CANADA

DEPARTMENT OF MINES AND RESOURCES

MINES AND GEOLOGY BRANCH

GEOLOGICAL SURVEY BULLETIN

No. 1

A DAY IN THE ARCTIC

BY

J. D. Bateman

OTTAWA
EDMOND CLOUTIER
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
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CONTENTS

Illustrations

PREFACE

Publications of the Geological Survey have in recent years included Memoirs, Economic Geology Series reports, and a Paper series of maps and reports. The Memoirs are essentially full descriptive accounts of the geology of particular map-areas and, commonly, are accompanied by coloured, lithographed maps. Economic Geology Series reports are mainly topical compilations of available information on particular metals, minerals, or natural mineral products. They are illustrated with figures, but as a rule do not include separate maps. Reports and maps of the Paper series are published promptly and in limited editions to serve a public particularly concerned in obtaining an early account of certain field investigations. To this end the reports are commonly mimeographed and the maps published as blue line prints.

The present report is the first of a new series by the Geological Survey entitled Geological Survey Bulletins. It is believed that this series will prove a useful medium for reports that do not fall readily into any of the above categories, but which deal more particularly with problems or events of interest such as are encountered so frequently by the geologist in the course of his field work. These problems may have received intermittent study over a period of years. In this respect the account of "A Day in the Arctic" may be regarded as unique, in that it envisages what can be learned, under modern conditions of travel, in a single day.

G. HANSON,
Chief Geologist

March 21, 1945

A DAY IN THE ARCTIC

INTRODUCTION

A trip was made by aircraft on August 18, 1944, over an area, largely unexplored, lying between Great Bear Lake and Darnley Bay on the Arctic Coast. Four landings were made, one at the Site of Fort Confidence, and three on lakes near the headwaters of Horton River and the eastern headwaters of Anderson River. The purpose of the trip was to obtain information on the position of the western boundary of the Precambrian rocks of the Canadian Shield, and on the general character of a region about which little is known. The distance covered by the entire flight north of the Arctic Circle was more than 600 miles, and the total time required was about 10 hours. Were it not for the use of aircraft such a trip would require months of preparation and travel with attendant hardships. The writer was accompanied by Messrs. R. Murphy and E. J. Walli, and the aircraft, a Norseman float 'plane', was piloted by A. Kaywood. The trip was made possible through the co-operation of Mr. G. A. LaBine and Eldorado Mining and Refining.

PREVIOUS EXPLORATION

The principal source of the geography appearing on maps of the region north of Great Bear Lake is based on the explorations of Emile Petitot[1], which were undertaken prior to 1875. Father Petitot, a missionary, made a remarkable series of journeys into unknown parts of the Canadian Arctic and sub-Arctic over a period of several years. He made numerous geographical observations and his maps and geological notes were used in the compilation of the geological map of the northern part of the Dominion of Canada[2], published in 1887. This map shows a great bulge of the Canadian Shield north of Great Bear Lake extending farther west than Lockhart (Carnwath) River, almost to the valley of the Mackenzie. As early as 1857 MacFarlane[3] had found bituminous coal, shale, and limestone on Lockhart River and on the upper or east branch of Anderson River, but his observations were not published until 1890. Thus it would seem that there are no Precambrian rocks west of Anderson River, and Petitot's geological observations cannot be accepted as entirely reliable[4]. The most recent geological map of the region[5] prepared by the Geological Survey indicates that between Dease Bay, Great Bear Lake, and Darnley Bay, on the Arctic Coast, the Precambrian boundary lies west of the upper part of Horton River and includes the headwater lakes of the east branch of Anderson River.

In November 1910, Stefansson[6] travelled overland from Dease Bay to Franklin Bay on the Arctic Ocean, following the valley of Horton River. He returned over the same route a month later in company with R. M. Anderson.

[1] Bull. de La Société de Géographie, sixième série, tome 10, pp. 5-42, 126-183, 242-290 (1875). Exploration de la région du Grand Lac des Ours, Paris, 1893.
[2] Dawson, G. M.: Geol. Surv., Canada, Ann. Rept. 1886, pt. R.
[3] Can. Rec. of Sci., vol. 4, 1890-91, pp. 28-53.
[4] Petitot apparently did not distinguish between bedrock and glacial erratics in the ground moraine.
[5] Issued as a supplement to the Annual Number of The Northern Miner, December 1943, Toronto.
[6] My Life with the Eskimo; Macmillan, 1913, pp. 227-234.

In his description of the trip Stefansson mentions that the Horton (in its upper reaches) in some places plunges through narrow limestone canyons. Mr. Anderson[1] states that the rocks encountered along the Horton were flat-lying dolomitic limestones, and that no Precambrian rocks were observed. Thus the Precambrian boundary probably lies east of Horton River—farther east than is indicated on any geological maps.

Preliminary maps prepared from trimetrogon aerial photography completed by the United States Army Air Forces in 1943 have indicated that the true positions of Smith Arm and the lakes to the north of Great Bear are some distance farther west than their positions shown on earlier maps. There are no photographs, however, covering the area of the present flight. The accompanying map (Figure 1) shows the course of the flight plotted on part of Northwest Territories[2] map, sheet No. 2, but the true positions are not known as there is not yet adequate control on which to base them.

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[1] Verbal communication.
[2] Topographical Survey, Dept. of the Interior, 1933. Out of print.

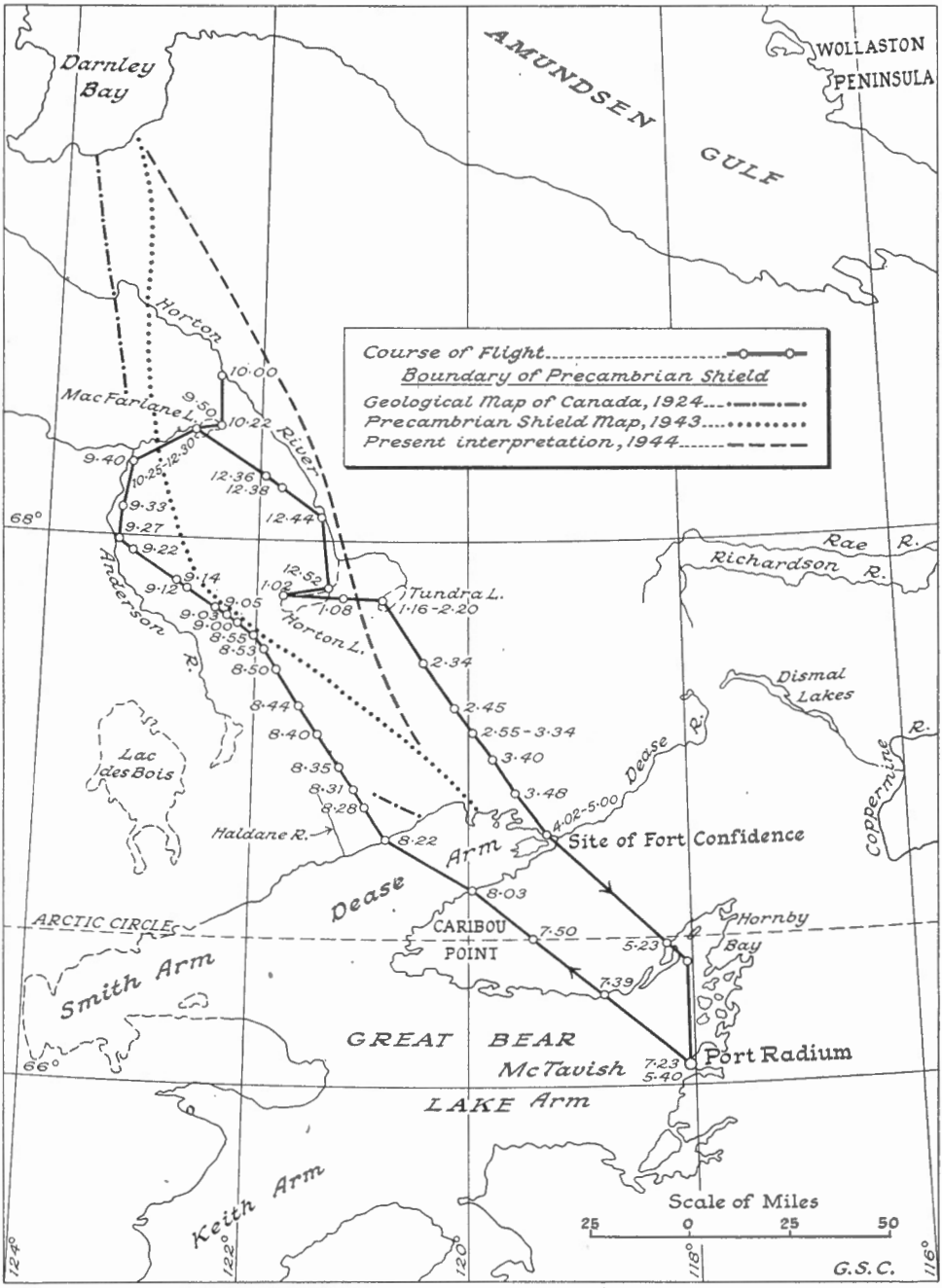


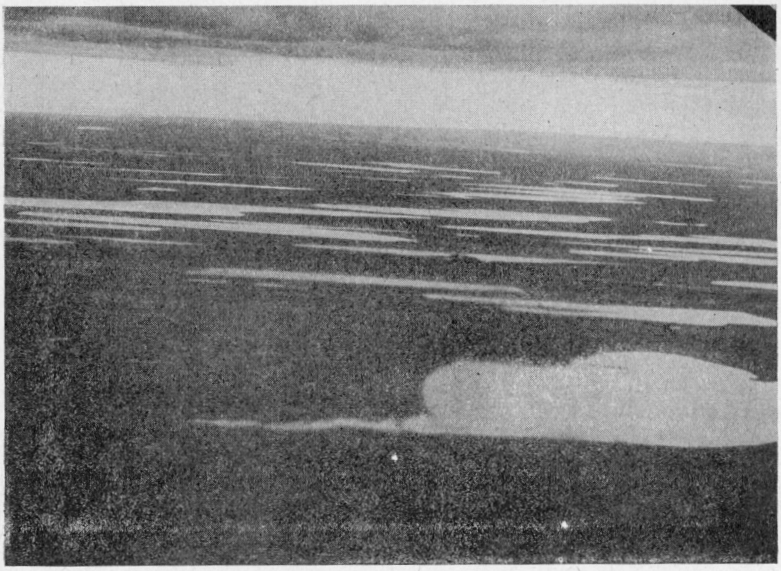
Figure 1. Map showing course of the flight, and position of the Precambrian boundary as indicated on published maps and as at present interpreted.

NOTES ON FLIGHT

Course	*Time*	
	7.15 a.m.	Take off from Port Radium; wing and belly tanks full, there being sufficient gasoline for about 10 hours flying.
NW.	7.23	Leave coast of Great Bear Lake on northwesterly course after circling to gain altitude.
	7.39	Over north shore of McTavish Arm, crossing Caribou Point.
	7.50	Cross Arctic Circle.
	8.03	Over south shore of Dease Arm.
	8.22	Over north shore of Dease Arm at mouth of Haldane (?) River. Our position is at least 8 miles east of the mouth of the Haldane as shown on map; low, rolling topography with extensive muskegs; distinctive emerged strandlines near lake shore do not extend far inland.
	8.28	Country thinly wooded with spruce; numerous small lakes; prominent hills some distance north.
	8.31	Area to southwest of line of flight shows a marked linear topography comprising long narrow lakes and low intervening ridges trending northwesterly.
	8.35	Cross winding river that cuts through the linear elements of the topography almost at right angles. Estimated position approximately: longitude 121° W., latitude 67° N.
	8.40	Prominent linear physiographic features still immediately southwest of flight line (Plate I A). Farther southwest the country rises to form a low range of hills.
	8.44	Approaching treeless country or barren grounds to north of flight line; many steep-walled, flat-topped hills and small round lakes without exterior drainage.
	8.50	Flight line following boundary between wooded country to the southwest and barren grounds on the northeast.
	8.53	Linear features in the timbered country tapering collectively to the northwest.
WNW.	8.55	Original course was planned to complete first leg of flight over the northeast end of Lac des Bois, but as the lake cannot be seen at this point, where the visibility is more than 50 miles at 6,000 feet elevation, the course is changed to the west towards wooded country.
	9.00	Large lake in barren grounds to northeast of flight line (partly shown in Plate I B). This is probably the southwest end of Horton Lake.
	9.03	Over abandoned river valley.
	9.05	Gently rolling country with numerous lakes.
	9.12	Timber somewhat more dense.
	9.14	Over south-flowing (?) river; several larger lakes lying to the south.
	9.22	Gently rolling, monotonous, timbered country; small, irregular lakes.
N.	9.27	Over upper part of Anderson River; Lac des Bois (?) observed far to the southwest. Course changed northward to follow river. Estimated position approximately: longitude 124°W., latitude 67°30′ N.
	9.33	Anderson River shows prominent meanders with oxbow lakes.
NE.	9.40	Swing course northeast on east branch of Anderson River.
N.	9.50	Course changed north into the barren grounds at MacFarlane Lake, and then crosses two larger lakes[1].
S.	10.00	At this point the course of the flight should be over Horton River, but despite good visibility there is no sign of the river valley. The barren grounds here are flat and saturated with water. Prominent tundra polygons can be seen from the air. Return southward over the two large lakes, searching for rock and flying low. As the flight enters thinly wooded country two old wigwams were observed along the lake shores.
	10.22	Circle MacFarlane and adjacent lakes, searching for rock outcrops. So far no rock has been observed since leaving the north shore of Great Bear Lake.

[1] Probably Petitot's "Lacs Delesse".

PLATE I



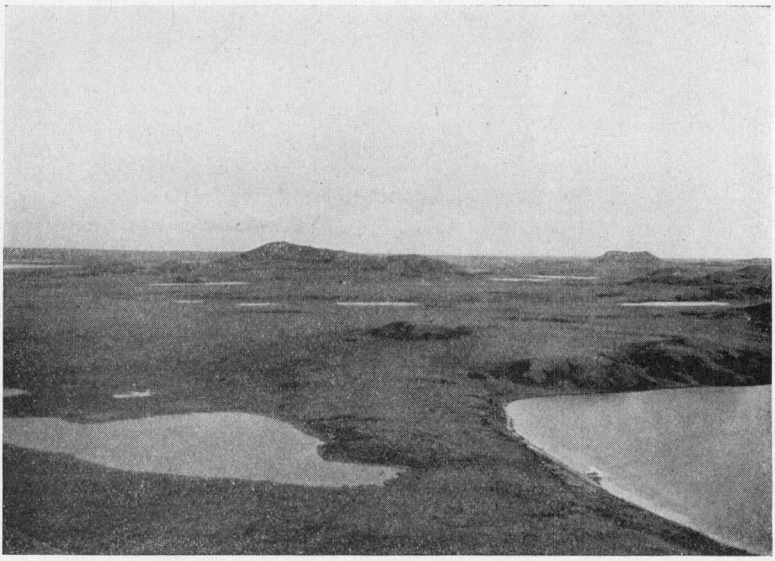
A. Air view of linear topography north of Dease Arm, showing general character of timbered country southwest of flight line.

B. Typical view of lake pattern in the barren grounds northeast of flight line. Lake in foreground is the eastern part of Horton Lake.

Course	*Time*	
	10.25	Land on MacFarlane Lake. The banks near the outlet consist of several feet of thinly varved clay. Taxi to gravel beach on north shore and climb hill; except for such hills the mossy ground is saturated with water. There is a relatively thick growth of small spruce. The ground moraine, as seen on the hills, contains an abundance of sandstone and limestone boulders. The presence of relatively large blocks of limestone (up to 200 pounds) suggests that Palæozoic bedrock is not far distant.
	12.30 p.m.	Take off after lunch, flying southeast with a very strong tail wind.
	12.36	Observe small monadnocks of flat-lying, stratified rocks, probably limestones or dolomites; circle low, but no nearby lake on which to land.
	12.38	Circle "gravel-pit" lake (Plate II A), which is a kettle lake of apparently recent origin. In the barren lands, particularly, the prevailing small round lakes with interior drainage are probably kettles (*See also* Plate I B).
S.	12.44	Over the upper part of Horton River. In the river valley there are small, isolated mesas of buff-coloured, flat-lying rocks—probably Palæozoic dolomitic limestones. Swing south on river. East of the river the country is more rugged, the hills sloping northwards at a gentle angle, suggesting a low northerly structural dip of the underlying bedrock.
SW.	12.52	Over the shore of Horton Lake, which is entirely in the barren grounds. Follow north shore southwest for 15 miles (the lake must be 20 miles long) flying low and searching for rock, but the hills along the shore are composed entirely of ground moraine.
E.	1.02	Swing east across Horton Lake towards distant, mountain-like hills in barren grounds.
	1.08	Crossing area of tundra polygons; large lake some distance north.
	1.16	Circle large hill near shore of Tundra Lake. (Plate II B is a photograph taken from the top of this hill, which is between 250 and 300 feet above the lake.)
	1.20	Land on Tundra Lake and climb the hill at northwest end. Members of the party anchored the aircraft to boulders during a strong offshore wind. The hills rise to a maximum height estimated at about 800 feet above Tundra Lake. They are composed entirely of glacial debris, which rests, in many places, with very steep slopes. The hill that was climbed at Tundra Lake is made up of boulders of igneous and sedimentary rocks, thinly bedded quartzite being the dominant type.
SE.	2.20	Take off from Tundra Lake, flying southeast before a storm. The country is less hilly with much gravel.
	2.34	Cross south-flowing river.
	2.45	Cross larger south-flowing river, which cuts a narrow canyon through solid rock. Low, flat rock outcrops are plentiful.
	2.55	Come down on shallow lake, after circling for suitable lakes on which to land. The rocks are white weathering quartzites with a light rusty brown appearance on the broken surface. The beds dip northward at a very gentle angle. These rocks are identical with late Precambrian formations at Great Bear Lake known as the Hornby Bay series, of which they are probably part. The country here is so flat that the caribou are silhouetted against the horizon.
	3.34	Take off on southeasterly course, running before the storm, which has caught up with us again. Rock outcrops are now continuous, being the same as those examined on the ground. Course takes us gradually out of the barren grounds into timbered country.
	3.40	Cross anticlinal axis in the white quartzites, which dip away 30 degrees on either side. Along the axis there is an oval-shaped mass of buff-yellow rock (pre-Hornby Bay?).
	3.48	The southerly dips of the quartzites south of the anticlinal axis abruptly change to a north dip of about 45 degrees. Prominent rock ridges alternate with depressions, the topography assuming a marked west-southwest linear element, which in this case is unquestionably controlled by rock structure.

PLATE II

A. Air view of small "gravel-pit" kettle southeast of MacFarlane Lake, on the fringe of the barren grounds.



B. Prominent hills composed of glacial debris in the barren grounds near Tundra Lake. Note aircraft on lake shore at lower right.

Course	*Time*	
	3.57	Circle Site of Fort Confidence.
	4.02	Land at Site of Fort Confidence. It was here that Thomas Simpson and Warren Dease established winter quarters in 1836 for their Arctic explorations. The chimneys are still standing (Plate III), although the cabins have long since been burned down.

PLATE III

Remains of Fort Confidence. In foreground is the principal chimney of Dease and Simpson's establishment, constructed more than 100 years ago.

	5.00	Take off at Site of Fort Confidence, continuing on southeast course.
S.	5.23	Cross north shore of Hornby Bay. Throughout the flight numerous caribou trails were seen, particularly in the barren grounds. The trails form narrow depressions that are in many places filled with water and, as seen from the air, appear like thin silver ribbons. Only a few caribou were seen north of Great Bear Lake, but north of Hornby Bay herds numbering several hundred animals were observed.
	5.40	Over Port Radium.
	5.44	Land on water at Port Radium.

DISCUSSION AND CONCLUSIONS

Several geomorphic features that admit of some further discussion were observed during the flight. Similar features on Victoria Island have been described by A. L. Washburn[1]. These include the linear pattern of the ground moraine, which is best developed southwest of the flight line between 8.31 and 8.41 a.m. Such a pattern could be formed through lithologic control, by glaciation, or by a combination of both. If lithology is the factor controlling the linear elements the underlying rocks are probably Precambrian, as younger formations in this region are not known to be folded sufficiently to reflect their structure in the topography. As the location is west of the area believed to be underlain by Precambrian rocks, glaciation best explains the linear features. This implies an ice movement in a northwesterly or southeasterly direction. Referring to similar features on Victoria Island Washburn states:

"In all instances observed, the strike [of the linear pattern] was essentially parallel with the direction of glaciation . . . . they may have an essentially drumlinlike origin."

Tundra polygons were observed in two small areas at 10 a.m. and 1.08 p.m. during the flight. It was not possible to determine their size from the air, but they must have had a diameter of at least several yards. Where observed the tundra was exceptionally flat and well saturated with water. The interstices of the polygons were filled with water and with black muck that might have been peat.

The most unusual surface features observed, however, were the steep, smooth hills in the barren grounds near Tundra Lake. The loose boulders and gravel comprising the hills, which rise as high as 500 feet above the surrounding country, are held together by Arctic vegetation. No clear instances of solifluction were seen around them. In origin they appear to be depositional, and at the time of formation many of the slopes must have been at or near the angle of rest for the material. Somewhat similar forms are described by Washburn in the vicinity of Mount Bumpus, Wollaston Peninsula, Victoria Island. The Tundra Lake hills are in a region where kettle lakes are common. The origin of the hills is a matter of speculation, but they were probably formed during a period of downwasting ice with attendant deposition of outwash gravels under conditions that permitted the piling up of debris.

Much of the region traversed by the flight is covered with a thick mantle of glacial deposits. Rock outcrops were found only in two localities: (a) in the upper part of Horton River Valley, where available evidence indicates that the rocks are younger than the Precambrian and probably of Palæozoic age; (b) southeast of Tundra Lake, where there is a broad belt of Proterozoic (Late Precambrian) Hornby Bay quartzites extending to and beyond the eastern part of Dease Arm.

Because of extensive overburden it is unlikely that the Precambrian boundary north of Great Bear Lake will ever be delineated accurately. The present investigation has shown that it probably lies farther east than is indicated on published maps. The testimony of the drift suggests that the boundary passes close to Tundra Lake, and its position, as shown on the accompanying map (Figure 1) is drawn in the light of the best available information.

The only part of the region observed that would attract prospectors searching for metalliferous deposits is a northeasterly trending belt of folded Precambrian rocks 30 miles wide lying to the north of the Site of Fort Confidence. Shearing in these rocks was observed from the air and, as they have not been explored, they are worth the attention of prospectors.

[1] Reconnaissance Geology of Portions of Victoria Island and Immediately Adjacent Regions, Arctic Canada; Yale University, Graduate School doctorate dissertation, 1942. MS. copy in Library, Geol. Surv., Canada.