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REPORT OF INVESTIGATIONS

EXPLORATION OF COAL DEPOSITS OF THE POINT BARROW AND
WAINWRIGHT AREAS, NORTHERN ALASKA



BY

ROBERT S. SANFORD AND HAROLD C. PIERCE

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By Robert S. Sanford^{2/} and Harold C. Pierce^{3/}

CONTENTS

	<u>Page</u>
Introduction.....	2
Acknowledgments.....	2
Location and accessibility.....	3
Physical features.....	4
Climate.....	5
Labor and living conditions.....	5
History and production.....	6
Geology.....	10
Occurrence of deposit.....	10
Character of coal deposits.....	11
Exploration by the Bureau of Mines.....	11
Sampling.....	13
Reserves.....	16
Equipment.....	16
Conclusions.....	17

TABLES

1. Monthly and annual mean temperature, arctic coast region, Barrow:	5
2. Ground temperatures.....	8
3. Summary of churn-drill holes.....	12
4. Stratigraphic section.....	13
5. Analysis of coal from Meade River, Peard Bay, and Kuk River beds.	14

ILLUSTRATIONS

<u>Fig.</u>	<u>Following page</u>
1. Index map, Point Barrow coal.....	2
2. Coal deposits vicinity Point Barrow, Alaska.....	2
3. Area adjacent to Meade River.....	10
4. Section Meade River area.....	10
5. Peard Bay area.....	10

^{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 Investigation 3934."

^{2/} Acting chief, Alaska Division, Mining Branch, Bureau of Mines, Juneau, Alaska.

^{3/} Mining engineer. Bureau of Mines. Fairbanks. Alaska.

INTRODUCTION

At one time the Alaskan Eskimo lived in many small settlements scattered along the Arctic coast. These settlements extended as far south as Bristol Bay and several miles inland on the large rivers. When the white man established trading posts, schools, hospitals, and missions, these people gradually congregated around them in a few large villages. The natural fuel supply near many of the large villages along the Arctic coast became exhausted as a result of the abnormally large influx of people from small outlying settlements.

The population of Barrow, Alaska, according to the 1940 census, is 363 persons, but since that time it has increased considerably, and later estimates place the present population between 400 and 500 persons. With the exception of 25 white persons, the entire population is comprised of Eskimos.

The government maintains a school, hospital, radio station, and weather station at Barrow. In addition to the government installations, there is a church, a privately owned trading post, and a cooperative store owned by the Eskimos.

For many years the Barrow Eskimos depended on driftwood and petroleum residue from Cape Simpson for their fuel supply. This fuel provided not only warmth for the Eskimo during the long cold winters but also heat for melting ice, the only source of water during the winter. In recent years the sources of petroleum residue and driftwood have not been adequate to meet the demands for fuel. During the winter of 1942-43 and again in 1943-44, Barrow experienced an acute shortage of fuel.

The fuel problem at Barrow was brought to the attention of Governor Ernest E. Gruening, who was instrumental in getting a Bureau of Mines engineer⁴ to investigate reported coal occurrences in the vicinity. Coal deposits along the Meade River and at Peard Bay were examined during the spring and fall of 1943. The Alaska Native Service shipped in mining equipment in September 1943 and commenced stripping an open-pit mine on the Meade River in June 1944. In conjunction with this work, an engineer⁵ of the Bureau explored by churn drilling to determine the tonnage of coal in the vicinity of the mine. In addition to this work, the Bureau of Mines examined coal deposits in Peard Bay area and along the Kuk River south of Wainwright.

ACKNOWLEDGMENTS

In its program of exploration of mineral deposits, the Bureau of Mines has as its primary objective the more effective utilization of our mineral resources to the end that they make the greatest possible contribution to national security and economy. It is the policy of the Bureau to publish the facts developed by each exploratory project as soon as practicable after its conclusion. The Mining Branch, Lowell B. Moon, chief, conducts preliminary

⁴/ Norman E. Ebbley, Jr.

⁵/ Harold C. Pierce.

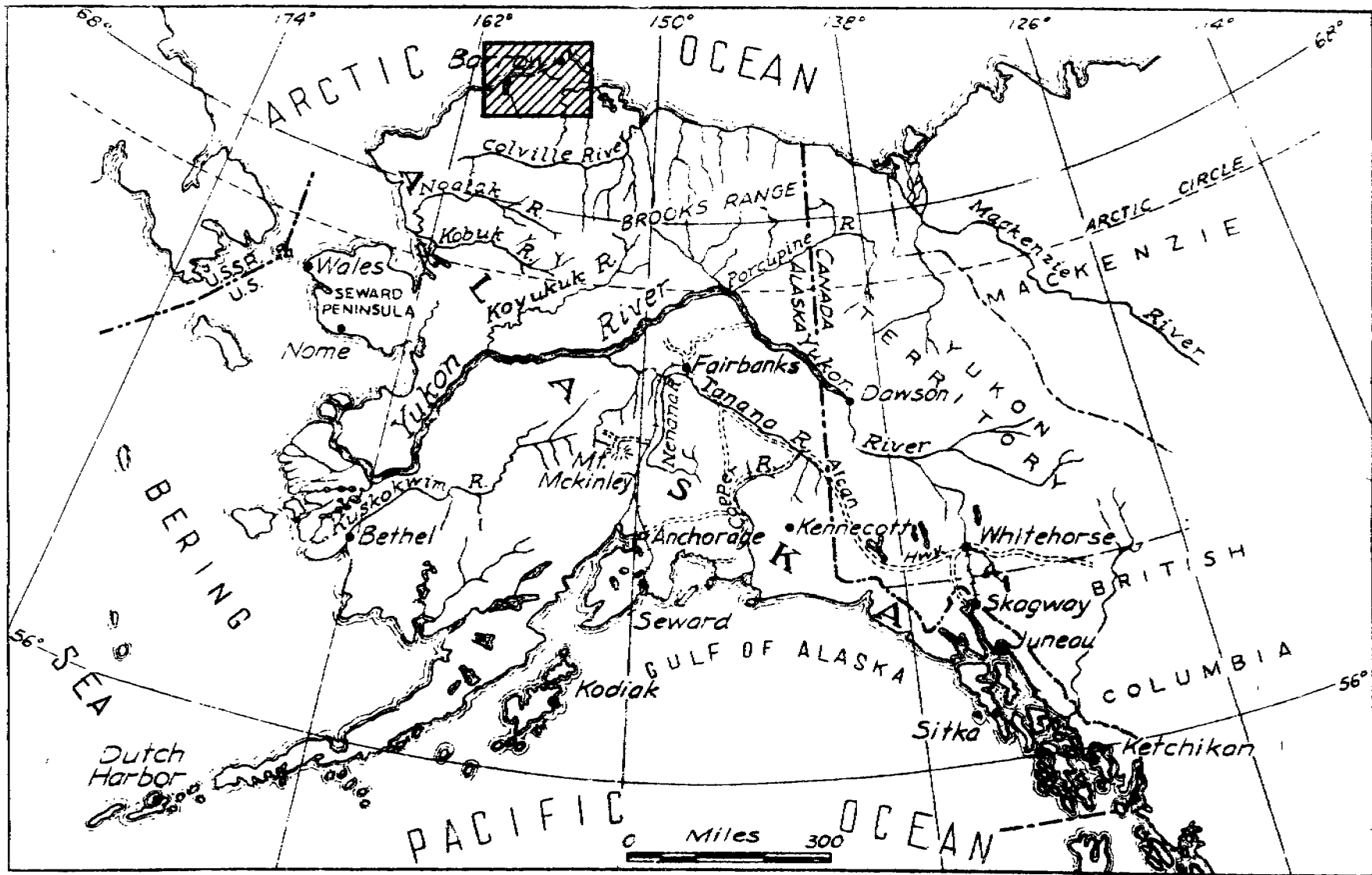


FIG. 1

INDEX MAP ~ POINT BARROW COAL

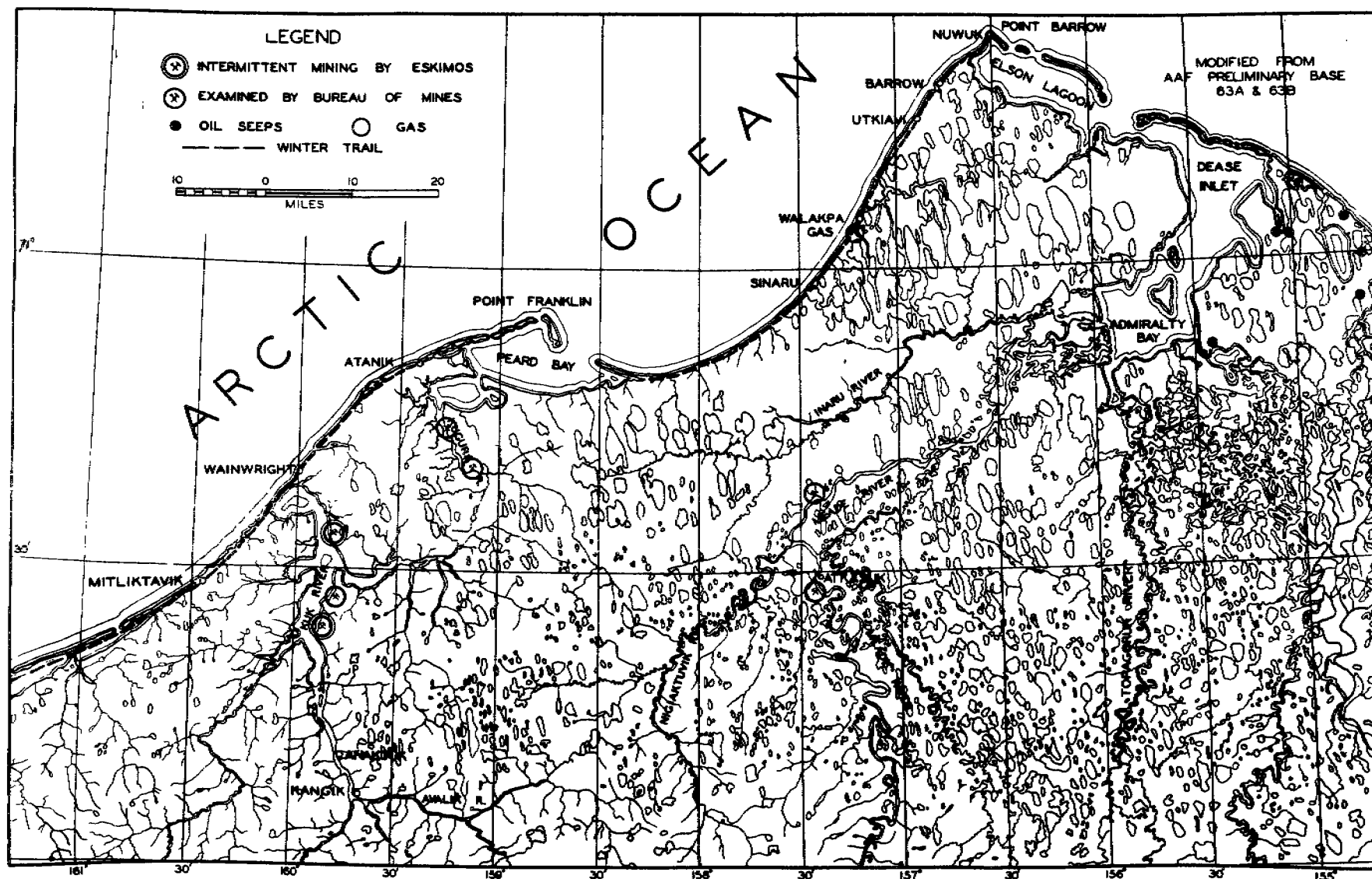


FIG. 2

COAL DEPOSITS VICINITY POINT BARROW, ALASKA

examinations, performs the actual exploratory work, and prepares the final report. The Metallurgical Branch, R. G. Knickerbocker, chief, analyzes samples and performs beneficiation tests. Both these branches are under the supervision of Dr. R. S. Dean, assistant director.

Special acknowledgment is due to R. S. Sanford, acting chief, Alaska Division, Mining Branch; Philip S. Smith and J. B. Mertie, Jr., Federal Geological Survey, and to members of the Coal Division, Bureau of Mines, Pittsburgh, Pa.

LOCATION AND ACCESSIBILITY

The Meade River coal mine, operated by the Alaska Native Service, is about 60 airline miles S. 16° W. of Barrow at approximate latitude 70° 28' N. and longitude 157° 26' W. (see figs. 1 and 2). The land in this area is public domain.

The Arctic Ocean in the vicinity of Barrow is usually sufficiently free of ice between the first of July and the latter part of September to permit the passage of ships. The ice pack is never very far north of Barrow, and a change in the wind at any time may drive the solid ice pack onto the beach between Peard Bay and Point Barrow. As only one supply ship a year calls at Barrow, equipment and supplies ordered from the United States must be on the dock in Seattle before the middle of June to be sure of reaching Barrow the same year. There are no harbors along the Arctic coast; hence the ship must anchor 2 to 20 miles offshore, and all supplies are lightered ashore in small barges or Eskimo umiaks, or skin boats. Cost of lighterage at Barrow is usually about \$7.50 a ton, which is added to the cost of freight from Seattle at \$40 to \$60 a ton, depending on the class of merchandise.

Usually the ice on the Meade River breaks late in June and freezes hard enough for dog-sled transportation late in September. From December 1 to June 1, the terrain is usually frozen sufficiently to permit heavy freighting with crawler-type tractor and heavy freighting sleds. January, February, March, and April have proved to be the most practical time for freighting. It is estimated that tractor freighting between Barrow and Meade River will cost about \$12 a ton.

There are no roads or trails in this area, and in summer the mine is completely isolated so far as overland transportation is concerned. During periods of high water in the summer, the mine can be reached by skin boat or small motor boat from Barrow by way of Dease Inlet and Meade River. However, shallowwater and shifting sand bars along the river make water transportation impractical during most of the summer.

An air strip 125 feet wide by 1,700 feet long has been constructed at the mine. Air transportation is now available if wheel-equipped planes are used in summer and ski-equipped planes in winter. During the summer, float planes can land on the Meade River at the mine or on one of the numerous lakes nearby.

Wein Alaska Airline express rate from Fairbanks to the Meade River is \$0.60 a pound. Trips from Barrow to the mine are on a charter basis and usually cost about \$100 for the round trip. These planes carry approximately 1,000-pound pay loads.

The Alaska Communication System (Army Signal Corps) maintains a radio station at Barrow, and the Alaska Native Service has a small radio station at the mine, which maintains daily schedules with the Barrow station.

Peard Bay lies about 75 miles S. 55° W. of Barrow, lat. 70° 47' N., long. 159° 15' W. (see fig. 2). Coal deposits in the area can be reached by small boats from Barrow, but Peard Bay and the coastal waters are quite shallow, and boats drawing more than 4 or 5 feet of water would not be practical. The only other means of summer transportation is by float plane, which can land on the sheltered waters of the bay. In winter, dog teams, tractors, or planes equipped with skis can be utilized for transportation.

This area is entirely uninhabited; the nearest village, Wainwright, is west 20 airline miles. Population of Wainwright varies between 300 and 400 Eskimos, and the only white residents are the Government teacher, his wife, and a nurse. There are a government school, radio station, cooperative store, and a privately owned trading post at Wainwright.

Although a mine at Peard Bay would be about 15 miles farther from Barrow than the Meade River mine, it would have several advantages. This area is accessible by small boats in summer, and in case of break down or other emergency it would not be necessary to depend altogether upon airplane transportation which is very unreliable at the present time. A mine located in this area could also supply Wainwright with fuel.

PHYSICAL FEATURES

The Meade River and Peard Bay coal deposits are in the relatively flat coastal plain, which extends inland 20 to 100 miles from Cape Beaufort to the mouth of the Colville River. This coastal plain is characterized by low, relatively flat topography, slow meandering streams, and innumerable lakes and ponds. The maximum relief of this region does not exceed 200 feet and in most places is not over 50 feet.

The area immediately adjacent to the Meade River mine is a low, and nearly flat plain, in which the Meade River and its tributaries have entrenched themselves to a depth of 20 to 40 feet. A fairly recent elevation of this area has left benches along the river about 15 feet higher than the low-water level. The most noticeable characteristic of the area is the flat land, as there are no prominent landmarks or timber to relieve the monotony of the landscape. All depressions on the plain catch the surface water which is held by the permanently frozen underlying strata, causing a large portion of the surface to be covered with lakes, ponds, and marsh land. The higher ground is covered by a thick mantle of spongy moss and decayed vegetation. Hence, overland travel is extremely circuitous and difficult in summer, and the soft spongy tundra makes foot travel an especially slow and tiresome undertaking.

Vegetation consists of a few stunted willows and other unidentified bushes growing along the larger streams. Few willows over 2 feet high are found; the majority are smaller, usually 18 inches or less. The vegetation more remote from the streams consists predominately of moss, lichens, grass, and sedges, with a few salmonberries and cranberries.

There is no suitable mine or building timber; all such material must be shipped from the United States.

CLIMATE

The climate is typical of all northwestern Alaska; that is, long cold winters accompanied by severe storms and short cool summers. The mean temperature at Barrow for June, July, August, and September is 37° F. Temperatures below 32° are likely to occur during any month of the year. The annual mean temperature for a period of 40 years is 10.1° F. Table 1 tabulates the monthly and annual mean temperature for this period.

TABLE 1. - Monthly and annual mean temperature,^{6/}
arctic coast region, Barrow

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1881	-	-	-	-	-	-	-	-	-	-	0	-18.0	-
1882	-15.5	-23.2	-4.6	-4.4	22.0	34.5	43.2	37.9	31.5	8.8	-7.1	-17.1	8.8
1883	-16.9	-6.3	-13.3	-2.8	23.0	32.3	36.2	37.0	-	-	-	-	-
1901	-	-	-	-	-	-	-	-	33.2	14.2	-4.7	-12.1	-
1902	-23.2	-6.5	-21.3	-1.4	21.4	39.6	39.7	38.0	31.9	25.2	2.4	-23.3	10.2
1903	-21.9	-15.6	-6.4	-3.0	18.1	36.1	38.2	38.5	30.1	5.7	-7.5	-5.6	8.9
1904	-26.2	-11.8	-2.6	1.6	-	-	-	-	-	-	-	-	-
1910	-	-	-	-	-	-	-	-	34.0	16.6	10.4	-13.8	-
1911	-23.0	-14.0	-22.7	-	23.8	37.2	45.6	42.5	35.6	27.2	7.6	-15.8	-
1915	-	-	-	-	-	-	-	-	-	-	-	-20.6	-
1916	-8.7	-15.2	-19.4	0.6	24.4	-	-	35.8	30.4	18.9	-2.8	-20.9	-
1917	-26.0	-4.8	-	-	-	-	-	-	-	-	-	-	-
1920	-	-	-	-	-	-	-	-	-	13.9	-1.3	-13.0	-
1921	-17.9	-19.4	-14.4	-2.4	19.0	32.2	42.3	40.0	30.4	15.8	6.0	-9.0	10.2
Means	-19.9	-13.0	-13.1	-1.7	21.7	35.3	40.9	38.5	32.1	16.3	0.3	-15.4	10.1

At Barrow the average precipitation recorded over 40 years was 5.34 inches. This includes the average snowfall for a 19-year period, which was 55.4 inches.^{6/} October is reported as having the greatest precipitation. Ample water for camp or mine use is available during the summer months from the rivers and their tributaries. During the winter the only water available is that obtained by melting ice or snow.

LABOR AND LIVING CONDITIONS

At present no housing facilities are available at the mine. During the summer of 1944, all the labor was performed by native Eskimos who either lived

^{6/} United States Weather Bureau.

in tents or sod igloos. Ed Burnell, the mine foreman employed by the Alaska Native Service, lived in a small cabin mounted on a bobsled, which had been towed out from Barrow.

Six native workers and their families live at the mine. Additional Eskimo labor can be obtained from Barrow, and although these natives are not skilled workmen they could be trained to handle semiskilled and skilled jobs. The present wage scale in Barrow for unskilled native labor is \$0.50 an hour with overtime for all over 40 hours per week. At present, skilled labor must be imported from Fairbanks or Seattle. The wage scale in Fairbanks at present (1945) is as follows:

	<u>Per hour</u>
Skilled labor.....	\$1.50 to \$2.00
Unskilled labor.....	\$1.00 to \$1.25

Time-and-a-half is paid for all over 40 hours a week and double time for Sunday. There are no housing facilities or labor of any kind at Peard Bay. Native labor can be procured from Wainwright or Barrow.

HISTORY AND PRODUCTION

The presence of coal deposits along the Arctic coast has been known for many years. The Eskimos used coal from the Meade River deposits for fuel at their hunting and fishing camps. At various times coal was mined and transported by the natives from the Peard Bay and Kuk River areas to Barrow and Wainwright for use by the Eskimos and the government school. During the past years little, if any, attempt has been made to develop and mine these coal deposits systematically.

In June 1943, a Bureau of Mines engineer made a preliminary examination of the deposits at Peard Bay and along the Meade River and recommended hydraulic stripping of the latter deposit using water pumped from the river. This recommendation was made without the aid of a detailed examination because it was imperative to lay out a mining program and purchase equipment and supplies before the ship sailed from Seattle to Barrow during the middle of July 1943. It was necessary to take immediate steps to alleviate the coal shortage at Barrow.

The equipment was purchased by the Alaska Native Service, shipped to Barrow, and transported by tractor-drawn sleds during the winter to the coal outcrop near the bank of Meade River.

During the winter of 1943-44, approximately 100 tons of coal were dug by hand from exposed portions of the beds. This coal was hauled with tractors and sleds to Barrow, where it was sold to the natives. This supplemented the fuel supply and alleviated the shortage. 7/

In the spring of 1944 a mine foreman was employed to supervise the operation of the open-pit mine. Hydraulic equipment was set up, and the overburden was stripped during the summer months. This operation exposed an area of coal

7/ Supervised by Leon Vincent, Superintendent of Schools at Barrow.

70 feet wide and 140 feet long on the banks of the river. Open-pit mining was started; however, in September, after 45 tons had been mined, flood waters covered the stripped coal.

An estimated 25,000 cubic yards of overburden was stripped during the summer of 1944 at an average cost of \$0.25 a cubic yard. During stripping, 9,800 cubic yards of overburden was removed from 1,960 tons of coal at a total cost of \$2,450, or \$1.25 per ton of coal stripped.

The following unfavorable conditions were found at the mine:

1. The coal bed is only 1 foot above the low-water level of the river; during floods, the coal bed is under water.
2. The overburden is about 25 feet deep, and it was found that pumping water to thaw and strip in northern Alaska is costly at this depth. Even during the summer the river water is only a little above freezing temperature and contains very little heat that can be utilized in thawing.
3. The Meade River is shallow and does not have sufficient current to carry away the stripped material. The sands do not stay in suspension and consequently pile up near the pit, necessitating handling the overburden two or three times.
4. When traveling in and out of the pit, the tractor brings in sand and clay on the caterpillar treads, which is soon ground into the coal. Under these conditions it is not possible to mine clean coal.

The knowledge gained from the first season's stripping operation enables operators to lower the cost materially in the future. The summer experience indicates that open-pit mining is feasible, even in the Arctic, if at suitable deposits.

The steamship that arrived in September 1944 did not discharge the coal consigned to Barrow, nor did it release the caterpillar tractor and freight sleds. Late fall rains resulted in high water in the Meade River, which flooded the open-pit mine. It became imperative that a source of fuel be found immediately. The Bureau of Mines enlarged the prospect shaft and extracted 10 tons of coal. This was done to determine whether or not it was feasible to mine frozen coal with the inadequate equipment on hand. The small churn drill was set up over the shaft and was used as a headframe and hoist. The Bureau recommended that experimental underground mining be continued.

The Alaska Native Service continued to mine coal from the enlarged prospect shaft, using the same make-shift hoisting equipment. During the winter 640 tons of coal was mined and 490 tons was hauled to Barrow with one tractor and sled. All of the coal was mined from one large 60- by 65-foot room.

At first, hand steel and hammers were used for drilling the coal preparatory to blasting, but later hand-operated coal augers were used. The augers

were kept sharp, and no difficulty was experienced in drilling the frozen coal. Blasting was usually done at the end of the shift, and the mine was clear of smoke in about 1 hour. As a safety precaution, a second shaft was excavated. A door was placed over this shaft to prevent cold air from passing through the mine as natural ventilation. Even though no timbers or pillars were used, there was no sign of roof failure.

Underground mining of the Meade River deposit has not presented any unsurmountable difficulties. The relatively shallow depth of overburden and the permanently frozen condition of these deposits have proved to be an advantage, as no timber is necessary. Throughout northern Alaska shafts have been sunk 15 to 20 feet into the frozen ground, and large rooms for storage of ice and meat have been excavated at the bottoms of these shafts. These underground cellars stand for many years with no timbering except near the collar of the shafts, where a water-tight seal must be made. The temperature in these cellars with the door closed is approximately 20° F. throughout the entire year. The ground temperature in the coal beds at the Meade River was found to be about 20° F. Table 2 lists the drill-hole temperatures on August 29, 1944. The air temperature was 42° F.

TABLE 2. - Ground temperatures, °F.

Depth, feet	Drill hole 9	Drill hole 11
5.....	38	32
10.....	30	30
15.....	26	25
20.....	22	23
25.....	20	20
30.....	18	1/19
35.....	18	1/30
1/ Coal bed.		

The advantages of underground mining over open-pit mining are as follows:

1. Underground mining is independent of season or weather, whereas open-pit operations are handicapped by short summers and inclement weather. All stripping and open-pit mining must be done during July and August when temperatures are high enough to thaw the overburden and coal. This necessitates carrying the stripping at least 1 year ahead of the mining, and any delay during July or August would seriously curtail production for that year.

2. Underground mining is not dependent on summer thawing; hence, there is no need to rush the work during the short season, as inefficiency and higher costs will result.

3. Coal could be mined during the winter and loaded directly into the sleighs; therefore, it would not be necessary to stock pile. Coal mined by open-pit methods would have to be removed from the pit and stock-piled on high ground where it would not be covered with drifting snow.

4. A small crew can mine all the coal required during the winter, which is the slack season when the Eskimos have no other employment.

5. Clean coal can be mined from underground working.

In the spring of 1945, when mining was stopped for the summer, both mine openings were sealed to prevent the roof from thawing and caving. This fall it is proposed to pump 6 inches of water into the mine, allow it to freeze, pump in 6 inches more, and freeze that, continuing the operation until the mine opening is one solid block of ice. This will serve as an ice pillar, and it will not be necessary to leave coal pillars. This fall two new shafts will be sunk in a better location and a new mine developed. However, before a shaft is definitely located three or four holes should be drilled in the area adjacent to hole 13. This would block out enough coal to supply Barrow for 10 to 15 years. These holes will furnish additional information that would allow the underground development to be laid out with favorable grades for tramming. This mine will need to produce 1,000 to 1,500 tons yearly and probably will be operated only during the winter months.

Transportation presented the most difficult problem last winter. Considerable trouble and many delays resulted from the frequent breakdown of the inadequate second-hand tractor. This region is so cold that the snow is dry and hard, almost like sand, and it will not pack to form a good tractor road. The steel sled runners act as though they were being drawn over sand rather than over snow. Most of the winter tractor road from Barrow to the Meade River coal mine is over frozen lakes and rivers, almost ideal for hauling. It was the occasional steep grade up from a lake bed or across a gully, entirely filled with drifted snow, that caused trouble. The caterpillar tractor often stood in one place and dug itself into the snow. Last winter, when hauling with one tractor, the load had to be limited to an amount that could be pulled over the most difficult section of the road.

The caterpillar tractor purchased in 1944 and left in Nome last winter was delivered to Barrow this summer. Two tractors will be available for hauling coal this winter. With each of them pulling a train of sleds loaded to capacity, under average conditions at least three times the tonnage of coal can be delivered to Barrow. For, when one tractor gets stuck on a steep grade or in a snow drift, the other tractor will uncouple from its train and assist.

The Meade River coal was sold to the hospital and the Eskimos at \$25 a ton through the Native Store at Barrow. This store is a cooperative enterprise owned and operated by the Barrow Eskimos. The price will be increased to \$30 a ton for unsacked coal beginning November 1, 1945. After the initial or high-cost stage of mine development, it is expected that the price of coal will be reduced.

The Alaska Native Service has obtained a "free use permit" to mine the coal on the public domain.

GEOLOGY^{8/}

The Arctic coastal-plain area is covered by a thick mantle of marine sands and silt, which effectively masks the underlying formations. In a few isolated locations local warping has brought older rocks near enough to the surface to be exposed by erosion. It is in these localities that coal beds have been exposed by stream action.

Fragments of broken sea shells in the sands indicate they were shallow-water marine deposits, probably of Pleistocene age. A slight general uplift of this area has brought the marine sands above sea level, and wind and water action has modeled them into a gently rolling coastal plain.

Along the Meade River, the Pleistocene deposits unconformably overlie a Cretaceous series, which contains coal beds. Previous to the deposition of the Pleistocene sands, the Cretaceous beds, composed principally of clay and coal with some interbedded shales, were warped so that they dip approximately 1° in an easterly direction. During the deposition of the Pleistocene sand, the Cretaceous beds were eroded to base level, and the coal above this base-level was worked over by wave action and concentrated as secondary deposits in the sands. A similar condition prevails at present near Wainwright, where the Arctic Ocean is bringing up coal and concentrating it on the beach in sufficient quantity to be an important source of fuel for the Wainwright village.

Large dikes and sills of ice are found cutting through the overburden in the Meade River area, but no evidence was found to indicate that the ice cut through the coal beds. However, at one locality near Peard Bay, dikes of ice were observed to cut through the coal beds as well as the overburden.

Occurrence of the Deposit

The Cretaceous series at the Meade River outcrop along the west bank of the stream. Four coal beds appear in this outcrop. The top, or No. 1 bed, is 34 inches thick; the second bed, No. 2, is 5 to 6 feet; and the two lower beds, Nos. 3 and 4, are approximately 12 inches thick. These coal beds are separated by 1 to 6 feet of clay and were originally overlain by clay of unknown thickness. During Pleistocene time most of this clay and the higher portions of the coal beds were eroded. The present coal appears as truncated beds dipping below the old erosional surface.

Sufficient work has not been completed at Peard Bay to determine the attitude of the coal beds, but exploration to date indicates they are nearly flat, and have been subjected to geologic processes similar to those occurring along the Meade River.

^{8/} Smith, Philip S., and Mertie, J. B., Jr., Geology and Mineral Resources of Northwestern Alaska: Geol. Surv. Bull. 815, 1930.

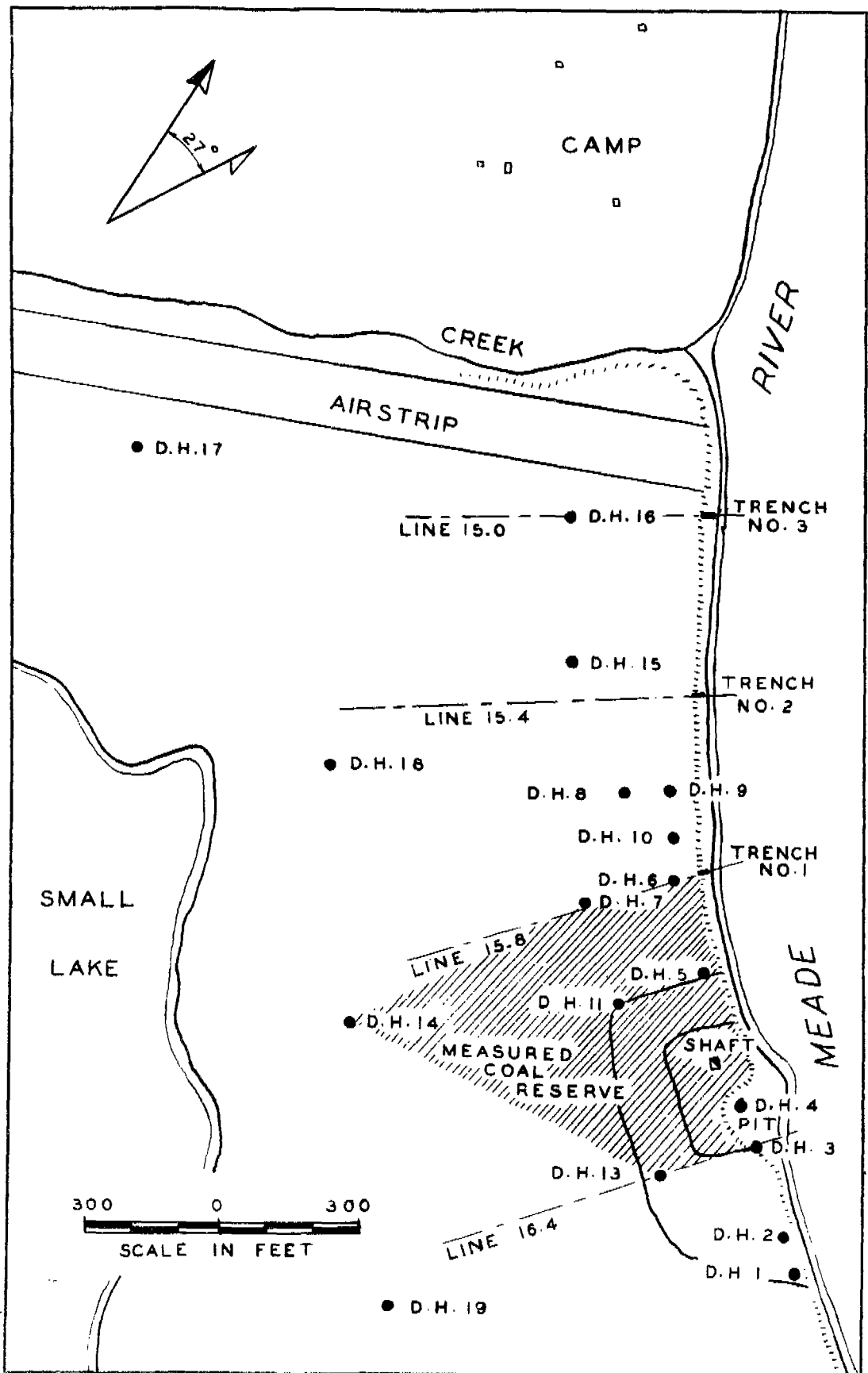


FIG. 3 AREA ADJACENT TO MEADE RIVER

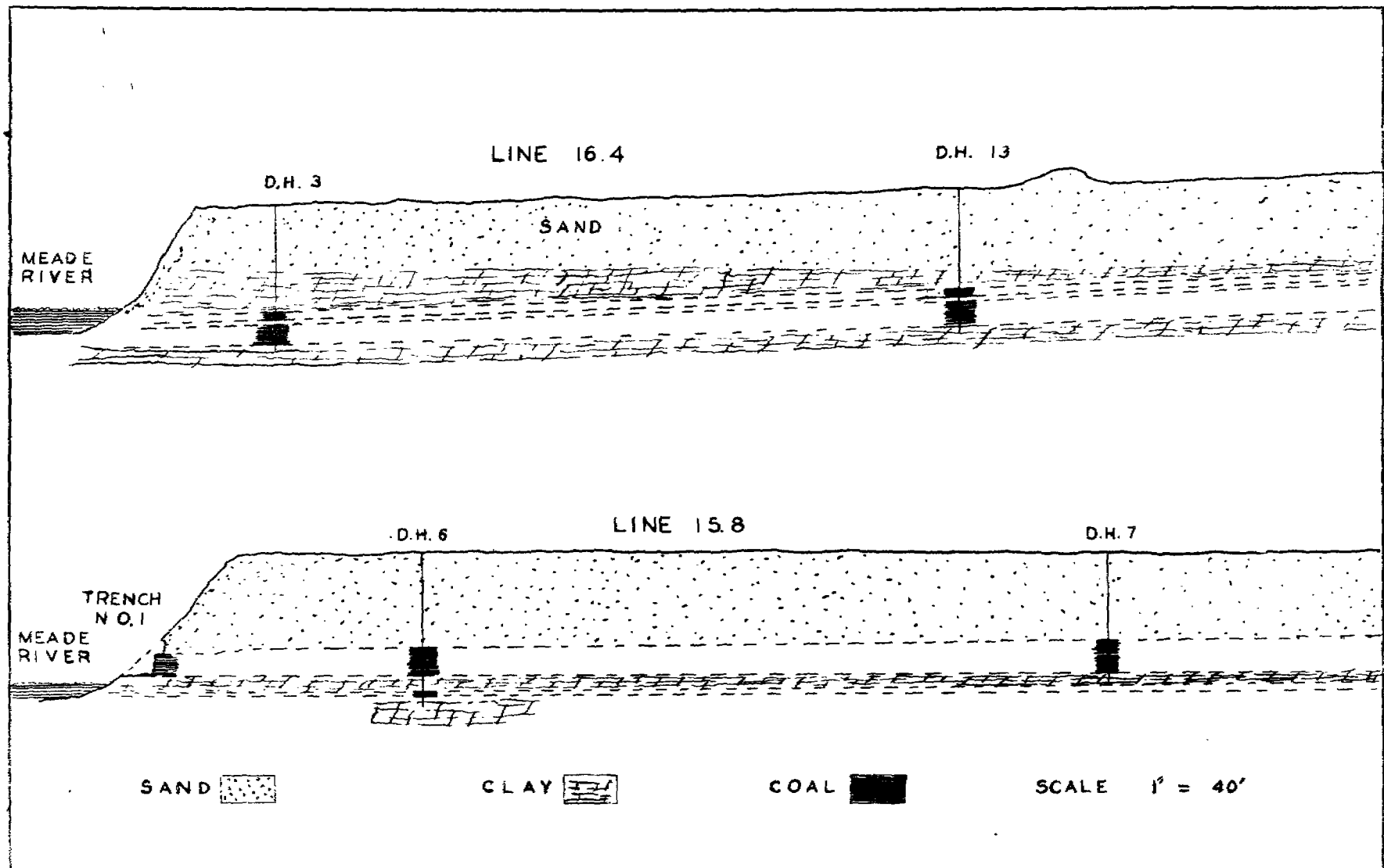


FIG. 4

SECTION MEADE RIVER AREA

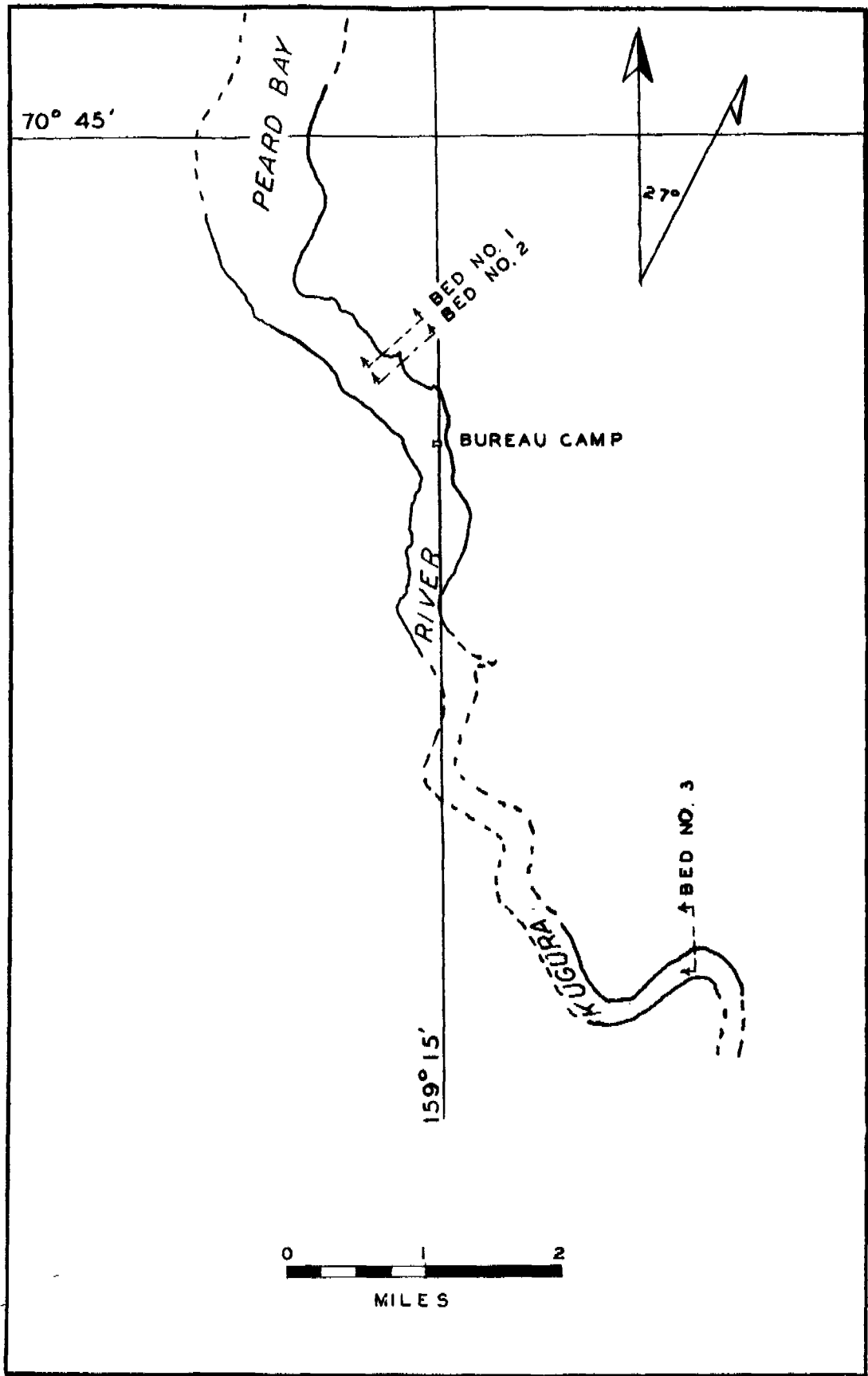


FIG. 5 PEARD BAY AREA

Character of Coal Deposits

Coal from Meade River, Peard Bay and the Kuk River areas is classed as subbituminous. The heat value ranges from 8,430 to 10,330 B.t.u., and the ash content is 3.0 percent to 9.8 percent. This coal is divided by a network of very thin ice seams along the cleats and bedding. Large lumps of seemingly solid coal will disintegrate into smaller pieces, 1/4 inch to 3/4 inch in size when thawed.

EXPLORATION BY THE BUREAU OF MINES

The Bureau of Mines drilled 15 churn-drill holes at Meade River. (See fig. 3) The drill used was a light machine designed for airplane transportation and uses 4-inch tools.

Lines of drill holes were laid out perpendicular to the course of the river and numbered, so that each full unit represents 1,000 feet. Thus, line 15.0 is 1,000 feet from line 16.0 and 200 feet from line 15.2.

No coal of minable thickness was found to the northwest of line 15.8. In this area the coal has been eroded. Between lines 15.8 and 16.4 the coal beds were found covered by 25 to 30 feet of overburden. The beds appear to continue to the southeast of line 16.4, but the dip in this direction makes them too deep to be reached with the light drilling equipment. A summary of churn-drilling results will be found in table 3.

Three trenches were dug along the bank of the Meade River north of the open pit. Trench 1 revealed the No. 2 coal bed directly below the Pleistocene sands. Bed 1 and the overlying clays are missing (see fig. 4). Prospecting at trench 2 revealed beds 3 and 4, whereas trench 3 showed only one small seam of coal, presumably bed 4.

In addition to the churn-drill holes and trenches, one prospect shaft was sunk through the coal as a check on the drilling. This shaft was later enlarged to 5 by 8 feet and used as the underground working shaft.

Three separate coal exposures were examined in the Peard Bay area. These are referred to as beds 1, 2, and 3 (see fig. 5). A total of 1,600 linear feet of coal beds are exposed in the cut banks along the shore of Peard Bay and Kugura River. These beds, ranging from 5 to 6 feet in thickness, were prospected by four prospect pits 60 to 100 feet from the outcrop. Two of the pits were located where dikes of ice cut through a coal bed. However, probing with a steam point from the surface in the areas between these dikes, indicated the existence of coal bed No. 1. This condition, where the ice cuts through the coal, is probably due to some unusual circumstance affecting only a small area, as the other two pits did encounter coal. Nowhere in the Meade River area were dikes of ice found cutting through the coal beds.

TABLE 3. - Summary of churn-drill holes

Hole No.	Line No.	Elev. of collar, feet	Depth of hole, feet	Depth of sand, feet	Formation
1	16.7				
2	16.6				
3	16.4				Drilled by the Alaska Native Service, June 1944.
4	16.3				
5	16.0	69.7	37.5	20	Clay from 20 to 27 feet; coal from 27 to 37 feet.
6	15.8	73.3	46.0	27	Coal from 27 to 35 feet; clay below 35 feet; thin bed coal at 39 feet.
7	15.8	75.2	36.0	24	Coal, 24 to 34 feet; clay, 34 to 36 feet.
8	15.6	73.7	25	24	Some coal at 25 feet; lost pump at 25 feet; abandoned hole.
9	15.6	72.5	42.5	25	Dirty coal 26 to 29 feet; clay from 29 to 42.5 feet.
10	15.7	73.2	37	30	Coal and sand from 30 to 34 feet; clay from 34 to 37 feet.
11	16.0	73.7	40	25	A little clay at 26 feet; coal, 26 to 30 feet; clay, 30 to 32 feet; coal, 32 to 38 feet.
12	16.15	-	-	-	Stuck tools at 25 feet; lost the hole.
13	16.4	68.3	41	22	Clay, 22 to 29 feet; coal, 29 to 39 feet.
14	15.9	66.0	25	14	Coal, 14 to 23 feet; clay, 23 to 25 feet.
15	15.3	75.1	35	25	Coal, 25 to 29 feet; clay, 29 to 35 feet.
16	15.0	74.5	34	29	Sand and coal, 29 to 32 feet; clay, 32 to 34 feet.
17	14.8	66.1	23	18	Sand and coal, 17 to 18 feet; clay, 18 to 23 feet.
18	15.5	66.2	22	18	Clay, 18 to 22 feet.
19	16.5	71.0	25	21	Sand pump broke at 25 feet.

A preliminary examination was made of the Kuk River deposits at latitude $70^{\circ} 24' N.$, longitude $159^{\circ} 51' W.$, which are approximately 18 miles (airline) south of Wainwright. Two coal beds outcrop in a cut bank for a distance of 1 mile along the east shore of the Kuk River. The top bed is 5 feet 6 inches thick, and the bottom one is 6 feet thick. One sample was cut across the full width of each bed. The coal from these beds is classed as subbituminous. Heat values and ash content are shown in table 5.

A stratigraphic section through the coal series at the location where the samples were cut is shown in the following table.

TABLE 4. - Stratigraphic section

Surface.....	0 feet
Overburden, clay and sand....	10-12 feet
Bone.....	1 foot 6 inches
Coal.....	5 feet 6 inches (sample 5)
Clay.....	4 feet 0 inches
Coal.....	6 feet 0 inches (sample 4)
Clay.....	6 inches
Water level in the Kuk River.	

Considerable difficulty was experienced in getting supplies and equipment onto the job. Several planes of the only airline serving the area were chartered to the Navy for work in connection with the Barrow petroleum exploration; consequently, transportation was a problem throughout the project, and much time was lost from lack of necessary tools and supplies.

SAMPLING

Clean samples were not obtained from the churn drilling, as sloughing of loose sand and clay in the holes contaminated the material pumped from the coal-bearing horizon. These samples were not shipped for analysis.

Sample 1 was cut from bed 2, which is now being mined at Meade River.

Sample 2 was cut on the north bank of the Meade River at the "big bend" and 1.1 miles (airline) north of the mine. The top of the bed is 3 feet above water level and at least 3 feet thick. The pit filled with water so fast that the full thickness could not be determined. Eskimos established a fish camp nearby and were using this coal.

Sample 3 was cut from bed 1 on the east bank of Kugura River, half a mile south of the mouth of the river at Peard Bay. The bed is 5 feet 6 inches thick and outcrops for more than 1,000 feet.

Sample 4 was cut from the bottom bed on the east bank of the Kuk River, 1.5 miles south of Wainwright. The outcrop is about half a mile long.

Sample 5 was cut from the top bed directly above No. 4. This bed outcrops for 1 mile and lies at the crest of an anticline, the north and south limbs of which dip about 30 feet to the mile. For many years the Eskimos have dug their fuel from shallow excavations in these two beds of coal. This would be an ideal site for hydraulic stripping, as the overburden is up to 10 feet thick.

Sample 6 was cut from the top 2 feet 6 inches of coal bed at the mouth of the Kugura River.

Sample 7 was collected on the beach 2 miles south of Wainwright. Each storm washes more coal up on the beach, where it is gathered by the Eskimos.

Sample 8 was cut in a prospect pit from bed 1 (see fig. 5).

TABLE 5. - Analysis of coal from Meade River, Peard Bay, and Kuk River beds^{1/}

Location of sample	Sample		Proximate, percent				Ultimate, percent					Air dry loss, percent	B.t.u.	Ash-softening Temp. °F.	Thick-ness, feet	Sampled by -
	No.	Condi- tion ^{2/}	Mois- ture	Vola- tile matter	Fixed car- bon	Ash	Sul- fur	Hydro- gen	Car- bon	Nitro- gen	Oxy- gen					
Meade River mine No. 2 bed 5 ft. 6 in. thick, now being mined.	1	1	14.4	33.5	47.3	4.8	0.6	5.5	60.6	1.4	27.1	6.8	10330	2290	5.5	Sanford
		2	-	39.1	55.3	5.6	.7	4.6	70.8	1.6	16.7	-	12070			
		3	-	41.4	58.6	-	.7	4.9	74.9	1.7	17.8	-	12780			
Meade River, 1 1/2 mile north of mine at lat. 70° 45' N. long. 157° 25' W.	2	1	16.3	33.8	47.0	2.9	.6	5.7	61.4	1.5	27.9	5.6	10470	2130	?	Do.
		2	-	40.3	56.2	3.5	.7	4.7	73.3	1.8	16.0	-	12510			
		3	-	41.8	58.2	-	.7	4.9	76.0	1.8	16.6	-	12960			
Peard Bay, bed No. 1, outcropping 1,000 ft. along east bank	3	1	17.8	31.9	40.5	9.8	.3	5.4	52.0	1.1	31.4	9.9	8780	2570	5.5	Do.
		2	-	38.9	49.1	12.0	.4	4.2	63.2	1.3	18.9	-	10680			
		3	-	44.1	55.9	-	.4	4.7	71.9	1.5	21.5	-	12140			
Kuk River, bottom bed, outcropping for half a mile along east bank.	4	1	19.3	32.0	45.7	3.0	.3	5.7	57.0	1.2	32.8	10.6	9570	2190	6.0	Do.
		2	-	39.6	56.7	3.7	.4	4.5	70.6	1.5	19.3	-	11850			
		3	-	41.1	58.9	-	.4	4.6	73.3	1.6	20.1	-	12310			
Kuk River, top bed, outcropping for 1 mile along east bank	5	1	18.9	34.1	43.4	3.6	.4	5.8	58.1	1.1	31.0	10.5	9850	2590	5.5	Do.
		2	-	42.0	53.6	4.4	.5	4.5	71.6	1.4	17.6	-	12140			
		3	-	44.0	56.0	-	.5	4.7	74.9	1.5	18.4	-	12700			

See footnotes on page 15.

TABLE 5. - Analysis of coal from Meado River, Peard Bay, and Kuk River beds^{1/} (Cont'd)

Location of sample	Sample No.	Proximate percent					Ultimate, percent					Air dry loss, per cent	B.t.u.	Ash-softening temp., °F.	Thick-ness, feet	Sampled by -
		Condi- tion ^{2/}	Mois- ture	Vola- tile matter	Fixed car- bon	Ash	Sul- fur	Hydro- gen	Car- bon	Nitro- gen	Oxy- gen					
Peard Bay, Kugura River, from top 2 1/2 feet of bed, Eskimo minc.	6	1	20.2	32.6	41.0	6.2	0.5	5.7	55.8	1.2	32.5	12.0	9140	2570	2.5	Pierce
		2	-	40.9	51.4	7.7	.7	5.4	67.5	1.4	17.3	-	11460			
		3	-	44.3	55.7	-	.7	5.9	73.2	1.6	18.6	-	12410			
Wainwright, coal washed up on beach after each storm 2 miles south of village	7	1	18.8	32.5	44.9	3.8	.5	5.9	58.1	1.1	30.6	9.2	10000	2000	?	Sandord
		2	-	40.0	55.3	4.7	.6	4.7	71.6	1.4	17.0	-	12320			
		3	-	42.0	58.0	-	.6	5.0	75.1	1.5	17.8	-	12920			
Peard Bay, Bed No. 1	8	1	24.5	29.7	39.8	6.0	.3					13.1	8430	2310	5.5	Pierce and Ebbley
		2	-	39.4	52.6	8.0	.4					-	11170			
		3	-	42.8	57.2	-	.5					-	12150			
Peard Bay, Bed No. 2, 5 ft. thick	9	1	22.9	30.0	41.6	5.5	.3					13.2	9220	2280	5.0	Do.
		2	-	38.9	54.0	7.1	.4					-	11960			
		3	-	41.9	58.1	-	.4					-	12870			
Peard Bay, Bed No. 3, 6 ft. 0 in. thick	10	1	22.1	31.9	42.6	3.4	.5					12.4	9440	2290	6.0	Do.
		2	-	41.0	54.7	4.3	.6					-	12120			
		3	-	42.8	57.2	-	.6					-	12660			

^{1/} Analysis by Bureau of Mines, Pittsburgh, Pa.

^{2/} 1, Sample as received; 2, moisture free; 3, moisture and ash free.

R.I. 3934

Sample 9 was in a prospect pit from bed 2.

Sample 10 was cut in a prospect pit from bed 3.

The analysis of the samples is shown in table 5.

RESERVES

Churn drilling, trenching, and shaft sinking by the Bureau of Mines reveal the existence of at least 68,000 short tons of measured coal in the area adjacent to the Meade River mine. These reserves are outlined by trench 1 and drill holes 7, 14, 13, and 3 (see fig. 3). This estimate is the amount of coal contained in the lower bed, which is 5 feet thick and which is now being mined by underground methods. The lack of evidence of severe faulting and folding makes it reasonable to assume that the deeper portions of this bed contain several times the tonnage of the measured coal. An overlying bed 2.8 feet thick is not included in the estimate, as the coal in this bed cannot be utilized without washing.

A total of 1,600 linear feet of coal beds is exposed along the bank of Peard Bay. These beds were prospected by three prospect pits and two trenches in the outcrop, indicating a strip of coal 100 feet wide along the outcrop. This strip is estimated to contain 32,000 short tons of coal.

Along the bank of the Kugura River in the Peard Bay area 12,000 tons of subbituminous coal was indicated by a trench and a test pit, which were sunk on a coal-bed outcrop 6 feet thick and 450 feet long. This bed is 9 feet above water level and is covered by frozen clay and slabby sandstone 3 to 10 feet thick. The beds appear to be nearly flat and may extend into the bank for several hundred feet.

EQUIPMENT

The mining operation at Meade River has been handicapped by many difficulties caused by the war. Tractors were needed to transport coal from the mine to Barrow, but only second-hand equipment could be obtained. Three used tractors of different models were purchased, which made it necessary to carry three sets of replacement parts.

It was impossible to purchase heavy-duty freight sleighs in 1943 for hauling coal; so "go-devils" were built at Nome and shipped to Barrow. These, however, did not prove to be satisfactory.

A partial inventory of mining equipment purchased by the Alaska Native Service is as follows:

- 1 RD6 caterpillar tractor (badly worn)
- 1 D-7 caterpillar tractor (fair condition)
- 4 "Go-devils" or home-made sleds
- 1 Cabin, 5 by 12 feet, mounted on bobsled

- 1 Cabin, 8 by 14 feet, mounted on bobsled
- 1 Arc welder (new)
- 1 Acetylene generator with torch and fittings
- 1 Pumping unit, 4,400 Diesel caterpillar with 8- by 10-inch Delaval pump.
- 300 feet of hydraulic pipe
- 1 Hydraulic giant with nozzle
- 1 4-inch churn drill with tools, light airplane type
- 3 Lengths of 4-inch drill casing

In addition, one RD-7 caterpillar tractor and four No. 6 heavy-duty sleighs were purchased in 1944 but were not received, as the boat did not stay at Barrow long enough to discharge all of its cargo. It returned south and unloaded at Nome. During the winter of 1944-45, two of these sleighs were flown to Barrow.

CONCLUSIONS

A simple geologic structure, with no evidence of severe faulting, together with widespread coal outcrops, indicate that large areas in northern Alaska are underlain, at no great depth, by beds of subbituminous coal.

Sufficient coal to supply local needs for many years was developed at Meade River. Indications are that additional work at Peard Bay and along the Kugara and Kuk Rivers will develop a larger tonnage than was found at the Meade River mine.

The Peard Bay occurrences are more favorably located than the present workings on Meade River, because Peard Bay is accessible during the summer months by small boats, whereas the present mine is entirely dependent upon air transportation. A mining operation here could also dispose of a limited amount of coal in Wainwright, which is only 20 airline miles from Peard Bay.

Prospecting during the fall and winter of 1944 was limited to areas that appeared favorable for strip mining, so that the mine equipment on hand could be used. One small area along the Kugara River and a larger area along the Kuk River were located where hydraulic stripping and open-pit mining could be undertaken.

The use of coal from the Meade River mine as fuel for heating government buildings at Barrow and Wainwright will effect a substantial saving. Furthermore, when the mine has been brought to capacity production, the coal can be sold to the Eskimos at a price they can afford to pay.