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**OIL SEEPAGES ON THE**  
**ARCTIC COASTAL PLAIN, ALASKA**

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**INTRODUCTION**

North of the Brooks Range in Arctic Alaska and beyond a belt of rolling foot hills, an area of very low relief covers more than 35,000 square miles. Much of this lies within U. S. Naval Petroleum Reserve No. 4 and has been adequately described in current and available literature together with details of test drilling by the Navy (Reed, 1958).

On the Reserve and in the area adjacent to it to the east there is surface evidence of oil in numerous places. It is the purpose of this paper to bring together in one place all of the information I have been able to gather during several years work in that region. My information has come from many sources: (a) published records; (b) interviews with residents; (c) personal investigation. The area is so large that a map suitable for octavo publication would be inadequate to show necessary details. Therefore reference is made to the Geological Map of Alaska compiled by Dutro & Payne (1957) which is currently available. The small outline map herewith will show the general location.

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\* The work upon which this report is based was done under subcontract No. ONR-205 with the Arctic Institute of North America and the Office of Naval Research.

In preparing this record I have received help from too many people to warrant individual acknowledgment, but to all of them I must express my deep appreciation. The result would have been extremely fragmentary, however, had it not been for the assistance of Mr. James Dalton of Fairbanks, Alaska, Manager of Construction of DEW line during my stay at Point Barrow; Mr. Ted Matthews, also of Fairbanks and in charge of transportation during much of the drilling operations for the Navy, 1944-1953 and Director of the Arctic Research Laboratory, 1954; Dr. Ira L. Wiggins, Director of the same Laboratory during much of the drilling activity; Mr. Max Brewer, Director of the Laboratory during a part of my stay there; and Lieutenant Commander R. L. Reynolds, U. S. Navy Ice Patrol, 1957, who furnished some much needed transportation. And lastly it is with much pleasure that I can record the valuable assistance of Messrs. George Gryc, George Gates, Don Miller, W. W. Patton, Jr., Robert Detterman, and Irving Tailleur of the Alaska Branch, U.S. Geological Survey for critically reviewing the manuscript.

#### HISTORICAL

It is natural to assume that all of the presently known oil seepages were discovered by Eskimos long ago but since they left no written record, our information from them is limited to the recollections of living persons. Therefore the historical record will be presented first.

The first Europeans to reach Point Barrow were two members of the crew of the British ship *Blossom* in 1826. These were Thomas Elson and Ensign Smyth who had proceeded northward along the coast in a small boat after the ship had been blocked by ice near Franklin Point (Reed, p. 17). The stay at Barrow was short and no mention of the seepages or oil has been recorded.

The first explorers who traversed the Arctic Coast past any of the seepages were Sir John Franklin and party in the same year. He was attempting to round the northern part of the continent and perhaps meet the *Blossom*, but his small boats were blocked by ice at Return Point near the mouth of Kuparuk River. They passed and named Manning Point and Humphrey Point, near both of which surface evidence of oil has been reliably reported, but no mention of this appeared in the report of the expedition.

In order to complete the traverse of the north coast, the Hudson's Bay Company outfitted a party in 1837 under Thomas Simpson and Peter Warren Dease. With 12 crew men and two specially built sail boats they descended the Mackenzie River, travelled westward through shoals and broken ice to a point four miles west of Cape Simpson, named for George Simpson, Governor of the Company. Because of ice conditions, the boats were left there in charge of Dease, and Simpson with five companions started on foot for Point Barrow on August 1. On the way they picked up an umiak and reached Point Barrow

by this boat August 4, 1837. On August 6 they rejoined their companions and proceeded eastward over their previous route. Thus Dease with seven men camped for over a week within a few miles of the Cape Simpson seepages but no mention is made of them in the narrative (Dease and Simpson, 1838, pp. 213-225; Simpson, 1843, pp. 109-168).

Among the many early ships which visited the Arctic, especially those in search of the missing explorer Sir John Franklin, there was one which it seems, might have come across the Cape Simpson seepages. This was H.M.S. *Plover*. This vessel had winter quarters in Elson Lagoon near Point Barrow during 1852-1853 and 1853-1854. The surgeon, John Simpson, (1855) published an extensive account of the Eskimos and their country. From this it is obvious that he acquired a good working knowledge of their language, but if they ever mentioned "pitch" to him he made no record of it.

During 1881-1883 an International Polar Expedition under Lieut. P. H. Ray was stationed at Point Barrow and resulted in the gathering of a wealth of information about that part of the Arctic (Ray, 1885). The general report contains no information regarding the presence of oil or tar. However, one member of the party was the indefatigable naturalist, John Murdoch. In his report on the Ethnological results of the Point Barrow Expedition he said: "We also heard a story of a lake of tar or bitumen 'a'dngm,' said to be situated on an island a day's sail east of the point" (Murdoch, 1892, p. 61). This unquestionably refers to the Cape Simpson seepage.

On May 4, 1896, Ensign W. L. Howard of Lieut. Stoney's party was travelling down the upper part of the Etivluk River on a trip from the Noatak River to Point Barrow. When about 50 miles down stream from the point where the portage strikes the Etivluk, he..... "passed a hill about 500 feet elevation with outcroppings of coal. On the sides of this hill beyond the coal were also found large pieces of a substance called wood by the natives; it was hard, brittle, light brown in color, very light in weight and burned readily, giving out quantities of gas. This material was scattered about in all shapes, sizes, and quantities. The snow and ice made it impossible to climb and dig; a specimen was preserved" (Stoney, 1899, p. 814).

In referring to this occurrence, Brooks (1909, p. 62) quoted Dall who probably saw the sample collected because of additional information he gave. He stated that the material ".....recalled pitch in hardness and weight, but not brilliant nor disposed to melt with heat, but making a clean cut, like 'plug' tobacco, when whittled with a knife. This material was sufficiently inflammable to ignite and burn with a steady flame on applying a match to a corner of it, so that in their cold and weary journey it formed a most welcome substitute for wood or other fuel for the camp fire" (Dall, 1896, p. 818).

This locality is in the upper drainage of the Colville River and on the Aupuk anticline. It is in the same vicinity as a methane gas seepage discov-

ered in 1944 by Field Party No. 4 of the U. S. Geological Survey. This seepage was described as rapidly escaping gas in a small lake about one mile above the junction of Aupuk Creek and the Colville and near the river (Reed, 1958, p. 56). A more detailed description of this seepage was given by Gryc (1959, p. 92), and is summarized later in this report. The age of the shale is given as Upper Jurassic, Fortress Mountain formation (Patton, W.W., Personal communication, 1961); it outcrops extensively and is found secondarily in later sediments.

Leffingwell (1918, p. 178) apparently did not visit the Cape Simpson seepages but gave a brief report of their existence from information received from natives and others prior to 1908. He gave the first chemical analysis (by David T. Day) of the residue, a sample he obtained from Charles Brower at Point Barrow. He added "...the natives say that a considerable amount could easily be dug out with spades."

His observations and a sample of the oil were evidently made and collected prior to 1908 because practically the same information is given by Brooks in his report of Alaska operations for that year.

He mentioned another reported "petroleum mound" between Humphrey Point and Aichillik River near the coast. This is east of Barter Island and almost on the 142° meridian. If true, it is the easternmost surface evidence of oil in the region, but may perhaps refer to the seepages called "Ungoon" Point by Ebbley and Joesting.

Ejnar Mikkelsen, who accompanied Leffingwell during the early part of his work in the Arctic, made an overland trip from Flaxman Island to Valdez during the winter of 1907-1908. On the way to Point Barrow he passed close to the Cape Simpson seepages but did not mention them in the narrative of his experience (1909, pp. 334-362). It seems that had he known of them he would have given them some notice, especially if at the time the residue was being used for fuel. He does tell about the beginning of the use of coal by Eskimos at Wainwright through the efforts of Mr. and Mrs. Kilbuck, school-teachers (Mikkelsen, 1909, p. 357).

Unless the Cape Simpson seepages were visited by one of the early explorers or whalers whose observations were not recorded or have been overlooked, the first white man to see them was the well known Charles Brower and his partner, Patrick Grey, while on a hunting trip. In August 1886, they walked inland toward a "distant hill." Near-by they found two so-called "lakes" in the larger of which there were four trapped caribou and several spectacled eider ducks (Brower, 1943, p. 84).

No doubt Brower staked claims on the seepages and maintained them as best he could for many years (Tommy Brower, verbal communication, 1957). In 1922 during a visit to San Francisco the elder Brower contacted the Standard Oil Company and the then Chief Geologist, G. C. Gester (verbal communi-

cation, 1958) was sufficiently impressed by the description that he despatched a geological party to Point Barrow to investigate the situation.

During the progress of the Canadian Arctic Expedition, 1913-1918, one of the party, Diamond Jenness, was camped at Cape Simpson and visited the seepages after being told of them by an Eskimo companion. He found an Arctic owl dead on the "shore" (Jenness, 1957, p. 21).

Van Valin (1941, pp. 117-122; 1945, pp. 94-199) published an account of a trip he made with a party of 20 to the Cape Simpson seepages in May, 1915. In the group were Charles Brower and T. L. Richardson, school teacher at Point Barrow. Some additional details of the trip have been supplied by Mrs. Ruth (Richardson) Belstorff, of Johnson, Nebraska, verbally and by letter. She was a young girl at Point Barrow at the time and has the diaries kept by her parents. Mr. Richardson had been to the seepages twice before this trip and was instrumental in organizing the large party. Two twenty-acre claims were staked under the name "Arctic Rim Mineral Oil Claims," and they were recorded at Kiana, on Squirrel Creek, a tributary of the Kobuk River according to Van Valin (p. 127). Mrs. Belstorff has copies of original papers pertaining to these claims (letter, May 8, 1960). Van Valin (p. 121) also described the low hills which mark the seepages and mentions numerous oil soaked and partly eaten birds around the margin in soft residue. He also speculated upon the possibility of these being traps of long duration similar to the La Brea Pits in Los Angeles, California. He evidently was in error in assuming that the Eskimos used this tar to "seal leaky seams in their skin boats."

Mr. George Gryc has examined the files of the U. S. Geological Survey in Washington and very kindly supplied the following information regarding the next oil excitement.

"We have two maps, one of the Wainwright-Smith Bay region at a scale of 1 inch equals 10 miles and another of the Cape Simpson area, at a scale of 1 inch equals 1 mile. The titles state 'examined by Adams Expedition for North Star Oil Syndicate. Mapping by Max Steineke, Harry Campbell and A.M. Smith.' The Wainwright-Smith Bay map has large areas outlined in the Cape Simpson, lower Meade River, and Skull Cliff areas, which were presumably staked according to the old placer claim laws. The maps are dated July 5 and August 30, 1921. This was after the placer laws were superceded by oil and gas-lease laws (February, 1920). I believe Sandy [A. M. Smith] told me that they were not aware of the new regulations at the time they were in the field. The mile to the inch map shows the area of the individual claims in the Cape Simpson area. The first map also has two seepages plotted in the Simpson area, two at Skull Cliff and a 'gas seepage' about 10 miles northeast along the coast from the Skull Cliff oil seepages. In the lower Meade River area several dips and strikes are plotted as well as six oil seepages."

According to Smith's account of the expedition as published in *Alaska Weekly*, April 20, 1923, he and R. D. Adams went north in the spring of 1921. Adams, it states, won a fortune in the Nome gold fields and he was one of the group of backers.

It seems apparent from available documents that much if not all of this early activity resulted from the promotional proclivities of prospector Alexander Malcom (Sandy) Smith. He was connected with the ill-fated attempt to take some tractors over the Brooks Range to Point Barrow in connection with exploratory flights by Sir Hubert Wilkins and Bernt Balchen (Wilkins, Jan. 1955, verbal communication). The machines were soon abandoned, but Smith and a companion, recorded as W. H. Berry, finally reached Point Barrow in a rather pitiful condition (Tommy Brower, personal communication, 1957). On the way, it seems that Smith got into one of the seepages and thereafter claimed to be the discoverer of what Charles Brower had visited long before. It is difficult to sift fact from fiction in the newspaper account (cited above) but it does appear that Smith's group staked 37 claims (in a four-page manuscript I have seen the number is given as 42) in the general Point Barrow area but locations are not given. The paper does not mention Harry S. Campbell but it is known that he prepared a report. It is mentioned in several U.S. Geological Survey Reports but was not found by Mr. Gryc in the Washington office files and Don Miller (verbal communication) was unable to locate it in the files of the Alaska Branch office at Menlo Park, California. Very likely information contained in it was used to some extent in the setting up of Naval Petroleum Reserve No. 4.

While on the Arctic Coast Mr. Campbell picked up a small series of recent marine shells which he presented to the California Academy of Sciences and they are now a part of the research collection of that institution.

In the collection of papers owned by Malcom A. Smith (son of "Sandy" Smith) there is a photograph of Harry S. Campbell, Max Steineke, W. D. Adams, Mr. Smith, and a man named "Pond" standing beside a low sod house, probably at Half Moon Ranch, the reindeer station of the Brower family. The photograph is not dated.

E. M. Butterworth and Charles Meek spent the season of 1923 working in the Point Barrow area for Standard Oil Company of California. They visited Cape Simpson and also Skull Cliff about 30 miles south of the point. A seepage was reported to them there. During the course of their work they collected a good series of Pleistocene fossils at Skull Cliff from the formation which has come under the name Gubik of later years. Meek described and illustrated these (Meek, 1923). Whatever their recommendations may have been regarding commercial oil possibilities, they were nullified soon thereafter by the setting aside of the entire area as Naval Petroleum Reserve No. 4 (Harding, 1923).



The documents and arguments which were presented and which resulted in the establishment of this Reserve, have not been published.

Thus, it appears clear that the first geologists who studied any part of the Arctic slope from a petroleum standpoint were Harry S. Campbell and Max Steineke in 1921, even though the results of their observations are fragmentary. Unfortunately it is necessary to omit from discussion in this connection the marvelous work of the justly celebrated geologist Schrader (1904) because his report contains no information regarding the presence of oil and gas.

Private investigations of the region ceased with 1923 and the setting aside of the Reserve. The first Government geological report appeared two years later by Paige, Foran, and Gilluly (1925) as a Bulletin of the U. S. Geological Survey. That branch of the Government has been responsible for nearly all subsequent work.

Paige *et al.* described the two main Capt Simpson seepages and photographed them. The "weathered" live oil was analyzed. They did not mention the presence of trapped animals or the mining of the heavier residues by the Eskimos. Mention was made of the presence of fragments of shale on the two mounds at the seepage localities. In sinking pits on the mounds which have the seepages, Patton (1948, p. 2) reported that no bed rock was found but in the silt and clay some rounded chert and quartzite pebbles were found. Also some pieces of limey shale, limestone, and ironstone float were found on the surface, and a few similar ones were found in the excavations. Two samples of silt and clay from pits Nos. 1 and 2 yielded four and seven species of Foraminifera respectively, generically determined only by Mrs. Helen Loeblich (Patton, 1948, p. 3).

The work of Smith and Mertie in 1925, although not published until 1930, is still a basic reference to the general geology of that region. Their efforts were concentrated on geology and no new seepages of oil were discovered. They quoted the description of the Cape Simpson seepages from Paige *et al.* (Smith and Mertie, pp. 176-278) and added a map to show their location. They did find a piece of oil shale as float on the Etivluk River not far from the occurrence described by Howard (in Stoney, 1899, p. 814). Two additional pieces of shale float were given to them, one from upper and one from lower Meade River (Smith and Mertie, 1930, p. 284).

In 1943 Norman Ebbley (U. S. Bureau of Mines), Henry R. Joesting (Territorial Department of Mines), and Henry F. Thomas (U. S. Army Engineers) were sent to the Arctic slope specifically to investigate oil and gas seepages. Sigurd Wien was pilot and Simon Paneak, an Eskimo of Anaktuvuk and Chandler Lake, was guide.

A comprehensive manuscript report on this work was submitted by Ebbley and Joesting (1943, 33 pp.). I had an opportunity to examine a copy of this through the courtesy of Mr. Max Brewer, Director, Arctic Research Laboratory.

It contains much more information than the condensed published report (Anon. 1944, pp. 1-9, and Ebbley, 1944, pp. 415-419). Since both reports are relatively inaccessible, numerous significant passages have been quoted herein.

#### SKULL CLIFF SEEPAGE

Skull Cliff is located on the coast about 30 miles south of Point Barrow and was evidently known by 1921 because the party sent north that year by the North Star Oil Syndicate staked claims there. George Gryc mentioned the seepage (1958, p. 126; 1959, p. 92) and that oil may be seen oozing from the Cretaceous rocks there. He also mentioned the seepages at the base of Umiat Mountain and in the lakes just west of it. In a very brief landing at Skull Cliff in 1954, I did not search for the oil although I examined the Cretaceous and Gubik rocks at that point for fossils.

Brooks (1916, p. 52) referred somewhat indefinitely to a seepage reported to him as near Wainwright Inlet and 100 miles southwest of Point Barrow. No additional information has been found. Possibly Skull Cliff could have been in the mind of the informant although the location is far off.

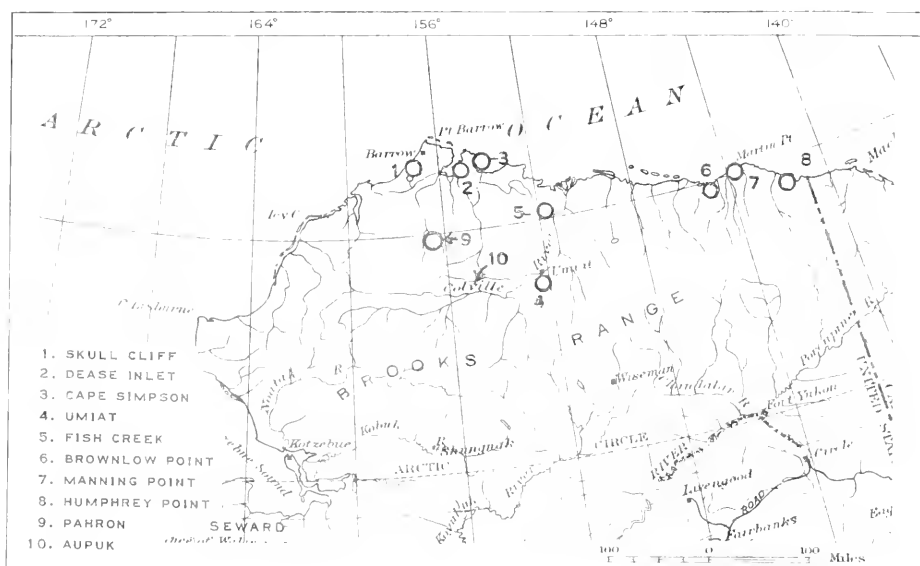


Figure 1. Outline map showing locations of oil and gas seepages in Arctic Alaska.

#### DEASE INLET SEEPAGE

Ebbley and Joesting located this seepage and another about 200 yards east of it, as on the east side of Dease Inlet about 4.5 miles northeast of

Thomas Brower's warehouse. The latter is indicated on U. S. Geological Survey Map E of Alaska, 1954, by the name Alaktak. This is near the mouth of Chipp River. Heavy residue had issued from a low mound. It formed a deposit sufficient for some mining operations by the Eskimos to secure fuel.

#### CAPE SIMPSON AREA

There are three well known seepages of oil in this area and they have been referred to repeatedly as Nos. 1, 2 and 3. Ebbley and Joesting located No. 1 as four miles northwest of Cape Simpson and 500 yards from the ocean shore. Seep No. 2, is on a prominent hill three miles south of No. 1. It is slightly south and about 500 yards east of the ocean shore. The oil flows down hill and eventually reaches a lake which covers several acres. At times it must cover the surface of the water and this led to early reports of "a lake of oil." There is much evidence of residue although parts of the area have been stripped by Eskimos for fuel. Seep No. 3 is about five miles south and a little east of No. 2. It is farther from the ocean than Nos. 1 and 2, and therefore was not mined as extensively. The residue covers an area about 800 feet  $\times$  1000 feet according to Ebbley and Joesting.

A fourth seep noted as 2A on a map prepared by Arctic Contractors, No. 1275, dated December, 1950, is located almost midway between Nos. 2 and 3. Well No. 31 was drilled here.

In addition to the above, Ebbley and Joesting stated that two additional seepages were known in this area about 10 miles west of Cape Simpson. No other reference to these has been found.

Numerous test wells and a few for production were drilled in the Cape Simpson area with some encouraging results. (For details, see Reed, 1958.)

In 1948 the U. S. Geological Survey (Patton, pp. 1-4) dug two pits on Seepage No. 1, four on Seepage No. 2, and one on Seepage No. 3. These varied in depth from 9 to 13 feet and were located so as to give as much information as possible on the origin of the light oil. No extensive deposit of residue was found. The oil seemed to be escaping by way of steeply dipping fractures in the permafrost which had no regular orientation. "The fractures varied in width from a few inches to a foot and were filled with loosely compacted oil saturated silt and clay."

From this investigation it seems unlikely that there is a reservoir of pitch of sufficient size to serve as an animal trap similar to those of McKittrick and La Brea in California.

The locations of the Cape Simpson seepages are more accurately shown on a map prepared by W.W. Patton, Jr. (1948). Using Cape Simpson as a reference point these are: No. 1 - 3 mi. N.,  $\frac{1}{4}$  mi. from ocean shore; No. 2 -  $3\frac{1}{4}$  mi. S. of No. 1,  $1\frac{1}{2}$  mi. from ocean shore; No. 3 -  $3\frac{1}{2}$  mi. S. of No. 2, 2 mi. from ocean shore.

#### WHITE MOUNTAIN AREA

Ebbley and Joesting had a report from Eskimo sources that there was a

seepage of oil about 5 or 10 miles north of the "White Mountains" and between the east and west forks of the Kupowruk River. They searched for, but did not find evidence of oil.

#### UMIAT AREA

Ebbley and Joesting described four seepages in this area. A steady flow of light oil and gas was found in a small lake "about a mile west of Umiat Mountain and 100 yards from the north bank of the Colville River. More oil was found in another lake about a mile west of this one. And sand containing high gravity oil was found on the river bank south of the first lake mentioned. They reported that seven years prior to their visit Simon Paneak collected a gallon of oil from the sand and this was burned in a lamp by a trader at Beechey Point.

Wells drilled in this area during Naval exploration showed on production tests that estimates of reserves were warranted.

#### FISH CREEK SEEPAGE

This small patch of residue was described by Ebbley and Joesting as being about 6 feet  $\times$  20 feet in extent. They noted that a "great many" birds and small rodents had been trapped in the tar. The location was said to be 25 miles southwest of the mouth of the Colville River and more specifically, 4 miles north 60° West from the junction of Ovolotuk and Fish creeks. Small production of heavy oil was obtained from a Navy test well drilled in this vicinity.

#### BROWNLOW POINT

In 1954 the U. S. Geological Survey received a report of a rather extensive seepage near Brownlow Point. It has not been investigated since as far as has been learned. An Air Force employee driving a tracked vehicle was mired in the tar and extracted himself with considerable difficulty. The exact location he gave was at the head of the small unnamed bay bounded on the east by the peninsula of which Brownlow Point is the north extremity, and on the southwest by a long narrow spit with Ruth Island off the extreme tip. This area is well shown on U. S. Geological Survey, Flaxman Island Quadrangle, Ed. 1951. The above information was furnished by Mrs. Florence (Robinson) Weber and Mr. George Gryc, both of the U. S. Geological Survey.

#### MANNING POINT SEEPAGE

Ebbley and Joesting describe this as an extensive beach with much

#### PLATE 1

- Upper figure. A portion of deposit of oil seepage residue (No. 2), Cape Simpson, Alaska, with Eskimo home-made spade used in gathering the material for fuel. 1918-1947.
- Lower figure. Pit at oil seepage No. 2, Cape Simpson, Alaska, with pool of live oil. The residue excavated contained many bones of animals.





free oil in evidence. The Point is located about two miles southeast of Barter Island. They add: "No actual pitch residue was noted; however, the northwest and northeast beaches which form the point are lined with oil froth for a mile and a half. A considerable portion of the beach particularly on the northwest side, consists of an oil bound silt and numerous boulders of soft oil bound reddish-brown sand were observed. Several trickles of water-carrying oil film cross the narrow beach. Oil soaked peat was noted at several places along the sloughed bank. Sample No. 11 was taken from the oil bound silt found in layers along the northwest beach. An unconsolidated oil soaked silt underlies the surface. Sample No. 12 was skimmed from the several small streams of water flowing from the bank to the ocean. Sample No. 13 was collected from exposures of an unconsolidated oil bound brownish red sand which appeared in places along the bank. Sample No. 14 consisted of oil soaked vegetable debris found along the bank throughout the entire mile and a half distance." The U.S. Bureau of Mines later extracted the oil from the above samples and the gravity varied as follows: 17.3°, 19.0°, 2.6° and 21.3° all API (Anon. p. 7). This field work was done in 1943 before any contamination from building or drilling activity was likely. I have seen no other reference to the occurrence.

#### UNGOON POINT SEEPAGE

This name is not located on any map available to me but Ebbley and Joesting give the position as 7 miles east of Humphrey Point and about 40 miles west of Demarcation Point. They added the following data: "Ungoon is the Eskimo term for pitch. Three evidences of petroleum seepages were found on Ungoon Point. The largest of these is a mile and a quarter south from the sod house on the Point. The pitch is black and hard and is extremely difficult to dig. A small amount of mining has been carried out and the pitch has appeared in several small holes where the tundra has been removed. The general area is approximately 300 feet north and south and 100 feet east and west.

"Six hundred yards east and about 250 yards from the east beach a small pool has been excavated in the center of a small hummock. Sample No. 16 was taken from this material which has the same consistency as the larger exposure. On the east side of Ungoon Point and in line with the two seepages mentioned above, an exposure of oil bound sand four feet thick appears along the bank for a distance of about 30 feet. This deposit is located one and one half miles southeasterly from Ungoon Point proper."

#### U. S. GEOLOGICAL SURVEY EXPLORATION

During the years 1944-1953, very extensive and detailed exploration of the Arctic Coastal Plain was made by geologists of the U. S. Geological Survey. These parties were well equipped with modern transportation and bases of supply at Point Barrow and Umiat. The work was a continuing project dur-

ing the test drilling of Navy Petroleum Reserve No. 4, so that plans could be made well in advance.

#### PAHRON GAS SEEPAGE

As might be expected these geological field parties visited all of the known oil and gas seepages in the area and searched for additional ones about which there were rumors. In addition to verifying an actual oil seepage at Skull Cliff, Webber (1947) reported briefly on a gas seepage named "Pahron" near the head waters of Meade River. Whittington and Keller (1950) revisited the seepage and gave a more precise locality as: 157° 36' W. Long. and one fourth mile north of the river. Gas was escaping about 100 feet out in the lake and along a zone about 50 feet in length (Gryc, 1959, p. 92).

#### APUK GAS SEEPAGE

A rather extensive seepage of dry gas was discovered in 1945 at the eastern end of the Aupuk Anticline in a small lake  $1\frac{3}{4}$  miles above the junction of Aupuk Creek and the Colville River.

In subsequent years this area was re-examined and Eberlein, Chapman, and Reynolds (1950) collected a sample. The gas bubbled to the surface of the lake over about 300 square feet. The analysis of the gas was published by Gryc (1959, p. 93), together with additional details pertaining to this and the Pahron seepage. Another seepage, which may possibly be an extension of Aupuk structure, was reported by R. F. Thurrell in May, 1947. In this case the bubbling of gas in the lake caused a small ice-free area (Gryc 1959, p. 93). Gryc (1959, pp. 94-95) mentioned oil-bearing sandstones found by various members of the Geological Survey from several localities: on the Kokolik River north of the axis of syncline 10; also in the Carbon Creek and Kigalik-Awuna Rivers area. Most significant possibly was the noting of an almost continuous belt of Upper Jurassic shale along the north front of the Brooks Range. It burns readily and undoubtedly was the fuel found in 1886 by Howard. And lastly, the Lisburne limestones of Mississippian age in the Brooks Range were found to have a strong odor and traces of petroleum (Gryc, 1959, p. 112).

#### USE OF OIL SEEPAGE RESIDUE BY ESKIMO PEOPLE

No definite evidence has been found to indicate that the native people used the pitch or tar from the oil seepages in prehistoric times (Ford, James A. Letter dated Jan. 20, 1950). This is surprising in view of their ingenuity in using many other available products.

Recollections of the people differ as to the exact year when they began using the material for fuel and who induced them to do so. The earliest definite record I have found was the spring of 1918 when Van Valen (1941, p. 149, 1945, p. 122) sent Eskimos to the [Cape Simpson] seepages for a supply of tar during a fuel shortage.



Stefansson (1913, pp. 45-46) spent a part of the winter of 1908-1909 at Point Barrow and described the extreme shortage of fuel. The Eskimos had exhausted the supply of driftwood for many miles each side of the village. If they had then known of the heating properties of the material at Cape Simpson the author would almost certainly have mentioned it. Thus it appears that the use of the residue from the seepages for fuel was started between 1908 and 1918.

Leffingwell's reference in his 1919 report is rather indefinite in this respect, but it indicates that some ten years prior to when his report was written, the natives knew how to go about mining the material. In the early spring of 1932 anthropologist James A. Ford, accompanied Alfred Hopson to seepages for two sled loads of fuel (Ford, 1959, p. 15).

When Ebbley and Joesting visited the Arctic Slope in 1943, they noted several hundred sacks of residue at the now abandoned Brower reindeer station on Dease Inlet. This had been removed from the seepage bearing that name. They also noted evidence of mining at Ungoon Point and at all three Cape Simpson seepages. They estimated the amount of material taken from the latter as 3000 sacks of 100 pounds each as the annual amount removed. I was able to verify this estimate from Eskimo sources.

In 1957 three reliable Eskimos, Peter Solvalik, Chester Lampe, and Kenneth Tuvak gave me a detailed account of the methods employed in gathering the residue. All three had worked at this and had first-hand knowledge.

The best season for cutting the "pitch," as it is locally known, was the spring. Homemade spades (fig. 1) were used to cut out rectangular blocks convenient in size to put in sacks of about 100 pounds each for transport to the village of Barrow. Much of it was hauled the 80 miles directly by dog team; a load would consist of six or seven sacks. A larger quantity, however, was hauled to the beach by dog team and when water transport became possible in the summer it was taken to the village by umiak.

The method of cutting the pitch was to heat a spade very hot over an open fire. This made the blocks easy to remove from a working face. All agreed that the material made excellent fuel which lasted a long time, and gave a great deal of heat together with much smoke. It was liked better than the coal which replaced it.

In mining the deposits, the Eskimos preferred to choose localities where the pitch had flowed out over the surface of the tundra and was about a foot thick. Only rarely did they go to a greater depth than two feet, and there seemed to be some fear of mining down if the center was worked. When the Navy established its camp for drilling Petroleum Reserve No. 4 and it became possible to haul coal from Meade River by tractor train in winter, enough of that fuel was brought in to supply the native village and some of the Government establishments located there. Work in the mine and for the Navy con-

tractors provided sufficient funds so that the natives could purchase the coal. This has continued until the present. Gas from the Barrow field was reported to have been made available to government buildings in the native village late in 1958 or early 1959.

#### TRAPPED ANIMALS

In recounting their mining experiences at the Cape Simpson seepages, the natives told of the large number of animals and birds which became trapped. They enumerated small land and shore birds, caribou, foxes, and wolves. No mention was made of lemmings, the most numerous of Arctic mammals.

I spent several days in the Cape Simpson area, in the summer of 1957 especially to investigate the reported trapped animals by Eskimos and by Ebbley and Joesting (1943). The latter also reported "great numbers of birds and small rodents caught in the gummy residue at the Fish Creek seepage." The bones which I collected were embedded in the tar. With better facilities for excavating, no doubt additional material could have been obtained.

At Seepage No. 1 many separate elements of caribou skeletons were found. In addition 10 parts of seal skeletons were picked up. At Seepage No. 2, 25 bones of caribou and 9 of seals were collected. Also there was a flipper bone of a small whale. The identifications were made by Dr. Robert T. Orr, California Academy of Sciences.

While all of the specimens which I collected belong to species now living in the area of the seepages, it seems reasonable to suppose that the tar has been effective as long as it has been present. It is not known if oil has been escaping since the emergence of the coastal plain or even earlier. If so, then there is a possibility of Pleistocene animals being present.

The actual cause of the mounds from which the oil emerges is not known for certain. The work of Patton (1948 and personal communication) does not indicate that they are the direct result of building of residue or residue-soaked silt. Anticlinal structure has not been definitely determined. There is a possibility that the fractures discovered in the pits were caused by earth movements, thus allowing surface water to penetrate. Expansion upon freezing could cause some heaving as it does in the formation of polygonal surface structures. One small mound was found north and a little east, one half mile from Seepage No. 2, which contained no evidence of oil in the pit Patton excavated.

Pit No. 2 was excavated to a depth of eight feet by bulldozer during drilling near by in order to secure fluid for oil base drilling mud (Ted Mathews, personal communication). It is noteworthy that the deepest material brought out then contained many bones and the matrix was still soft "tar" (fig. 2). It was noted that the bones from the deepest material excavated were not as well preserved as those higher up. No evidence of mummification or

flesh preservation was seen, although this might be expected in the climate of that area.

Among the bones collected in 1957 there were numerous parts of skeletons of seals. The natives who worked at mining the pitch undoubtedly carried some of them there with their food and may have brought them all. The only other explanation would seem to be to assume a late marine submergence so that the mounds became islands, which is a possibility but lacks definite proof. In the Antarctic mummified seals have been found many miles inland from salt water (Péwé, Rivard and Llanco, 1959), but the Eskimos I consulted had no knowledge of such movements of seals in Arctic Alaska.

With the limited time and equipment at my disposal it is not strange that no remains of polar bears were found in the seepages, and perhaps there are none. It is well known that the large brown bears of central and western Alaska habitually seek oil seepages and wallow in them (Hanna, 1948, pp. 138-139). However, inquiry among reliable Eskimos of Point Barrow did not yield any information indicating such an activity for the polar bears of that region.

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