UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

BUREAU OF MINES
R. R. Sayers, Director

War Minerals Report 258

OIL SEEPAGES OF THE ALASKA ARCTIC SLOPE

Petroleum

WASHINGTON: 1944

The War Minerals Reports of the Bureau of Mines are issued by the United States Department of the Interior to give official expression to the conclusions reached on various investigations relating to domestic minerals. These reports are based upon the field work of the Bureau of Mines and upon data made available to the Department from other sources. The primary purpose of these reports is to provide essential information to the war agencies of the United States Government and to assist owners and operators of mining properties in the production of minerals vital to the prosecution of the war.

WAR MINERALS REPORT
UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

W.M.R. 258 — Petroleum October 1944

OIL SEEPAGES OF THE ALASKA ARCTIC SLOPE

INTRODUCTION

Seepages of oil near Cape Simpson, on the Arctic coast of Alaska about 60 miles southeast of Point Barrow, have been reported for many years. In 1923, an area of 35,000 square miles in this region was designated as Naval Petroleum Reserve No. 4. For several years thereafter, field parties of the Geological Survey operated in the Arctic-slope region with the primary purpose of investigating its oil resources. These parties found no additional seeps other than those already known at Cape Simpson, although they located favorable structures and discovered oil shales that might be sources of oil seeps.[1]

In 1943, the possibility was widely recognized that Alaska might become an important base for transpolar air flights. Development of the Fort Norman oil district in northern Canada was actually proceeding. Rapid depletion of oil reserves of the United States revived speculation concerning oil in Alaska, when additional seeps were said to have been discovered. A large additional area of the public domain, extending east from Naval Reserve No. 4 to the Canadian boundary, was accordingly withdrawn from location.

The Bureau of Mines, anticipating the need for additional evidence of the existence of petroleum in the Arctic coastal region, and in response to inquiries by officers of the Alaska Defense Command and officials of the Territory of Alaska, sent an engineer[2] in charge of a field party into the area late in the summer of 1943 to investigate the numerous, persistent rumors of oil seepages other than those at Cape Simpson. The primary purpose was to locate the seeps definitely, if they existed, and to obtain samples of oil from them for testing.

Using a float-type plane, the Bureau's field party spent more than 3 weeks on the Arctic slope investigating the rumors, most of which proved to be well-founded and led to the discovery of actual petroleum-seepage areas.

1 Smith, P. S., and Mertie, J. B., Geology and Mineral Resources of Northwestern Alaska: Geol. Survey Bull. 815, 1930, 351 pp.

2 Norman Ebbley, Jr. His party included Sigurd Wien, of the Wien Alaska Air Lines, pilot of the plane; Capt. Henry F. Thomas, U. S. Army Engineers; Dr. Henry R. Joesting, of the Alaska Bureau of Mines; and Simon Paneak, an Eskimo from Chandler Lake, who had intimate knowledge of the area to be traversed. The party left Fairbanks August 22, 1943.

Petroleum indications were visited throughout an area about 325 miles in length along the arctic coast, and extending inward from the coast for about 100 miles. Six separate localities containing evidences of petroleum were examined, and samples were collected from 12 separate seepages in these areas.

The samples were shipped to the Bartlesville petroleum experiment station of the Bureau, where they were analyzed and their nature was confirmed. The samples ranged in character from actual oil to asphaltic residue that is being used by Eskimos as a fuel. The A.P.I. gravities of these samples indicated that the oil had been severely "weathered," and all the lighter oil materials, such as gasoline and kerosene, had evaporated. Two of the samples collected were weathered naphthalene-base oils; three had A.P.I. gravities of less than 10, indicating that they were definitely "asphaltic;" and the remaining samples had A.P.I. gravities ranging from 10 to 19 and probably would be classed as "semiasphaltic."

In May 1944, the Navy sent a party of engineers and geologists to the Arctic-coast area reported upon by the Bureau of Mines to map and study the seeps and to plan for petroleum exploration by drilling.

THE ARCTIC SLOPE

The Arctic slope may be regarded as subdivided into three provinces extending east and west, parallel to the Arctic coast on the north and the Brooks range of mountains on the south. The most northerly of these provinces is the coastal plain, which extends south to about the 70th parallel. This is succeeded by a plateau province lying between the coastal plain and the mountainous highland province of the Brooks Range, which separates the Arctic slope from central Alaska. Its greatest width is 150 miles, and the altitude of its peaks averages about 6,000 to 7,000 feet. Several low passes permit fairly easy passage through the Range. From its base at an elevation of about 3,500 feet, the plateau descends gradually to the gentle slope of the coastal province.

The climate of the Arctic slope is severe. From December to March, the average temperature is about 15 to 20 degrees below zero, but minus 50° F. is not uncommon. From August to September, the usual range is between 20 and 40 degrees. Precipitation in the area is low, seldom averaging more than 5 or 6 inches a year. Along the coast, the snowfall is light, but in the mountains snow accumulates to a depth of 3 or 4 feet during the winter.

Incessant winds sweep the area. The yearly average velocity has been as high as 14 miles an hour. Hourly averages during heavy blows attain 60 to 70 miles. Frequent fogs, especially along the coastal plain, contribute to the heavy icing of airplanes, which makes even local flying hazardous.

Large areas are covered by marshy tundra. There are many large lakes and numerous northerly flowing streams that segment the coastal plain.

Driftwood is usually available along the coast, but inland from the coast for a distance of 30 to 50 miles there is no fuel whatever, except a few dwarf willows about a foot high and a little yellow moss. In the plateau country, however, willows as much as 15 feet high may be found along the banks of streams. There is little game in the coastal area, but in the plateau country caribou are fairly common and there are a few moose. Mountain sheep are plentiful in parts of the highlands.

The population of the Arctic slope includes only a few hundred Eskimos and halfbreeds in an area of about 100,000 square miles extending from Point Barrow to the Canadian boundary.

TRAVEL CONDITIONS

Transportation by dogteam, snowmobile, or tractor is feasible from November to early June. East-west foot travel is made slow and tedious by the rivers, lakes, and marshy tundra. Small boats may travel along the coast during August and September, when the ice pack is away from the shore. Air travel has proved the most practical means of transportation. Flying conditions are best from March to June, inclusive. Aviation gasoline and oil are available at Barrow, but caches containing them must be established in other areas where flying is to be done.

EXAMINATION OF THE OIL SEEPS

The Bureau of Mines party, by traveling light and using a floatplane for all but local foot travel, was able to investigate all the petroleum seepages of which there were current rumors in a little more than three weeks. Although this reconnaissance trip required but a relatively short time, it was necessary to fly more than 8,000 miles to complete the work.

An oil seepage is merely an indication petroleum probably is somewhere in the near vicinity. These seepages make their appearance when there is a natural escape of petroleum to the surface, either directly from an outcrop of oil-bearing sand or through a fault that acts as a channel from oil source rock underground. When the oil reaches the surface, it either flows away with the water in normal drainage or evaporates. Consequently, seep material usually has little resemblance to the oil in the formation from which it comes.

All the seepages visited by the Bureau of Mines reconnaissance party were sampled. The A.P.I. gravities of these samples indicated that the oil had been severely "weathered" and all the lighter oil materials, such as gasoline and kerosene, had evaporated. Two of the samples collected were weathered naphthalene-base oils; three had A.P.I. gravities of less than 10, indicating that they were definitely "asphaltic;" and the remaining samples had A.P.I. gravities ranging from 10 up to 19 and probably would be classed as "semiasphaltic."

Following is a brief description of the areas visited by the reconnaissance party where petroleum seepages were found:

Umiat Mountain Area

This area is on the north side of the Colville River, approximately 15 miles west of the confluence of the Anaktuvuk and Colville Rivers.

One seepage was in a small lake about a mile west of Umiat Mountain and about 100 yards from the north bank of the Colville River. On the north side of this lake, which was about 200 yards across, a slow but steady seep of oil appeared, together with bubbles of gas. A sample of the oil was obtained by digging a pot hole on the north bank of the lake, stirring the moss and vegetable matter in the hole, and skimming off the oil that collected on top of the water. This oil had the appearance of a light distillate. The sample was tested by the Bartlesville laboratory of the Bureau with the following results.

Specific gravity at 60/60 - 0.884 - 28.6 degrees API.

Distillation (Engler):

	°F.
First drop	275
10 percent	437
20 percent	495
30 percent	529
40 percent	563

Distillation discontinued at 580° F.
Total amount distilled, 46 percent.

REMARKS: The above figures indicate that there are no low-boiling fractions (gasoline) in this sample. The distillation figures taken together with the gravity indicate that this would be an asphaltic or naphthenic petroleum. The sample, however, was too small to allow a complete distillation analysis.

A second oil indication was in the form of oil-bound sand and gravel on the river bank south of the lake. This oil was of high gravity and apparently similar to that in the lake nearby. The report on the sample was:

Hydrocarbon material extracted, percent - 0.16.
Specific gravity at 60/60 - 0.976 - 13.5° API.
Extracted material: Black, semifluid residue.

A third seepage was found in a lake about a mile west of the first seepage. Here a light oil and gas were rising from the lake bed, but there were no residues along the shore.

A film of oil also appeared at intervals in the Colville River near the west end of Umiat Mountain.

The oil seep near the Colville River had been reported previously. This seep was supposed to flow 4 to 5 barrels in 24 hours. This reported seep has now been identified as the Umiat Mountain seep, and the reconnaissance party's guide, a native named Simon Paneak, stated that several years ago the oil-saturated gravel on the bank of the river was actually flowing a small trickle of oil into the river, and that at that time he collected a 1-gallon sample which he took to the Arctic coast, where a trader at Beechey Point actually burned the sample in a lamp.

Fish River Seep

This area, about 25 miles southwest of the mouth of the Colville River, is 4 miles N. 60° W. of the confluence of Ovolotuk Creek and Fish River. The pitch seep is about 6 feet wide and 20 feet long, and the pool is a solid, tarlike mass having no thin oil on the surface. The gummy residue in the deposit has trapped a number of birds and small rodents. Report on sample:

Hydrocarbon material extracted, percent - 51.2.
Specific gravity at 60/60 - 0.986 - 12.0° API.
Extracted material: Black, viscous, asphaltic material.

Dease Inlet Seep

This seep is about 1-1/4 miles east of Doonakavik Cove, on the east side of Dease Inlet. Doonakavik is about 4-1/2 miles northeast of Thomas Brower's warehouse, which is on Dease Inlet near the mouth of the Chipp River. The deposit consists of a heavy petroleum residue coming from a low mound. The petroleum residue was also found beneath the moss in several places around the mound. Most of the material had apparently been long exposed to the air and was almost hard enough to walk on with the air temperature at 35°F. Several hundred sacks of pitch have been mined from a pit for fuel by the natives in the area. There was some fresher material of lower viscosity near the center of the seep. Report on sample:

Hydrocarbon material extracted, percent - 67.39.
Specific gravity at 60/60 - 0.967 - 14.8° API.
Extracted material: Black, asphaltic mass.

About 200 yards east of the deposit, pitch-soaked moss and silt were found along a low bench for a distance of 300 feet. Pitch was also found under the moss at several places on the bench. Report on sample:

Hydrocarbon material extracted, percent - 34.25.
Specific gravity at 60/60 - 0.989 - 11.6° API.
Extracted material: Solid, black, asphaltic material.

Cape Simpson Area

Three seeps near Cape Simpson were visited. The seepages in this area emerged from rather prominent mounds, roughly alined north and south.

The first seep was 4 miles northwest of Cape Simpson and about 500 yards south of the Arctic Ocean shore. This seep was an actual surface flow

about 800 feet long and 200 feet wide. It had been exposed over most of its extent by the natives of Barrow, who mined it for pitch. Several smaller pools not connected with the main pitch flow showed that the pitch apparently underlay the tundra over an area approximately 1,200 by 800 feet. As a rule, removal of the surface vegetation or tundra in this area allows the underlying pitch to ooze to the surface. Reports on two samples:

Hydrocarbon material extracted, percent - 45.88.
Specific gravity at 60/60 - 0.965 - 15.1° API.
Extracted material: Black, viscous liquid.

Hydrocarbon material extracted, percent - 48.72.
Specific gravity at 60/60 - 0.949 - 17.6° API.
Extracted material: Medium viscous, black oil.

The second Cape Simpson seep was approximately 3-1/2 miles south of the first and flowed out of a round knoll for a distance of 600 feet, where it ran into a small lake. The actual surface flow was about 150 feet wide. This seep also had been mined by the natives. Numerous small pitch pools showed the petroleum residue underlying the tundra in an area about 700 by 500 feet. Reports on two samples:

From hard pitch:

Hydrocarbon material extracted, percent - 37.02.
Specific gravity at 60/60 - 0.941 - 18.9° API.
Extracted material: Black, viscous material with cokey deposit.

From flowing oil:

Specific gravity at 60/60 - 0.937 - 19.5° API.

Distillation (Engler):

	°F.
First drop	492
10 percent	581
20 percent	629
30 percent	641

Distillation discontinued at 641° F.
Total amount distilled, 30 percent.

REMARKS: The above figures indicate that there are no low-boiling fractions (gasoline) in this sample. The distillation figures taken together with the gravity indicate that this would be an asphaltic or naphthenic petroleum. The sample, however, was too small to allow a complete distillation analysis.

The third seep was approximately 3 miles south of the second and, although not as large as the first two, was of considerable size. The exposed surface flow was about 300 by 100 feet, and apparently the pitch underlay an

area about 800 by 1,000 feet. Pitch mining at this deposit had not been as extensive as at the first two, probably because of its distance from the coast. Report on sample:

Hydrocarbon material extracted, percent - 90.68.
Specific gravity at 60/60 - 0.975 - 13.6° API.
Extracted material: Black, fluid oil interspersed with particles of cokey material.

Arctic-slope Eskimos have been mining pitch from these seeps for a number of years, and at present approximately 3,000 sacks of 100 pounds each are being mined each summer. The material is sticky and difficult to handle, but it is burned successfully in the Point Barrow area.

The first two seeps mentioned above have been described in U. S. Geological Survey Bulletin 815. Three other seeps are known to exist in the Cape Simpson area, but these were not visited by the Bureau of Mines reconnaissance party.

Barter Island Area

The oil seepages in the Barter Island area are on Manning Point, about 2 miles southeast of Barter Island. This point is on tide water, and during high tide it becomes an island about 1-1/2 miles in diameter. No actual pitch residue was noted here, but the northeast and northwest beaches of the point were lined with oil froth for a mile and a half. Oil-bound silt and sand and oil-soaked vegetable matter abound in the area. Oil skimmed from small streams of water trickling across the beach had the appearance of a light distillate, and the oil-bound silt and sand, when dried and heated on a stove, burned readily, giving off a strong odor of kerosene. Reports on four samples:

Hydrocarbon material extracted, percent - 0.12.
Specific gravity at 60/60 - 0.951 - 17.3° API.
Extracted material: Brownish-green oil, fairly fluid.

Hydrocarbon material extracted, percent - 0.49.
Specific gravity at 60/60 - 0.940 - 19.0° API.
Extracted material: Brownish-black oil, fairly fluid.

Hydrocarbon material extracted, percent - 1.30.
Specific gravity at 60/60 - 1.055 - 2.6° API.
Extracted material: Solid, black, asphaltic mass.

Hydrocarbon material extracted, percent - 8.33.
Specific gravity at 60/60 - 0.926 - 21.3° API.
Extracted material: Brownish-green, waxy oil.

Un-goon Point Area

"Un-goon" is an Eskimo term meaning pitch. Un-goon Point is 7 miles east of Humphrey Point and approximately 40 miles west of Demarcation Point. Three evidences of petroleum seepage were found in this area.

The largest of the seeps was a mile and a quarter south of the sod house on the Point. The pitch was hard and extremely difficult to dig. Some pitch had been mined here, and pitch appeared in several small holes where the tundra had been removed. The general area of the seepage was about 300 by 100 feet. Report on sample:

> Hydrocarbon material extracted, percent - 74.04.
> Specific gravity at 60/60 - 1.000 - 10.0° API.
> Extracted material: Black, viscous, asphaltic material.

Six hundred yards east and about 250 yards from the east beach, a small pitch pool had been excavated in the center of a small hummock. The material here was of about the same consistency as that at the larger exposure. Report on sample:

> Hydrocarbon material extracted, percent - 56.94.
> Specific gravity at 60/60 - 1.023 - 6.8° API.
> Extracted material: Solid, black, asphaltic mass.

On the east side of the Point and in line with the two seeps just mentioned, an exposure of oil-bearing sand 4 feet thick appears along the bank for about 30 feet. This deposit is about 1-1/2 miles along the beach southeast from Un-goon Point proper. Report on sample:

> Hydrocarbon material extracted, percent - 13.34.
> Specific gravity at 60/60 - 1.040 - 4.6° API.
> Extracted material: Extra heavy, black, asphaltic material.

White Mountain Area

A petroleum seepage is reported to occur about 5 or 10 miles north of the "White Mountains," between the east fork and the west fork of the Kupowruk River. Because of lack of time and a sufficiently exact knowledge of the location, search for this seep was unsuccessful. The party's Eskimo guide had not seen this seep himself but thought he could find it from a description given him years ago. The rumor of this seep is sufficiently persistent to make further investigation worth while, and, according to information collected later during the trip, the party apparently fell just short of reaching the seep.

Comment on the Samples

The following general comment is quoted from the laboratory report on the samples:

> The A.P.I. gravities of all of these seepage samples indicate that they have been very severely weathered. Furthermore, the material we received was in almost every case a mixture of mineral matter, decayed vegetable matter, and a comparatively small amount of what our chemists describe as "hydrocarbons," which in this case means petroleum residuum, that is, oil from which all the lighter materials such as gasoline and kerosene had been evaporated. Some of the samples also indicate that they have been very considerably oxidized. Thus in most of these cases all that can be done is to determine the amount of hydrocarbon material present and then measure its specific gravity. You will note that with five exceptions these hydrocarbons range from 10 up to 19 A.P.I. Three of the samples have A.P.I. gravities lower than 10; therefore, they are definitely "asphalts." Those ranging from 10 up to 19 more probably would be classed as "semi-asphalts."

CONCLUSION

The existence of additional oil seeps on the Arctic slope of Alaska has been confirmed, and the showings amply warrant exploration by drilling to ascertain whether an oil field exists there.

A report, of which this War Minerals Report is an abstract, was made to the Navy, which is now sending a party of engineers and geologists to map and study the seeps and plan for exploration by drilling. If an oil field is discovered, it is feasible to build a road and pipeline from the Cape Simpson area to Fairbanks through Anaktuvuk Pass. The distance is about 625 miles, about half the length of the recently installed line from Fort Norman, Canada, through Whitehorse to Fairbanks.

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DEC 4 1943

November 23, 1943
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AIRMAIL

Mr. Robert S. Sanford
Bureau of Mines
Box 2990
Juneau, Alaska

Dear Mr. Sanford:

This refers to my letter of November 15 concerning the work on the seepage samples and shale samples from Alaska. Enclosed herewith is the original of a report on the analyses of the seepage samples. A carbon copy of this report is going forward by regular mail and a carbon copy is also being sent to Mr. E. D. Gardner at Rolla.

In most cases, due to the small size of the sample and the character of the material, it was impossible to do much more than determine the amount of hydrocarbon material present and its specific gravity. In the case of two samples, numbers 1 and 10, which were already fluid oils that did not need to be extracted, we were able to make an incomplete distillation.

The retorting of the shales is well under way and should be finished within the next week.

Yours very truly,

N. A. C. SMITH
Supervising Engineer
Petroleum Experiment Station

cc: Mr. R. S. Sanford
Mr. E. D. Gardner

ANALYSES OF ALASKA SEEPAGE SAMPLES

Bartlesville Laboratory Sample No. 43053

Mark No. 1

IDENTIFICATION: "This sample was taken from a small pot-hole on the north side of Umiat Mountain Lake. The sample was obtained by stirring the moss and vegetable matter in this hole and then skimming off the oil which collected on top of the water. The oil has the appearance of a light distillate and has a distinct kerosene odor."

CHARACTERISTICS OF SAMPLE: Approximately 1 pint composed of about 50% oil and 50% water. The oil is green in color with a distinct kerosene odor.

ANALYSIS OF SAMPLE: The mixture was allowed to settle and the oil decanted for laboratory tests. The oil showed the following properties:

Specific gravity at 60/60 - 0.884 - 28.6° API

DISTILLATION (ENGLER):

First drop	275°F.
10%	437°
20%	495°
30%	529°
40%	563°

Distillation discontinued at 580°F.
Total amount distilled 46%.

REMARKS: The above figures indicate that there are no low boiling fractions (gasoline) in this sample. The distillation figures taken together with the gravity indicate that this would be an asphaltic or naphthenic petroleum. The sample, however, was too small to allow of a complete distillation analysis.

Mark No. 2

IDENTIFICATION: "Sample of oil-saturated gravel taken from a cut six feet deep to water level along the river bank. The location was directly north 300 feet from Umiat Mountain Lake. This oil seems to be of the same high gravity as that noted in the lake above."

Hydrocarbon material extracted, percent - 0.16
Specific gravity at 60/60 - 0.976 - 13.5° API
Extracted Material: black, semi-fluid residue

Mark No. 3

IDENTIFICATION: "'Pitch' sample taken from a small seep 4 miles N 60°W from the confluence of Ovolotuk Creek and Fish River. The general location is about 25 miles southwest of the mouth of the Colville River. The pitch pool is a solid, tarry material having no apparent thin oil on the surface."

Hydrocarbon material extracted, percent - 51.2
Specific gravity at 60/60 - 0.986 - 12.0° API
Extracted Material: black, viscous, asphaltic material

Mark No. 4

IDENTIFICATION: "This sample consists of a heavy petroleum residue which extrudes from a low mound about 4½ miles northeast of Thomas Brower's warehouse which is on Dease Inlet near the mouth of the Chipp River. This residue had apparently been long exposed to the air and was almost hard enough to walk on at an air temperature of 35°F. A fresher material of lower viscosity appeared nearer the center of the seep."

Hydrocarbon material extracted, percent - 67.39
Specific gravity at 60/60 - 0.967 - 14.8° API
Extracted Material: black, asphaltic mass

Mark No. 5

IDENTIFICATION: "This sample was taken from a pitch-soaked moss and silt found along the edge of a low bench about 200 yards east from the location of the pitch pools where Sample No. 4 was collected. Sample No. 5 consists of the higher grade pitch-impregnated moss found along the edge of the bench."

Hydrocarbon material extracted, percent - 34.25
Specific gravity at 60/60 - 0.989 - 11.6° API
Extracted Material: solid, black asphaltic material

Mark No. 6

IDENTIFICATION: "This sample was collected from Seep No. 3 in the Cape Simpson area. The sample consists of the hard pitch material which is being mined for fuel by the natives."

Hydrocarbon material extracted, percent - 90.68
Specific gravity at 60/60 - 0.975 - 13.6° API
Extracted Material: black, fluid oil interspersed with particles of cokey material

Mark No. 7

IDENTIFICATION: "This sample consists of both the hard-pitch material and the fresher flow directly underlying the hard surface. This material is being mined by the natives for fuel. Sample No. 7 has been taken from Seep No. 1."

Hydrocarbon material extracted, percent - 43.88
Specific gravity at 60/60 - 0.965 - 15.1° API
Extracted Material: black viscous liquid

Mark No. 8

IDENTIFICATION: "Also collected from Seep No. 1 in Cape Simpson area, this sample represents a thinner oil which appeared near the top of the knoll. The oil had a greenish color and actually was flowing down the slight slope at a temperature of 33°F.

Hydrocarbon material extracted, percent - 48.72
Specific gravity at 60/60 - 0.949 - 17.6° API
Extracted Material: medium viscous black oil

Mark No. 9

IDENTIFICATION: "This sample was taken from the hard pitch material exposed in Seep No. 2 of the Cape Simpson area. This material is being mined for fuel by the natives."

Hydrocarbon material extracted, percent - 37.02
Specific gravity at 60/60 - 0.941 - 18.9° API
Extracted Material: black viscous material, with cokey deposit

Mark No. 10

IDENTIFICATION: "This is a sample of greenish-colored, thin oil which is flowing on the surface near the head of the knoll at Seep No. 2."

CHARACTERISTICS OF SAMPLE: Approximately 1 pint of heavy oil, brownish-green in color. Sample contained considerable B.S. & W.

ANALYSIS OF SAMPLE: The mixture was centrifuged before distilling to separate the oil from the water and settlings.

Specific gravity at 60/60 - 0.937 - 19.5° API

DISTILLATION (ENGLER):

First drop	492°F.
10%	581°
20%	629°
30%	641°

Distillation discontinued at 641°F.
Total amount distilled 30%

REMARKS: The above figures indicate that there are no low boiling fractions (gasoline) in this sample. The distillation figures taken together with the gravity indicate that this would be an asphaltic or naphthenic petroleum. The sample, however, was too small to allow of a complete distillation analysis.

Mark No. 11

IDENTIFICATION: "A sample of oil-bound silt found in layers along the northwest beach at Manning Point in the Barter Island area. Digging into this oil-bound silt exposed unconsolidated oil-soaked silt underlying the surface."

Hydrocarbon material extracted, percent - 0.12
Specific gravity at 60/60 - 0.951 - 17.3°API
Extracted Material: brownish-green oil, fairly fluid

Mark No. 12

IDENTIFICATION: "Sample collected by skimming off the surface of several small streams of water which were flowing from the bank to the ocean in the above area."

Hydrocarbon material extracted, percent - 0.49
Specific gravity at 60/60 - 0.940 - 19.0° API
Extracted Material: brownish-black oil, fairly fluid

Mark No. 13

IDENTIFICATION: "Collected from several exposures of an unconsolidated oil-soaked, brownish-red sand which appears in several places along the bank in the above area."

Hydrocarbon material extracted, percent - 1.30
Specific gravity at 60/60 - 1.055 - 2.6° API
Extracted Material: solid, black asphaltic mass

Mark No. 14

IDENTIFICATION: "Oil-soaked vegetable debris found along the bank throughout the entire mile and a half distance covered by the north beach. The oil from the above four samples has the appearance of a light distillate and the oil-bound silt and sand when dried or heated on a stove, burns readily and gives off a strong odor of kerosene."

Hydrocarbon material extracted, percent - 8.33
Specific gravity at 60/60 - 0.926 - 21.3° API
Extracted Material: brownish-green, waxy oil

Mark No. 15

IDENTIFICATION: "Collected from several pitch pools located 1½ miles south of Un-Goon Point which is located 7 miles east of Humphrey Point on the Arctic Ocean. The pitch is a hard, black material and is extremely difficult to dig. A small amount of mining has been carried out and the pitch has made its appearance in several small holes where the tundra has been removed."

Hydrocarbon material extracted, percent - 74.04
Specific gravity at 60/60 - 1.000 - 10.0° API
Extracted Material: black viscous asphaltic material

Mark No. 16

IDENTIFICATION: "The material appears identical to that from which Sample No. 15 was taken and is located approximately 600 yards east. A small pitch pool has been excavated in the center of a small hummock."

Hydrocarbon material extracted, percent - 56.94
Specific gravity at 60/60 - 1.023 - 6.8° API
Extracted Material: solid, black, asphaltic mass

Mark No. 17

IDENTIFICATION: "This sample was collected from an oil-bound sand which somewhat resists the erosive effects of wave action along the beach 250 yards east from the location where Sample No. 16 was obtained. This oil-bound sand is exposed for 30 feet along the bank and appears to be at least four feet think. This location is one and one-half miles along the beach from Un-Goon Point proper."

Hydrocarbon material extracted, percent - 13.34
Specific gravity at 60/60 - 1.040 - 4.6° API
Extracted Material: extra heavy, black asphaltic material

Mark No. E5

IDENTIFICATION: "Sample from Point Barrow, Alaska, shipped from Fairbanks to Anchorage 6-5-43. Received at Anchorage 6-21-43. Packed in Gold Shield Coffee can."

Hydrocarbon material extracted, percent - 70.76
Specific gravity at 60/60 - 0.950 - 17.5° API
Extracted Material: black heavy semi-fluid mass

Mark No. E6

IDENTIFICATION: "Sample from Point Barrow, Alaska. Shipped from Fairbanks to Anchorage 6-5-43. Received at Anchorage 6-21-43. Packed in KLIM can."

Hydrocarbon material extracted, percent - 69.86
Specific gravity at 60/60 - 0.955 - 16.7° API
Extracted Material: black, heavy material, very viscous

NOTES ON NORTHERN ALASKA

Supplementing

REPORT OF INVESTIGATION OF PETROLEUM SEEPAGES,

ARCTIC SLOPE AREA, ALASKA, OCTOBER, 1943

by

Henry R. Joesting,
Associate Mining Engineer
Territorial Department of Mines
November 15, 1943

NOTES ON NORTHERN ALASKA

supplementing

REPORT OF INVESTIGATION OF PETROLEUM SEEPAGES,

ARCTIC SLOPE AREA, ALASKA. OCTOBER, 1943

Introduction

During the oil reconnaissance trip in northern Alaska, made by a U. S. Bureau of Mines field party between August 22 and September 14, 1943, information was obtained on a variety of subjects which could not conveniently be included in the formal report. Some of this information, together with inferences drawn from it, is submitted here because it may be of use to subsequent field parties.

Vegetation

In general, the Arctic Plateau and Coastal Plain are similar in appearance and support the same types of vegetation as the treeless parts of the lower Yukon and Seward Peninsula regions. Most of the surface is covered by a rather dense growth of grasses, sedges, mosses and flowering plants. Flowering plants are abundant, both in amount and variety, and include most of the species found above timber in interior Alaska. During June and July much of the tundra is evidently covered by flowers, but by late August the flowering season had passed and large, white patches of Alaska cotton afforded the only relief from the dull greens and browns of the surface cover.

Clumps of bunchgrass forming "niggerheads" are found in parts of both the plateau and coastal plain, but they are neither as large nor as common as in interior Alaska. Thus, except in the swampy parts of the coastal plain, footing is generally good.

Willows and alders, some of them 15 feet high, are plentiful in the Colville River valley within about 30 miles of the coast. They are said to be absent farther downstream, although it is likely that stunted willows grow nearly to the coast. Similar conditions are said to prevail in other large valleys. In general the willows are relatively large in the mountain and plateau regions and become progressively smaller to the north. Dwarf willows a few inches high grow on the tundra close to the coast, but they are too small to be of much use for firewood.

Most of the dry willows suitable for firewood were found as driftwood on the river banks and bars, where they were left by ice and high water. We used green willows and alders on several occasions when dry wood was scarce. Contrary to experience in interior Alaska, green willows burned somewhat better than green alders.

When dry firewood is unavailable, the small, evergreen shrub, Cassiope tetragona, may be used. This shrub, called "Piliararuk" by the Barrow Eskimos, is found both in Arctic Alaska and in interior Alaska above timber. Since it burns well when green, it is especially valuable on the tundra away from large valleys, where the willows grow only a few inches high. Ebbley and Simon Panea, one of our guides, used it when they spend several days hunting for the Fish River seep. Other shrubs related to C. tetragona are probably also flamable.

Dwarf birch or buckbursh grows in abundance on benches of the Colville River, just above the fringe of alders and willows. Labrador tea occurs widespread over the tundra. Leaves of the Labrador tea are occasionally used by the Eskimos for tea and apparently as a tonic.

The Eskimos make use of a considerable number of plants, although

they constitute only a small part of the total food consumed. As far as I could learn, they eat mainly meat, fish and birds, together with imported foods such as flour and sugar. Probably during hard times they eat larger proportion of plants, although the same ones do not seem to be eaten by all the natives, but when meat is plentiful a number of green plants are eaten, either fresh during the summer or preserved in oil during the winter. Several types of starchy roots are also used and some of the native families store them for the winter. Berries are apparently used to a greater extent than green or starchy plants. They are eaten fresh, sometimes after being annointed with seal oil or mixed with caribou or reindeer fat. According to Simon Panea, willow buds and catkins are sometimes eaten in the spring when they are tender and tasteful. Dandelions and several varieties of saxafrage, wild rhubarb (Kwarag) and many other edible green plants that also grow in interior Alaska are gathered and eaten by the Eskimos.

One of the more important food plants is called "massu", "mashu" or "muchu", according to the locality. It supplies a large root up to several feet in length, which is eaten either raw, boiled or baked. I was unable to identify the massu with certainty because I saw only a part of a single root that had been carried down a cut bank by a mud slide. I ate about a foot (1/2 pound) of this root, after cleaning off the mud; and found it to be fairly tender, slightly sweet and altogether palatable. It apparently contains considerable starch and some sugar.

The use of "massu" by the Eskimos is noted on page 81 of U. S. Geological Survey Bull. 815, where it is identified as either Polygonum bistorta, P. vivinarum, or P. fugax. This identification was apparently

based on a description of the plant rather than on specimens, and I do not believe it is correct. Several polygonum species are used by the natives, but the roots are bulbous and small rather than long and fleshy. The "massu" cannot be finally identified without a specimen, but it is probably a hedysarum - either H. boreale or H. mackenzii, or a similar species.

Most of the berries found above timber line in interior Alaska grow on the Arctic slope. Blueberries are abundant in the plateau region and the low-bush or mountain cranberry grows on the tundra clear up to the coast. The cloudberry (Rubus chamaemorus), called salmonberry by the Eskimos, is also widely distributed and greatly relished. The bearberry (Arctostaphylos alpina)and the crowberry (Empetrum nigrum) grow in a number of places and are used to some extent.

On page 80 of U.S.Geological Survey Bull. 615, the belief is stated that blueberries require two seasons to mature; that the bushes flower and produce green berries one summer and ripe berries early in the following summer. This would be interesting if true, but according to my observations, supported by statements of several natives, Arctic slope blueberries ripen in a single season, just as do normal blueberries elsewhere. Along the Colville River they had ripened by mid-August and by late August they were somewhat past their prime. I saw no immature berries in the late summer. It is not unlikely that the observers quoted in Bull. 615 found berries that had ripened the preceding summer and remained on the bushes over winter, a not uncommon occurrence in other regions.

Mushrooms are widely distributed, but not abundant; however, their relative abundance may vary considerably from one summer to another. Various types of puffballs were probably the commonest observed. Other varieties were too old to be identified. I saw no Amanita muscaria, a poisonous mushroom that is common in interior Alaska.

Animals

Caribou were plentiful during the late summer along the middle course of the Colville and in much of the plateau region. In mid-September, on our return from Barrow, we flew over hundreds of small herds between the Colville River and Anaktuvuk Pass. Caribou were constantly in view; the total must have amount to many thousands. So far as I could learn, moose are found north of the Brooks Range only in the Colville River valley and near the head of the Mead River. We saw a number of them from the plane in the Colville River valley.

Wolf tracks were seen on most of the bars of the Colville River on which we landed. Wolves are doubtless numerous wherever caribou are plentiful. Brown and grizzly bears are apparently not numerous. Sig Wien flew over one near the Umiat Mountain seep on the Colville River and we saw several near the Anaktuvuk River.

Farther west reindeer are herded, both by Thomas Brower, whose range is along the Ikpikpuk and Chipp Rivers, and by the Office of Indian Affairs, whose range is closer to Barrow. Brower's herd is in good shape and large enough so that a considerable number of animals may be slaughtered each year. The Indian Affiars' herd, on the other

hand, is badly depleted because of improper herding and management, and at present no animals are being slaughtered. The Eskimos eat much of their caribou and reindeer meat raw and partly dried, at least during the summer. Raw meat is generally more tender than cooked meat, although it is less palatable to white people.

Ptarmigan are abundant almost everywhere in northern Alaska. By the middle of September they had started to band into very large flocks. Ducks, geese, brandt and other waterfowl were also plentiful, but probably much less so than earlier in the summer. Grayling evidently live in all clear streams. Whitefish are abundant along the coast and in lakes and rivers. They are an important item of food and are generally eaten frozen and raw. Raw, frozen whitefish, called "kwok", is tender, mild-flavored and nutritious. Because "kwok" is rich and oily it is especially prized by the Eskimos. Salmon are said to be found very rarely along the northern coast.

White fox are plentiful most years. As in other Arctic regions where seal and polar bear are found, the foxes spend much of the winter on the sea ice, living on the remains of seals killed by bears. Little trapping has been done in the region east of Barrow during the past several years.

Charlie Brower of Barrow told me that a new mammal was shot several years ago by an Eskimo somewhere east of Barrow. The Eskimo knew that Mr.Brower purchased rare specimens, so he laboriously prepared the skin and skeleton, with the expectation of getting at least fifty dollars for his discovery. When he brought it in, however, the new mammal proved to be a horse; possibly one that had strayed from a boundary survey party. It was of course a new animal to the Eskimo.

Bowhead whales, ugnuk (bearded seals) and walrus are hunted at Barrow but are said to be uncommon between Barrow and Herschel Island. The small Point Barrow seal is apparently plentiful all along the Arctic coast.

Indications are that at present game and fur-bearing animals in northern Alaska are increasing in number, because they are less hunted than formerly.

Natives

Northern Alaska is at present more sparsely populated than at any time in the historic past. As stated in an informal report by Norman Ebbley, Jr. to R. S. Sanford, there are now only about 130 natives between Barrow and Demarcation Point. Between 50 and 200 people formerly lived in the native village near Point Barrow, but this site has been abandoned for several years. A decrease is also reported in the number of people living more or less permanently along the coast east of Point Barrow and inland along the rivers.

According to accounts of earlier observers, there has been a decline in population since the first advent of the whites. Much of this decline is apparently the result of the introduction of new diseases against which the Eskimos had little immunity. In recent years, however, many of the natives have moved to Barrow from the Colville River region and other regions to the eastward, while others are said to have moved into Canada. One cause of this emigration was apparently poor hunting conditions several years ago. One result is that the native population of Barrow is considerably larger than can be supported by the resources of the surrounding region.

Barrow is well located for whaling and trading, and therefore would normally support a relatively large number of people. Many other Eskimos live there because they are employed in the various establishments of the Federal Government, and still others because they depend on imported food to a considerable extent. The presence of the hospital, school and church also make it convenient to live at Barrow, both for the natives and for the whites in charge of these establishments.

The hospital and school are undoubtedly beneficial, particularly since they help the Eskimos adjust themselves to the inevitable changes brought about by contact with white people. Considerable effort is made to prevent and control tuberculosis and other communicable diseases, but apparently with indifferent success because of the unfavorable living conditions of the natives and because of their disinclination to isolate themselves when sick. Venereal diseases, on the other hand, are now virtually nonexistent around Barrow and to the eastward, according to Dr. Edward Seinfeld, resident physician at the Barrow hospital. In view of this statment, the remark by Simon Panea that his wife had syphilis "plenty bad" for a number of years before she died and that he did not contract it because of his "strong blood", should be regarded with skepticism (see Ebbley informal report).

Most of the younger natives can read, write and speak English, while many of the older ones can read and write, but have not learned to speak English. Considerable progress is also made in teaching various manual arts, at which the Eskimo is naturally adept. Whalebone baskets are being made in increasing numbers and their quality is constantly improving. During the past year their price at Barrow

has doubled because of the increased demand.

Most of the natives at Barrow live in small, poorly constructed and insulated frame houses, instead of in sod igloos as formerly. Their frame houses are gnerally overcrowded and difficult to keep warm with the limited supply of fuel available, and these conditions are doubtless responsible for many of the respiratory infections that are prevalent. It must be pointed out, however, that housing conditions at Barrow are no worse than in other towns in Alaska where natives congregate.

For a number of years the wage rate at Barrow for native labor has been five dollars a day. After the war there may be a demand to adjust wages to conform to those in other parts of Alaska, because a number of Eskimos are now working on war jobs at high wages in other parts of Alaska. Many of the younger men have also entered military service.

Manning Point Oil Seeps

In addition to those listed on page 13 of the Ebbley-Joesting report, the Manning Point seeps near Barter Island were visited by Joe Alkire and George Kraebel, according to information obtained when Alkire was in Fairbanks in 1942. These men prospected in the Hulahula and Canning River regions in 1940 and 1941. Alkire formerly worked in the Independence mine at Willow Creek, and is said to be now living in Anchorage.

Geology and Oil Seeps in the Umiat Mountain Area

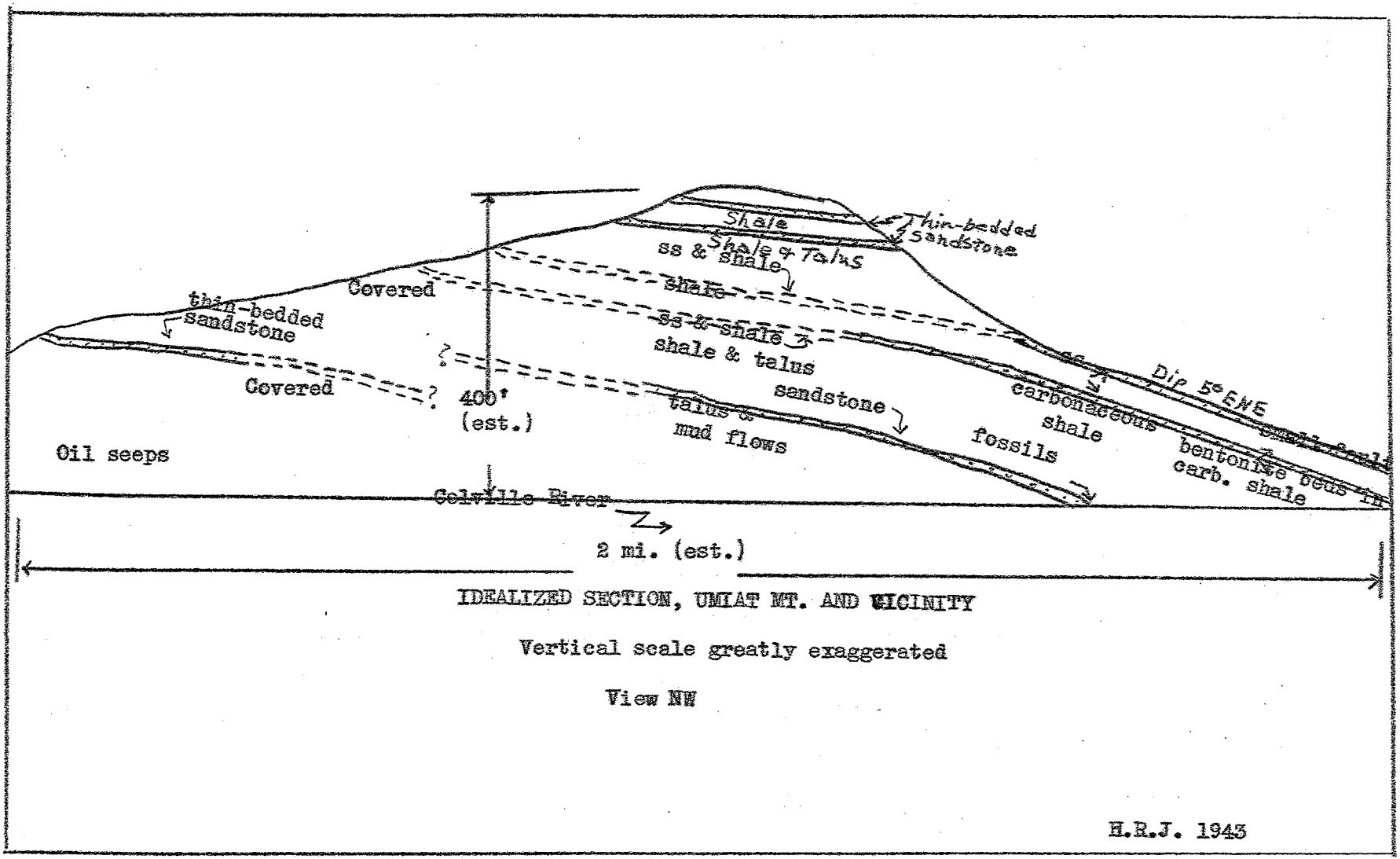
The Umiat Mountain seeps are the farthest south of all the seeps found in northern Alaska, and the only seeps near which consolidated rocks

are exposed. Shale and sandstone are exposed in cliffs that are more or less continuous for several miles along the north side of the Colville River. The seeps occur along the river bank and on a low bench at the foot of the cliffs. (Fig. 2 Ebbley-Joesting report).

The rocks in the Umiat Mountain area consist predominantly of dark shales, interbedded with minor amounts of light brown and gray sandstone. In general, the sandstone is more resistant to weathering and caps the steeper parts of the cliffs. The total thickness of section exposed is about 500 feet (see accompanying sketch).

Much of the shale is carbonaceous and in places it is interbedded with numerous coaly seams that are rarely over 1mm. thick. For the most part it is soft, but it also contains a few well indurated beds, as well as a number of spheroidal concretions measuring up to a foot along the bedding and six inches across the bedding. About two miles east of the seeps the carbonaceous shale in the cliff face is interbedded with numerous beds of nearly pure bentonite with a maximum thickness of 1-1/2 feet. Considerable alum and other salts have leached from the shale and deposits on the surface, and a few small, secondary veins of calcite have formed. Mud flows consisting of disintegrated shale occur wherever surface water has percolated into the shale along the cliff. Alternate freezing and thawing, combined with the clay-like nature of the shale, have made the mud unusually soft and fluid.

The sandstone members of the section reach a thickness of 20 to 30 feet and appear massive at a distance. Many of them, however, are interbedded with shale, and some of them grade into sandy shale



IDEALIZED SECTION, UMIAT MT. AND VICINITY

Vertical scale greatly exaggerated

View NW

H.R.J. 1943

along the bedding. The sandstone is moderately fine-grained and thin bedded. One piece of float with ripple marks was found, but these indications of near-shore deposition are not as common as in exposures 50 miles upstream. Numerous inoceramus fossils and casts were found in a sandstone bed in the lower part of the exposed section. Specimens of these fossils were collected and submitted for identification.

In the high cliffs east of the oil seeps the beds dip ENE at about 5 degrees, while still further east they are nearly flat. West of the high cliffs, near the seeps, the beds are also nearly flat. Thus the oil seeps are near the upper change of dip of a broad monoclinal fold.

A small thrust fault occurs near the east end of the cliff, about two miles from the oil seeps. This fault extends for only a short distance, however, and all of the displacement is in the soft shale. Several pieces of slickensided sandstone float were found in the cliff just north of the seeps, but no fault was exposed. Apparently none of the faults in this area are large or continuous, since no displacement was observable in any of the sandstone beds.

Most of the sandstone beds are sufficiently porous to serve as reservoir beds for oil. This was demonstrated by tests on a large piece of oil-saturated sandstone float, similar to the sandstone exposed in the cliffs, which was found on the beach upstream from the seeps. A half-pound piece of the float yielded about 5 cc. of oil with the appearance and viscosity of light lubricating oil. Since the rock was not found in place it is of course not certain that the oil was

not introduced from the seep while the rock lay on the beach.

Although no rocks are exposed in the immediate vicinity of the seeps, it is considered likely that the oil is escaping directly from oil-bearing beds which have been uncovered by erosion, rather than along faults from deeper lying beds. It is doubtful if there are any faults of sufficient continuity to provide channels for the escape of oil from underlying beds.

The rocks in the Umiat Mountain area lie in the northern part of the broad east-west belt of Upper Cretaceous rocks that extends across northern Alaska (Plate 2, U. S. Geological Survey Bull. 815). Since the general dip is north and since the dip gradually decreases to the north, the rocks in this area-and also the oil-bearing beds-must then lie in the upper part of the Upper Cretaceous series.

Cape Simpson Area

No rock exposures are found in the Cape Simpson area, consequently little can be determined from surface studies of the structure or stratigraphy of the formations with which the oil is associated. Information was obtained, however, on the relative thickness of the unconsolidated Quaternary and Tertiary formations that overlie the oil-bearing formations.

Several of the seeps issue from mounds which were apparently formed by oil escaping under considerable pressure. On the mounds were found a number of angular fragments of well indurated sandstone. Based on lithologic evidence, these fragments are from the upper Cretaceous, rather than from the poorly consolidated Tertiary series. They were apparently carried to the surface with the escaping oil,

and since it is unlikely that they could be so-carried from great depths, it is inferred that the upper Cretaceous rocks lie within a few hundred feet of the surface.

Stratigraphic Position and Depth of Oil-bearing Horizons

That oil-bearing horizons in northern Alaska occur in the upper part of the upper Cretaceous series and thus are at relatively shallow depths in the seepage areas is indicated both by the areal distribution of seeps and by geologic evidence in the Umiat Mountain area.

All of the known seeps are in the northern part of the region, where the upper part of the upper Cretaceous series is present. Conversely, no seeps have been found farther south where these rocks are absent, in spite of structural conditions that favor their occurrence. If oil were present in the lower part of the upper Cretaceous series, or in still older rocks, seeps should occur where these rocks are exposed.

The seeps near Umiat Mountain, which are the farthest south of any know, apparently issue directly from oil-bearing sandstone beds. These beds are above the middle part of the upper Cretaceous series and are probably in the upper quarter of the series.

The thickness of the upper Cretaceous series in northwest Alaska is estimated to be between 10,000 and 17,000 feet (U. S. Geological Survey Bull. 815, p. 218). East of the Colville River the series may decrease considerably in thickness. In the Canning River region upper Cretaceous rocks were not identified by Leffingwell (U. S. Geological Survey Prof. Paper 109), but it is probable that some of the rocks classified as Tertiary may eventually be correlated

with the upper Cretaceous.

If the upper Cretaceous rocks are 17,000 feet thick, the oil-bearing horizons exposed in the Umiat Mountain area should lie within 8,500 feet of the top of the series. Since the Tertiary and Quaternary deposits which overlie the upper Cretaceous on the coastal plain are probably not over a few hundred feet thick, the maximum depth to oil horizons in this region would not be over about 8,500 feet. The actual depth is probably considerably less than 8,500 feet.

Henry R. Joesting
Assoc. Mining Engineer
Territorial Dept. of Mines
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