THE WHITEHORSE COAL AREA, YUKON TERRITORY

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
R. SPENCE TAYLOR
Expiry Date: March 26

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Edmonton, Alberta

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ADDENDUM

This report was delivered to Luscar Limited on 8 September, 1969. On 9 September, 1969 - through the sharp eye and quick action of R. W. Zeindler (Luscar Ltd.) - it was learned that the low B.T.U. values reported on the nine samples analyzed were gravely in error.

The B.T.U. values originally given in this report have been corrected as indicated by re-runs of all samples (Tables I and II, p. 22; Appendix A, p. 27 - 35, inclusive).

The Summary of this report is changed by the corrected B.T.U. data in the fourth paragraph only. That is, the best coal found is a high-ash anthracitic coal of higher quality than originally stated.

Conclusion 1 is changed as indicated in the paragraph above; the remaining four Conclusions hold true.

The Recommendation is modified, in that the higher quality of the coal makes this prospect more attractive economically. I say now, that if the Client considers the development of a coal mine in this particular area especially desirable, that this coal area merits further examination.

Richard Spence Taylor, Ph.D.
P. Geol. (Alta.)
P. Eng. (B. C.)

September 11, 1969

Expiry Date: March 26, 1970

SUMMARY

The areal extent of the coal-bearing Tantalus formation within the boundary of the coal reservations is significantly less than is shown on the Whitehorse geological map-sheet.

The coal measures were traced discontinuously over a distance of 7½ miles; six miles northwest of Coal Lake and 1½ miles southeast of the lake. The coal measures were found to be more disturbed structurally than was indicated prior to this summer's field work.

The discovery workings of 1900 were found, as were many old pits and trenches. The maximum number of coal seams found in any section of the measures was three, at two locations 1½ miles apart. At one location, the old discovery workings on Fisher Creek, the three seams from bottom up are 2' 2", 6' 2", and 10' 10" in thickness. At the second three-seam section, the seams in the same order are 2' 6", 2', and 2' in thickness. This latter section is in the markedly disturbed northwestern part of the work area. Elsewhere, with one exception, only one seam - or evidence for only one seam - was found in the measures. On Double Mountain there is some evidence for two seams.

The best coal found - in the Lower Bench of the Upper Seam in the Fisher Creek section - is a low quality (high ash) anthracitic coal with a thickness of 6' 6". The Middle Seam and Upper Bench, Upper Seam are so high in ash as to not merit being called coal. The Lower Seam is too thin to be of economic value. Only one other sample, from the measures 2½ miles southeast of the Fisher Creek section, yielded analytical values comparable to the best of that above.

Tonnage calculations based on the underground mining of one six-foot seam above valley-bottom base-levels in the Double Mountain, Camp 4 Ridge, and Camp 2 areas yields a tonnage estimate of 2,625,000 recoverable short tons.

Opportunities for strip-mining in the work area are negligible.

CONCLUSIONS

1. One low-quality, high-rank coal seam of mineable thickness was found.
2. This seam may extend along the coal measures for as much as three miles. The actual extent of the seam may be markedly less, or perhaps even more, than this.
3. Underground mining would be required; opportunities for strip-mining are negligible.
4. This would be a high-cost mining operation for any tonnage produced.
5. A prospecting programme designed to yield data adequate to permit a decision as to the feasibility of initiating a development programme would cost at least $100,000.

RECOMMENDATION

1. Unless there are very strong considerations impelling the Client to the development of a coal mine in this particular area, I recommend that this project be dropped.

THE WHITEHORSE COAL AREA, YUKON TERRITORY

INTRODUCTION

Report to:

Luscar Limited
918 Royal Bank Building,
Edmonton, Alberta

Terms of Reference:

The general terms of reference were discussed with Mr. R. W. Zeindler of Luscar Limited on 7 April, 29 May, and 14 July, 1969. No formal Terms of Reference were set down in Letter or Memorandum.

Crown Coal Reservations:

Pursuant to applications dated 2 April, 1969, Luscar Limited was granted for a period of three years, on 9 May, 1969, licences numbers 3, 4, and 5. These three coal exploration licences cover, respectively, the NW1/4 of Mineral Claim Staking Sheet 105D - 6 (approximately 47,468.75 acres), the NE1/4 of Mineral Claim Staking Sheet 105D - 6 (approximately 47,468.75 acres), and the SW1/4 of Mineral Claim Staking Sheet 105D - 11 (approximately 47,107.5 acres) for a total of about 142,045 acres. These three licences cover virtually all the Whitehorse Coal Area, excepting only two small areas that total less than one square mile, in the belt of Tantalus rocks southwest of Whitehorse (Map I).

Location and access, Whitehorse Coal Area:

Whitehorse, Y.T., may be reached via the Alaska Highway, by scheduled airlines from Alaska or the provinces, or by rail from Skagway, Alaska. This railroad - the White Pass and Yukon - passes within 10 to 12 miles to the eastward of the southern part of the area examined (Figure 1).

The Double Mountain section of the Tantalus formation, which bears the coal measures, can be reached by 11½ miles of fair to poor road and bulldozed track southwest from Robinson on the Whitehorse - Carcross highway. (Robinson is approximately 20 miles S.S.E. of Whitehorse.) From the end of this track at the west tip of Goat Mountain (reachable with two-wheel drive in dry weather) a trail goes 1½ miles farther up Two Horse Creek. From this point (site of Camp 1) it's about 2½ miles through the bush to the nearest Tantalus outcrops on Double Mountain. (Map II).

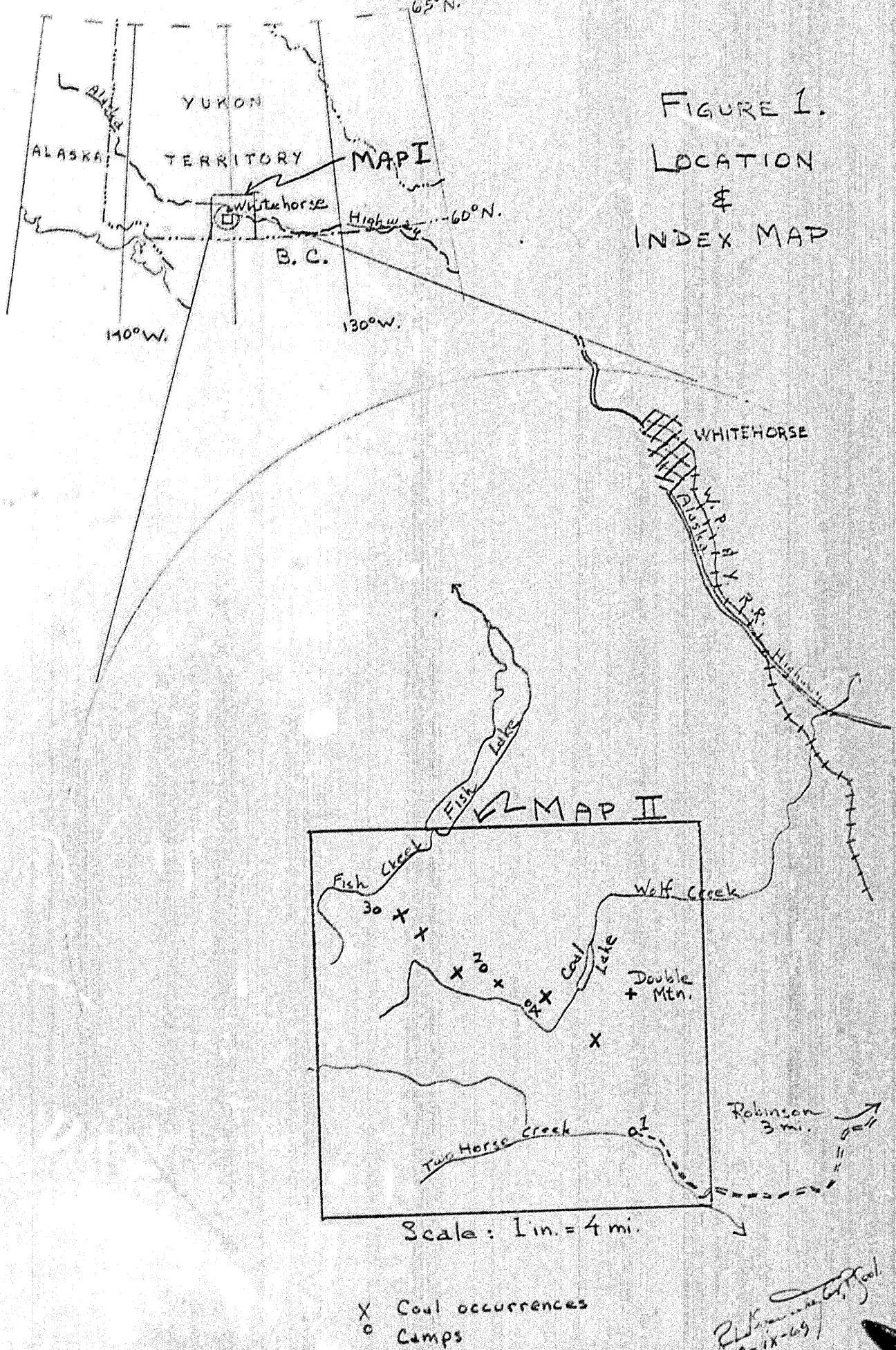


FIGURE 1.
LOCATION
&
INDEX MAP

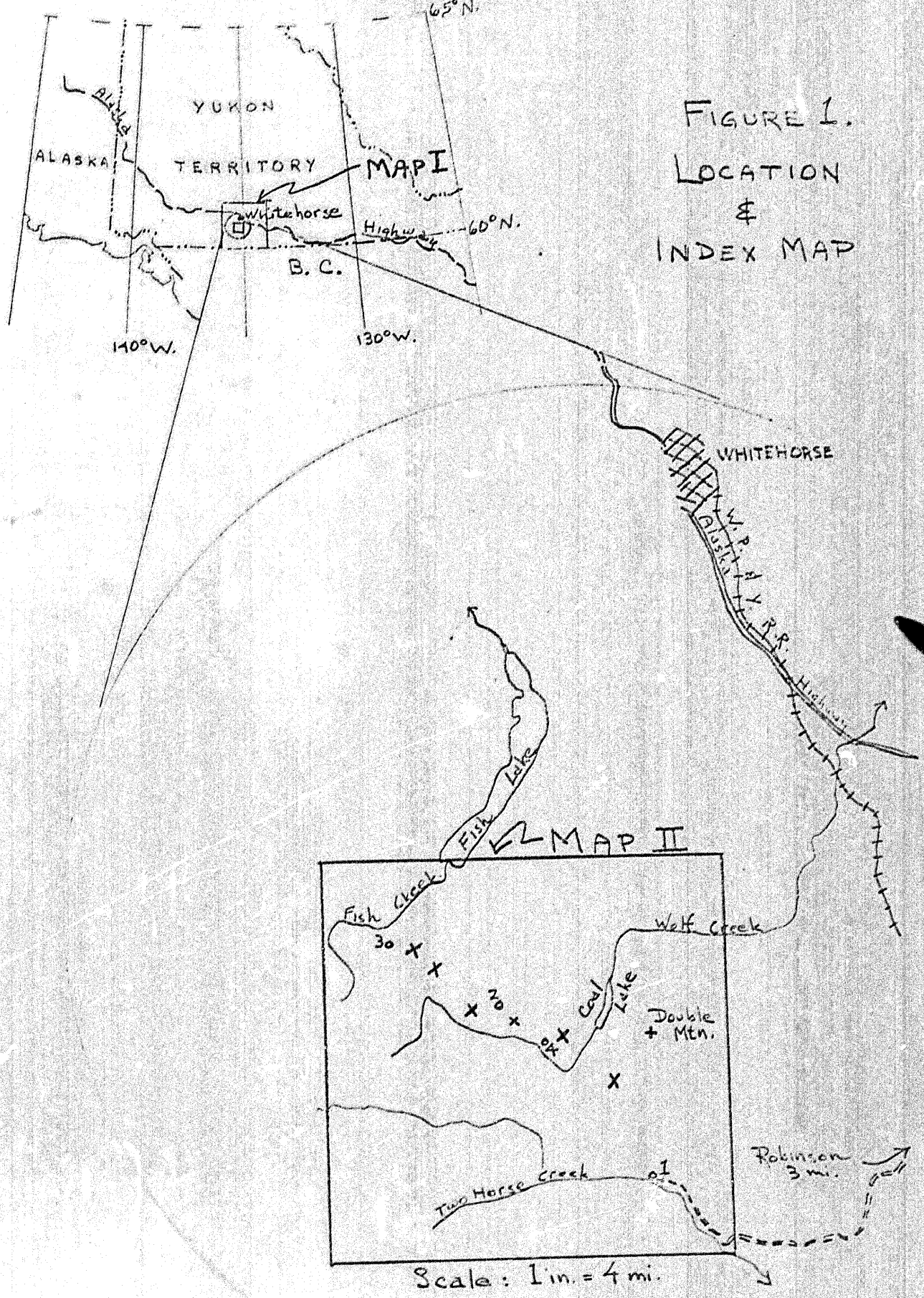


FIGURE 1.
LOCATION
&
INDEX MAP

All of the area can be reached handily by pack-train outfitted at either Carcross or Whitehorse, or by helicopter from Whitehorse airport. This latter method was used to establish Camps 2, 3, and 4. A Jet Ranger helicopter with a useful load of 1000 pounds, owned by Trans-North Turbo Air, was chartered for this work. The use of helicopters, combined with a radio transceiver in field camps, is the method I recommend for working in this country.

Duration and purpose of visit:

Whitehorse was reached on 22 July, and departure was on 20 August, 1969. Of this period of 29 days, all or parts of 25 days were spent in the field in four different camps. My field assistant for this work was A. J. Fisher.

Weather handicapped field work to a certain extent. It rained on six days, snowed or snowed and rained on nine others, and temperatures were at or below freezing on seven or more days. A windstorm (estimated gust velocities, 70 knots) in the early morning hours of 10 August destroyed one tent and blew down the other two tents of Camp 3.

The purposes of the field work were several: to verify data presented in old reports on prospecting work done in the Whitehorse Coal Area; to extend and amplify these data as much as practicable during the field examination; to determine if sufficient coal was present in mineable seams to be of interest to the Client; to determine whether opportunity existed for strip-mining or whether any mining would of necessity be entirely underground; and to acquire sufficient data to recommend a programme for further exploration and/or development work should the Client desire to carry this project forward.

Water; Power; Timber:

Most streams in the area of interest are intermittent and do not run all year long. Upper Fish Creek, upper Wolf Creek, and a left-bank tributary to Wolf Creek about a mile upstream of Coal Lake are probably the only perennial streams in the area. None of these three creeks carry more than a few cubic feet per second of water in the summer time. Fish and Coal lakes form large natural reservoirs, but the level of Fish Lake is controlled by Yukon Power and I do not know if water from this lake would be divertable.

The nearest existing sources of power are the diesel and hydroelectric plants of Yukon Power and the Northern Canada Power Commission in and near Whitehorse.

Timberline in the area of interest ranges between 4000' and 4500' A.S.L. At the latter elevation, trees (fir, pine, and aspen poplar) are scattered, scarce, and stunted. Usable timber is normally found only on valley flats and lower hillsides below 4000' A.S.L.

Methods of study:

Literature search: - Prior to leaving for the field area a detailed search of the literature was made for the period 1900 - 1969. Papers found of value to this study are cited appropriately within the text and listed within the last chapter of this report.

Field work: - With one exception, standard reconnaissance techniques were used. I and my field assistant usually made independent traverses. Sampling was done by myself at all locations. Sections were surveyed by pace-and-compass; coal seams were measured with tape and compass. Sketches included in this report are generalized and not to scale. Altimetry was carried out using a base altimeter for control and a field altimeter for spot elevations. The exception mentioned above was a Rokon Trail Breaker. I used it from Camp 1 for five days to reach and traverse most of the Double Mountain section.

GENERAL GEOLOGY OF THE WHITEHORSE COAL AREA

The layered rocks of interest in the work area consist of the Lewes River group (Upper Triassic in age), the Laberge group (Lower Jurassic and later), the Tantalus formation (Upper Jurassic (?) and Lower Cretaceous), and the Miles Canyon basalt (Pleistocene). All but the last of these have been intruded by rocks ranging from basalt to granite in composition (Map 1).

The marine Lewes River group of sedimentary and volcanic rocks - several thousand feet thick - consists of greywacke, siltstone, argillite, conglomerate, tuffaceous equivalents of the foregoing, limestone, and andesite and basalt flows and associated pyroclastics. All of the rocks of this group seen in the work area consist of volcanics that have been altered to greenstones.

The partly-marine Laberge group consists of greywacke, arkose, quartzite, conglomerate, siltstone, argillite, and hornfels several thousand feet thick. The most distinctive rock of this assemblage seen in the work area is the conglomerate: a greenish cobble conglomerate in which many of the cobbles are of medium-grained granitic material.

The non-marine Tantalus formation consists of a distinctive chert conglomerate, arkose, shale, minor argillite and sandstone, and coal. The distinctive grey and black chert pebbles of the conglomerate are usually an inch or less in diameter.

The Miles Canyon basalt was found only at the extreme northwest part of the area worked, where it lies on the Tantalus formation. There, it is dense, black, and fine-grained, and not over 100 - 150 feet thick.

In the work area the Tantalus formation has been down-faulted as a southeast to northwest-oriented wedge - point to northwest - between the two older groups of rocks. Its thickness varies from a reported 5000 feet in Double Mountain (Cairnes, 1912a, p. 58) to possibly no more than 500 feet in the small area northwest of Camp 3. The Double Mountain section may have its great thickness because of repetition by folding or faulting.

The Laberge and Tantalus rocks form part of the southwest limb of the Fish Lake syncline and have moderate to steep dips towards the northeast. In places in the work area local deformation has altered dip-directions to west of north.

Physiographically, the work area lies in the transition zone between the Coast Mountains and the interior Yukon Plateau. Valley bottoms are wide and relatively flat. Lower mountain slopes are steep, and lead up to gently rounded ridges or to

gently rolling upland surfaces. Minor tributaries to the valley streams are usually deeply incised, steep-walled, and commonly head in cirques.

The entire area has been ice-covered in the past to an elevation of 6000 feet or more. As a result, glacial debris mantles most slopes and occurs in depth in the valleys. Cirques characterize the higher elevations. Abandoned glacial meltwater channels are noticeable everywhere, incised into uplands and across ridge spurs. This is especially true on the Double Mountain upland where the aggregate length of the many old meltwater channels totals several miles.

Most of the above information comes from the best general reference to the entire map-area: Wheeler, 1961.

HISTORY OF THE WHITEHORSE COAL AREA

The first published notice of coal in this area was by R. G. McConnell of the Geological Survey, reporting on his work in the summer of 1900. He commented -

> " - - - , and during the last season [1899?] a possibly important discovery of anthracite coal was made west of Dugdale station on the White Pass railway and only a few miles from the White Horse copper District. The specimens sent in for examination are crushed and coarsely foliated. The following is the result of an analysis made in the laboratory of the Survey:
>
> | | |
> |---|---|
> | Hygroscopic water | 2.31 |
> | Volatile combustible matter | 5.59 |
> | Fixed carbon | 67.20 |
> | Ash | 24.90 |
> | | 100.00 |
>
> Coke per centage (non-coherent) 92.10
>
> The percentage of ash in the specimen assayed is high, but it is possible that a purer variety may be discovered in the course of the exploration now in progress." (McConnell, 1901, p. 33).

Dugdale station no longer exists, but it was at the intersection of Wolf Creek and the railroad.

In 1901 the discovery lands were surveyed by H. G. Dickson, D.L.S. of Whitehorse. The survey encompassed nine lots (nine $\frac{1}{4}$ - sections) totalling 1440 acres and were labelled the 'Black Diamond Coal Land' (Map III).

By 1906 three seams were known in the coal measures here: 2' 6", 10' 4", and 9' 8" thick from the bottom up. A 60-foot tunnel had been driven on the upper seam. At the face, the attitude of the seam was (strike) 297° T., (dip) 42° N.E. The general strike of the measures was reported as quite regular and about 286° T. It was felt probable that other coal seams occurred in the area (Cairnes, 1906, p. 28).

In 1908, Cairnes expanded the above data with four analyses that I include in the 'Quality of Coal' section of the next chapter. He also commented that no seams of coking coal were found (Cairnes, 1908, p. 258).

In 1912 Cairnes stated that the coal measures were followed for over five miles to the northwest of Coal Lake, and that it was claimed that they extended seven miles farther to the northwest. He also noted that the measures outcropped to the east of Coal Lake, but had not there been prospected or developed (1912b, p. 391).

Nothing found in the literature indicates that any work has been done on this coal since 1906, or even earlier: published papers of later date merely recapitulate the above data. However, many trenches and pits were found this past summer that

show that the old prospecting work was more widespread than the literature indicates.

Johnny Johns of Carcross told me that the U. S. Army Corps of Engineers investigated the coal on the 'Black Diamond Coal Land' in 1942 (personal communication, 1969).

A 5 $\frac{1}{2}$ oz. fruit-juice can with very little rust on it, found by us near the old workings immediately east of Camp 4, indicates the probability that someone investigated these coal occurrences in the past 5 - 15 years.

RESULTS OF INVESTIGATION

The Tantalus formation, Whitehorse Coal Area:

Extent:- The field work of the past summer showed that the actual area underlain by the Tantalus formation in the work area is significantly smaller than is shown on Map I. The presently-determined boundaries are shown in some detail on Maps II and IV. The intrusive and metamorphic rocks between Camps 2 and 3 may completely break the continuity of the formation in this area, although it is possible that some of the metamorphic rocks are unrecognizably altered forms of the Tantalus succession.

Stratigraphy and structure:- The dominant rock-type of the formation is a quartz and chert pebble-conglomerate. While this rock is in places poorly cemented, in general it is the most erosion-resistant of the Tantalus assemblage and thus forms the majority of outcrops. Characteristically, these outcrops take the form of low, rounded ridges with elevations of only 10 to 20 feet above that of adjacent slopes or depressions. The conglomerate bands, usually 50 feet or less thick, frequently have within them minor beds of arkose (similar to the matrix of the conglomerate) or - less commonly - shale or sandstone. All gradations exist from a buff, medium-grained arkose through grits to the more common brown pebble-conglomerate in which pebble diameter averages an inch or less.

Shale, usually fissile and black, commonly occurs in beds only a few feet thick and is sometimes interbedded with dark grey to purplish siltstones in thin alternating layers. However, several more massive occurrences of shale were noted, one being about 75 feet thick. The coal seams are associated with the black shales. At several places, where the effects of deformation are apparently greatest, the black shales might reasonably be called argillites.

Sandstones - as distinct from arkoses - are relatively uncommon, and only one good outcrop of a clean, light buff sandstone more than several feet thick was found.

In several localities, most notably close eastward of Camp 3 and between Camps 2 and 4, bands of a dark grey, fine- to medium-grained quartzite occur within the Tantalus. These rocks form prominent outcrops.

According to Cairnes (1910, p. 25), the coal measures in the Tantalus are near the top of the formation. In a later cross-section he depicts the coal as occurring in the upper third of the formation - approximately 600 to 850 feet above the base of a 1000-foot section (1912b, p. 369). As a generalization, this appears true for part of the work area, but not necessarily for all of it. It may well be that

where this generalization appears incorrect, repetition of beds by faulting and/or folding is involved.

One section of the coal measures was measured in some detail along the creek where most of the early work was done (Figure 2). This is the only place in the area investigated where such detail is available. The measured thickness of the section here is about 550 feet. The maximum thickness of the Tantalus formation in the Camp 2 area is not known; it is at least 1800 feet thick and may be markedly thicker than this.

The shales, siltstones, and sandstones - and sometimes the arkoses, too - are commonly concealed in depressions between conglomerate bands or, less commonly, between quartzite bands.

The regional structure of the Tantalus formation in this area, as shown on Map I, is a simple one: a wedge-shaped block down-faulted against the older Laberge rocks on the northeast and against the still-older Lewes River group on the southeast and southwest. In general, the Tantalus rocks have the moderate northeasterly dips of the adjacent Laberge rocks, towards the axis of the Fish Lake syncline. As a generality, the above is correct; in detail - as shown on Maps II and IV - this does not hold true locally. Dips as great as 80° were recorded in the field, and dips towards both the northwest and southwest were found.

Nothing was learned from the field work that contributes to a better understanding of the excessively thick Tantalus section in Double Mountain. Outcrops are uncommon there except in the banks of the few more deeply-incised glacial meltwater channels in the unpland surface.

The area of Tantalus outcrops on the ridge northeast of Camp 4 ('Camp 4 Ridge') probably totals less than 100 acres. While dips are steep there, the structure appears to be a simple and straightforward northwestward continuation of the trend found in Double Mountain.

Immediately south of Camp 4 a single outcrop of greenish volcanic rock indicates that some of the Lewes River rocks were carried down with the faulted Tantalus rocks here.

Between Camps 4 and 2 the structure appears simple - perhaps only because it's mostly concealed. Between Camp 2 and the old workings to the west the structure is obscure mainly because of a lack of outcrops that yield any information. The fold and fault shown on Map IV are the simplest solution to the indicated offset in bedding: this is probably not the correct solution. It does not, for example,

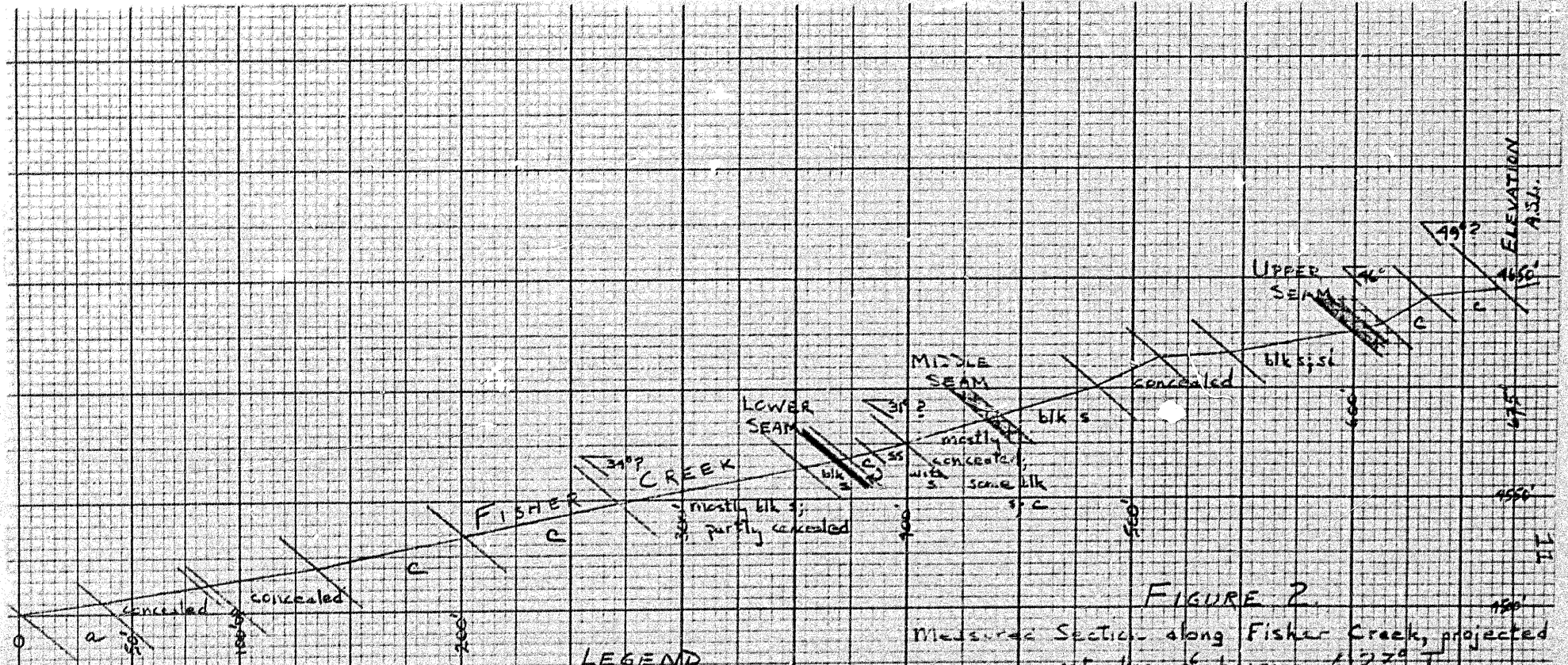


FIGURE 2.

Measured Section along Fisher Creek, projected onto line of bearing S 23° E.

Dip assumed at 40° N.E. throughout; observed dips shown above section where measured.

Scale: 50'

LEGEND

a	arkose
blk	black
c	conglomerate
q	quartzite
sh	shale
si	siltstone
ss	sandstone

explain the occurrence of coal bloom north of the northeast corner of Lot 33. More field data are required here.

Besides the above local complication, the strike of the conglomerate bands above and below the old workings on Fisher Creek is such as to indicate that these bands - faintly traceable through the mantle of glacial debris and thick buck-brush - continue on this trend until cut off by the fault along the adjacent valley. A similar impression of trend and truncation was gained while working over the Tantalus outcrops south of West Hill.

The Tantalus formation thus appears to be truncated at a high angle by the fault assumed to run along the southwest side of the formation. That is, the formation is thinned to the northwestward by the removal of successive beds from the base upwards by this fault.

The manner by which the Tantalus formation regains its upslope position to the northwest of the area of intrusive and metamorphic rocks is not known. It is obvious that folding or faulting, or both, must be present in this area to account for the displacement of the coal measures. In addition, what few field data were gathered in this part of the work area indicate that the Tantalus formation is most likely interrupted by the intrusive rocks, at least in the upper part of the Tantalus succession.

Closer to Camp 3 the structure appears somewhat simpler, and it is apparent that the formation is a good deal thinner (perhaps less than 1300 feet thick) than at Camp 2. Immediately southeast of Camp 3 it appears that the Tantalus fault-wedge is terminated, with some local deformation of bedding. West and southwest of Camp 3 it was found that volcanics of the Lewes River group are more widespread than is indicated on Map I.

The attitude of the Tantalus formation in the small area of outcrop across Fish Creek northwest of Camp 3 was not determinable. The total thickness of Tantalus rocks here, assuming a dip of 35° - 45° N.E., may be as little as 350 - 400 feet These rocks are covered at the top of this little ridge and hill by a thin sheet of the Miles Canyon basalt.

Although corrections are made to the mapped positions of parts of the major faults assumed to bound this Tantalus wedge, nothing was learned of the nature of these faults.

The Coal Measures:

Extent:- The coal measures have been traced discontinuously for seven and a half miles in two segments. In the six-mile segment northwest of Coal Lake, folding and faulting has occurred. The shorter Double Mountain segment is cut off at its southeast end by a fault.

Number and thickness of seams:- The maximum number of coal seams found in any one section is three. These occur at two separate locations: on Fisher Creek west of Camp 2, and on the creek one and a half miles southeast of Camp 3. Elsewhere, such as on East Hill near Camp 2, while the possibility of three seams is indicated by the extent of old workings, only one seam is known to exist within the measures. At some locations, the only evidence for even one seam is in the presence of frost-heaved coal in the form of small 'medallions' or in larger patches of black, coaly, soil (coal bloom). It is probable that in most - or all - such occurrences that the bedrock from which the coal debris has been frost-heaved is at a depth of at least five feet. This depth figure is concurred in by the Territorial Engineer as reasonable for the existing conditions (Baker, personal communication, 1969).

The various occurrences and old workings are discussed below from southeast to northwest.

Although Cairnes (1912b, p. 391) stated that Double Mountain had not been prospected or developed, either before or shortly after that date Double Mountain was prospected. On 28 July, 1969, the cairn shown on Figure 3 was found. Immediately below the remnants of the cairn on the floor of the meltwater channel a partly-overgrown, four-foot claim post (?) with two squared faces was located. This post and cairn showed effects of weathering and frost action of the same order of magnitude as those shown by the post and monument of Dickson's survey found west of Camp 2. This survey was made in April 1901 (Maps III, IV). Because this is the only part of Double Mountain in which any evidence of coal was found, the cairn was rebuilt and the post replaced. No evidence of old diggings was found anywhere on Double Mountain, so it appears that only the most preliminary prospecting was done there.

The distance between the conglomerate bands at and north of the cairn is such that the true thickness of the shale (with coal) underlying the channel appears to be 50 or 60 feet. The distribution of the coal bloom occurrences makes it appear that there may be two seams of coal here. One is indicated by the patch of bloom immediately below the cairn (which was sampled), the other - higher in the

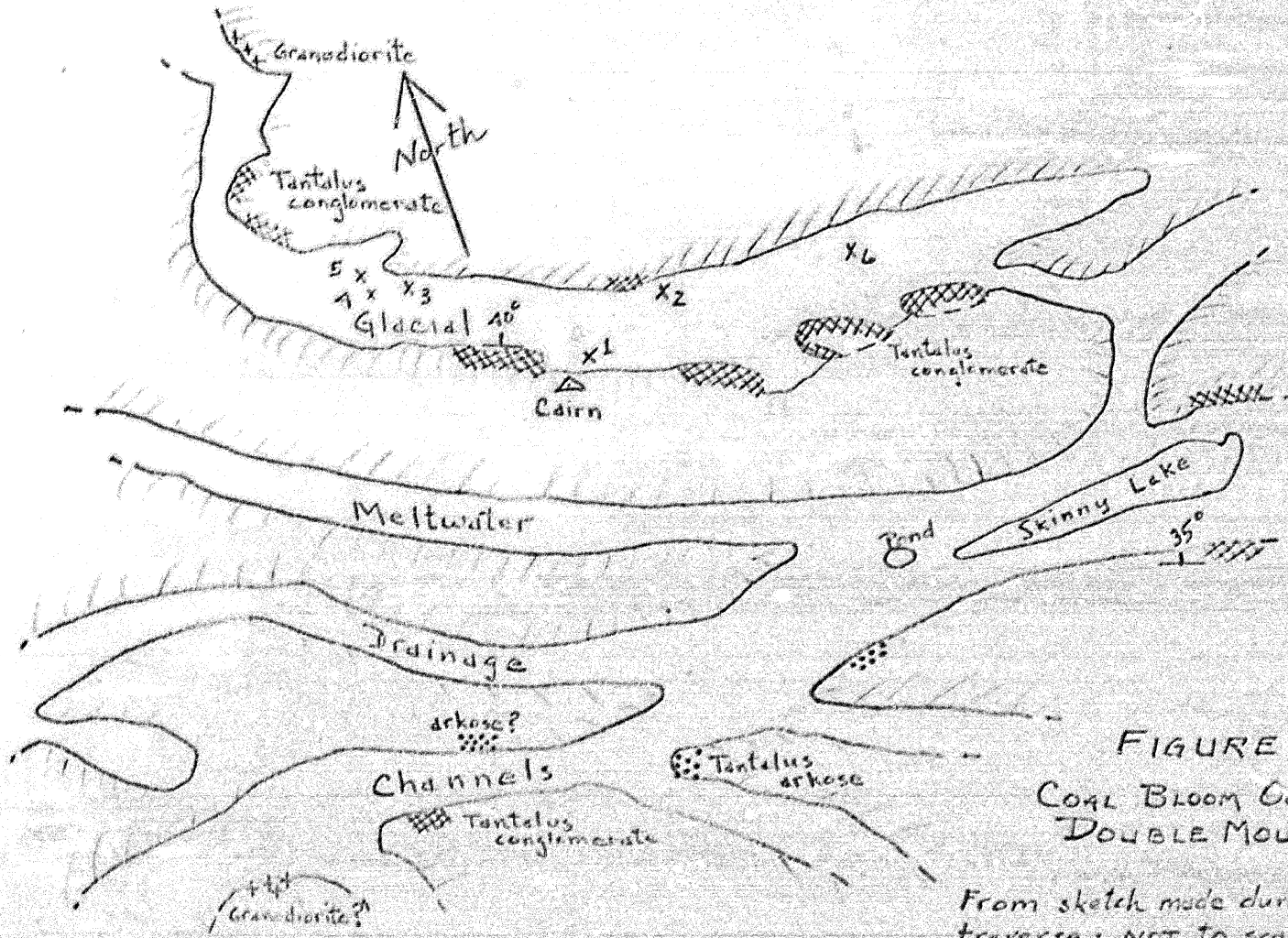


FIGURE 3.

COAL BLOOM OCCURRENCES, DOUBLE MOUNTAIN

From sketch made during field traverse: NOT to scale.

Distance from cairn to Skinny Lake uncertain, but probably 300 yards or less.

X Occurrence of coal bloom

section - by the five patches along and immediately below the upper (northern) conglomerate band. Nothing was learned of the thickness of the coal seams (?) here. Minor cross-faulting is shown by the small offset in the conglomerate wall immediately below and west of the cairn.

The topographic distinctiveness of the conglomerate bands associated with the coal measures here is shown on Figure 4.

The coal measures on Camp 4 Ridge are also shown on Figure 4. Greater detail in the vicinity of the old workings there is shown on Figure 5. These workings yield little evidence on seam thickness. The old trench was at least 15' x 3' x 3' (?) perpendicular to strike. However, much of its spoil appeared free of coal. The patch of bloom next to and slightly downslope of this trench, that we sampled with an 8' x $1\frac{1}{2}$' x $1\frac{1}{2}$' trench perpendicular to strike, had only six and a half feet of clean coal debris in its lower end. Conceivably, a three or four foot seam at depth could yield this amount of coal with the help of frost action and soil creep It is also possible that the coal debris extended farther downslope than our trench did; thus the underlying seam might well be thicker.

The side-hill pit, slightly upsection from (stratigraphically higher than) the old trench and immediately under the conglomerate, had little or no coal in its spoil. The available evidence indicates the presence of only one coal seam here. The true thickness of the coal-bearing section between the quartzite below and the conglomerate above appears to be in the order of 50 or 60 feet; it may be somewhat greater.

East Hill in the Camp 2 area is the site of several old trenches. The first found is shown on Map IV at elevation 4575'. What are possibly the remnants of two other trenches were noted on the slope below this one. However, soil flow is so active on this slope that no dimensional information was obtained. The relatively clean coal spoil,of the first-mentioned trench above, was sampled.

The highest workings on East Hill consist of two pits on the same line perpendicular to strike, and separated by eight to ten feet. The upper pit appears to have been about 12' x 4' x 3' ; the topographically and stratigraphically lower pit, 14' x 5' x 3+'. In gross appearance, they were dug for two seams separated by six to eight feet of shale. We sank a 4' x 4' pit three and a half feet deep into the lower of the old pits (which had the most coal in its spoil) and sampled heavily-weathered coal that appeared in place. This was about $4\frac{1}{2}$ - $5\frac{1}{2}$ feet below the original surface. No attempt was made to excavate the full width of the seam found here.

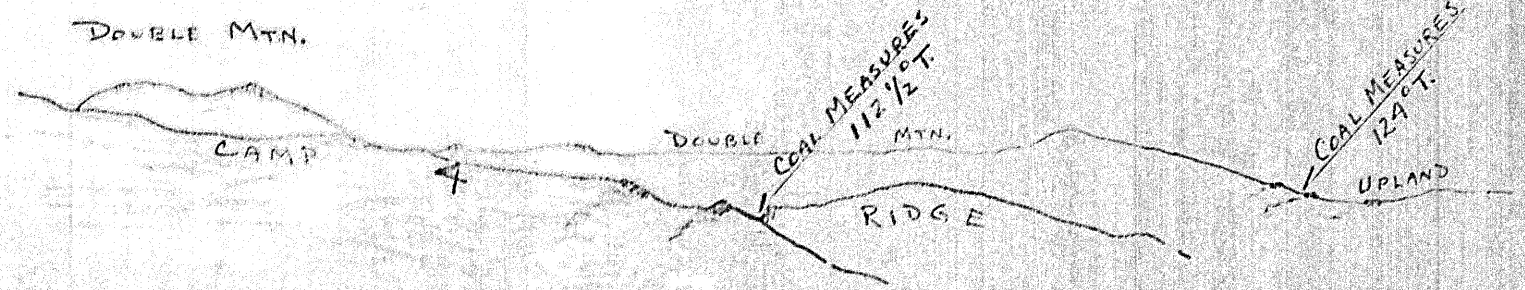


FIGURE 4.
COAL MEASURES OF DOUBLE MOUNTAIN AND CAMP 4 RIDGE.
Sketched from East Hill, Camp 2 area.
Distance to measures in Double Mountain: 3/2 miles;
in Camp 4 Ridge: 1 1/2 miles.

NOT to Scale

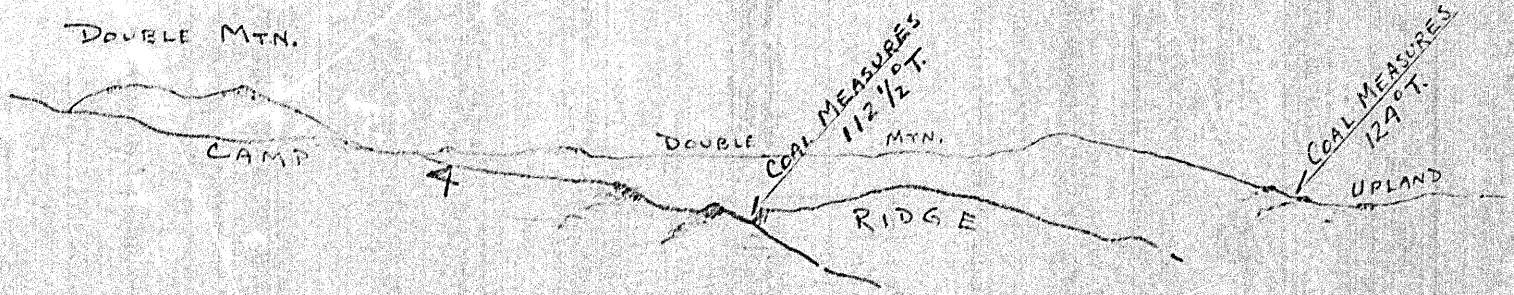


FIGURE 4.
COAL MEASURES OF DOUBLE MOUNTAIN AND CAMP 4 RIDGE.
Sketched from East Hill, Camp 2 area.
Distance to measures in Double Mountain: 3½ miles;
in Camp 4 Ridge: 1½ miles.

NOT to Scale

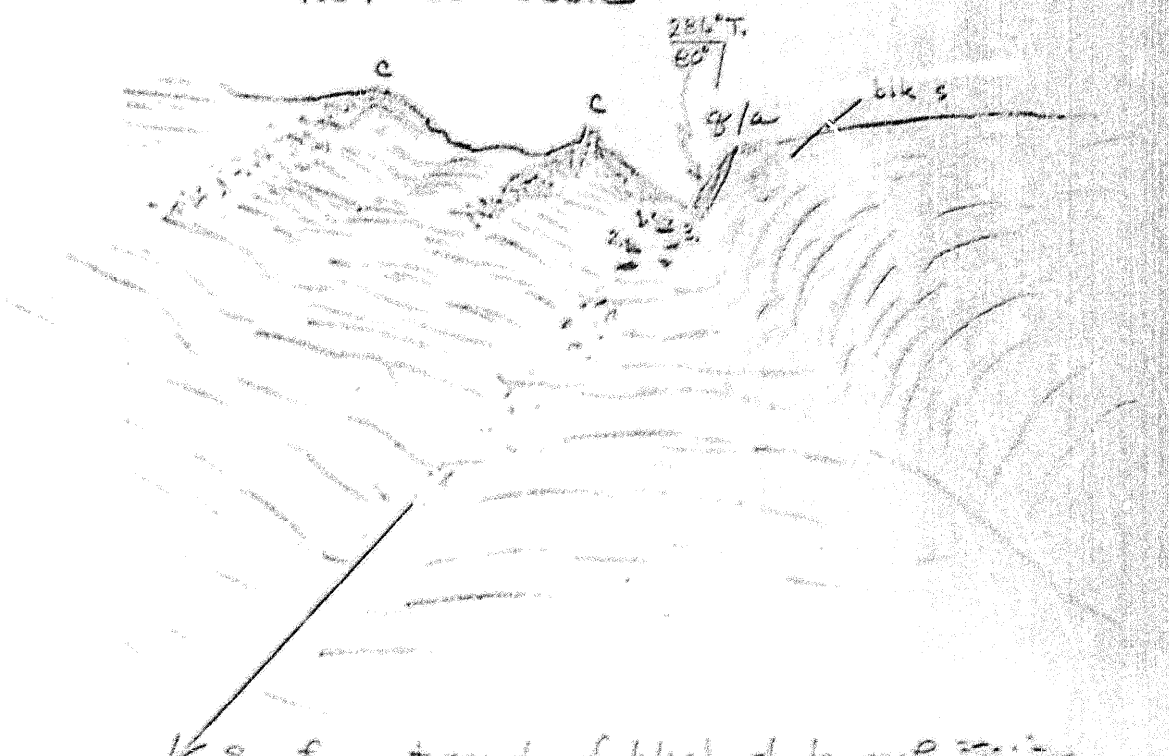
FIGURE 5.
Old workings, Camp 4 Ridge.

Sketched from west side of gap.

1. Old Trench
2. Old Side-hill pit
3. Sampled occurrence of coal bloom

a arkose
blk black
c conglomerate
q quartzite
s shale

NOT to Scale



Below these two pits - and nearly on the same line - another old trench about 12' x 3' x 3' was found, but its spoil showed much less coal than that of the two pits above. As is explained a bit later, both the above high pits are believed to have been sunk in a search for just one seam.

My work on East Hill was sufficient only to determine the presence of one seam, three-plus feet thick.

The stratigraphic interval between the conglomerates above and below the section with the high pits appears to be 50 to 60 feet thick. The coal measures here present a characteristic appearance duplicated in the two areas found to the southeast. Figure 6 shows this appearance in some detail. West Hill is a slightly larger and higher, virtual mirror image of that shown in Figure 6, differing only in having a slightly wider, non-coal-bearing (?) shoulder on its north side.

It is because of this characteristic topographic expression of the coal measures that the measures are mapped as running out W.N.W. of West Hill (Map IV) along the ridge-line, rather than being swung farther to the northward to enclose the line of coal bloom at the foot of the high ridge.

On West Hill the most extensive of the old workings are those immediately southeast of the peak. These consist of two bench-cuts on the slope - one immediately upslope and along strike from the other. The reason for this is obscure: of necessity, both would have to be on the same seam. The lower and larger one measured about 18 feet on contour with a four to five-foot face. We re-excavated this cut across 14 feet of the face and cut the face back 1½ - 2 feet to a depth of four feet to obtain cleaner material for our sample. The coal seam here is 6' 6" thick and has siliceous black shale as floor and roof.

Downslope to the eastward along the measures an old trench was found at about the same rock horizon. To the westward 500 feet along the measures a third trench was located, but this one appeared shallow, incomplete, and showed no coal at all in its spoil. No additional information was gained from these latter two trenches, nor was any evidence of coal found along the measures - as mapped - to the west of the bench-cut atop West Hill. Thus, in West Hill, one 6' 6" seam is known.

The main coal shows are those along Fisher Creek, depicted on Figure 2. Three seams occur in slightly over 200 feet of section. These seams are, from bottom to top, respectively, 2' 2", 6' 2", and 10' 10" thick. All three seams were sampled, the upper in two benches.

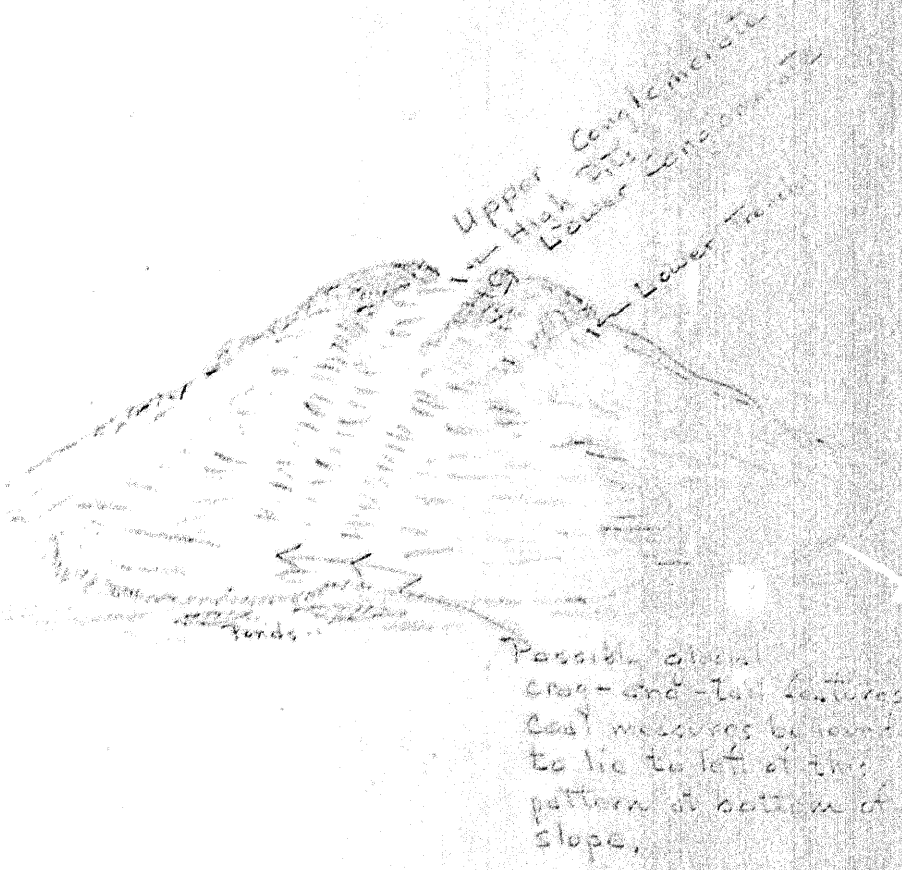


FIGURE 6.
Old workings in Coal Measures,
EAST HILL, CAMP 2.

Sketched from bench-cut, West
Hill, with upper pits bearing 140° T.
NOT to Scale.

There is no question but that this is the area described by Cairnes 60-plus years ago. The collapsed portal of the old tunnel was found in the right bank of the creek opposite our bench-cut across the upper seam. Camp debris was found on the same bank slightly downstream of the portal. In making the upper-seam bench-cut, we evidently repeated work of sixty-plus years ago. Within the material we removed we found an old shovel and - 30 inches below the surface - an old long-handled prospector's pick.

The stratigraphic interval between the two lower, and the upper, seams is about 130 feet. This would make it appear that most of the old workings described earlier in my report were done either in search for the upper seam or for the middle seam, and most likely the former. This explanation - of concentrated prospecting for the upper seam - best fits the pattern of old workings on East Hill. It also says that the upper pit atop East Hill was probably dug first and missed the seam and that the lower pit is larger because it was dug into the seam.

Before ending my discussion of the Camp 2 area, I should note that the second coal occurrence shown within the work area on Map I - about a mile northwest of East Hill - does not in fact exist. The rocks in this area are of the Laberge group rather than of the Tantalus formation as shown on Map I. Two days of field traversing failed to reveal any evidence of coal in the immediate area of the mapped occurrence, nor is the Laberge group known to be coal-bearing within the area covered by Map I.

Information on number and thickness of seams was next gathered on the creek one and a half miles southeast of Camp 3. At elevation about 5040' on the creek a contorted band of coal/bony coal outcrops in the left bank. This coal - crushed, finely foliate, and dirty - varies from about $2\frac{1}{2}$ - 4 feet thick in this very limited exposure. The enclosing shale is markedly disturbed and it is evident that the coal has been squeezed. Upstream of this occurrence 150 feet are two two-foot bands of coal about 20 feet apart within black shale, and also in the left bank.

The stratigraphic interval between the lower, and the two upper, seams is about 140 feet. This is much the same value as that found in the Fisher Creek occurrence, but there the sequence consists of two lower and one high seam - the reverse of that found here. While I don't hesitate to regard this section as part of the same coal-bearing horizon in the Tantalus formation, I will not attempt to correlate these two sets of three seams. There is no guarantee of individual coal-seam continuity within these measures. It is quite possible that one seam pinches out while another - at a slightly different horizon - appears and maintains the

continuity of the measures.

So - three seams of crushed coal aggregating a bit over six feet, in markedly disturbed rocks. The Tantalus formation here may be no more than 1000 feet thick - a marked decrease from that of the Camp 2 area. Rocks of the Laberge group occur just 300 feet upstream of the highest coal seam here. Thus, some of the thinning of the coal and disturbance of the enclosing Tantalus rocks here may have been caused by the fault between the Laberge and Tantalus rocks having cut down-section through the upper part of the Tantalus formation to more closely approach the coal measures and to more directly affect them.

The northwesternmost occurrence of the coal measures was found upstream on the creek passing Camp 3. At elevation 4730' on the right bank of the creek, coal bloom was found immediately above an outcrop of massive Tantalus conglomerate. This bloom consisted mostly of the debris of black shale; in the surficial materials I found only a half-dozen small pieces of coal/bony coal. While other patches of black soil were found to the eastward and southeastward, they appeared to contain little or no coal. At the best, one seam of coal of unknown thickness is indicated here.

Such coal as does occur in the above section must be markedly disturbed - that is, intensely foliate and crushed. The fragments of siliceous shale associated with the measures here are in smaller - more intensely broken - fragments than were observed elsewhere in the entire work area.

The marked change of strike in the Tantalus rocks down the creek from the measures indicate the probable end of this faulted wedge of Tantalus rocks.

Quality of coal:- Nine samples were taken and submitted for analysis. The analytical data, with descriptive notes, make up Appendix A.

Few data are available from the old workings in the field area; only five analyses were located in the literature. The oldest of these five was given by McConnell (1901, p. 33) in the first report on the discovery of coal in this area. The other four were all reported by Cairnes in 1908 (p. 258), and are of the seams along Fisher Creek.

All of the available analytical data are given in Tables I and II.

It is apparent that the best of this material is a low-quality, high-ash, anthracitic coal. Much of it - with coal defined as containing less than 40% of inorganic compounds on a dry basis (A.G.I., 1957, p. 55) - should not be called coal.

TABLE I

COAL: ANALYTICAL DATA, MOIST BASIS[1]

	McConnell, 1901[2]	Cairnes, 1908a Lower Seam	1969 Lower Seam	Cairnes, 1908b Middle Seam	Cairnes, 1908 Middle Seam	1969 Middle Seam	Cairnes, 1908 Upper Seam	1969 Up. Seam Lower Bench	1969 Up. Seam Upper Bench	1969 West Hill[3]	1969 East Hill Pit[3]	1969 East Hill W.M. Hole[3]	1969 Camp A Trench[4]	1969 Double Mtn.[3]
Moisture Content	2.31 %	3.76 %	8.4 %	3.78 %	2.35 %	4.3 %	2.15 %	4.5 %	6.3 %	4.7 %	13.8 %	19.1 %	17.7 %	12.4 %
Ash	24.90	25.40	32.5	47.78	48.73	61.6	21.98	36.5	52.1	52.4	58.4	51.8	32.1	55.6
Volatile Matter	5.59	8.34	11.7	10.06	6.65	9.4	6.01	10.0	7.3	11.3	8.8	10.8	9.5	12.4
Fixed Carbon	67.20	62.50	47.4	38.38	42.27	24.7	69.86	49.1	34.0	31.6	13.0	18.4	40.8	19.5
B.T.U.'s	–	–	7820	–	–	4287	–	8124	5514	5445	2719	3238	5832	3672
FIXED CARBON[5]	95.1	91.3	84.1	87.1	–	85.5	94.5	87.8	–	–	–	–	85.9	–
RANK	Anthracite	Semi-Anthracite	Low Vol. Bit.	Semi-Anthracite	–	Low Vol. Bit	Anthracite	Semi-Anthracite	–	–	–	–	Low Vol. Bit	–

TABLE II

COAL: ANALYTICAL DATA, DRY BASIS[1]

	McConnell, 1901[2]	Cairnes, 1908a Lower Seam	1969 Lower Seam	Cairnes, 1908b Middle Seam	Cairnes, 1908 Middle Seam	1969 Middle Seam	Cairnes, 1908 Upper Seam	1969 Up. Seam Lower Bench	1969 Up. Seam Upper Bench	1969 West Hill[3]	1969 East Hill Pit[3]	1969 East Hill W.M. Hole[3]	1969 Camp A Trench[4]	1969 Double Mtn.[3]
Ash	25.5 %	26.4 %	35.4	49.7 %	49.9 %	64.3 %	22.4 %	38.2 %	55.7 %	55.0 %	67.7 %	63.9 %	39.0 %	63.5 %
Volatile Matter	5.7	8.7	12.7	10.4	6.8	9.9	6.2	10.4	7.9	11.8	10.2	13.3	11.5	14.7
Fixed Carbon	68.8	64.9	51.8	39.9	43.3	25.8	71.4	51.3	36.3	33.2	22.1	22.7	49.5	22.2
B.T.U.'s	–	–	8537	–	–	4479	–	8501	5901	5710	3153	4000	7208	4192

1 Refer to text, and Appendix A for details of 1969 samples.

2 Seam not known, most probably Upper Seam, Fisher Creek.

3 Correlation with any Fisher Creek seam uncertain; most closely resembles data of Middle Seam.

4 Correlation with any Fisher Creek seam uncertain; with thickness, most closely resembles data of Lower Bench, Upper Seam.

5 FIXED CARBON from moist condition by PARR FORMULA (A.S.T.M., 1966, p. 77) to dry, mineral-matter-free condition. Sulphur assumed to be 0.5 %

a Average outcrop sample, 2'6" seam

b Average outcrop sample 10'2" seam (Middle Seam).

c Average outcrop sample Middle Seam in creek below camp.

d Average sample 9'8" seam at end of 60' tunnel

TABLE I

COAL: ANALYTICAL DATA, MOIST BASIS[1]

	Mesonell 1901	Cairns 1968 Lower Seam	1968 Lower Seam	Cairns 1968 Middle Seam	Cairns 1968 Middle Seam	1968 Middle Seam	Cairns 1968 Upper Seam	1969 Up. Seam Lower Bench	1969 Up. Seam Upper Bench	1969 West Hill	1969 East Hill	1969 East Hill Wall	1969 Camp 4 Trenches	1969 Double Mtn.
Moisture content	2.31%	3.76%	8.4%	3.78%	2.35%	4.3%	2.15%	4.5%	6.3%	4.7%	13.8%	19.1%	17.7%	12.4%
Ash	24.90	25.40	32.5	47.78	48.73	61.6	21.98	36.5	52.1	52.4	58.4	51.8	32.1	55.6
Volatile Matter	5.59	8.34	11.7	10.06	6.65	9.4	6.01	10.0	7.3	11.3	8.8	10.8	9.5	12.4
Fixed Carbon	67.20	62.50	47.4	38.38	42.27	29.7	69.86	49.1	34.0	31.6	13.0	18.4	40.8	19.5
B.T.U.'s	—	—	7820	—	—	4287	—	8124	5514	5445	2719	3238	5932	3672
FIXED CARBON[5]	95.1	91.3	84.1	87.1	—	85.5	54.5	87.8	—	—	—	—	85.9	—
RANK	Anthracite	Semi-Anthracite	Low Vol. Bit.	Semi-Anthracite	—	Low Vol. Bit.	Anthracite	Semi-Anthracite	—	—	—	—	Low Vol. Bit.	—

TABLE II

COAL: ANALYTICAL DATA, DRY BASIS[1]

Ash	25.5%	26.4%	35.4	49.7%	49.9%	64.3%	22.4%	38.2%	55.7%	55.0%	67.7%	63.9%	39.0%	63.5%
Volatile Matter	5.7	8.7	12.7	10.4	6.8	9.9	6.2	10.4	7.9	11.8	10.2	13.3	11.5	14.2
Fixed Carbon	68.8	69.9	51.8	39.9	43.3	25.8	71.4	51.3	36.3	33.2	22.1	22.7	49.5	22.2
B.T.U.'s	—	—	8537	—	—	4479	—	8501	5901	5710	3153	4000	7208	4192

1 Refer to text and Appendix A for details of 1969 samples.

2 Seam not known, most probably Upper Seam, Fisher Creek.

3 Correlation with any Fisher Creek seam uncertain; most closely resembles data of middle seam.

4 Correlation with any Fisher Creek seam uncertain; with thickness, most closely resembles data of lower Bench, Upper Seam.

5 FIXED CARBON from moist condition by PARR FORMULA (A.S.T.M. 1942, p. 77) based on mineral-matter-free condition. Sulphur assumed to be 0.5%

a Average outcrop sample, 2'6" seam

b Average outcrop sample 12'2" seam (Middle Seam).

c Average outcrop sample Middle Seam in creek below camp

d Average sample 9'8" seam at end of 69' tunnel

From an economic point of view, only one seam is of sufficient quality and thickness to merit further consideration. This is the Upper Seam of the Fisher Creek section as measured by Cairnes; only the Lower Bench of my Upper Seam falls into this category. The Lower Seam of this section is too thin; the Middle Seam is too dirty.

Further study of the tabulated data reveal two other facts of interest. The 6' 6" seam I sampled in West Hill most closely resembles the Fisher Creek Middle Seam, a fact noted in the field while sampling. The East Hill and Double Mountain samples also most closely resemble the Middle Seam, although it is not perhaps fair to compare them with any seam. The Camp 4 trench sample, on the other hand, is markedly higher in quality than any of those from - or resembling - the Fisher Creek Middle Seam. It can only be compared with the Lower or (Cairnes') Upper Seams on Fisher Creek, or with my Lower Bench, Upper Seam.

The above notes lead to the conclusion that it is quite possible that the old workings - and my samples - on West and East hills are in and of the equivalent of the Fisher Creek Middle Seam. This, despite my earlier comment to the effect that the old prospecting had been concentrated on the Upper Seam. It may well be that there is a coal seam of higher quality farther up in the coal measures east and southeast of Fisher Creek, that neither the old timers nor I found, excepting perhaps in the Camp 4 trench.

It will also be noted that the seam samples I took are consistently dirtier (by 7 - 15%) than those taken 60-plus years ago. It is obvious that - disregarding the tunnel-face sample on the Upper Seam - the old timers dug deeper and got cleaner samples than I did. There is no doubt in my mind that most of the higher ash contents of my samples are caused by surficial contamination related to both weathering and our digging operations.

Estimates of tonnage:-There is only one seam on which estimates of tonnage can reasonably be based at the present time - the highest known seam in the coal measures. This is Cairnes' Upper Seam on Fisher Creek and its equivalents elsewhere (Camp 4 Ridge?).

Cairnes said that the seam in the tunnel face was 9' 8" thick; My sampled equivalent - the Lower Bench, Upper Seam of roughly comparable quality - is only 6' 6" thick and contains 10" of siltstone/bony coal in six bands (not included in my sample). The material of the Upper Bench (4' 4" thick) that I sampled is of such poor quality as to merit no further consideration. It does, however, point up the possibility of marked variation in quality-of-coal within any one seam along the measures.

On these limited data, I regard it as unwise at present to base tonnage estimates on a usable seam thickness of more than six feet, with 50% recovery. This is on the assumption of underground mining - opportunities for strip-mining in the area examined are regarded as negligible.

In addition, until such time as information on the nature and condition of this seam at depth is available, I regard it as equally unwise to calculate tonnages based on coal below adjacent valley-bottom base-levels. There is still much to be learned in the work area regarding the degree of structural disturbance. Because of the disturbance that has been noted northwest of the igneous and metamorphic rocks, northwest of Fisher Creek, no tonnage estimate is made for this part of the coal measures.

The following estimates are first approximations only, and the calculations are simplified as much as possible. Only three panels are considered: Double Mountain, Camp 4 Ridge, and the Camp 2 area east of a point in the measures 0.6 mile west of Fisher Creek.

On the above bases, and using a specific-gravity value of 1.58 for a semi-anthracite coal with about 25% ash (Stansfield and Lang, 1944, p. 105), the following tonnage estimates are obtained for Double Mountain, Camp 4 Ridge, and the Camp 2 area, respectively: 900,000, 300,000, and 1,425,000 for a total of 2,625,000 recoverable short tons.

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APPENDIX A

Coal Analyses

PHONE 469-2391

CREST LABORATORIES LTD.

B.C. REGISTERED ASSAYERS
INDUSTRIAL and RESEARCH CHEMISTS

7911 ARGYLL ROAD
EDMONTON, ALBERTA

September 10. 1969.

CORRECTED RESULTS.

Spence Taylor & Associates Ltd.,
Suite 301 - 8621 - 109 Street,
Edmonton, Alberta.

Lab No. 1109 Sample Marked: 1359B (Fisher Creek - 30" Seam) R.S.T.
Lower Seam R.S.T.

The results of the requested analyses of the above sample are as follows:

	As Received	Dry Basis
Moisture	8.4	
Ash	32.5	35.4
Volatile Matter	11.7	12.7
Free Carbon	47.4	51.8
B.T.U.'s	7,820	8,537

Yours very truly,

CREST LABORATORIES LTD.

R. Sawyer,
Chemist.

Annotated, 11-ix-69:
True width of seam, 26 inches.
Sample does not include a one-inch band of siltstone within seam. R.S.T.

RS/bb

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INDUSTRIAL and RESEARCH CHEMISTS

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EDMONTON, ALBERTA

September 10, 1969

CORRECTED RESULTS.

Spence Taylor & Associates Ltd.,
Suite 301 - 8621 - 109 Street,
Edmonton, Alberta.

Lab No. 1104 Sample Marked: 1352B (Fisher Creek, R.S.T. Middle Seam)

Dear Sir:

The results of the requested analyses of the above sample are as follows:

	As Received	Dry Basis
Moisture	4.3	
Ash	61.6	64.3
Volatile Matter	9.4	9.9
Free Carbon	24.7	25.8
B.T.U.'s	4,287	4,479

Yours very truly

CREST LABORATORIES LTD.

R. Sawyer,
Chemist.

RS/bb

Annotated, 11-ix-69:
True width of seam, 74 inches.
Sample does not include one three-inch siltstone band within seam. R.S.T.

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CORRECTED RESULTS

Spence Taylor & Associates Ltd.,
Suite 301 - 8621 - 109 Street,
Edmonton, Alberta.

Lab No. 1103 Sample Marked: 1351B (Fisher Creek, R.S.T. Upper Seam - Lower Bench)

Dear Sir:

The results of the requested analyses of the above sample are as follows:

	As Received	Dry Basis
Moisture	4.5	
Ash	36.5	38.2
Volatile Matter	10.0	10.4
Free Carbon	49.1	51.3
B.T.U.'s	8,124	8,501

Yours very truly,

CREST LABORATORIES LTD.

R. Sawyer,
Chemist.

Annotated, 11-ix-69:
True width of bench, 78 inches.
Sample does not include ten inches of siltstone and bone in six, 1 - 2 inch bands. R.S.T.

RS/bb

- 30 Corrected -

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EDMONTON, ALBERTA

September 10, 1969.

CORRECTED RESULTS.

Spence Taylor & Associates Ltd.,
Suite 301 - 8621 - 109 Street,
Edmonton, Alberta.

Lab No. 1108 Sample Marked: 1358B (Fisher R.S.T. Creek Upper Seam - Above ~~.05 lime~~ ss lens. R.S.T. Upper Bench)

Dear Sir:

The results of the requested analyses of the above sample are as follows:

	As Received	Dry Basis
Moisture	6.3	
Ash	52.1	55.7
Volatile Matter	7.3	7.9
Free Carbon	34.0	36.3
B.T.U.'s	5,514	5,901

Yours very truly,

CREST LABORATORIES LTD.

R. Sawyer,
Chemist.

Annotated, 11-ix-69:
True width of bench, 52 inches.
Sample does not include a six-inch band of siltstone within seam.
R.S.T.

RS/bb

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EDMONTON, ALBERTA

September 10, 1969.

CORRECTED RESULTS.

Spence Taylor & Associates Ltd.,
Suite 301 - 8621 - 109 Street,
Edmonton, Alberta.

Lab No. 1105 Sample Marked: 1353B (~~North~~ West R.S.T. Hill Seam)

Dear Sir:

The results of the requested analyses of the above sample are as follows:

	As Received	Dry Basis
Moisture	4.7	
Ash	52.4	55.0
Volatile Matter	11.3	11.8
Free Carbon	31.6	33.2
B.T.U.'s	5,445	5,710

Yours very truly,

CREST LABORATORIES LTD.

R. Sawyer,
Chemist.

RS/bb

Annotated, 11-ix-69:
True width of seam, 78 inches.
Sample does not include a two-inch clay-shale band 28" above the shale floor. Top 22" of seam has about 14" of bony coal. R.S.T.

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INDUSTRIAL and RESEARCH CHEMISTS

7911 ARGYLL ROAD
EDMONTON, ALBERTA

September 10, 1969

CORRECTED RESULTS

Spence Taylor & Associates Ltd.,
Suite 301 - 8621 - 109 Street,
Edmonton, Alberta.

Lab No. 1107 Sample Marked: 1357B (~~South~~ East R.S.T. Hill - High Trench - ~~West~~ Low R.S.T. Pit)

Dear Sir:

The results of the requested analyses of the above sample are as follows:

	As Received	Dry Basis
Moisture	13.8	
Ash	58.4	67.7
Volatile Matter	8.8	10.2
Free Carbon	19.0	22.1
B.T.U.'s	2,719	3,153

Yours very truly,

CREST LABORATORIES LTD.

R. Sawyer,
Chemist.

RS/bb

Annotated, 11-ix-69:
Sample taken from bottom of new pit in old trench, 4½'-5½' below original surface. Coal much weathered. Took coal from above and below two-inch clay-shale band, across horizontal width of three feet. True width of seam not known. R.S.T.

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B.C. REGISTERED ASSAYERS
INDUSTRIAL and RESEARCH CHEMISTS

7911 ARGYLL ROAD
EDMONTON, ALBERTA

September 10, 1969.

CORRECTED RESULTS.

Spence Taylor & Associates Ltd.,
Suite 301 - 8621 - 109 Street,
Edmonton, Alberta.

Lab No. 1106 Sample Marked: 13568 (Williams Hole - ~~South~~ East Hill) R.P.T.

Dear Sir:

The results of the requested analyses of the above sample are as follows:

	As Received	Dry Basis
Moisture	19.1	
Ash	51.8	63.9
Volatile Matter	10.8	13.3
Free Carbon	18.4	22.7
B.T.U.'s	3,238	4,000

Yours very truly,

CREST LABORATORIES LTD.

R. Sawyer,
Chemist.

RS/bb

Annotated, 11-ix-69:
Took sample at depth 18"-24"
in clean-looking coaly material
in patch of bloom related to
spoil of old trench(?) R.P.T.

PHONE 469-2391

CREST LABORATORIES LTD.

B.C. REGISTERED ASSAYERS
INDUSTRIAL and RESEARCH CHEMISTS

7911 ARGYLL ROAD
EDMONTON, ALBERTA

September 10, 1969.

CORRECTED RESULTS

Spence Taylor & Associates Ltd.,
Suite 301 - 8621 - 109th Street,
Edmonton, Alberta.

Lab No. 1111 Sample Marked: 1362B (Camp 4 Trench)

Dear Sir:

The results of the requested analyses of the above sample are as follows:

	As Received	Dry Basis
Moisture	17.7	
Ash	32.1	39.0
Volatile Matter	9.5	11.5
Free Carbon	40.8	49.5
B.T.U.'s	5,932	7,208

Yours very truly,

CREST LABORATORIES LTD.

R. Sawyer,
Chemist.

RS/bb

Annotated, 11-ix-69:
Trench dug in largest area of coal bloom, perpendicular to strike of adjacent rocks, to 8' X 1½' X 1½'. Sampled lower 6½' of trench at depth 18". Upslope 1½' of trench showed coal debris and brown soil inter-tongued. Coaly debris clean to downslope end of trench; probably extended farther. RS

PHONE 469-2391

CREST LABORATORIES LTD.

B.C. REGISTERED ASSAYERS
INDUSTRIAL and RESEARCH CHEMISTS

7911 ARGYLL ROAD
EDMONTON, ALBERTA

September 10, 1969.

CORRECTED RESULTS.

Spence Taylor & Associates Ltd.,
Suite 301 - 8621 - 109 Street,
Edmonton, Alberta.

Lab No. 1110 Sample Marked: 1360B (Double Mountain)

Dear Sir:

The results of the requested analyses of the above sample are as follows:

	As Received	Dry Basis
Moisture	12.4	
Ash	55.6	63.5
Volatile Matter	12.4	14.2
Free Carbon	19.5	22.2
B.T.U.'s	3,672	4,192

Yours very truly,

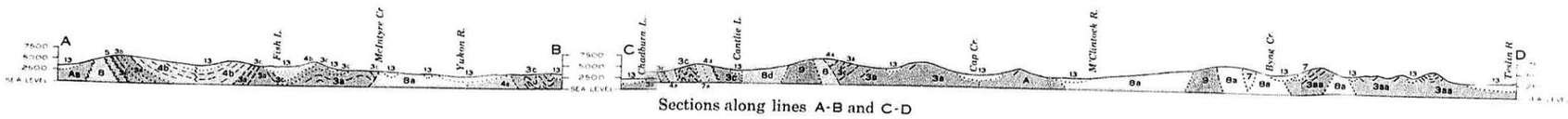
CREST LABORATORIES LTD.

R. Sawyer,
Chemist.

Annotated, 11-ix-69:
Sample taken of surficial several inches of conly soil in patch of bloom immediately below cairn (Figure 3). R.S.T.

RS/bb

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS



Sections along lines A-B and C-D

SHEET 105 D

LEGEND

CENOZOIC

QUATERNARY

13 — *Alluvium, glacial deposits, volcanic ash, loess*

12 — *MILES CANYON BASALT* basalt, minor pyroclastic rocks

TERTIARY OR EARLIER

11 — *Granite porphyry, rhyolite*

SKUKUM GROUP

10 — *Andesite, basalt, rhyolite, and trachyte breccias, tuffs, and flows, 'granitic agglomerate', minor greywacke*

9 — *Pink quartz monzonite*

CRETACEOUS

COAST INTRUSIONS

8 — *Granodiorite, granite, quartz monzonite, quartz diorite, and allied rocks,* **8a**, *hornblende-biotite-oligoclase granodiorite;* **8b**, *leucocratic granite, biotite granite;* **8c**, *biotite-hornblende quartz diorite;* **8d**, *hornblende diorite;* **8e**, *gneissic 'porphyritic granodiorite';* **8f**, *shattered granodiorite and 'granitic breccia';* **8g**, *pegmatitic syenite*

HUTSHI GROUP

7 — *Basalt, andesite, quartz latite, and rhyolite flows, breccias, and tuffs, conglomerate, minor greywacke and argillite,* **7a**, *basalt dyke;* **7b**, *altered volcanic rocks probably belonging to Hutshi group*

MESOZOIC

6 — *Peridotite, dunite, serpentinite, pyroxenite*

JURASSIC (?) AND CRETACEOUS
UPPER JURASSIC (?) AND LOWER CRETACEOUS

5 — *TANTALUS FORMATION arkose, siltstone, conglomerate, argillite, coal*

JURASSIC
LOWER JURASSIC AND LATER
LABERGE GROUP

4 — **4a**, *greywacke, arkose, quartzite, conglomerate, siltstone, argillite, hornfels,* **4b**, *mainly conglomerate*

TRIASSIC,
UPPER TRIASSIC
LEWES RIVER GROUP

3 — **3a**, *greywacke, siltstone, argillite, conglomerate, and tuffaceous equivalents,* **3aa**, *includes Jurassic rocks,* **3b**, *andesite, basalt flows and associated pyroclastic rocks,* **3c**, *limestone, limestone breccia,* **3d**, *metamorphosed rocks, probably belonging to Lewes River group*

PALÆOZOIC

PENNSYLVANIAN (?) AND PERMIAN
TAKU GROUP

2 — **2a**, *mainly chert,* **2b**, *greenstone flows and pyroclastic rocks,* **2c**, *limestone, limestone breccia,* **2d**, *metamorphosed volcanic rocks, probably belonging to Taku group,* **2ds**, *metamorphosed volcanic rocks containing numerous serpentine bodies*

PRECAMBRIAN AND LATER

YUKON GROUP

1 — **1a**, *Quartz-mica, quartz-chlorite, and mica schists, quartzite, micaceous quartzite, gneiss, and amphibolite,* **1b**, *feldspathic gneiss, gneissic granitic rocks, hi par-lit gneiss,* **1c**, *crystalline limestone*

A — *Volcanic rocks of uncertain age,* **Aa**, *metamorphosed volcanic rocks*

Bedding (horizontal, inclined, vertical, overturned)
Bedding (dip known, top of bed unknown)
Schistosity, gneissosity (inclined, vertical)
Slaty cleavage (inclined, vertical)
Fault (defined, approximate, assumed)
Anticlinal axis (arrow indicates direction of plunge)
Synclinal axis (arrow indicates direction of plunge)
Fossil locality 23 (F)
Mine 15
Mineral occurrence 16 ×
Placer deposit

SYMBOLS FOR METALS AND MINERALS

Antimony	Sb	Gold	Au
Coal	Coal	Lead	Pb
Copper	Cu	Silver	Ag
Fluorite	fl	Zinc	Zn

Geology by J. G. Fyles, 1946, J. R. Johnston, 1947, and J. O. Wheeler, 1948–1951

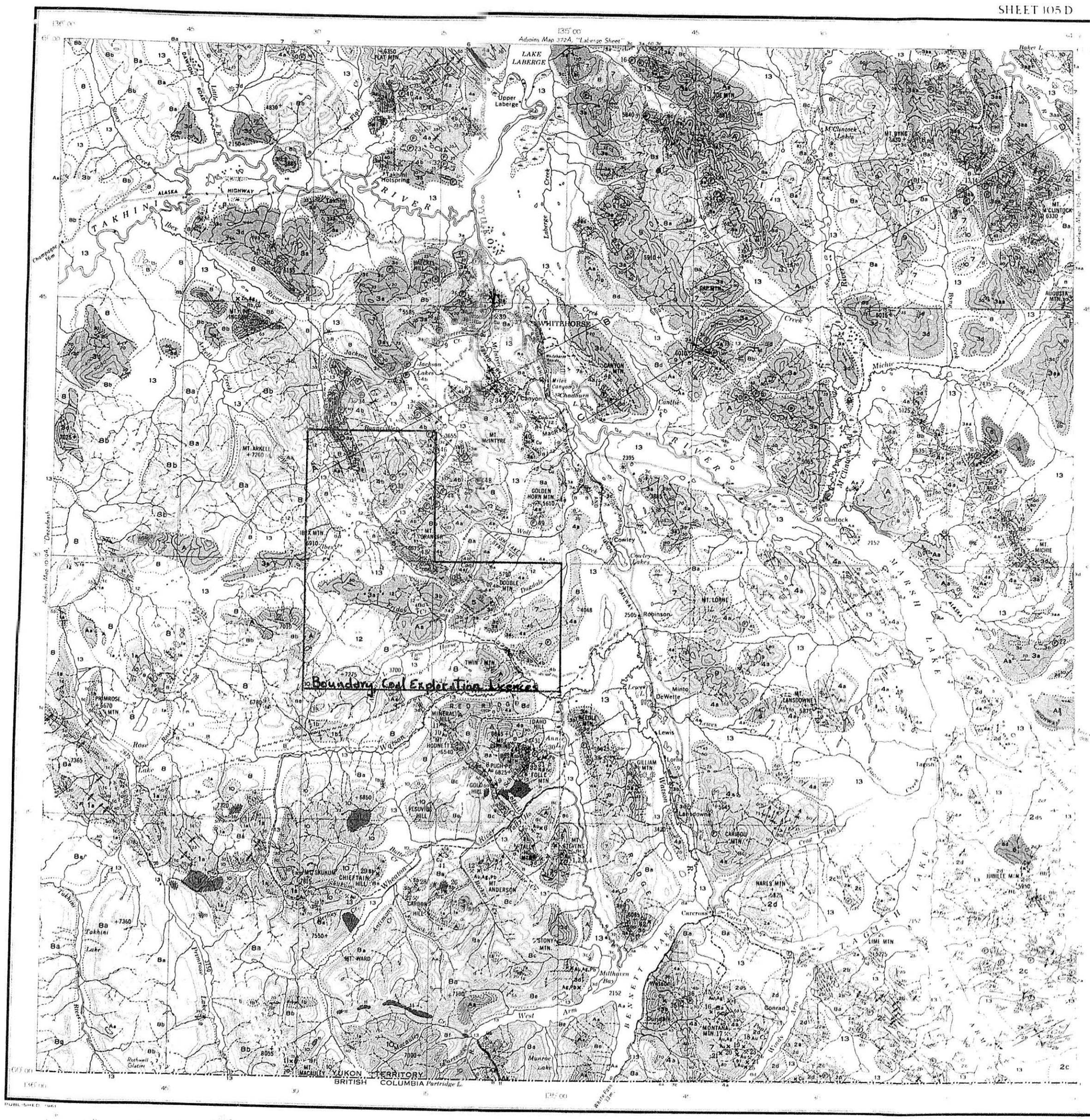
To accompany G.S.C. Memoir 312 by J. O. Wheeler

Approximate magnetic declination 31°16' East

Base-map compiled by the Topographical Survey, 1947

Cartography by the Geological Survey of Canada, 1960

Air photographs covering this map-area may be obtained through the National Air Photographic Library, Topographical Survey, Ottawa, Ontario



INDEX TO MINING PROPERTIES

Gold-Silver
1 Hawk Eye group
2 Acme claim
3 Midnight group
4 Hidden Ore group
5 Buffalo Hump group
6 Wheaton Mountain claims
7 Tally Ho group
8 Gold Reef claim
9 Dail Creek claims
10 Lucky Boy claim
11 Legal Tender claim
12 Mount Anderson claims
13 Mount Reid claims
14 Mascot group
15 Big Thing mine
16 Jean claim
17 Montana mine
18 Joe Petty claim
19 Uranus claim
20 Thistle claim
21 Aurora claim
22 M and M claim
23 Vault mine
24 Venus mine
25 Dail and Fleming groups

Antimony-Silver
26 Becker Cochran claims
27 Fleming claims
28 Goddell's claims
29 Chieftain Hill claims

Silver-Lead
30 Idaho Hill claims
31 Export group
32 Cardoon group

Copper
33 Arctic Chief mine
34 Grafter mine
35 Best Chance claim
36 Pueblo mine
37 War Eagle claim
38 Anaconda claim
39 Copper King mine
40 Valerie mine
41 Fleming group
42 College Green claim

Coal
43 Whitehorse coal
44 Mount Bush coal

MAP 1093A

GEOLOGY

WHITEHORSE

YUKON TERRITORY

Scale: One Inch to Four Miles = 1/253,440

Miles 4 2 0 4 8 12

COPIES OF THIS MAP MAY BE OBTAINED FROM THE DIRECTOR GEOLOGICAL SURVEY OF CANADA OTTAWA

REFERENCE

7490

MAP I

MAP II

WHITEHORSE COAL AREA:

FIELD GEOLOGY

LEGEND

X — Tantalus outcrop
- a — arkose
- ar — argillite
- c — conglomerate
- q — quartzite
- s — shale
- si — siltstone
- ss — sandstone

Coal
- Area of coal bloom
- May be only black shale soil
- Surface trace of Coal Measures: known / inferred / assumed
- $\square_T$ Trench or bench-cut

Fault: known / inferred / assumed

Contact

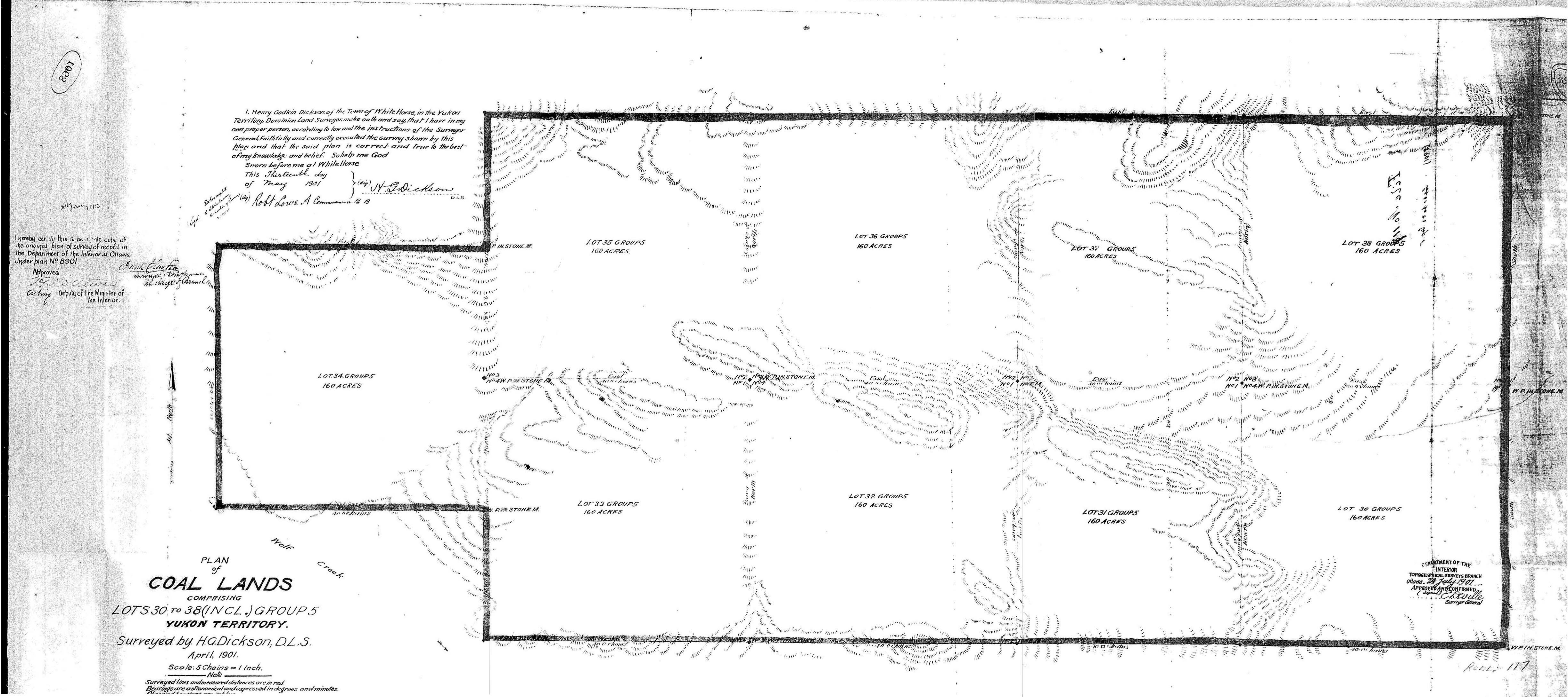
Strike and dip

Base map: a composite of three 1:50,000 topographic maps (105D/6 E; 105D/11 E and W) and Mineral Claim Staking Sheet 105D-6 (2 in. = 1 mi.).

SCALE: approximately 2 inches to the mile.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF BRITISH COLUMBIA
PERMIT NUMBER P 178
SPENCE TAYLOR & ASSOCIATES LTD

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
R. SPENCE TAYLOR
Expiry Date: March 26, 1970


8901
I, Henry Godkin Dickson, of the Town of White Horse, in the Yukon Territory, Dominion Land Surveyor, make oath and say, that I have in my own proper person, according to law and the instructions of the Surveyor General, faithfully and correctly executed the survey shown by this plan and that the said plan is correct and true to the best of my knowledge and belief. So help me God
Sworn before me at White Horse
This Thirteenth day
of May 1901
(sig) H. G. Dickson
D.L.S.
(sig) Robt Lowe. A Commissioner in B B
I hereby certify this to be a true copy of the original plan of survey of record in the Department of the Interior at Ottawa under plan Nº 8901
Approved
Acting Deputy of the Minister of the Interior.
Surveyor & Draftsman in charge of Branch
LOT 35 GROUP 5
160 ACRES
LOT 36 GROUP 5
160 ACRES
LOT 37 GROUP 5
160 ACRES
LOT 38 GROUP 5
160 ACRES
LOT 34 GROUP 5
160 ACRES
LOT 33 GROUP 5
160 ACRES
LOT 32 GROUP 5
160 ACRES
LOT 31 GROUP 5
160 ACRES
LOT 30 GROUP 5
160 ACRES
P. IN. STONE M.
W. P. IN. STONE M.
W. P. IN. STONE M.
W. P. IN. STONE M.
Nº 3
Nº 4 W. P. IN. STONE M.
Nº 2 Nº 3 W. P. IN. STONE M.
Nº 1 Nº 4
Nº 2 Nº 3
Nº 1 Nº 4 W. P. IN. STONE M.
Nº 2 Nº 3
Nº 1 Nº 4 W. P. IN. STONE M.
East
East
East
North
Wolf Creek
PLAN
of
COAL LANDS
COMPRISING
LOTS 30 TO 38 (INCL.) GROUP 5
YUKON TERRITORY.
Surveyed by H.G. Dickson, D.L.S.
April, 1901.
Scale: 5 Chains = 1 Inch.
Note
Surveyed lines and measured distances are in red.
Bearings are astronomical and expressed in degrees and minutes.
DEPARTMENT OF THE INTERIOR
TOPOGRAPHICAL SURVEYS BRANCH
Ottawa 24 July 1901
APPROVED AND CONFIRMED
(signed) E. Deville
Surveyor General
Roll 117