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ASBESTOS AND JADE OCCURRENCES IN THE KOBUK RIVER REGION, ALASKA

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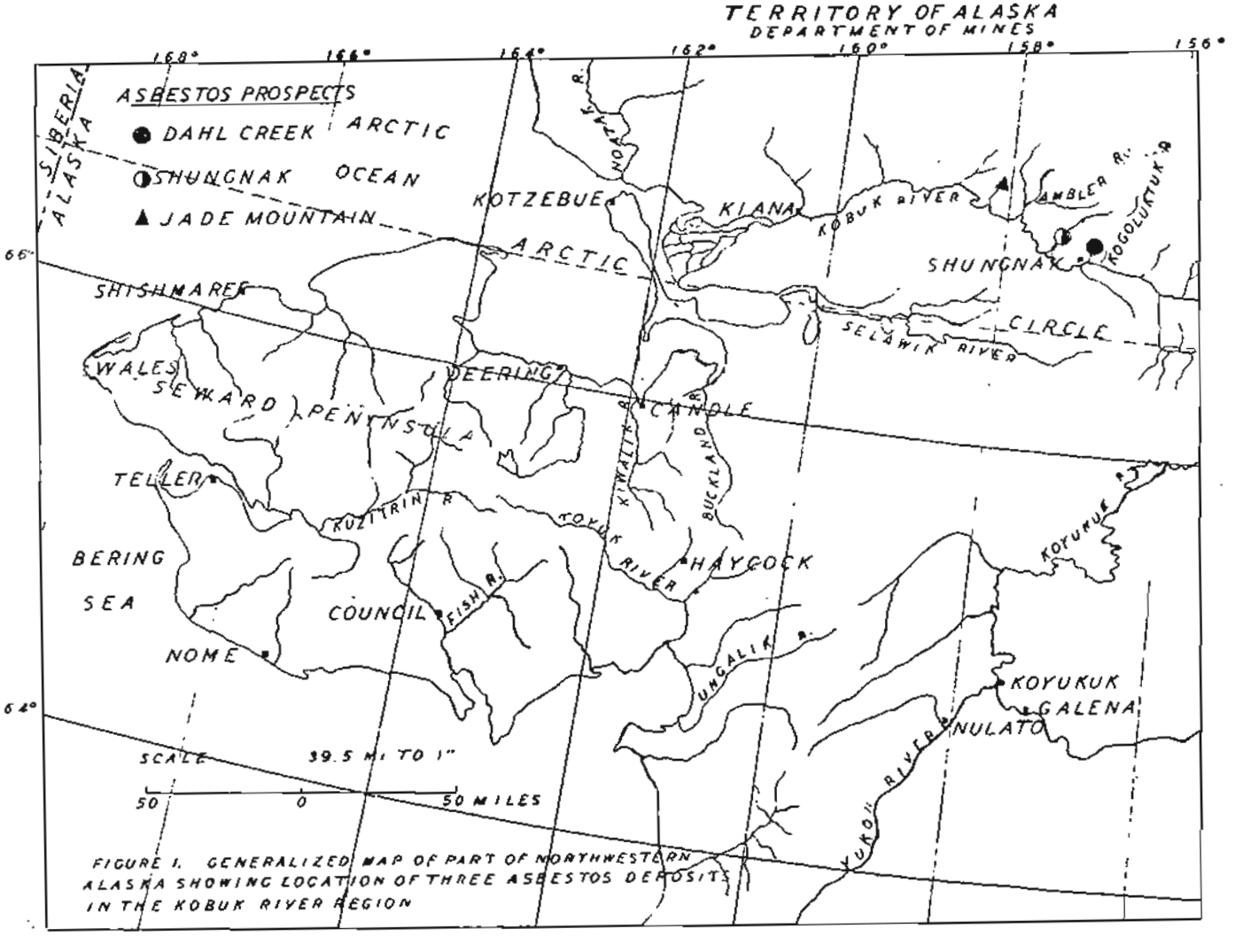

FIGURE 1. GENERALIZED MAP OF PART OF NORTHWESTERN ALASKA SHOWING LOCATION OF THREE ASBESTOS DEPOSITS IN THE KOBUK RIVER REGION

ASBESTOS AND JADE OCCURRENCES IN THE KOBUK RIVER REGION, ALASKA

SUMMARY

During part of August 1943, parts of June and July 1944, and part of June in 1945, examinations were made by the Territorial Department of Mines of asbestos and jade deposits between Jade Mountain on the west and the Kogoluktuk River basin on the east, in a remote region lying a few miles north of and roughly paralleling the Kobuk River in northwestern Alaska. (Fig. 1.)

In 1944, as a combined result of the enterprise shown by the Arctic Circle Exploration Company of Candle and these investigations into the value and amounts of different types of asbestos, the first commercial production of asbestos from Alaska was made. Over twenty tons of the tremolite variety was produced in 1944 and over 25 tons is said to have been produced during 1945. The tremolite, originally valued at about $500 a ton, is reported to have been sold in different lots at prices varying from $400 to $1,000 a ton. In addition to the tremolite lens which is being mined on Dahl Creek, other occurrences have been found there and on other creeks in the vicinity.

High-grade slip-fiber chrysotile has long been known to occur on Dahl Creek. About a ton of long slip-fiber chrysotile was shipped from these deposits in 1945. More extensive deposits of cross-fiber chrysotile have been found on Cosmos Creek, Shungnak River and Jade Mountain. Some development work has been done on each of these deposits.

Float and bedrock occurrences of the nephrite variety of jade have been observed in various parts of the Jade Hills and the Cosmos Hills. Some of the jade is of gem quality, and excellent jewelry has been made of fine, pale

to deep green, translucent jade float from Shungnak River and from Jade Creek. Though representing only a very small proportion of the total amount, the nephrite jade which can be classified as gem material or as semi-precious stone is probably present in large enough quantity to support a small jade-cutting industry among the Kobuk Eskimos, or to provide them with a moderate source of income if the material is sold in rough, uncut pieces. During 1945 about five tons of raw jade was shipped from the Kobuk district. The material has not yet been used and the proportion of the shipment which can be considered as precious stone is not yet known.

Asbestos and jade in the Kobuk region occur in a series of outcrops of ultrabasic rocks intruded mainly in schist and limestone. These outcrops have been so little prospected that the total extent of the area in which they occur has not yet been determined. Even within the zone, about 40 miles long and 10 miles wide, that is known to contain asbestos and jade deposits, large outcrop areas have been observed only from airplanes.

INTRODUCTION

Since the gold stampede to the district about 1898, white men have known of the occurence of asbestos and nephrite jade in regions north of the Kobuk River. Both minerals have been found in excavations of ancient village sites between Shungnak and Kiana and were used by Eskimos at least as long as several hundred years ago.

Asbestos occurrences on Dahl Creek, a tributary of Kobuk River near Shungnak, were reported in 1910 to be chrysotile asbestos of good color but of slight tenacity and unsuitable for making high grade articles.† In 1931, Irving Reed, Associate Engineer, Territorial Department of Mines, examined later discoveries in the Dahl Creek area.‡ A sample forwarded at that time to the U. S.

† Mineral Resources of Alaska, 1910; U. S. G. S. Bull 480, p. 304.

‡ Mining Investigations and Mine Inspection in Alaska, B. D. Stewart, Territorial Department of Mines; report for biennium ending March 31, 1933, pp. 21-22.

Bureau of Mines, Washington, D. C., was identified as chrysotile asbestos of the finest grade material of its type yet submitted to that office from an undeveloped prospect.

The presence of tremolite asbestos at the Dahl Creek deposits was not definitely recognized until its identification in September 1943 at the Fairbanks office of the Territorial Department of Mines. Most types of tremolite are of insufficient value to be of commercial importance in remote regions of Alaska. During the early months of 1944, and after rejection of the material by several asbestos purchasers, samples tested by one buyer were determined to be of a type suitable for special uses in the chemical industry. The asbestos at that time was given a tentative value of from $300 to $500 a ton. The Arctic Circle Exploration Company, which had contemplated abandonment of development work on the tremolite prospect, then resumed its activity there. During 1944 pits were sunk on tremolite lenses, one of which was over 6 feet wide where exposed near the surface. Over 20 tons of tremolite was shipped from Kotzebue in 1944 and about 25 tons is said to have been shipped during 1945.

Asbestos deposits on Shungnak River, Cosmos Creek and Jade Mountain have been known to prospectors for some time. During the field seasons from 1943 to 1945 about six weeks were spent in the examination of these and other asbestos occurrences. A zone roughly parallel to and north of the Kobuk River containing occasional bodies of serpentinized and nephritized asbestos-bearing rocks was outlined roughly for a distance of about 40 miles between the Kogoluktuk River and Jade Mountain. Within this zone there are now known to be deposits of tremolite and slip-fiber chrysotile, as well as stock-works of cross-fiber chrysotile. Tests on all these types have shown that some of the material is of commercial value. The tremolite has assumed some importance commercially. In places the chrysotile also occurs in sufficient amount to justify more thorough prospecting.

Parts of the region have not yet been prospected and

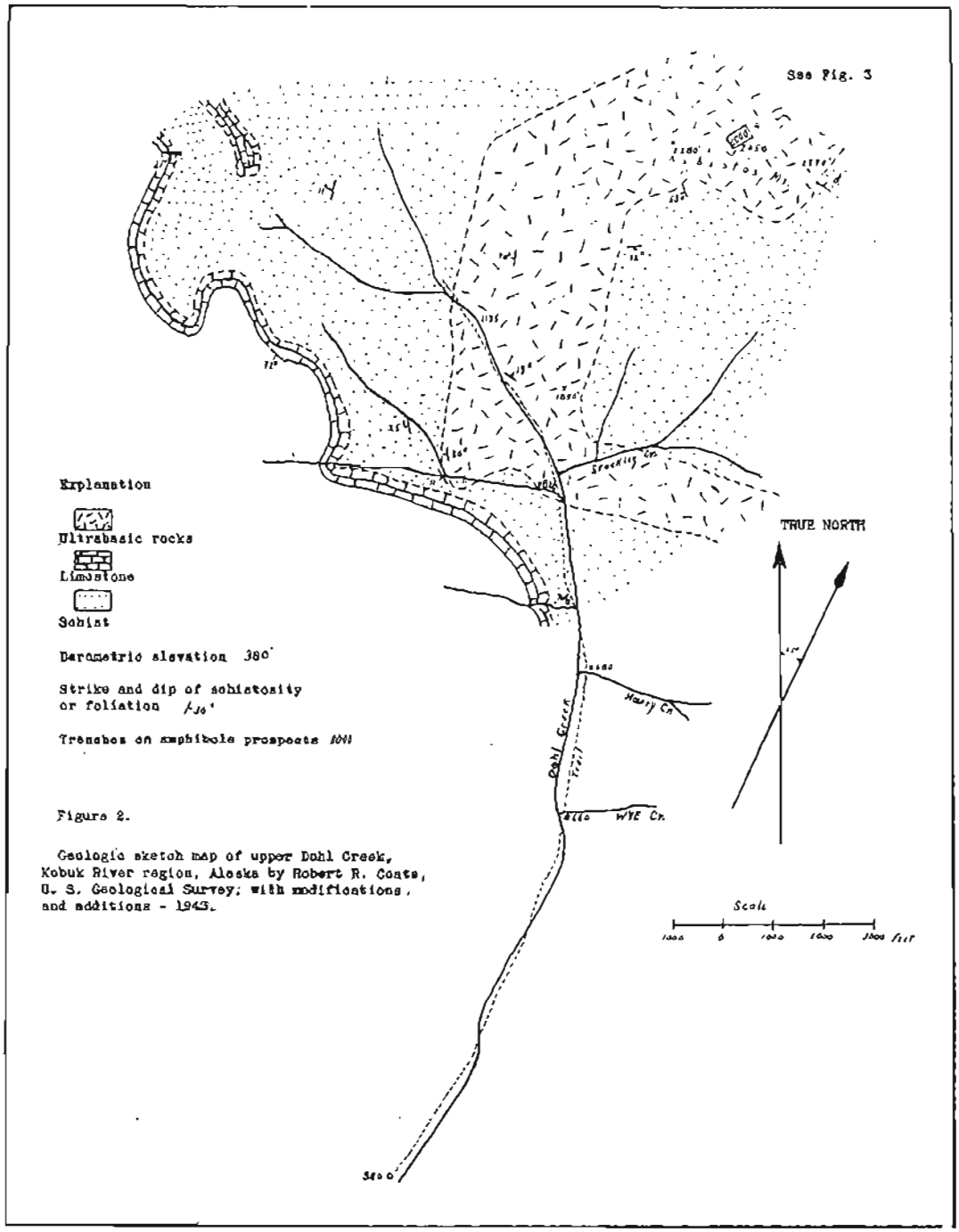

Figure 2.

Geologic sketch map of upper Dahl Creek, Kobuk River region, Alaska by Robert R. Coats, U. S. Geological Survey; with modifications, and additions - 1943.

it appears probable that the asbestos-bearing region may be extended as more information is obtained.

In some places the nephrite variety of jade occurs with or near the asbestos deposits as one of the alteration phases of the ultrabasic rocks of the region. Some of this material is of gem quality.

In 1943, from August 7 to August 11, the Dahl Creek asbestos deposits were examined in the company of Harold E. Heide of the U. S. Bureau of Mines and Robert R. Coats of the U. S. Geological Survey. From August 12 to August 24, 1943, the writer with Mark Cleveland and Walter Douglas, both of Shungnak, examined for the Territorial Department of Mines asbestos, quartz crystal, and other mineral occurrences in the region between the Kogoluktuk River and Jade Creek.

In 1944, under the same auspices, Frank Jackson and Peter Atoruk of Kiana, in company with the writer, spent the period from July 14 to August 1 in examinations of asbestos deposits on Jade Mountain, Shungnak River, Cosmos Creek, Dahl Creek, and California Creek, a tributary of the Kogoluktuk River. In that time a hasty investigation was also made of the geology of the lower Ambler and Redstone River regions.

Lawrence Gray of Shungnak and the writer, as representatives of the Territory, spent ten days during June of 1945 in the asbestos and jade bearing area between Kogoluktuk and Shungnak Rivers.

Harold E. Heide of the U. S. Bureau of Mines, in 1944 began development of the Shungnak River asbestos deposits, employing several men during much of the summer. Bulldozer and hand trenching and sampling of the deposit were undertaken. A similar development program on the Cosmos Creek deposit, begun by the U. S. Bureau of Mines in July 1945, was halted a month later upon cessation of hostilities with Japan. Occurrences of tremolite and

Trench #1. About 2½' deep exposing layer of white asbestos float overlying nephrite float for twenty feet from lower or north end of cut to vein exposed in bedrock. Asbestos layer reaches maximum thickness of 26 inches below vein in trench and contains a small proportion of bedrock inclusions. Above or south of vein the layer of white asbestos continues although thinner and containing more bedrock particles.

Trench #2. Float - mainly serpentine and nephrite with a small amount of finely divided white asbestos.

Trench #3. Float predominantly white asbestos with pieces of nephrite and serpentine.

Trench #4. Much whitish green asbestos with serpentine and nephrite float.

Figure 3. Sketch map of shallow, surface trenches at tremolite prospect on north slope of Asbestos Mt., Dahl Creek, tributary to Kobuk River, Alaska. August, 1943. For general location of pits see Fig. 8.

jade on Wesley Creek and of asbestos on Hunt River were also investigated.

The geological sketch map of upper Dahl Creek (Fig. 2) included in this report was made by Robert R. Coats of the U. S. Geological Survey.

GENERAL INFORMATION

The upper Kobuk area is accessible from Kotzebue for several months during the summer by river boat as well as by airplane. Kotzebue is visited by sea-going vessels from July to late September when the southern parts of the Arctic Ocean are relatively free of ice. Freight is lightered ashore or transferred to river boats for shipment to villages as far east as Shungnak and Kobuk P. O., about 150 miles east of Kotzebue. River boats now in use on the Kobuk are capable of handling any freight necessary for small mining operations. During the winter months the region is accessible by airplane and dog team. Airplane fare in 1945 from Fairbanks to Shungnak was $75.

Almost all of the few inhabitants of the upper Kobuk region live in small villages on the banks of the river. Only a limited number of Eskimos are available for labor. A few experienced miners are now employed on underground work and for supervision of mining operations. For large-scale operations most of the employees would have to be imported from other parts of Alaska and from continental United States. The only trading post in the district is at Kobuk where some supplies may be obtained.

The climate of the district is similar to that of interior Alaska, but the snow-free season is somewhat shorter and usually extends from the latter part of May to early in September. The Kobuk lowlands are mainly tundra-covered and swampy, but spruce for mine timber is available on the mountain slopes within a mile of each of the asbestos deposits here described.

The maximum relief in the region from the Kogoluktuk River to the Jade Hills is probably less than 3000

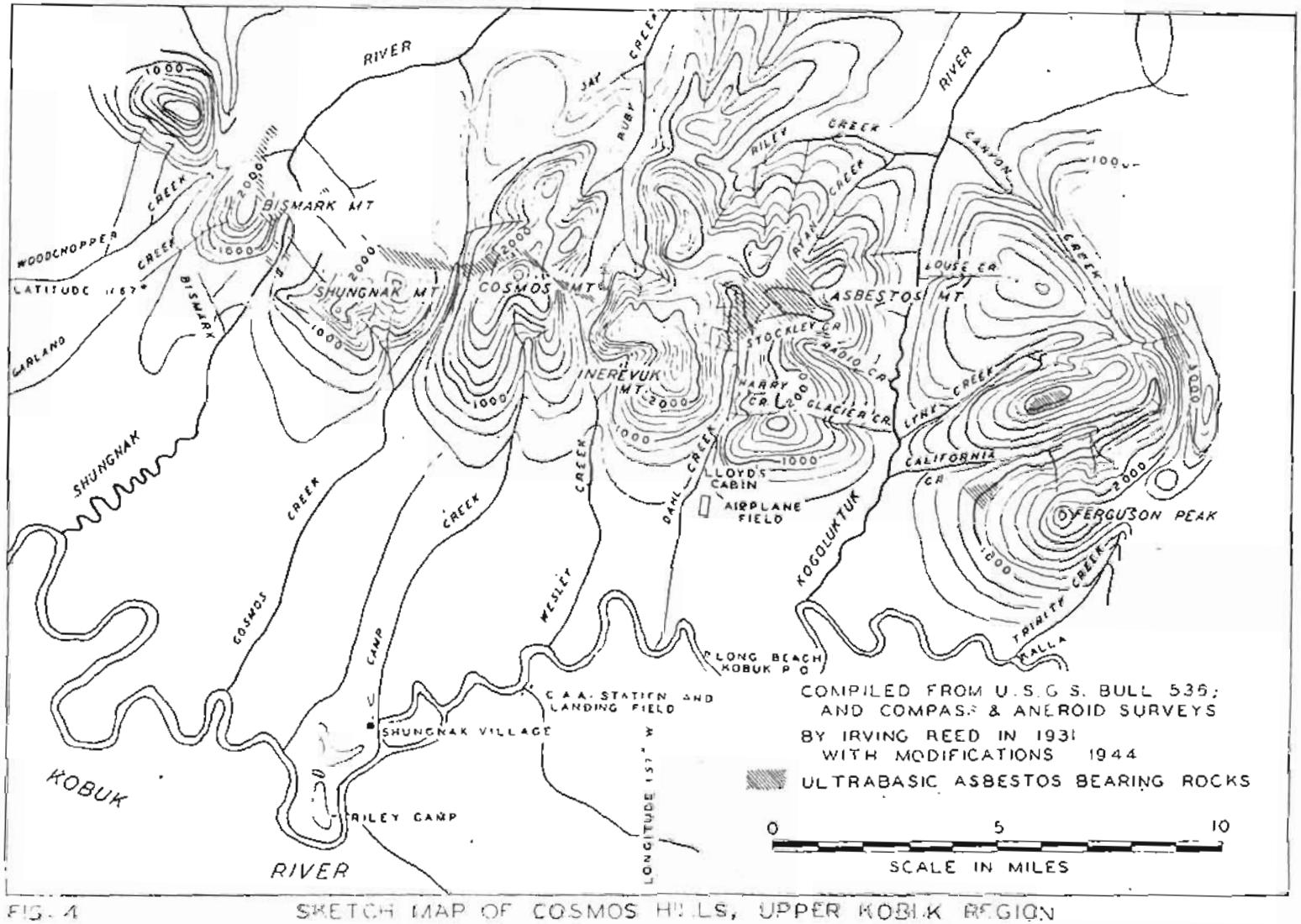

FIG. 1 SKETCH MAP OF COSMOS HILLS, UPPER KOBUK REGION

feet. The highest mountains are about 3000 feet high while the Kobuk lowlands vary from 200 to 300 feet in elevation.

The Dahl Creek deposits lie about 8 miles north of the Kobuk River at elevations of from nearly 900 to 2500 feet. (Figs. 2 and 3). They are accessible by a 4-mile trail from a small landing field situated about 3 miles above the mouth of Dahl Creek. Larger planes can be landed on a newly constructed CAA field at Kuikcherk, a few miles upstream from Shungnak and about 10 miles from the deposit. In 1944 a cat trail was made from the village of Kobuk, on the Kobuk River, up Dahl Creek to the tremolite deposits. A new landing field was also built during 1944 by the Arctic Circle Exploration Company. The new field is west of Dahl Creek on the gravel slopes between the foothills and the Kobuk River.

The deposits on Shungnak River and Jade Mountain are about 12 miles west and 35 miles northwest, respectively, of the Dahl Creek deposits and are similarly located with respect to the Kobuk River. Each lies on the south slope of mountains which sweep up and northward from the broad Kobuk lowlands.

The Cosmos Creek and Wesley Creek deposits also lie from 7 to 10 miles north of the Kobuk River and, respectively, about 5 and 8 airline miles west of the Dahl Creek tremolite prospect. (Fig. 4). On California Creek, a tributary of Kogoluktuk River from the east, amphibole and cross-fiber chrysotile float were found, but as yet little more is known of the asbestos occurrences there.

DAHL CREEK DEPOSITS

History

The Dahl Creek asbestos occurrences have been prospected intermittently since white men first came to the region. In 1932 and 1933 Michael Garland, working under the old Prospectors' Aid plan of the Territorial Depart-

ment of Mines, revived interest in the deposits by locating outcrops containing high quality chrysotile.

The first actual development work was done in the summer of 1943 on claims owned by the Arctic Circle Exploration Company of Candle, Alaska. At the summit of Asbestos Mountain four shallow trenches were dug by hand during that year on a zone in which large amounts of tremolite float were found. In 1944 shallow shafts were sunk on tremolite lenses and about 25 tons of tremolite was sacked for shipment. During the winter of 1944 and 1945 an adit was driven to tap the tremolite lenses from below.

A large cabin has been built near the deposit for the accommodation of the crew. An air compressor and mine drills are the only mechanical equipment which has been installed at the prospect thus far.

Geology

Both the chrysotile and tremolite of Dahl Creek occur in a body of much altered ultrabasic rocks intruding an area composed chiefly of mica schists. (Fig 2.) Massive limestone cliffs outcrop a short distance to the west of the asbestos-bearing intrusive. Few minerals of which the original ultrabasic intrusive was composed are now recognizable, but before its alteration the rock apparently was peridotite. Most of the outcrops are massive serpentine containing occasional irregular and narrow seams of long-fiber chrysotile. Outcrops are scarce in the lower parts of the area but abundant near the top of Asbestos Mountain.

A zone of sheared serpentine and nephrite cuts across the summit of Asbestos Mountain in a northeasterly direction. Within this sheared zone for a distance of several hundred feet along the north side and near the top of the mountain there is much fibrous tremolite float, the tremolite apparently occurring mainly in the nephritic bedrock. Four shallow trenches were made across this zone in 1943. (Figs. 2 and 3.) One narrow vein of tremolite was then exposed in place and the presence of others

was indicated by large amounts of float (Fig. 3.) During 1944 shallow shafts were sunk on steeply dipping tremolite lenses, one of which was over 6 feet thick where exposed.

Several thousand feet east of the trenches brown long-fibered chrysotile float is found in amounts which justify enough development work to determine its bedrock occurrence.

Tremolite Prospects

Tremolite of the type and purity of that found on Asbestos Mountain is scarce and in great demand for use in the chemical industry. The Dahl Creek deposits therefore have assumed some economic importance and if a steady supply of the material can be obtained from the various lenses indicated by surface float the deposits may be of some importance during 1946 and 1947.

Tests of samples taken from the only vein exposed in place in 1943 indicated that the material would be suitable for use as a filter medium in the chemical industry. First prices quoted by the contractor for material similar to that of the samples were $300 to $400 a ton delivered boatside at Kotzebue, Alaska. The difference between $300 and $400 was expected to be determined after delivery by the amount of impurities in the material. A shipment of from 20 to 30 tons was requested for 1944 and that shipment was made by the Arctic Circle Exploration Company in October of that year. A shipment of about the same tonnage was made during 1945. The price received for the asbestos, taken from the ore body by hand and with only a small amount of sorting necessary, is reported to have ranged from $500 to $1000 a ton for lots of different grades. Annual requirements of this type of tremolite asbestos are stated by the buyer to be from 100 to 150 tons for the present with a probability of an expansion of the uses to which it could be applied if a sufficient quantity becomes available.

The four trenches dug on the tremolite prospects in

1943 lie almost at right angles to the trend of a sheared zone containing abundant asbestos float. (Fig. 3.) This zone is about 50 feet wide, over 300 feet long, and strikes about N. 60° E. Bedrock was reached in the trenches in a few places and one vein in place was then exposed. In Trench No. 1 (Fig. 3.) a large part of the material excavated was white, short asbestos fiber. The average thickness of the mat of tremolite in this cut was close to one foot. The vein exposed in Trench No. 1 was from 5 to 6 inches thick, with a strike of from N. 10° to N. 15° E. and a dip of about 70° SE. The vein material was snow white, silky, tremolite of little tenacity, in which impurities were practically absent. The asbestos samples were removed by hand from the veins in bundles up to 20 inches long. The fibers were parallel to the walls of the vein and to the structure of the scaly nephritic bedrock.

In Trench No. 2 the proportion of fibrous tremolite in material excavated was small. In Trench No. 3, at least half the float was asbestos and in Trench No. 4 there was also a high proportion of tremolite in the float excavated.

During 1944 a shallow pit was sunk on a steeply dipping lens of tremolite in Trench No. 4. Within a few feet the lens pinched out and another pit was then sunk on the vein in Trench No. 1. At the time of the visit to the deposit by the writer in 1944 a tremolite lens about 6 feet thick and 20 feet long was exposed in this trench, which was then about 8 feet deep. Structural relations were almost indistinguishable, as the walls of the lens could not be seen, and the bottom of the trench was a mass of smeared talcose fiber. Where it could be determined the strike of the lens, as well as that of the fibers, appeared to be about N. 50° E. and the dip was steep. It was estimated that almost two-thirds of the material in the lens was high-grade tremolite. The remainder of the vein material appeared to be mainly nephrite and steatite, a variety of talc.

In the winter of 1944 and 1945 an adit about 200 feet

long was driven to tap the tremolite lenses from below. One raise was driven from this adit to the bottom of the largest known tremolite lens. The lens was shown to be a shallow, canoe-shaped ore body containing about 45 tons of high-grade tremolite. Late in 1945 development work was begun on adjacent tremolite lenses and zones of tremolite float and this work is expected to be continued during 1946.

Nearly one thousand feet southwest of the large tremolite lens a hand-excavated trench and an 8-foot pit were dug on another deposit of float asbestos. There was an abundance of tremolite float present in the trench and pit, although it was reported that the vein in place had not yet been found.

About 22 tons of high-grade tremolite was sacked and shipped in 1944 and about 25 tons in 1945.

Ore Reserves:

The distribution of the areas of abundant tremolite float indicates that a number of lenses are present in the zone near the top of Asbestos Mountain. However, at the end of 1945, there was no ore actually blocked out. It is very unlikely that the high-grade tremolite will extend to a depth of much more than 15 or 20 feet or that the tonnage from any newly discovered lens will be much greater than that taken from the larger lens so far mined.

Proposed Operations:

It is suggested that further trenching, both by hand and by bulldozer, be done during 1946. New asbestos lenses should be first developed by open cuts and shafts sunk directly on the veins. The tunnel that was driven to tap the largest tremolite lens yet found should be extended to tap any other large adjacent lenses which may be found by surface prospecting. No milling facilities have been required, but it is possible that separation of tremolite from the impurities may be more difficult in other lenses.

Chrysotile Prospects

Narrow seams of long-fibered chrysotile are found on

faulted and slickensided surfaces in many of the massive serpentine outcrops on Dahl Creek. Most of the chrysotile is brown, slip-fiber asbestos of exceptional quality and length. The seams observed were two inches thick at the maximum, but usually less than an inch thick, and irregular in strike and dip. The length of the fibers is unusual, often exceeding 12 inches. At no place observed did the veins form a stockworks which could be considered minable.

About a ton of long, slip-fiber chrysotile was taken from a few of these veins during 1945 and was shipped to the continental United States.

Cross-fiber chrysotile is also found in the Dahl Creek serpentine area but so far only isolated, very narrow and discontinuous veinlets are known.

A few hundred feet east of the trenches near the top of Asbestos Mountain the zone containing tremolite float ends and for a short distance a large amount of chrysotile float is present. During mining operations on the tremolite, crosscuts to bedrock also should be made in this area.

Minerals associated with the chrysotile are massive serpentine, magnesite, antigorite and magnetite. A specimen of chrysotile and antigorite taken from near the mouth of Stockley Creek and submitted to the U. S. Bureau of Mines gave a good test for nickel.

Reserves:

A few tons of high-grade chrysotile could probably be recovered by sniping operations on outcrops now known in the Dahl Creek serpentine area. The value of the material would probably be at least a few hundred dollars a ton. No dependable supply of a reasonable quantity of chrysotile is assured from discoveries made thus far, but the area is worthy of a considerable amount of prospecting.

SHUNGNAK RIVER DEPOSIT

Lower Shungnak River is about 12 miles west of

Dahl Creek. Bismark Mt. is the first mountain north of the Kobuk River and immediately west of Shungnak River. (Fig. 4.) On the east slope of Bismark Mt. and from 8 to 10 miles north of the Kobuk River is a large area of ultrabasic rocks intruded into schists and containing some highly serpentinized asbestos-bearing rocks. In the Kobuk region the massive ultrabasic rocks weather to a brown color in sharp contrast to which highly serpentinized zones within these intrusives usually are whitish-green in color, support little or no vegetation, and are visible from great distances on clear days.

Several hundred feet below the summit of Bismark Mountain on its eastern slope claims were staked long ago on asbestos prospects but no development work was done until 1944. Here the asbestos occurs in a sheared and highly serpentinized part of the intrusive and when the writer visited the deposit in 1943 was observed mainly as fibers in a mass of scaly serpentine float about 800 feet long and several hundred feet wide. This mass of float is soft, incoherent and in places over 8 feet deep. It is composed almost entirely of small, whitish-green scales of serpentine with asbestos fibers still attached to many flakes. Some strong and silky, short, cross-fiber chrysotile was found. Much of the fibrous material is less than one inch in length and is lacking in tensile strength.

From surface indications it appears that the bedrock is a serpentine which has yielded to pressure by flowing in the solid state and has developed a scaly to fibrous structure. The asbestos occurs as short cross-fiber chrysotile and as slip-fiber chrysotile covering flakes of serpentine. The fibrous material probably comprises at least several per cent of the bulk of the bedrock as some of the scaly material breaks down into fibers. There were no bedrock exposures of the highly sheared serpentine. Outcrops of massive serpentine nearby show some tendency toward a fibrous structure, but no distinct veins of chrysotile were observed in place. Veinlets of magnesite are present in the area.

During 1944 trenching by hand and with a bulldozer was begun on the Shungnak River deposits and large samples of the bedrock were shipped to mills for testing. This work was done by the U. S. Bureau of Mines and a full report of their work has not yet been issued for general distribution. The amount of salable material recovered is said to compare with that from deposits now being operated in other parts of the world.

A colorless, glassy and somewhat brittle asbestiform mineral is common in serpentine areas on Shungnak River and Cosmos Creek. Specimens of the mineral sent to the laboratories of the U. S. Geological Survey and the University of Minnesota were identified as nemalite, an unusual variety of brucite. Only a few occurrences of nemalite have been recorded and no commercial uses have been developed as yet. If the mineral becomes available in quantity it may be possible that some utilization can be made of its most distinctive characteristic, a perfect cleavage which permits its subdivision into extremely fine, almost invisible fibers.

Reserves:

An estimate of reserves of chrysotile asbestos at the Shungnak River deposits is not possible from the surface exposures or from the small amount of development work done. Additional test runs in a commercial mill of large bedrock samples should be made to determine the percentage and value of recoverable fiber and the size of the ore body. The serpentine area on Shungnak River is now known to extend for over 2 miles and to contain asbestos in various parts of that area. Until the summer of 1944 it was virtually unprospected.

COSMOS CREEK DEPOSIT

Cosmos Creek is about 4 miles east of Shungnak River and about 8 miles west of the Dahl Creek tremolite deposits. (Fig. 4.) Just above the canyon on Cosmos Creek and about 11 miles from the Kobuk River is an asbestos deposit similar to the one just described on Shungnak

River but containing more important bedrock exposures of chrysotile.

Beginning a few hundrel feet west of the creek and extending for over half a mile to the northwest is a band of float rock several hundred feet wide and composed of whitish-green serpentine float. Also exposed are occasional blocky outcrops of serpentine. Over a distance of almost a quarter of a mile within this band of serpentine rocks silky, cross-fiber chrysotile occurs in networks of narrow veins in most outcrops observed. The serpentine in the outcrops is massive but is cut into blocks by chrysotile veinlets, which in places are as little as 6 inches apart and which cut the serpentine in two and three directions, roughly at right angles to each other. In other places the veins intersect, and bend and curve in many directions. The thickest veins observed were about three-fourths of an inch across and the longest fibers were about three-fourths of an inch long. Most of the veins were between one-quarter and one-half inch across and much of the fiber recovered would be as long as the veins are thick.

The examination of the Cosmos Creek deposit was made by the writer alone and under unfavorable conditions. No quantitative estimate of ore reserves was possible. Tests of the small samples that it was possible to carry out by pack show that they represent fiber of commercial value, similar to Rhodesian fiber but with less length and tensile strength. The asbestos occurrences had not been examined previously and no time was available in which to select and sample the most favorable areas.

During July 1945 the U. S. Bureau of Mines began development work on the Cosmos Creek deposit. This project was halted almost before it began at the end of the war with Japan.

WESLEY CREEK

About 6 miles west of the Dahl Creek tremolite mine and near the head of Wesley Creek the presence of other tremolite occurrences was noted by representatives of the

U. S. Bureau of Mines in 1944. Nephrite jade of gem quality is said to be found in places and directly associated with the asbestos at one of these deposits.

KOGOLUKTUK RIVER

The ultrabasic intrusive rocks, which in so many places in this region are asbestos-bearing, outcrop at least as far as 7 miles east of Dahl Creek on upper California Creek, a tributary of the Kogoluktuk River from the east. Specimens of float of cross-fiber chrysotile were found on the mountain slopes south of lower California Creek and amphibole asbestos was also observed there. No investigation of the asbestos possibilities in this area has ever been made.

JADE MOUNTAIN DEPOSITS

Jade Mountain is a highly serpentinized portion of an area of ultrabasic rocks that lies at the head of Jade Creek about 25 miles northwest of the Shungnak River asbestos deposits and about 8 miles north of the Kobuk River. Like other bodies of completely serpentinized rocks in the region this mountain is of conspicuous whitish-green color and can be seen from great distances by travelers on the Kobuk, although it is much lower than sharp peaks a short distance to the north. It lies within the range of mountains west of lower Ambler River that are called the Jade Hills. Very little is known of the geology of the Jade Hills.

The ultrabasic intrusive of which Jade Mountain is a part occupies an area of at least two square miles and probably covers a much larger area. Thin sections of specimens of the less altered rock show serpentine replacing olivine and pyroxene, with minor amounts of accessory minerals. The original rock was apparently peridotite. The most conspicuous part of Jade Mountain is the highly serpentinized and sheared area which forms its highest parts. There are comparatively few bedrock outcrops on the

mountain. Float material is almost all lustrous, greenish-white, slickensided scales and slabs of serpentine. Some of this serpentine contains small veinlets of cross-fiber chrysotile asbestos.

Near the top of the mountain and within the zone of scaly and slickensided serpentine float is a narrow zone of outcrops of schistose nephrite. About 1925 these outcrops were prospected both for asbestos and jade. This nephritic rock weathers brown, but on fresh surfaces is a light green color. The material exposed is an inferior type of jade and apparently is of no value. Slabs of nephritic float material containing white cross-fiber tremolite of considerable tensile strength were found in this area. The largest veinlet seen was about one inch thick.

About three-fourths of a mile north of a point where the mountain breaks abruptly upward from the Kobuk lowland there is an area in which bedrock is exposed for some distance along the banks of the creek cutting the eastern edge of the distinctive, whitish-green serpentine mass of Jade Mountain. For at least 600 feet horizontally and 300 feet almost vertically along the west bank of this creek there are many outcrops. A network of narrow, cross-fiber chrysotile veins, similar to the one described on Cosmos Creek but better exposed, is present throughout this outcrop area. Where observed the seams vary from a fraction of an inch to five-eighths of an inch across and average about one-quarter of an inch in thickness. In general they occur in three planes roughly at right angles to each other and cut the serpentinized peridotite into blocks. The veins apparently were formed by filling along joint planes. The distance between seams averages from 2 to 3 feet over the entire area. The fiber length of this chrysotile is shorter than that of the asbestos seen at Cosmos Creek. The veins themselves are narrower and most of the chrysotile fiber when split from the veins, breaks up into much shorter lengths, terminating on planes which are the result of successive depositions of chrysotile within each vein.

Many years ago a short tunnel was driven on a particularly favorable zone in the deposit. The veins in this tunnel are of about the same size and character as those observed in the outcrops. No other development work has been done.

Because of the shortness of the chrysotile fiber actual development work does not appear to be warranted at this place. However, other places on Jade Mountain should be more thoroughly prospected and it is known that asbestos occurs in other geologically favorable parts of the Jade Hills.

Specimens of bedrock from near Ambler River, at the eastern foot of the Jade Hills and about 10 miles from Jade Mountain, were found to contain small amounts of nickel in garnierite or a closely related mineral. No commercial importance is attached to the nickel occurrences so far observed in the Kobuk region.

JADE DEPOSITS OF THE KOBUK REGION

Float and bedrock occurrences of the nephrite variety of jade have been found in various places in the Jade and the Cosmos Hills from Jade Mountain on the west to a few miles east of the Kogoluktuk River, an airline distance of over 40 miles. The nephrite occurs as part of the bedrock in the asbestos-bearing areas and appears to represent one of the phases of the alteration of the ultrabasic intrusive rocks of the region.

By far the greater portion of the material is opaque, of poor quality and cannot possibly be classed as semi-precious stone. Some of the nephrite, however, is of gem quality and excellent jewelry has been made of pale to deep green translucent jade float from Shungnak River and from Jade Creek. Though representing only a small proportion of the total amount, the nephrite jade which can be considered as gem material or as semi-precious stone is probably present in large enough quantities to support a small jade cutting industry among the Kobuk

Eskimos, or to provide them with a moderate additional source of income if the material is sold in rough, uncut pieces to jewelers.

Boulders of nephrite have been found in the gravels of Jade Creek, Shungnak River, Dahl Creek, Cosmos Creek, and California Creek. Other streams cutting the asbestos-bearing formations undoubtedly carry jade boulders in their gravels but have never been prospected for jade and have very seldom been visited since the early stampede to the Kobuk region. Placer miners of the district refer to the nephrite boulders as "asbestos rock", deriving that name from their observations of the constant association of nephrite and asbestos.

At the mouth of the Shungnak River canyon many boulders of nephrite have been found. A single small boulder brought from there in 1944 by the writer furnished material for jade jewelry and for large cut and polished specimens of singular beauty. The bedrock source of the nephrite is in the bodies of ultrabasic rock in the canyon of Shungnak River. On Shungnak Mountain, adjacent to an asbestos deposit, there is also an occurrence of nephrite bedrock.

Deposits of nephrite in bedrock and also float nephrite have been found in the vicinity of Jade Mountain. The source of apple-green gem material brought from there is not known to the writer. Present day Eskimos maintain that much of the jade used by ancient tribes as tools and as articles of trade came from Jade Creek as well as from Shungnak River.

Nephrite boulders are common on Dahl Creek and on California Creek, a tributary of the Kogoluktuk River, but very little of this material approaches gem quality. On the east side of the summit of Asbestos Mountain there is said to be a large amount of dark to light green translucent nephrite, some of which may be of value.

Jade suitable for jewelry was found in 1944 by a U. S. Brueau of Mines field party between two stringers

of tremolite asbestos near the head of Wesley Creek. It is reported by Eskimos that jade of good quality has also been found on Mauneluk River, almost 20 miles east of any previously reported occurrences of either asbestos or jade.

During 1945 over five tons of placer jade was shipped from this district. Most of it was float picked up by Eskimos along the banks of Shungnak River. Smaller amounts came from Cosmos, Dahl, and Jade Creeks.

A large number of fine gem stones were cut from some of this jade by a Fairbanks concern and were on sale late in 1945 as the first Alaskan jade jewelry to be placed on the market. Much of the material has been sold in sawed slabs for use by amateur lapidarists. Some is reported to have been purchased by Chinese merchants for carving in China by the Chinese.

The selling price of jade varies according to quality of individual pieces. Rough material of unknown quality may sell for a dollar or two a pound in the Kobuk area, whereas a small finished cabochon of good quality may be valued from $5 up to $100 or more.

The region in which jade is known to occur is relatively unprospected. Prospectors for asbestos may be expected to find moderate amounts of jade of gem quality, both in place and as float, especially in the vicinity of tremolite deposits.