 40° SE. The flank of the ridge is very steep and for the most part covered with a wild tangle of brush and weeds throughout its length; rock exposures are few and small in extent, which, combined with much faulting and folding, makes correlations difficult and more or less conjectural. Some tunnels, now caved, were driven years ago, but results apparently were discouraging since no further work was done. Ash, clinker, and burned shale indicate the presence of burned coal beds in this area. Drill hole 8 was put down to explore the creek-bottom area and the ground under the ridge. The cores showed great variation in dips of the beds and much shattering and slickensiding owing to faulting. At a point 700 feet upstream from the Baxter portal the conglomerate again occurs on the ridge and continues as a flat-lying cap for 2,000 feet, ending at a steep-sided gully which cuts easterly into the ridge. In the area from the Premier to this gully the ground south of the crest of the ridge slopes gently downward to the southwest.

Upstream from the gully the ridge continues for 1,700 feet to the line of drill hole 1 on the Buffalo property, where another similar gully cuts through the ridge. The ridge here is not nearly as high or steep-sided, and beyond the crest the ground slopes very gently upward. There are no rock exposures or other features to indicate geologic conditions. The rock is covered with glacial till. No prospecting has been done in this area.

Between the vertical plane through drill hole 3 and that through drill holes 2 and 5 has been apparent horizontal displacement; there is also horizontal displacement between drill holes 2 and 1, as shown in figures 14, 15, and 16. This movement may be the result of faulting or change in strike of the beds by some other geologic agency throwing the outcrop to the east of holes 2 and 1. However, the gully between holes 1 and 2 and a wide swale between holes 2 and 3 suggest offsets due to faulting.

Between holes 3 and 4 the ground appears to be relatively free from faulting. One transverse fault, with a displacement of 15 feet, occurs in the 1,000 feet of gangway on the No. 2 bed in the Buffalo mine. The area northeast of hole 4 has not been drilled. Superficial examination and surface topography do not suggest faulting or other displacement of any magnitude to the limits of the Buffalo property, approximately 2,800 feet northeast of hole 4.

Some areas along Moose Creek have been disturbed by intense faulting and folding, such as the region between the Premier fault zone and the Baxter mine. Here the Buffalo-Premier series of coal beds was not encountered in drilling. The stretch of ground between holes 3 and 4 on the Buffalo property is virtually undisturbed. Also there is apparently little, if any, disturbance northeast of hole 4. The ground between holes 1 and 8 has not been drilled or otherwise explored, but the topography of the area south of the creek indicates little disturbance. The faulting in the Moose Creek district is most complex and unpredictable. Information thus far available does not point to any system of faulting or movement. Rolls and minor folds occur in the formation, as was revealed in the sinking of the Buffalo shaft, shown in figure 14, and in drill hole 7, shown in figure 18.

COAL DEPOSITS

The coal in the Moose Creek area occurs interbedded with shales. Usually the shales are dark and carbonaceous, and occasionally dark gray and sandy, against the coal bed. In none of the drill holes or other openings examined did true sandstone become the foot wall or hanging wall of a coal bed. The shale generally is soft and easily broken at and near a coal bed; pressure and movement have caused slickensiding and slabbing of the shale in many places on the foot and hanging walls; moreover, thin coal veinlets, carbonaceous matter, and bone produce weakness in the shale, all of which will cause caving when the supporting coal is being removed.

The coal beds usually occur in a closely spaced series, but there are frequent isolated beds of good coal in minable thickness between two series. In the Buffalo ground, the openings and drilling revealed two coal series, that is, the Buffalo series and the Lower series. The Buffalo series might properly be said to include bed 2 through bed 7, because of close spacing. Bed 1 and the Powder House bed (so-called because it outcrops in the Powder House) may be considered outliers because of the distance between them and between any one and the next series. An additional bed with a shale parting was cut in hole 2 but did not occur in hole 1, hence may not be continuous. Four more rather widely spaced beds were cut below the Lower series in hole 5, making a total of 16 beds of coal in a depth of approximately 850 feet. For present purposes the Buffalo series, which here includes bed 1, will be considered for tonnage estimates and mining. The beds vary somewhat in thickness laterally and in elevation from place to place. Thin or subordinate beds may attain considerable thickness in spots and then diminish to a mere parting or disappear entirely. The series persists over considerable distances laterally and can be traced with confidence by drill holes spaced 1,000 feet or more apart. Moreover, the dominant bed or beds of a series retain that characteristic throughout, although its thickness and distance from other beds may vary. Likewise the thickness of the series will vary. As shown in figure 17, there is marked similarity in sequence and other characteristics of the beds in the Buffalo series and the Premier column. The No. 2 bed in the Buffalo is the dominant bed of the series and corresponds to the No. 3 bed in Premier; the Buffalo No. 1 corresponds to the Premier No. 5, and the Buffalo No. 5 is equivalent to Premier No. 2. The Premier No. 4 and 4-1/2 have no counterpart in the Buffalo, except that there are some thin, unnumbered seams in the footwall of the Buffalo No. 2 which may have thickened to minable beds in Premier. Other changes have occurred in the distance of 9,000 feet.

The beds in the upper workings at Buffalo and Premier (fig. 20 and 21) dip 65° and 70°, respectively, to the southeast and strike approximately N. 45° E. and N. 33° E., respectively. The dip of No. 2 bed in the Buffalo gradually flattened from 65° to 52° in a depth of 400 feet.

CHARACTER OF THE COAL

The Moose Creek coal is classified as high-volatile B bituminous of poor coking quality. On a moisture- and ash-free basis its calorific value is over 14,000 B.t.u. Pressure and movement have enhanced the quality of the coal but have developed incipient shear cracks to such an extent that the coal breaks small in mining. Thin shale partings, 1 inch to 3 inches in thickness, occur in some of the beds. Not enough openings have been made in these beds to determine whether the partings can be used as positive identification of a particular bed over lateral distances of a few hundred feet to a mile or more, or to identify the bed at depth. In the Buffalo No. 1 bed these partings or "markers" seem to persist for 70 feet; that is, they appear about the same in thickness and relative position at each end of the drift. It has been observed in some places that these markers are thin flat lenses petering to paper-thin seams. Drill cores from some beds show that calcite has entered the fractures in the coal, giving the core a lacy appearance in black and white. This may later serve as an identifier. Buffalo No. 2 bed appears to get thicker as the dip flattens. In appearance the Buffalo and Premier coals are identical.

Channel samples were cut across the beds normal to the walls in the Buffalo and Premier underground workings and where a bed was exposed on the surface or in a trench. Outcrops were sampled when the bed was of mining width and gave promise of economic volume or was expected to tie into a drill hole at depth. In cutting a sample, the procedure was as follows: The face of coal was squared at the place of sampling, and a channel normal to the walls was cut 12 inches wide and to a depth sufficient to expose fresh coal throughout. This material was removed and canvas laid down. A groove 6 inches wide by 2 inches deep was then carefully moiled from wall to wall in the center of the 12-inch cleaned channel. All markers, shale, or waste material that could be eliminated in the mining or before marketing were omitted from the sample.

In core drilling the entire core from a given bed was sent for analysis. Beds 2-1/2 feet or more in thickness were sampled, even though isolated. Thinner beds were sampled when they were part of a series or close to a thicker bed. Thinner beds were also sampled to permit correlation of beds. At the beginning of the drilling, panning tests of the return water showed sludge samples to be erratic and unreliable, because of the varying softness of the rocks, therefore sludge samples were not saved for analysis. However, the return water served to indicate accurately whether or not the bit was in

FIGURE 20.- Drilling hole I, Buffalo property, Moose Creek, Alaska.

FIGURE 21.- Portal of Premier mine, Moose Creek, Alaska.

coal and also indicated by the change in color when the bit passed out of the coal bed. As soon as a coal bed was entered by the bit, the return water became black; quick panning showed whether the blackness was due to coal or to black shale. When the return water began to get lighter in color, frequent panning told when little or no coal was present. As the specific gravity of the country rock is high compared with that of coal, cuttings from the latter rose quickly to the discharge, serving as an accurate guide, hence the sludge discharge was closely watched at all times. When drilling in country rock, pulls were 5 to 10 feet, or as far as the core barrel would permit without grinding the core. The drilling interval in coal never exceeded 5 feet; shorter pulls were resorted to in shattered beds to improve the percentage of core recovery. Pulls were made as soon as a coal bed was entered and again when it was left. The rock drilled easily, and diamond loss was low. A good flow of circulating water was essential to prevent "muddling up" and sticking the bit. Unconsolidated clay or gouge caused trouble by being squeezed into the hole by pressure. Drilling through overburden slowed progress when the cover exceeded 15 feet. Much better progress was made in warm weather than in cold. It is suggested that no drilling be done in this area with gasoline rigs from November through February.

All samples were sent to Maurice L. Sharp, coal analyst for the Alaska Railroad, Anchorage, for proximate analysis. Extraneous moisture due to circulating drill water was removed before the cores were sacked and sent for analysis. Some selected samples were sent to the Bureau of Mines laboratory in Pittsburgh, Pa., for ultimate analysis. 91 samples were sent to Anchorage for assay; of these 53 were core and 38 channel samples. A total of 4,833 feet was drilled in 8 holes; the minumum depth drilled was 416 feet and the maximum 805 feet.

"THE BUFFALO SERIES"

The Buffalo series consists of seven coal beds numbered in order as cut by the main entry tunnel. No. 1 bed, 6 feet thick, was cut at 73 feet from the portal; 91 feet of shale separates the No. 1 from the No. 2 bed, which is 6.5 feet thick. 12 feet of shale separates No. 2 bed and No. 3, which is 2.75 feet thick; 4.5 feet of shale separates No. 3 bed from No. 4, also 2.75 feet thick. 3 feet of shale separates the No. 4 bed from No. 5, which is 7 feet thick. Between No. 5 and No. 6, which is 4.6 feet thick, is 1 foot of shale. There is 3.4 feet of shale between No. 6 and No. 7, which is 4 feet thick. The measurements from the No. 2 through the No. 7 are normal to the walls and aggregate 51.5 feet in the entry tunnel. An analysis of coal from the Buffalo series is shown in table 1.

COAL RESERVES

Core drilling in holes 3 and 4, as well as underground development, proved the Buffalo series (beds 1 to 7, inclusive) to a minimum depth of 400 feet and a strike length of 2,050 feet, giving 1,004,000 gross tons of measured and indicated coal. Holes 1, 2, and 5 revealed, at 350 feet, stratigraphically below the No. 1 bed, another coal series in a thickness of 60 feet of carbonaceous shale. This "Lower series" contains approximately 9 feet of minable coal. These beds vary in thickness in the three holes because of probable differences in dips of the beds at the three points of intersection,

TABLE 1. - Analyses of coal from "Buffalo series" - Buffalo Coal Co., Moose Creek, Alaska[1]

Rank: High-volatile B bituminous

Bed	Location of sample	Sample No.	Condition[2]	Proximate, percent: Moisture	Volatile matter	Fixed carbon	Ash	Ultimate, percent: Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Air-dry loss, percent	B.t.u.	Ash-softening temp., °F.	Agglomerating index
1	S. face of No. 1 gangway	(1)	1	5.1	36.7	45.9	12.3	0.5	5.2	65.5	1.3	15.2	1.5	11,670	2,720	CP
			2	---	38.7	48.3	13.0	.5	4.9	69.0	1.3	11.3	---	12,300		
			3	---	44.4	55.6	---	.5	5.6	79.4	1.5	13.0	---	14,140		
2	Across back 6 feet from N. face of No. 2 gangway	(2)	1	4.7	39.8	48.8	6.7	.4	5.6	70.9	1.2	15.2	1.6	12,670	2,730	CP
			2	---	41.8	51.1	7.1	.4	5.3	74.3	1.3	11.6	---	13,280		
			3	---	44.9	55.1	---	.4	5.8	80.0	1.4	12.4	---	14,290		
2	South side of shaft, 92 feet below No. 2 gangway	(3)	1	3.9	40.0	49.7	6.4	.2	5.6	72.2	1.3	14.3	.9	12,920	2,520	CP
			2	---	41.6	51.8	6.6	.3	5.4	75.2	1.3	11.2	---	13,440		
			3	---	44.5	55.5	---	.3	5.8	80.5	1.4	12.0	---	14,390		
3	Face of No. 3 gangway N. of main entry	(5)	1	4.6	40.0	51.0	4.4	.4	5.7	73.0	1.2	15.3	1.4	13,070	2,640	CP
			2	---	41.9	53.5	4.6	.4	5.5	76.6	1.3	11.6	---	13,700		
			3	---	44.0	56.0	---	.4	5.7	80.3	1.4	12.2	---	14,370		
3	Face of short drift, 10 feet N. of main entry	(6)	1	4.1	39.5	49.9	6.5	.3	5.6	71.8	1.2	14.6	1.0	12,820	2,830	CP
			2	---	41.2	52.0	6.8	.3	5.4	74.8	1.2	11.5	---	13,360		
			3	---	44.2	55.8	---	.3	5.8	80.3	1.3	12.3	---	14,340		
4	North wall of main entry intersection with bed	(7)	1	4.8	39.0	50.6	5.6	.3	5.6	71.9	1.1	15.5	1.7	12,860	2,310	CP
			2	---	41.0	53.2	5.8	.3	5.3	75.5	1.1	12.0	---	13,510		
			3	---	43.5	56.5	---	.4	5.7	80.2	1.2	12.5	---	14,340		

See footnotes on page 20.

TABLE 1. - Analyses of coal from "Buffalo series" - Buffalo Coal Co., Moose Creek, Alaska[1] (Cont'd)

Location of sample	Sample: No.	Sample: Condition[2]	Proximate, percent: Moisture	Proximate, percent: Volatile matter	Proximate, percent: Fixed carbon	Proximate, percent: Ash	Ultimate, percent: Sulfur	Ultimate, percent: Hydrogen	Ultimate, percent: Carbon	Ultimate, percent: Nitrogen	Ultimate, percent: Oxygen	Air-dry loss, percent	B.t.u.	Ash-softening temp., °F.	Agglomerating index
N. wall of main entry at intersection with bed 5	(8)	1	4.3	37.0	44.8	13.9	0.3	5.2	64.7	1.0	14.9	1.5	11,540	2,710	CP
		2	---	38.7	46.7	14.6	.3	4.9	67.6	1.1	11.5	---	12,060		
		3	---	45.3	54.7	---	.5	5.8	79.1	1.3	13.5	---	14,120		
N. wall of main entry, at intersection with bed 5	(9)	1	4.2	38.6	49.9	7.3	.3	5.5	71.0	1.2	14.7	1.3	12,690	2,720	CP
		2	---	40.2	52.2	7.6	.3	5.3	74.1	1.2	11.5	---	13,240		
		3	---	43.5	56.5	---	.3	5.7	80.2	1.3	12.5	---	14,320		
N. wall of main entry, at intersection with bed 5	(10)	1	2.7	25.8	24.3	47.2	.3	3.4	37.1	.5	11.5	.5	6,510	2,680	Nab
		2	---	26.5	25.0	48.5	.3	3.2	38.1	.6	9.3	---	6,690		
		3	---	51.5	48.5	---	.5	6.1	74.0	1.1	18.3	---	12,980		
N. wall of main entry, at intersection with bed 6	(11)	1	3.9	30.7	31.4	34.0	.3	4.2	47.3	.9	13.3	1.5	8,420		AF
		2	---	31.9	32.7	35.4	.3	3.9	49.3	.9	10.2	---	8,770		
		3	---	49.4	50.6	---	.5	6.1	76.2	1.4	15.8	---	13,564		
N. wall of main entry, at intersection with bed 7	(12)	1	3.8	39.9	43.9	12.4	.3	5.5	66.4	1.3	14.1	1.1	11,940	2,910	CP
		2	---	41.5	45.6	12.9	.3	5.3	69.1	1.3	11.1	---	12,410		
		3	---	47.7	52.3	---	.4	6.0	79.3	1.5	12.8	---	14,260		

e footnotes on page 20.

TABLE 1. - Analyses of coal from "Buffalo series" - Buffalo Coal Co., Moose Creek, Alaska[1] (Cont'd)

Bed	Location of sample	Sample No.	Sample Condition[2]	Proximate, percent: Moisture	Proximate, percent: Volatile matter	Proximate, percent: Fixed carbon	Proximate, percent: Ash	Ultimate, percent: Sulfur	Ultimate, percent: Hydrogen	Ultimate, percent: Carbon	Ultimate, percent: Nitrogen	Ultimate, percent: Oxygen	Air-dry loss, percent	B.t.u.	Ash-softening temp., °F.	Agglomerating index
7	As above.	(13)	1	3.2	34.0	35.6	27.2	.2	4.7	54.2	1.1	12.6	.7	9,760	2,910	AI
	Continuation		2	---	35.1	36.8	28.1	.3	4.5	56.0	1.1	10.0	.7	10,080		
	of sample (12)		3	---	48.9	51.1	---	.4	6.2	77.9	1.6	13.9	---	14,020		
1-7	Average		1	4.3	37.3	45.1	13.3							11,700		
Incl.			2	---	39.0	47.2	13.8							11,970		
			3	---	45.5	54.5	---							14,150		

1/ Analyses by Bureau of Mines, Pittsburgh, Pa.
2/ 1. Sample as received; 2, moisture free; 3, moisture and ash free.

In a distance of 110 to 220 feet below the "Lower series", four more coal beds were cut in hole 5, but only one was of minable thickness. Because of the remoteness of these beds, their thinness, and the fact that they were cut in only one hole they have been disregarded in tonnage estimates.

Hole 5 was located vertically above hole 2, and both have the same inclination and bearing; hence, both lie in the same vertical plane. Correlation of the cores and the strike of the beds reveal one or more offsets or a decided change in strike of the beds between the shaft and the plane of holes 2 and 5, and a further change between this plane and hole 1, indicating one or more faults or an eastward swing of the beds. Topography suggests a possible east-west fault about midway (300 feet) between the shaft and hole 2 and another east-west fault between holes 2 and 1 (fig. 13). More drilling or underground exploration would be needed to prove this geology. For purposes of estimating tonnage, the beds are assumed to cut off at the probable fault 300 feet southwest of the shaft. Holes 1, 2, 3, and 5 dip 45° and bear approximately N. 50° W.; hole 4 dips 60° and bears N. 40° W. A tonnage factor of 24 cubic feet of coal in place to the short ton is used in the computations. No deductions have been made for waste or possible loss of coal in mining.

Measured Coal

Measured coal is that in the Buffalo series, beds 1 to 7, inclusive, lying between the upper gangway and the proposed lower gangway, a measured depth of 350 feet and a length of 1,050 feet, which is the measured length of the upper gangway. There are 514,200 tons of measured coal in this block. Table 2 gives partial and total tonnage and value for the Buffalo series.

Indicated Coal

Indicated coal is that in the Buffalo series for the same depth (350 feet) lying between the northerly end of the upper gangway and drill hole 4, a length of 700 feet, also that for a depth of 350 feet lying between the southerly end of the upper gangway and the first postulated fault 300 feet southwest of the Buffalo shaft, making a total length of 1,000 feet. The total volume of the two blocks is 489,900 tons of indicated coal.

Inferred Coal

Inferred coal in the Buffalo series is that to a depth of 350 feet, which lies between the northeast limit of the indicated coal and the property boundary on the northeast, a distance of 2,800 feet measured along the projected strike of the beds. This block contains 1,371,400 tons of coal. Adding 247,300 tons in the Powder House bed and 636,500 tons in the Lower series to a depth of 350 feet and a length of 4,850 feet, the strike length of measured, indicated, and inferred coal in the Buffalo series from the northeast property line to the possible fault 300 feet southwest of the Buffalo shaft, there is a total of 2,255,200 tons of inferred coal and 3,259,300 tons of all classes of coal.

TABLE 2. - Tonnage and sales value of coal beds in Buffalo Coal Co. property, Moose Creek, Alaska .

24 cubic feet of coal in place = 1 short ton.

No. or name of bed	Thick-ness of bed, feet	Tons per foot of length to depth of 350 ft.	MEASURED COAL, to depth of 350 ft. below, and length of No. 2 gangway, i.e., 350 x 1,050 feet	INDICATED COAL, 700 ft. NE. from N. end and 300 ft. SW. from S. end N. 2 gangway, to depth of 350 ft.	INFERRED COAL, FROM NE. limit of indicated coal to NE. limit of property. 2,800 ft. long by 350 ft. deep	Total tons (in place)	Estimated percent recovery of coal	Estimated tonnage recoverable	Sales value of recoverable tonnage at $5.00 per ton, f.o.b. mine	Royalty value on recoverabl tonnage at $0.035 a ton
7	4.00	58.3	61,200	58,300	163,200	282,700	80	226,200	$ 1,131,000	$ 7,917.
6	4.60	67.0	70,300	67,000	187,600	324,900	80	260,000	1,300,000	9,100.
5	7.00	102.1	107,200	102,100	285,800	495,100	80	396,100	1,980,500	13,864.
4	2.75	40.1	42,100	40,100	112,200	194,400	50	97,200	486,000	3,402.
3	2.75	40.1	42,100	40,100	112,200	194,400	50	97,200	486,000	3,402.
2	6.50	94.8	99,500	94,800	265,400	459,700	80	367,800	1,839,000	12,873.
1	6.00	87.5	91,800	87,500	245,000	424,300	50	212,200	1,061,000	7,427
Totals	33.60	489.9	514,200	489,900	1,371,400	2,375,500	69.7	1,656,700	$ 8,283,500	$ 57,985.
Recoverable tonnage			358,600	341,600	956,500			1,656,700		
SALES VALUE at $5.00 a ton			$1,793,000	$1,708,000	$4,782,500				$ 8,283,500	
Powder Hse. bed	3.50	51.0			247,300	247,300	80	197,800	$ 989,000	$ 6,923
Totals	37.10	540.9			1,618,700	2,622,800		1,854,500	$ 9,272,500	$ 64,908.
In the lower series of 4 beds having a combined thickness of 9 ft. minable coal; 4,850 ft. long, 350 ft. deep.					636,500	636,500	80	509,200	$ 2,546,000	$ 17,822
TOTALS (all beds encountered in drilling)					2,255,200	3,259,300		2,363,700	$11,818,500	$ 82,730

Holes 1 and 2 did not cut the Buffalo series, therefore no coal is inferred beyond the southwest limit of indicated coal. There is some doubt as to the continuity of the beds in this area; a series of faults would render mining a profitless operation. However, if holes 1 and 2 missed the Buffalo series because of a swing to the eastward in the strike of the beds instead of being cut off by faulting, the Buffalo series in this area would contain 343,000 tons of coal; adding to this 35,000 tons in the Powder House bed and 92,000 in the Lower series would make an additional 470,000 tons, or a total of 2,725,200 tons of inferred coal.

VALUE OF THE PRODUCT

The Alaska Railroad has been the principal consumer of coal in Alaska. Its sources of supply in the Matanuska field are the Evan Jones mine and its own Eska mine. Smaller quantities for their operations at the Fairbanks end were obtained from the Suntrana mine at Healy. This mine supplies coal for commercial and domestic use in the Fairbanks area. Since the outbreak of the war, military needs have more than doubled the demand for coal in Alaska. The Alaska Railroad buys its coal in large quantities on contract at a much lower price than that paid by small consumers. In the winter of 1942-43 Healy coal in small lots for domestic use sold in Fairbanks for $13.75 a ton; Matanuska coal for domestic use sold for $12.00 a ton in Anchorage. High transportation and handling charges were responsible for the high costs. During the 1942-43 season the Moose Creek mines (Buffalo and Premier) were paid $6.00 to $6.75 a ton at the mine by truckers who resold the coal in the Palmer-Anchorage area. It has been reliably stated that coal delivered to Fort Richardson from the United States, particularly the West Virginia field, costs $40.00 a ton.

Before the United States entered the second World War, the average price of Alaska coal in the railroad belt in car lots, f.o.b. mine, was $4.00 a ton but has increased a minimum of $1.00 a ton since January 1942. It is estimated that an efficiently operated, fully mechanized coal mine in the Alaska Railroad belt can make a reasonable profit on washed coal under present conditions at a selling price of $5.00 a ton f.o.b. mine, which is the basis of calculations herein.

PROPOSAL FOR ADDITIONAL EXPLORATION BY THE BUREAU OF MINES

Present Territorial demands are estimated at 500,000 tons a year. Based upon the area served by the Alaska Railroad, the Healy-Nenana fields, producing subbituminous and bituminous coal, would serve two-fifths the area or would require 200,000 tons a year, leaving 300,000 tons a year to be supplied by the Matanuska field; this amounts to 1,000 tons a day.

The Evan Jones mine has been and still is the principal producer in the Matanuska field. The production is limited to the washery capacity of 200 tons a day. The daily output often exceeds 200 tons through shipping mine-run coal.

The Eska mine, property of the Government owned and operated Alaska Railroad, lies 1-1/4 miles easterly from the Evan Jones. Both the Eska and the Evan Jones mines are served by the Alaska Railroad; no highway or wagon road touches either mine location. The Eska mine has been operated to the limit of its capacity during the past 2 years, but production has been limited by inadequate equipment and development. Owing to the augmented demands for coal by the Army, railroad, and others, the Eska is now being developed and equipped for production. It is expected that the Eska and Evan Jones will have a combined production of 500 tons a day, therefore the production planned for the Buffalo, to meet the anticipated 1,000 tons a day, is 500 tons a day.

The work recently completed by the Bureau of Mines revealed 514,200 tons of measured coal, 489,900 tons of indicated coal, and 1,371,400 tons of inferred coal. At 500 tons a day there would be 3.6 years operation on the measured coal and 6.7 years operation on both measured and indicated coal. The inferred coal lies northeast of the indicated coal along the projected strike of the Buffalo series. Two drill holes, each 600 to 700 feet deep, spaced between hole 4 and the property boundary, would give the needed geologic information as to the minability of the coal. The limits of indicated coal would thus be extended to the property boundary or the point where minability ceased. Tracing the Buffalo series would be continued as far as practicable beyond the Wishbone Hill, Rawson, and Alaska Matanuska mines. A vertical hole about 600 feet deep, 580 feet S. 50° W. of the Buffalo shaft, and another vertical hole of about the same depth, 1,550 feet N. 47° 30' E. of the first, is expected to prove an additional million tons of coal on the Buffalo if the sequence of beds were found to be about normal. The Buffalo series could then be traced southwest from holes 1 and 2 in an endeavor to find the present position of the beds from which the Premier fault block was displaced. Transit surveys should be made of the surface area to be drilled, as well as of all accessible workings. The drilling program outlined above will add greatly to the tonnage of the present rather small reserve. Location, depth, and inclination of drill holes will have to be left to the judgment of the engineer in charge, since he must be guided by findings as work progresses. Much pertinent information has been gained and recorded as a result of the work just completed; moreover, certain large areas have been eliminated from further consideration.

From 5,000 to 8,000 feet of core drilling would be required to explore the area outlined above and shown on figure 2. Estimates of the cost of the minimum and maximum amount of drilling are as follows:

Item	5,000 feet of core drilling	8,000 feet of core drilling
Supervision	$ 8,000.00	$11,000.00
Labor, W.A.E.	10,000.00	15,000.00
Travel	6,000.00	8,000.00
Supplies	3,000.00	4,000.00
Contract drilling, using 2 drills, 2 shifts a day	35,000.00	52,000.00
Total	$62,000.00	$90,000.00

These estimates are based upon costs of the previous work accomplished at Moose Creek. It is estimated that this exploratory work will reveal to 8 million additional tons of coal.

DEVELOPMENT

A section through the Buffalo main entry is shown in figure 17. The beds were numbered in order as encountered in driving the entry. Beds too narrow for mining were not numbered. The total length of the entry tunnel is 225 feet.

A short gangway 65 feet in length was driven southwest on No. 1 bed. Gangways were driven both ways from the entry tunnel on the No. 2 bed 208 feet southwest and 842 feet northeast - a total length of 1,050 feet. At 818 feet northeast a ventilation raise was put through to surface. At 190 feet southwest of the entry a shaft was raised to surface on the No. 2 bed at a dip of 65° southeast.

It was found that the height of coal (lift) above the No. 2 gangway ranged from 11 to 30 feet, giving a negligible coal reserve. Accordingly, early in 1943 work was started to deepen the shaft on the No. 2 bed to 400 feet. The dip of the bed gradually changed from 65° at the upper gangway to 52° at the bottom, giving plausibility to the synclinal structure theory. A roll was encountered in sinking, in which the dip flattened to 28° but shortly began to steepen. This is shown in figure 8. Near the bottom of the shaft the No. 2 bed was 8-1/2 feet thick. An air shaft was raised on the No. 2 bed from the counter level to the upper gangway, 50 feet northeast of the hoisting shaft; five air courses connect the two shafts. The counter level is 50 feet above what will be the lower gangway. The volume of gas increased noticeably with depth. At this stage in the development the mine made water at an estimated rate of 4,000 gallons a day. Drill hole 3 was encountered in the first air course above the counter. Its position showed that the hole had not deviated appreciably and that the correct bed had been identified in the drill cores.

In the upper gangway about 140 feet northeast of the main entry a fault displaced the beds 15 feet northward, placing the No. 3 bed in line with the No. 2. The gangway was carried forward on the No. 3 a short distance, when it became apparent to the miners that they were on the wrong bed. A short crosscut revealed the position of No. 2 bed, and drifting on it continued. In the gangway northeast of the fault, 12 raises were put up in the coal and connected with a counter. Loading chutes were built in the raises, and some coal was mined. All haulage was by hand. Most of the development on the entry level was done by hand methods before incorporation, after which pneumatic drills were used. All shaft work was done by air drills. Permissible explosives were used throughout. Very little gas was encountered at this elevation. Grades were such that water drained out the portal, and the flow was very light - approximately 500 gallons a day.

Equipment at the Buffalo mine was second-hand when installed, and much of it was in badly worn condition. Even though it was in first-class mechanical condition, the greater protion of it would be inadequate for a full-scale development program. However, it is planned to use the present equipment to good advantage up to a certain point in the underground development.

Equipment on hand early in 1943 included an old 80-hp. hand-stoked boiler; a small D.C. generator for lights and battery charging and a 2-drill stationary compressor, badly worn, both run by a 15-hp. reciprocating steam engine; a 20-hp. steam, single-drum hoist; a 1/2-ton skip; a 10-hp. steam-engine and shaking-screen unit; a 10-hp. steam-engine and fan unit; a 60-g.p.m. pump; 2 jack hammers; a hand forge, anvil, and miscellaneous blacksmith, carpenter and mining tools; 6 mine cars (3 large, 2 small and 1 timber truck); a narrow-gage steam locomotive; and 10 electric cap lamps and batteries. There is a round-timber head frame and 5-ton loading pocket at the shaft and a 30-ton storage bunker for Steam and Nut coal. A big, active horse is also part of the property.

Camp buildings include one log cook house, two log bunk houses, and a log stable, none of which could be moved to any new camp location. The combined boiler house and change house is of lumber and "outside" celotex and corrugated-iron construction and is of little value.

PAST PRODUCTION

It is estimated that 1,000 tons of coal was mined above the No. 2 gangway northeast of the fault; and 3,800 tons was produced by development, making a total production of 4,800 tons.

During sinking operation, the coal was hoisted and passed over a shaking screen where about 5 percent of the total, as waste, was hand-picked. Screening yields 70 percent steam and 25 percent Nut- to Lump-size coal. Production during sinking averaged 8 to 10 tons daily.

PROPOSAL FOR FUTURE OPERATIONS

Development and operation of the Buffalo coal mine appear to be a commercially sound venture for a private company having adequate financial backing to make the necessary plant installation and to carry development and mining operations for a 2-year period.

The present lessees will need financial assistance and experienced supervision for assured successful operation on a 500-ton-a-day production scale. Whether this financial assistance comes from some Government agency or from private sources, it will be fully secured by the value of the installation and the coal reserves on the Buffalo property. In this connection, several pertinent points should be borne in mind:

(1) More coal is needed in Alaska, even under peacetime conditions, therefore this is not an emergency operation dependent upon war conditions for market.

(2) The quality of Moose Creek coal is excellent, the best produced in the Matanuska field, and much in demand in the Territory.

(3) The coal is amenable to storage, not subject to spontaneous combustion or disintergration (slacking).

(4) Truck transportation is available from the mine to the highway system.

When production tonnage warrants, a preferable means of transportation will be available through construction, by the Alaska Railroad, of 3 to 5 miles of standard-gage branch railroad connecting the mine with some point on the existing railroad in the Matanuska Valley, thus affording railroad transportation to seaports and all interior cities and towns on the Alaska Railroad.

Development

A general plan of development taking advantage of work already accomplished and using the present equipment as long as practicable is as follows: Deepen the shaft to provide ample sump capacity, and construct a 30- to 50-ton loading pocket. Drive double entries or gangways northeast, one on No. 2 bed and one on No. 5 or No. 6 bed, for 1,200 feet, with break-throughs at 60- or 120-foot centers, one entry for air intake and haulage, the other for return air. All equipment would be on 250-volt direct current, except jack hammers for rockwork. Air for hammers would be supplied by electrically driven, portable air compressors. Electric auger drills and two coal cutters with 9-foot bars are to be used in entries and other work in coal wherever practicable, and shaking conveyors with duckbill loaders, a 40-foot cross conveyor, and belt conveyors to be used for haulage.

On surface about 1,200 feet northeast of the shaft is a gently sloping bench, ideal for the location of the hoisting shaft, washer, surface plant, and camp site. This location is away from flood danger and is protected from severe storms by the surrounding hills. The site is indicated in figure 6.

A three compartment shaft is to be raised, or raised and sunk simultaneously on a constant inclination, and located in the blocky shale between the No. 1 and No. 2 beds. Four-ton skips, steam or electrically operated, are to be used for hoisting. Ample sump capacity and loading pockets are to be provided at the station. At completion of shaft and station the driving of the entries is to be continued to the northeast boundary or as far as the coal can be profitably mined in that direction.

Underground development at the Buffalo mine will consist in driving 8,900 feet of entries, 1,100 feet of counters, 1,200 feet of break-throughs, 1,000 feet of raises (room necks), 450 feet of three compartment hoisting shaft, loading pockets, sump, shaft station, crosscut from shaft to entries, and an air shaft. The present shaft is inadequate for the proposed production but can be used to good advantage for development until the new shaft is in operation, after which it will serve for auxiliary ventilation and a surface escape. Work in the entries, counters, and raises will produce coal at an average of 2 tons a foot of advance; an estimated 450 tons will come from break-throughs. It is estimated that the development outlined will produce 22,450 tons of coal valued at $112,250, using a figure of $5.00 a ton f.o.b. mine. The rate of progress is estimated at 60 to 80 feet a day in entries, break-throughs, raises, and counters.

Six months will be required for the initial development and construction work if enough labor is available and mechanized equipment is used throughout. The progress of development is based upon two shifts a day, using a total of 40 men - 22 underground (including 2 shift bosses) and 18 on surface (including superintendent, engineer, and clerk). These men will be directly concerned with mine development; however, approximately 10 additional men will be engaged on construction of the mine plant and camp during this period. In the following calculations no allowance has been made for food supplies and cookery, as the culinary department is expected to be self-supporting. Allowance has been made in the estimates for high labor and transportation costs in Alaska.

The best season for the construction work is from April to October on account of long daylight and mild weather.

Mining

The battery breast system, a modification of the room-and-pillar method applied to steeply pitching coal beds, seems well-adapted to the Buffalo mine. This system is somewhat similar to the shrinkage-stope system of metal mining. Rooms are turned off at 50- to 60-foot centers and raises put up to the air course or monkey, and 30 to 50 feet of the raises are timbered for chute and manway. The rooms start to widen at the air course, and two rows of props are set and lagged as the work advances. Manways are maintained alongside each row of props, and the broken coal fills the space between the rows of props. The miner stands on the broken coal to drill his round and set timber. After the blast enough coal is removed by drawing it off or throwing it down the manway to give headroom to work the next round. As the work advances cross-cuts are run between rooms for ventilation at the face. Pillars are drawn after the "first mining" is finished.

Other systems of mining pitch coal having poor roof and floor conditions are the Tesla (California) system and the cut-back system used in the Pennsylvania anthracites. No doubt a system of mining based on those mentioned or an entirely new and safe method can be evolved for Moose Creek which will result in maximum recovery of coal.

To obtain the maximum recovery of coal from the Buffalo mine, beds 2 to 7, inclusive, should be mined simultaneously in echelon, working back toward the shaft, work on No. 7 bed being farther advanced than No. 6, which would be ahead of No. 5, etc. Nos. 5 and 6 may have to be worked as one bed because of the thin parting between them, or part of No. 5 may be left to hole the roof. The No. 1 bed may be mined with or after the No. 2 bed. Not enough information is available concerning the roof and floor of the beds to permit laying out a detailed mining plan.

Ample headroom for mining narrow beds is afforded by the steepness of pitch; this has the further advantage of requiring less timber to hold the roof.

Development must precede mining throughout operation of the mine; however, it will not be a major item of expense after the initial development is completed. The amount of development ahead of mining will depend upon the method of mining adopted and the condition of the roof and floors of the beds.

Cardox is suggested as the explosive for development and mining. Its use eliminates gas and dust explosions due to blasting and loss of time waiting for fumes to clear. It is excellent protection against fire.

All safety rules must be strictly observed with regard to lights, dust sampling, rock dusting, ventilation, permissible equipment and explosives, etc.

Calcium chloride should be dusted on entry floors and at shaft stations.

Cost of Mine Plant

Following is an estimate of the cost of equipment, supplies, buildings, etc., for a mechanized mining operation of 500 tons daily capacity installed at Moose Creek, Alaska. Power underground is calculated for 250-volt D.C.; on surface, steam and 250-volt D.C. Some of the equipment might be purchased second-hand, but in good condition, at various defunct mines in the Territory, or from dealers in used equipment in the United States at a considerable saving.

Underground

2 coal cutters, 9-foot bars; 1 extra armature	$ 12,000	
2 caterpillar mounts	6,000	
2 electric auger drills with 2 extra armatures	600	
2 300-foot shaking conveyors complete with drive and duckbill loaders, and 1 40-foot cross	13,000	
1 belt conveyor, 1,000-foot unit	14,500	
4 jack hammers	1,000	
2 compressors (portable)	4,000	
Miscellaneous: Pump, steel, hand tools, etc.	2,000	
		$ 53,100

Surface

Head frame, washery, bins, and building complete	$ 75,000	
Railroad yard - 4,500 feet of rail, 8 switches, frogs etc. - laid	14,300	
Railroad platform scale, 75-tons capacity	8,000	
15-ton gasoline locomotive	10,000	
Hoist-steam or electric	20,000	
2 skips, 4-ton	1,000	
		$128,300

Power Plant

2 D.C. generators; 200-kw. and 300-kw., steam-driven.	$ 10,000	
1 compressor, 360 cu. ft.	1,500	
2 200-hp. boilers	20,000	
2 stokers, spreader type	2,500	
Building - change house, Cardox charging plant	10,000	
		$ 44,000

Shops

Machine, blacksmith, carpenters, electric equipped .... $ 30,000

Ventilation

Fan house and fan (50,000 cu. ft. per min.) .... $ 5,000

Miscellaneous

Fire-fighting equipment (hose, hydrants, pump, pressure tank bulldozer) .... $ 10,600

Camp

Office, warehouse, mess house, bunk houses .... $ 9,000

Total $280,000

Operating Costs

No date are available on the cost of operation for mechanized, steeply pitching coal mines in Alaska, and little information is published on similar mines in the United States. A further handicap to accurate estimates exists in the lack of complete knowledge of underground conditions, type and availability of labor, transportation of supplies, etc. The following estimates are based upon a study of available data, accomplishments in the district using hand methods, and what might logically be expected under modern conditions of operation. It is assumed that competent "pitch" miners and other experienced labor are available; that proper equipment and supplies are easily obtainable; that underground conditions are average; and that railroad transportation of the product is assured.

Construction and development for the Buffalo mine are estimated at 6 months, minimum, 2 shifts a day and 25 workdays a month.

Production during development is 22,450 tons. Daily production after development - 500 tons, or 150,000 tons a year of 300 days. Total production, 10 years operation - 1,447,450 tons.

Life of the mine, including development period: Measured coal, 3.77 years; measured and indicated coal, 7 years; all catagories, 16.2 years for the Buffalo series to 350-foot depth, assuming 100-percent recovery of coal and all inferred coal as minable.

Development Costs

The estimated cost of development, which will result in the production of 22,450 tons of coal, is shown in the following tabulation:

Estimated cost of development, based upon existing conditions of open shop, etc.

Item	Number of men	Monthly pay roll	Pay roll - 6 months development period
Labor underground	22	$ 6,650.00	$ 39,900.00
Labor surface	13	3,200.00	19,200.00
Monthly employees	5	1,750.00	10,500.00
Total labor	40	$11,600.00	$ 69,600.00
Supplies, power, miscellaneous			20,500.00
Other charges (based on production)			7,900.00

Estimated cost of development work .... $ 98,000.00
Production from development ....tons 22,450

Financial condition at end of development period:

Cost of mine plant installed	$280,000.00
Operating Fund	98,000.00
Capital investment	$378,000.00
Interest at 4 percent for 6 months	7,550.00
	$385,550.00
Value of production at $5.00 a ton	112,250.00
Indebtedness at end of development	$273,300.00

Mining Costs

The Evan Jones mine is the only unionized coal mine in Alaska; however, it is highly probable that, when the Buffalo mine gets into production, the United Mine Workers of America wage scale will prevail. Labor costs are based upon U. M. W. of A. wage scales in the following estimates.

Territorial tax laws (Session Laws of Alaska 1937, chapter 20) require "an operator to apply for, obtain and pay for a license for the business of mining valuable metals, ores, minerals, asbestos, gypsum, coal, marketable earth or stone." (Gold and metals or minerals of the platinum or palladium group have a different tax rate.)

The license tax on all net incomes is as follows:

Net income	Percent
Not over $ 10,000	3/4
over 10,000 and not over $ 20,000	1-1/4
over 20,000 and not over 100,000	1-3/4
over 100,000 and not over 150,000	3
over 150,000 and not over 250,000	4
over 250,000 and not over 500,000	5
over 500,000 and not over 750,000	6
over 750,000 and not over 1,000,000	7
over 1,000,000	8

By "net income" is meant the cash value of the output of the mine less the following deductions, viz.: (a) Actual operating expenses; (b) repairs actually made; (c) royalties actually paid; and (d) by way of depreciation, 10 percent of the actual cost of permanent improvements actually made during the calendar year and 10 percent for each of the 9 calendar years immediately following ....etc. From the foregoing, "net income" is pretty much a matter of bookkeeping.

The Alaska coal mines have not been paying the above tax, their reasons being, in part, that they are operating on land leased from the Federal Government and pay to the Government a royalty on production. No doubt this Territorial tax will eventually be collectible, therefore it is included in mining costs.

Estimated mining costs (Based on U. M. W. of A. contract).

Item	Cost a ton	
Labor (includes supervision and clerical)	$ 2.35	
Supplies, power, and miscellaneous	.72	
Mine operating cost		$ 3.07
Taxes	.05	
Compensation and social security	.15	
Royalty	.04	
Depreciation of mine plant (10 percent)	.21	
Other charges before amortization		$ .45
Mining costs before amortization	$ 3.52	$ 3.52
Amortization and interest at 4 percent for 6 years	.35	.35
Cost of washed coal, f.o.b. mine storage bin	$ 3.87	$ 3.87

Financial Analysis, Based on above costs; mechanized mine, 500 tons daily, operating 25 days a month

Cost items	Monthly cost	Annual cost	Cost for 6-yr. period
Labor; includes supervision, engineering, clerical, etc.	$ 29,375	$ 352,500	$ 2,115,000
Supplies, power and miscellaneous expenses	9,000	108,000	648,000
Other charges	10,000	120,000	720,000
Total operating costs	$ 48,375	$ 580,500	$ 3,483,000
Sales value of product at $5.00 a ton	62,500	750,000	4,500,000
Gain (exclusive of sales and administration costs)	$ 14,125	$ 169,000	$ 1,017,000

Recapitulation

Sales value of product, f.o.b. mine	$ 5.00 a ton
Operating cost before amortization and after all other mining charges	3.52 a ton
Gain before amortization of capital invested	$ 1.48 a ton

Amortization of capital indebtedness of $ 273,300

Plan No.	Time: Unit of Payments	Time: Total for retirement	Amount of - Periodic payments on principal	Amount of - Total interest paid at 4 percent	Amount of - Principal and interest	Amortization rate per ton	Production cost per ton	Gain per ton	Tons of washed coal required	Surplus at end of period
1	Monthly	16 mo.	$ 18,500.00*	$ 7,430.10	$280,730.10	$1.48	$5.00	$0.00	190,400	$ 15,300
2	Quarterly	18 mo.	55,500.00**	8,376.62	281,676.62	1.48	5.00	.00	191,000	51,300
3	Quarterly	2 yr.	34,162.50	12,298.50	285,598.50	.95	4.47	.53	300,000	158,400
	Semiannual	2 yr.	68,325.00	13,675.00	286,975.00	.96	4.46	.54	300,000	157,025
5	Annual	2 yr.	136,650.00	16,398.00	289,698.00	.97	4.45	.55	300,000	154,300
6	Annual	6 yr.	45,550.00	38,262.00	311,562.00	.35	3.87	1.13	900,000	1,020,000

*Last payment: P = $3,219.37; I = $10.73; Total of $ 3,230.10
**Last payment: P = $4,135.27; I = $41.35; Total of $ 4,176.62

Plans 1 and 2 are based upon immediate retirement of indebtedness, with accrued interest at 4 percent; the others upon equal quarterly, semiannual, and annual payments over different periods of time. An appreciable saving of interest is indicated in plan 1 over plan 5.

CONCLUSIONS

Coal from Moose Creek is classed as poor-coking, high-volatile bituminous B of high heating value. It is the best bituminous coal produced commercially in Alaska and is much desired for domestic and commercial purposes. It is amenable to open or closed storage, because it does not disintegrate (slack) on exposure, and its low moisture and sulfur content minimizes danger of spontaneous combustion. It is adaptable for use in domestic and commercial stokers.

The present annual demand for coal in Alaska totals 500,000 tons. By virtue of location, transportation advantages, and high quality of coal, the Matanuska field should supply 300,000 tons or three-fifths of the annual consumption. To accomplish this production, the present output must be doubled. Activities by the lessees, together with the exploratory work by the Bureau of Mines, have made this possible on the Buffalo property for a minimum period of 10 years, there being a total of 2,375,500 tons of measured, indicated, and inferred coal in the Buffalo series, of which 1,656,700 tons are estimated as recoverable.[13]

All coal lands in Alaska are Government reserves, and land is leased to private interests for exploration and for mining. In case of an acute emergency the Government may be forced to mine coal in Alaska, since the largest consumer by far is the Government itself, through its agencies, such as the Army, the Alaska Railroad, the Alaska Road Commission, Bureau of Indian Affairs, etc. Therefore the fullest information obtainable on the coal reserves should be on record.

Certain areas in the Moose Creek district merit investigation by additional core drilling, particularly the area along the north flank of Wishbone Hill eastward from the Buffalo property toward the Evan Jones mine. Also, the ground between the Buffalo mine and the Premier fault south of the area previously drilled has excellent possibilities of workable coal deposits of some magnitude. The area is on high ground, with a surface covering of glacial till which appears to be rather shallow, although there are no rock exposures. Information gleaned from the previous work points to the existence of the Buffalo coal series in this area some distance south of Moose Creek.

The Federal income from royalties on the estimated production at the Buffalo for the first 5 years at 2 cents a ton is $13,950 and $37,500 for the next 5 years at 5 cents a ton, making a total of $51,450. At $5.00 a ton the gross value of the 1,656,700 tons of recoverable coal revealed by the Bureau of Mines work is $8,283,500.

SUPPLEMENT

Alaska Matanuska Property

The Alaska Matanuska property is locally called the Premier and embraces both the Premier and the Baxter mines. This property adjoins the Buffalo on

13. Table 2, p. 21.

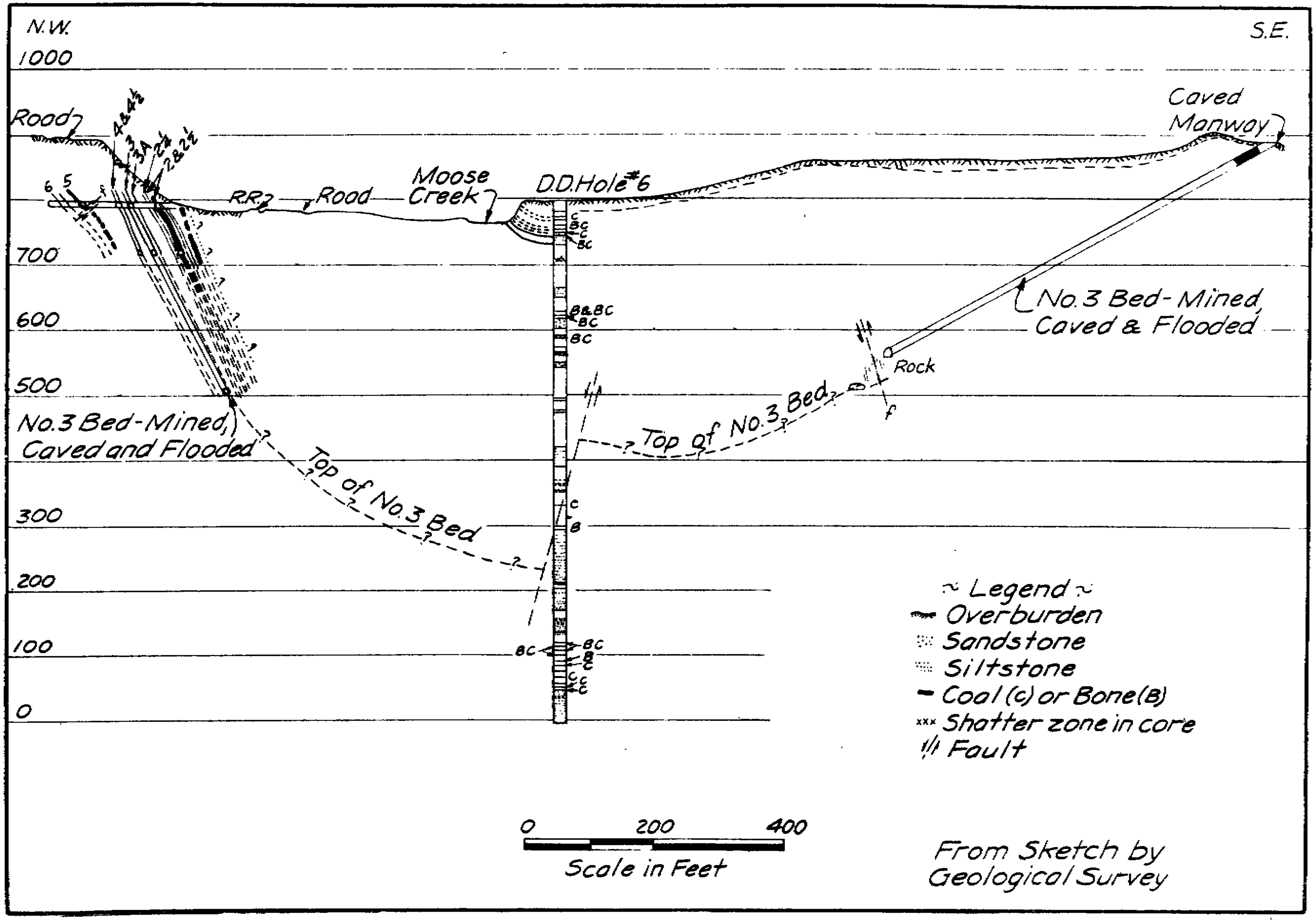

FIGURE 22.- Geologic section A-A' through diamond drill hole 6.

the west. The Baxter mine was abandoned in 1925 owing to depletion of its coal reserves. Exploratory work underground failed to reveal coal because of the badly faulted condition of the ground. Bureau of Mines drill holes 7 and 8, downstream and upstream, respectively, from the Baxter portal, revealed faulting and folding of the formation to such a degree that economic continuity of any bed or beds is absent. The Buffalo series was definitely absent in the creek bottom and in the ridge south of the creek for the distance from the Premier fault to the Buffalo property line.

On the Premier ground, hole 6, southwest of the Premier fault, failed to cut the Premier series in a depth of 800 feet vertically. The hole was put down to prospect for coal below the flooded workings in the Premier mine, but no coal of economic value was found. Figure 22 shows a section through hole 6.

The Premier mine is on an isolated fault block which apparently has been moved a considerable distance westerly along the Premier fault. The beds form a minor syncline plunging northeast; the dip of the beds on the west limb is steeply east; on the east limb the dip is west, indicating the synclinal structure.

The Premier mine was an important producer from 1925 to 1933, when it was accidentally flooded. Since the flooding, it has produced in a small way from the beds on the west limb above flood water. These reserves have been mined out, and operations ceased in August 1943.

A study of drilling results and surface geology indicates that no coal of economic value exists in the portion of the Alaska Matanuska property covered by the exploration, that is in the creek bottom or its immediate vicinity.

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