DEPARTMENT OF MINES AND NATURAL RESOURCES

PROVINCE OF MANITOBA — CANADA

HON. J. S. MCDIARMID, *Minister* D. M. STEPHENS, *Deputy Minister*

MINES BRANCH
GEO. F. COLE, *Director*

GEOLOGICAL REPORT No. 38-1

BIGSTONE LAKE AREA

By R. T. McINTOSH

GEOLOGICAL REPORT No. 39-1

ASSEAN-SPLIT LAKES AREA

By A. S. DAWSON

Printed by J. L. COWIE, King's Printer for Manitoba
WINNIPEG
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TABLE OF CONTENTS

•

Bigstone Lake Area

Assean-Split Lakes Area

ILLUSTRATIONS

•

Bigstone Lake Area

By R. T. McIntosh

INTRODUCTION

Bigstone Lake area is located approximately 90 miles east of Norway House, northeastern Manitoba. The area mapped during the summer of 1938 covers about 370 square miles and the portion of interest to prospectors is approximately 30 miles long by 4 miles wide and lies in the basins of Bigstone, Knight and Clam lakes.

No previous geological work had been done in the area. Base maps used were sections of sheet 53E published by the Topographical Survey of Canada, enlarged to the scale of ½ mile to the inch. Traverses to granite contacts were run every ½ mile along the shores of the lakes. On the final map of the area, the scale is reduced to 1 mile to the inch.

There is little evidence of intensive prospecting having been done in the area, except at the east end of Bigstone lake in the vicinity of the Diamond Queen mining claims (Location A). During the 1938 season two parties of prospectors visited the area.

Acknowledgments

The party is indebted to J. G. Reahil and associates for assistance and information given during the summer. Thanks are also due to W. F. Baker and D. H. Halstead of God's Lake Gold Mines, Limited.

Assistance was rendered by P. C. Jones, H. O. Olafson, G. S. Thurber, E. W. Montgomery, J. Wach and J. B. McGreevy, all students of the University of Manitoba.

Means of Access and Canoe Routes

The most convenient means of access is by airplane from either Berens river or Norway House. Berens river is 110 miles south of Bigstone lake, whereas Norway House is 90 miles distant, but a saving of a day is effected by using Berens river as a base and eliminating the boat trip from Berens river to Norway House. Two air companies maintained bases at both places. The area may also be reached by airplane from Winnipeg and Ilford, Mile 286, Hudson Bay railway.

If travel is by canoe, the Island Lake route is used as far as Willow lake. This route is described by J. F. Wright,[1] as follows:

> "The present route to the lake is from Winnipeg to Selkirk by bus; from Selkirk to Norway House by steamer, which makes weekly trips up and down Lake Winnipeg from the first of June to the middle of October. From Norway House the canoe route usually followed is south to the mouth of Gunisao river (locally called Jack); up this river to the junction of McLaughlin river; up the McLaughlin to Little Goose lake; and up Ponask creek from the east end of this lake to Ponask lake. Ponask creek is very crooked and narrow, and if the water be low is unnavigable with large and heavily loaded canoes.
>
> "The first of the height of land, or the Ponask, portages leaves the south shore of Ponask lake about 5 miles east of its outlet. These portages are 4 in number and are 1,400, 1,600, 6,200 and 6,500 feet long, respectively. They

(1) Wright, J. F. "Island Lake Area, Manitoba", Geol. Surv., Canada, Sum. Rept. 1927, pt. B, pp. 54-55.

are connected by three shallow lakes; the two longer portages cross rocky, hilly country with wet swamps in the depressions, and, on the last small lake, going east, the landings are very wet and soft.

"The canoe route from the last Ponask portage to Fairy rock is downstream along a small river with several portages past rapids and falls; Pelican and Stevenson lakes are the two larger lakes crossed, the route following the long, narrow, east arm of the latter lake for over 30 miles."

Between Willow and Fairy lakes the route to Bigstone lake branches off and continues up a small creek, connecting a chain of small lakes, to Dobbs lake; up Mainland river to Begg lake and into Bigstone lake at its extreme east end. A shorter, alternative route for parties travelling light leaves the Island Lake route at a bay on the south shore of Stevenson lake, about 10 miles from the west end, and from there crosses a series of small lakes into Long bay and Bigstone lake. This route is considerably shorter but the portages are much longer.

Topography and Drainage

The topography of the Bigstone Lake area is typical of the Precambrian of Manitoba. In the vicinity of Bigstone lake, the terrain is fairly flat with few rock ridges rising over 50 feet above the muskeg. Around Knight and Clam Lakes the topography is more rugged. In this area some of the hills rise to a height of 200 to 300 feet above the level of the lakes. Rock exposures are fairly plentiful, particularly around the shores of the lakes. East of Clam lake much of the country is heavily overburdened by sand ridges, particularly in the area underlain by granite.

Mainland river is the largest stream in the area and drains Bigstone, Knight and Wass lakes. Other rivers are small, hardly more than creeks, and most of them are not navigable by canoe. Between Knight and Clam lakes there is a height of land, the area to the west draining down Mainland river to Island lake and the area to the east draining directly into Island lake via Clam creek. This creek was mapped as far as Picket lake in the course of traversing.

The contour of the lakes, particularly Bigstone lake, is controlled to a large extent by the structure of the underlying rocks, and the shore lines commonly follow the general strike of the schistosity of the rock.

Inhabitants

There are no permanent residents in the Bigstone Lake area, and the closest trading posts are to be found at Island lake. During the summer months a few Indians from the Island Lake reserve were seen. It is evident from the number of Indian camps near lakeshores that a few families from Island lake come into the country to trap during the winter.

Natural Resources

FORESTS:

The timber in the area is comparatively light and is made up for the most part of spruce, jackpine and white poplar, with local stands of birch, black poplar and tamarack. Timber suitable for building purposes is largely confined to islands in the large lakes which have not been burnt over. Some trees over 10 inches at the butt were noted in the bush. There is, however, a considerable amount of spruce and poplar suitable for cordwood purposes. Except for a few local burns, there have been no large bush fires in recent years. There is, however, evidence that the whole area has been burnt over several years ago.

Fish and Game:

Fish were found to be very abundant, particularly in Bigstone lake. Those chiefly noted were pike or jackfish, pickerel and whitefish. In addition to these, maria, perch and tullibee were also to be found. The jumbo whitefish in Wass lake are reported to be particularly good. Game appears to be comparatively scarce; one moose and a few muskrat were seen by the party during the summer.

Water Power:

The rivers in the area, with the exception of Mainland river, are all small and are, therefore, not suitable for power developments. One power site, possibly adequate for the operation of a small mine, was noted at the second rapids from Bigstone lake on Mainland river. At this point there is a drop of about 18 feet in a short distance and the banks on both sides of the river are fairly high.

GENERAL GEOLOGY

The consolidated rock types of the area are all of Precambrian age. They are overlain by sands, clays and gravel of Pleistocene age and locally by recent muskegs. The following is a tentative classification of the rock assemblages encountered in the area, the youngest being placed at the top and the oldest at the bottom:

Table of Formations

Quaternary	Recent and Pleistocene	River alluvium, peat, etc. Clay, sand and gravel	
		Unconformity	
Precambrian	Intrusives	Younger basic intrusives	Diabase and lamprophyre
			Intrusive contact
		Granitic intrusives	Aplite, pegmatite and porphyritic dykes Granite and granite gneiss Granodiorite and diorite
		Intrusive contact	
	Sediments	Island Lake series	Quartzite, conglomerate, arkose, chert and greywacke
		Unconformity?	
	Volcanics and Sediments	Hayes River group	Volcanics, including andesite, dacite, and rhyolite and derived chlorite and carbonate schists Sediments, including altered arkose, quartz-mica schist and conglomerate
		Base unknown	

The volcanic and sedimentary formations mapped form a continuous belt approximately 30 miles in length. At Bigstone lake the belt attains its greatest width of 7 miles. Between Bigstone and Knight lakes it narrows down to 1/4 mile in width. At the east end of Knight lake and at the west end of Clam lake it again widens out to about 6 miles. The greater portion of the area is underlain by lavas, with sediments in minor amounts. The intrusive rocks are predominantly granitic. The general trend of schistosity and bedding is east and west, with local variations. Dips range from 55 degrees to vertical.

The volcanic rocks have been tentatively identified with the Hayes River group to conform with the classification adopted by J. F. Wright[1] in the Island Lake area to the east. The sediments occupying the synclinal troughs are interpreted as being representative of the Island Lake series of fragmental rocks. Definite evidence of an unconformity between the sediments and lavas was not found in this area, and it is therefore possible that some or all of the sediments of the area belong to the Hayes River group.

Volcanic Rocks

Volcanic rocks are the most abundant type in the area. Andesite flows are predominant and, in addition, there are areas underlain by flows of dacite and rhyolite. Locally there are small beds of tuff or volcanic fragmental material.

ANDESITE:

Lavas with the composition of andesite comprise the most abundant volcanic rock type in the area. The flows are apparently very thick, although practically no flow contacts were observed within the andesite itself. Large areas are underlain by coarse-grained massive andesite, typified by that occurring on the long peninsula on the north side of Bigstone lake. The coarse-grained andesite grades into a very fine-grained variety. The colour ranges from green to greenish grey. Locally pillows are well developed, while elsewhere they have been squeezed and much elongated, making them difficult to recognize.

A microscopic examination of the very fine-grained andesite showed this type of rock to be composed of an aggregate of secondary products, chiefly saussurite, and approximately 20 per cent actinolite. Primary feldspar has been entirely altered. The accessory minerals are biotite, chlorite and magnetite. Quartz has been introduced as a secondary mineral.

A thin section of the coarse-grained andesite shows well-developed augite. Secondary minerals are prominent, the primary feldspar having been largely altered to mica and saussurite and the augite in part to hornblende and actinolite. Accessory minerals are magnetite and a small amount of quartz.

Chlorite schists have been developed along shear zones. Near the granite contact and as far as 1,500 feet from it, baking and recrystallization have taken place. The effect of this metamorphism lessens as the distance from the granite contact increases. Locally, recrystallization has produced a porphyroblastic andesite with prominent feldspar metacrysts.

North of Knight lake a large area of andesite has been much altered by granitization. Here the original andesite is hardly recognizable, owing to the introduction of granitic minerals. The rock, instead of being dark green as it was originally, is now grey with green bands, giving it the appearance of gneiss.

1. Wright, J. F. "Island Lake Area, Manitoba," Geol. Surv., Canada, Sum. Rept., 1927, pt. B, pp. 54-80.

Hydrothermal alteration and replacement to a marked degree is indicated on some of the islands in the central part of Bigstone lake. A thin section of the more highly altered material shows that all the original minerals have been altered to calcite, quartz and possibly some sericite. Variations may be traced through a gradual transition into the original lava. A thin section of the intermediate rock shows only remnants of the primary mafic minerals, the remainder having been altered to epidote, zoisite, calcite and quartz.

Dacite:

Only a few small flows of dacite were seen on Bigstone lake. Between Knight and Wass lakes, however, several flows of this type of volcanic rock were seen. Lavas mapped as dacite are a light green colour, massive and very fine grained. A microscopic examination gave little indication of the composition, as it was almost impossible to identify individual grains.

On the south shore of Knight lake, small, poorly-defined beds of dacite tuff were found.

Rhyolite:

Lavas of this type are not common. Rhyolite was seen at only one place in the whole area, at the north shore of Bigstone lake. This rock is fine grained, massive and a light grey in colour.

Sedimentary Rocks

The sediments of the area are confined to narrow belts within the lavas; those at Bigstone lake appear to occupy the trough of a major syncline. At their widest point at the west end of Bigstone lake the sediments are exposed over a width of approximately 1 mile. To the east they narrow abruptly, and continue in a very narrow belt to the extreme east end of the lake, where they widen and are apparently much drag-folded. They then continue eastward in a narrow belt along the channel towards Knight lake portage where they terminate.

Sediments are well exposed along the central part of the south shore of Bigstone lake and bedding planes are very well defined along their north contact at that point. In the vicinity of this lake the sediments to the west are mainly argillite and arkose; to the east they are made up of coarser grained arkose, greywacke, chert and conglomerate.

An outcrop of conglomerate occurs on a small island on the south shore of Bigstone lake, and contains pebbles of granite, greenstone and vein quartz. Pebbles in this bed range from less than 1 inch in length to somewhat more than 1 foot. At the extreme east end of the lake there are also a few small beds of conglomerate containing pebbles of greenstone and quartz, or possibly quartzite, ranging in size from less than ½ inch to 3 inches.

Zones of arkose are made up of many fairly large grains of quartz, and although no feldspar was visible in hand specimens, a microscopic examination of the arkose showed the cementing material to be made up of muscovite, epidote and zoisite, suggesting the original presence of both acid and basic feldspar.

A thin section of the argillite from the west end of this belt of sediments showed it to be composed of very small angular grains of quartz, muscovite and biotite.

At the east end of Knight lake the sediments are readily distinguishable where they have been well exposed by fire. Arkose comprises the larger part of the exposed rock, but small lenses of conglomerate are prominent. Pebbles in the conglomerate, largely composed of vein quartz, are up to 2 inches in length. There are a few pebbles of what may have been an older acid porphyry and others of an unidentified material similar to rhyolite. The arkose in the hand specimen is seen to be composed of angular grains of quartz in a fine-grained, light grey matrix. No feldspars were apparent.

From the eastern part of Knight lake two divergent belts of sedimentary rocks trend east and northeast respectively. The east-trending belt narrows and disappears to the south of Clam lake; the other continues northeast to the granite-greenstone contact. The most logical interpretation of this structure is to assume an easterly plunging syncline. If this interpretation is correct, then lavas occupying the trough of the syncline lie structurally above the sediments, suggesting that these sedimentary belts are referrable to the Hayes River group. The strong shearing and high degree of alteration of these rocks lend evidence to this interpretation. No original sedimentary structures are preserved and in many places it is difficult to decide whether the rock is of sedimentary or intrusive origin without seeking further evidence along the strike.

The typical rock is altered arkose; microscopic examination shows that quartz makes up about 60 per cent of the rock and that the feldspar originally present has been almost completely altered to sericite. Other minerals present are muscovite, biotite, apatite, zoisite and pyrite.

Intrusive Rocks

PORPHYRITIC DYKE ROCKS:

Porphyry dykes are not at all abundant in the area. At Bigstone lake very few dykes were seen. In the vicinity of Knight and Clam lakes, porphyries were observed at several places. Dykes were observed on islands at the east end of Knight lake, ranging from less than 5 to 20 feet in width. These dykes are for the most part quartz porphyries, but quartz-feldspar porphyries were seen which grade almost into granite. Other dykes similar to the ones found on these islands were also found between Knight and Wass lakes.

An outcrop of quartz-feldspar porphyry, strongly sheared along the hanging-wall contact, was found between Clam and Picket lakes. Elsewhere the mass was covered by rather heavy overburden.

GRANITE AND GRANODIORITE:

Granodiorite grades almost imperceptibly into granite within about 2,000 feet of its contact with volcanic rocks. No definite contact could be discerned between the granite and granodiorite and it was concluded that the granodiorite was a basic marginal phase of the granite. The contact shown on the map is only approximate. The basic phase was mapped only on the Diamond Queen claims and at the east end of Wass lake where it was best illustrated.

Only scattered crystals of quartz could be seen in the typical granodiorite hand specimen. In thin section, however, a fair percentage of quartz was present.

in addition to albite, orthoclase and hornblende. The albite is comparatively fresh, whereas the orthoclase is largely altered to kaolinite and some of the hornblende is altered to chlorite.

The entire Bigstone Lake area is surrounded by granite. This granite area, so far as is known, extends north to the Stevenson-Ponask area[1] and east to Island lake. To the south and west granite occurs for many miles. To date, large areas of granite have been of little interest to prospectors, and no attempt was made to study this rock in detail. Traverses were not run more than ½ mile into the main granite mass. The granite varies in colour from grey to pink, the greater part being of the grey variety. Hornblende and biotite are the chief ferro-magnesian minerals.

Only two granite bosses of consequence were noted in the area. The larger one, the east end of which is practically joined with the main granite mass, is about 2 miles long and 1 mile wide and occupies the basin of Clam lake. The second and smaller one is about ½ mile long and ¼ mile wide, and lies north of Wass lake and east of Wass river.

Between Knight and Clam lakes there are several granite dykes which strike irregularly; the majority, however, trend east and west. These dykes are in all probability offshoots from the granite boss in the basin of Clam lake.

Diabase and Lamprophyre:

Some diabase dykes were noted, very few of which occurred within the lavas. One dyke was noted cutting across the sediments on the south shore of Bigstone lake and several very fine-grained dykes were noted in the granite areas, particularly at the narrows of Bigstone lake approaching its outlet.

Lamprophyre dykes are very few in number; only one of consequence was observed and occurred on the south shore of the narrows at the east end of Bigstone lake. The dyke crosses the regional strike and may possibly extend as far south as the Diamond Queen mining claims.

ECONOMIC GEOLOGY

Very few discoveries have been made in the area to date and so far none have been shown to be of commercial importance. At one time there were as many as 76 mining claims staked. Most of these, however, have been dropped and in 1938 only two groups were being held, namely, the Diamond Queen group at the east end of Bigstone lake, and the I.X.L. group at the east end of Clam lake. All exploration work has been on gold-bearing quartz veins. Other minerals noted in the area were galena, pyrite, chalcopyrite, and pyrrhotite in quartz veins, and molybdenite in aplite dykes on Bigstone lake.

Diamond Queen Group

The original Diamond Queen group (Location A) was staked in late August and early September, 1934, by J. G. Reahil and associates. Some surface work consisting of trenching and stripping had been done previous to the writer's visit. During the field season of 1938 a diamond drilling programme was carried out by God's Lake Gold Mines, Limited. The principal occurrence on the Diamond Queen

(1) Greer, W. L. C.: "Ponask-Stevenson Lakes Area;" Bul., Dept. Mines and Nat. Res., Man., 1938.

group is a blue to white quartz vein which strikes approximately northwest and crosses the regional strike of the surrounding volcanic rocks. The dip of the vein is approximately 80 degrees to the northeast. It has been traced approximately 1,500 feet and along its length the vein varies in width from a few inches to about 3 feet. It was difficult to determine the average width owing to heavy overburden. The quartz is mineralized with pyrite and chalcopyrite.

During the diamond drilling programme another smaller vein was found to the north of the original discovery. The quartz in this vein was also of the blue variety, mineralized with pyrite and galena. Visible gold was seen in one pit on the vein which has been traced for approximately 175 feet but is very narrow. Five drill holes were put down on this vein and 12 were drilled on the discovery vein.

I.X.L. Group

The original group (Location B) consisted of 16 claims staked in February, 1937, by J. G. Reahil and associates near the southeast end of Clam lake.

The vein strikes approximately north 65 degrees east and dips 85 degrees southeast. The vein consists of a series of quartz stringers intruding quartz porphyry and adjacent volcanic rock. The quartz is blue to white in colour and is mineralized with pyrite and chalcopyrite. The porphyry is pale green and is considerably silicified. Some work has been done on the vein and consists of a series of trenches at intervals along the strike.

Jack of Spades Claim

The Jack of Spades claim (Location C), located on an island in the central part of Bigstone lake, is the only other claim in good standing. Here a vein, for the most part under water, is exposed on the east end of the island over a width of about 6 feet. The quartz is fine grained and mineralized with pyrite and arsenopyrite. A considerable amount of rusty, weathered carbonate is associated with the quartz. No work has been done on this vein.

Several other claims have been staked at scattered points throughout the area, but the majority of these were never recorded.

CONCLUSIONS

Gold occurs in quartz veins within the area and further search should be made for such veins, particularly in zones of more intense folding and in the vicinity of small bosses of granitic rocks and of marked projections from the main granite mass into the lavas and sediments. Shear zones in which sulphides and carbonates are prominently developed should also be investigated.

The area between Knight and Wass lakes seems to be favourable prospecting ground. In this vicinity, during the summer of 1938, Messrs. S. Macdonald and C. Libert panned gold at several places but did not make a discovery of commercial importance.

Very few discoveries have been made to date within the area; however, this is to be expected since the area has received comparatively little attention from prospectors, and this fact should not deter prospectors from further exploration.

Assean-Split Lakes Area

By A. S. Dawson

INTRODUCTION

Prospecting in recent years has proven the occurrence of gold-bearing deposits on Assean lake. This report covers work undertaken during 1939 in an attempt to outline the rock formations and conditions favourable for mineral exploration in this area. Topography and geology were mapped simultaneously by compass traverse, closures being made as frequently as possible to control the accuracy of the work. In mapping the topography of Split lake, use was made of oblique aerial photographs furnished by the Department of National Defence, Ottawa.

Acknowledgments

Assistance in the field was rendered by Messrs. J. B. McGreevy, L. Lynd, A. Hay, B. McHugh, H. Sigurdson and W. Stewart, all of the University of Manitoba. Thanks are also due to Messrs. J. Dunbrack, G. Green, R. J. Campbell, O. Lindal and to A. Miller of the Hudson's Bay Company for their many courtesies.

Means of Access and Canoe Routes

The area examined is contained in a rectangle approximately 35 miles by 38 miles in extent, the southeast corner of which takes in Mile 279 on the Hudson Bay railway. Supplies going into the area by canoe are shipped to the latter point which is known as Landing river or Split Lake station. Air transport facilities are available at Ilford, Mile 286, Hudson Bay railway.

The main canoe route into the area leads northwest from Mile 279 via Aiken river, locally known as Landing river, a distance of 17 miles to Split lake. Two portages, totalling 23 chains, are crossed enroute. To facilitate travel on the upper part of the river, a dam was built in 1939 at the first rapids by the Manitoba Government.

Four canoe routes lead from Split lake to Assean lake. The best of these, and the one usually travelled, is at the west end of Split lake. This consists of two portages, 66 chains and 14 chains respectively, with an intervening small lake, and leads northward into Burntwood bay near the southwest end of Assean lake. The second route follows the north branch of a creek emptying into a long narrow bay west of the Hudson's Bay Company post. From the creek two portages, 80 chains and 24 chains, and a small lake, are crossed to reach the narrows of Assean lake. The third route starts from the bay to the north of the Hudson's Bay Company post and crosses a 120-chain portage to Fox lake. From Fox lake a creek is followed to the northeast end of Assean lake. From the extreme east end of Split lake, Assean river can be travelled upstream a distance of 16 miles to Assean lake. For upstream travel this is the poorest of the four routes, but going downstream the rapids can be run with little trouble.

From the northeast end of Assean lake a canoe route leads north via Assean and Crying rivers to Crying lake, crossing one 11-chain portage. From Crying lake a creek can be travelled to Crooked lake, and from here a 2-mile portage and a number of shorter portages cross the height of land to Waskaiowaka (Big) lake. Little Churchill river which drains this lake can be followed downstream to Churchill river.

There is no canoe route from Crying lake northeast to Limestone lake, but a winter route is sometimes used by Indians and trappers.

History

The early history of the region is associated with that of the fur trade. It is thought by some that the first white man to visit the area was Henry Kelsey, in 1691.[1]

The first fur traders in the area were the North-West Company, followed at a later date by the Hudson's Bay Company. In 1792 Split lake was crossed by David Thompson, surveyor for the Hudson's Bay Company, who ascended Nelson river as far as Sipiwesk lake and the following year returned to York Factory via Burntwood river and Split lake. His map of the Northwest Territories was compiled in 1814 and served as a basis for general maps of the region until comparatively recent times.

In the years 1878-9, R. Bell made a track survey down Nelson river to Split lake and traversed the route from Split lake to Churchill river via Assean and Crying lakes. He mentions the occurrence of granite, sedimentary rocks, grey gneiss and diorite dykes on Split lake.[2] Wm. McInnes visited Split lake in 1906 and also travelled north from there to Churchill river. His description of this area is included in a memoir published in 1913.[3]

GENERAL CHARACTER OF THE AREA

Split lake and Assean lake are the two large bodies of water in the area. The former is a widening of Nelson river and is 28 miles in length by airline. Strong current flows through a number of the narrower parts of Split lake and for this reason the water is very choppy in windy weather, especially so when the direction of the wind is against the current. There are numerous islands, particularly in the central and western parts of the lake, 320 having been mapped. Four of these are each several miles in length. The extremely irregular shoreline of Split lake is due to the differential erosion of the underlying gneisses which are variable in composition and hardness. The shores are for the most part rocky, with occasional boulder beaches and a few of sand. Some of the narrow bays and inlets have reedy shores.

Assean lake lies to the northwest of Split lake and is 22½ miles long. The lake is elongated in a direction about north 65 degrees east, which corresponds to the strike of bedding and foliation of the underlying sediments and gneisses. Toward the southwest end the lake reaches its greatest width of 4 miles, while in the central part or "narrows" it is 400 feet wide.

(1) Alcock, F. J.: Geol. Surv., Canada, Sum. Report, 1920, Part C, p. 7.
(2) Bell, R. Geol. Surv., Canada, Reports of Explorations and Surveys, 1878-9, p. 12c.
(3) McInnes, Wm., "Basins of Nelson and Churchill Rivers," Geol. Surv., Canada, Memoir 30, 1913.

Assean lake differs from most lakes of the Canadian Shield in the manner by which it is fed. Clay river, which has a comparatively small flow of water, is the only stream of any consequence emptying into the lake. Assean river drains the lake and, in its upper part, is a broad, sluggish stream. About $1\frac{1}{2}$ miles from Assean lake, Crying river joins Assean river; Crying river drains a large area to the north and has a large flow of water. At the time of spring floods part of this flow is diverted via Assean river into Assean lake, equilibrium is finally reached and Assean lake is later drained via Assean river into Split lake. The lake is thus a natural reservoir and for this reason the water level of Assean lake is high for some time after that of Split lake has subsided. This was the condition during the 1939 field season. In July the water level of Split lake was below normal, while high water still held in Assean lake.

Like Split lake, Assean lake has rocky shore with some boulders and reeds. Along the north shore of the southwest end of the lake clay banks as high as 20 feet rise above the water, and good exposures of varved clay can be seen. Wave erosion of the banks makes the water muddy at this end of the lake.

The area is not well wooded by far the greater part of the timber has been burnt and in places there is a sparse second growth. Stands of timber suitable for mining operations are found on the north shore of Crying lake, at several points on Assean lake, and on many of the islands of Split lake. Difficulty might be experienced, however, in finding material for heavy stulls or large dimension timber.

An Indian population numbering something over 450 live on the Indian reserve or hunt, trap and fish within the area. The Hudson's Bay Company has a store on the Indian reserve where there is also a Mission and school maintained by the Anglican Church.

The area forms part of the Canadian Shield. The contact of the Palaeozoic rocks bordering on Hudson bay lies not far distant to the northeast of the map sheet, but its location was not determined.

The greater part of the area is covered by a heavy mantle of varved, glacial-lake clay and, consequently, presents a flat, even surface. A few ridges of sand and boulder clay, and even fewer rock ridges, rise above the surrounding country. With few exceptions, rock outcrops are confined to the shores of larger lakes and rivers. Because of the scarcity of rock outcrops, the distribution of rock types as shown on the accompanying map is to some extent generalized; geological boundaries are as a rule only approximately located.

GENERAL GEOLOGY

The consolidated rocks of the area are all of Precambrian age. With the exception of the basic intrusives and younger granitic intrusives, the rocks have been highly metamorphosed and the greater part have a distinctly gneissic character. Some of the gneisses have been recrystallized to such an extent that all traces of original structures have been lost and only indirect evidence as to their original nature is available. Such gneisses have been classified as igneous or sedimentary according to their mineralogical composition and from field evidence such as variability and lateral gradation into gneisses of known origin.

Assean-Split Lakes Area

Table of Formations

Quaternary	Recent and Pleistocene	River alluvium, peat, etc. Glacial lake clay Boulder clay, sand, gravel
	Unconformity	
Precambrian	Granitic intrusives	Granite, pegmatite, aplite
	Intrusive contact	
	Basic intrusives	Gabbro, basalt, diabase, diorite, peridotite, pyroxenite, anorthosite
	Intrusive contact	
	Granitic gneisses	Altered, fine-grained, acidic intrusives Pegmatite, greisen Granite gneiss, quartz-diorite gneiss Lit-par-lit gneiss
		Intrusive contact
		"Quartz-eye granite gneiss" (May be older than Assean Lake series)
	Intrusive contact	
	Assean Lake series	Volcanics—basalt, andesite Sediments—quartzite, arkose, greywacke, chert, argillite
	Unconformity	
	Pre-Assean Lake group	Grey gneisses—quartz-feldspar-hornblende gneiss, diorite gneiss, hornblendite, feldspar-garnet-hornblende gneiss
		Intrusive contact?
		Conglomerate, altered greywacke, quartz-mica gneiss, gneissic quartzite, garnet-mica gneiss, mica schist, actinolite-chlorite schist (volcanic?)

Pre-Assean Lake Group

Here are included the oldest known rocks of the area. They are predominantly gneissic or schistose and include sedimentary gneisses and schists, and grey gneisses of intrusive origin. Highly altered remnants of volcanic rocks may also be represented.

Sedimentary Gneiss:

The area about Burntwood bay of Assean lake is underlain by sedimentary gneiss. This belt of rock is about 9 miles long in a northeasterly direction by about 3 miles at the widest point.

These rocks weather dark grey and the outcrops commonly have a ribbed appearance due to differential erosion of alternate bands. The typical rock is coarsely-banded quartz-mica gneiss. The quartz is usually finely granular and forms bands up to 1 inch in width. Narrow bands consisting largely of coarse flakes of black biotite are interlaminated with the quartzose bands. Feldspar, hornblende, chlorite and sericite are present in varying minor amounts. In places, this gneiss grades into gneissic quartzite of which quartz is the chief constituent along with thin films of biotite and sericite. Locally, mica schist sometimes 2 to 3 feet in width may represent argillaceous material interbedded with the impure quartzites which were the original constituents of the bulk of the gneiss. Conglomerate was encountered in very few localities at the southwest end of Assean lake. Where found, the beds are thin and lenticular in habit, passing along the strike into typical gneiss devoid of pebbles. The matrix of such conglomerate is quartz-mica gneiss; the pebbles are not abundant and consist of granite, greenstone and quartz. The pebbles are greatly elongated in a direction parallel to the gneissic banding.

On the northwest shore of Assean lake near the mouth of Clay river a belt of garnetiferous quartz-mica gneiss outcrops. The outcrops weather red to grey and have a massive, granitic appearance. The fresh rock is seen to consist chiefly of mica, hornblende, quartz, feldspar and garnet, the mafic materials predominating. The garnet is pink and occurs in round clusters which also contain quartz. Feldspar having the composition of intermediate plagioclase occurs in irregular grains.

The area between Four Mile lake and Crying lake, extending southwest along Hunting river, is also underlain by rocks of sedimentary origin. The southwestern part of this belt is underlain by quartz-mica gneiss, sometimes feldspathic, and in general similar to the gneiss described above. These rocks pass northward into a large belt of conglomerate (Plate IA, p. 29) which is at least 1 mile wide and outcrops along the north shore of Four Mile lake, extending at least 4 miles to the west of this lake. South of the junction of Hunting and Crying rivers a large conglomerate ridge rises about 100 feet above the surrounding country and forms a landmark which is plainly visible from the lower part of Crying river, from Four Mile lake and from higher ground in the vicinity for miles around. A similar ridge occurs about 2 miles northwest, to the north of Hunting river.

The groundmass of this conglomerate is schistose, fine grained, contains many elongate bands of material rich in epidote and is in general similar to the altered greywacke described on page 18. Pebbles are very numerous and form up to 80 per cent of the rock material. The most abundant pebbles are pink to grey granite, while a few of vein quartz, greenstone, diorite, gabbro and pegmatite were encountered.

The pebbles are all greatly elongated. One of the larger pebbles measured 3 feet by 6 inches by 2 inches, a pebble of average size is 4 inches long by 1/2 inch by 3/4 inch. Smaller pebbles are more numerous and are not so greatly elongated in proportion to their size. The pebbles are elongated in the plane of schistosity of the matrix which strikes in a general east-west direction. The long axis of the pebbles was observed to plunge at about 30 degrees to the east.

To the north pebbles become fewer and the conglomerate grades into altered greywacke. This is a slightly schistose, green-weathering rock in which evidence of original bedding has been obliterated. The green colour is due largely to the presence of material rich in epidote. The rock is fairly uniform in appearance wherever encountered, but exposures are few and scattered. Microscopic examination of a thin section of this rock shows it to consist of quartz and epidote in about equal amounts, with about 20 per cent of hornblende. The quartz is finely recrystallized and is present as irregular bands. Apparently all of the feldspar originally present in the rock, and possibly some of the hornblende, has been altered to epidote. The epidote occurs as small grains associated with hornblende which is present in somewhat larger grains. Magnetite in scattered crystals is a minor constituent of the rock.

The sedimentary gneisses and schists are presumably derived from coarse clastic sediments including impure sandstone, arkose, greywacke and conglomerate. Argillaceous material may be represented by small bands of mica schist but is present in very minor amounts. Original bedding of these sediments is probably parallel to or close to the gneissic banding, since marked and sudden changes in material are seen when crossing the strike of the gneiss, while individual bands are sometimes remarkably uniform along their strike.

Rocks of volcanic origin were not seen in direct association with these sedimentary gneisses and schists. In the central section of Split lake inclusions of actinolite-chlorite schist occur within the grey gneiss of this locality. Such inclusions may represent remnants of closely-folded volcanic rocks equivalent in age to the sedimentary gneiss. None of these inclusions is of sufficient extent to be indicated on the accompanying map.

GREY GNEISS:

Two belts of grey igneous gneiss were encountered. One underlies the central, northern and eastern portion of Split lake; the other lies to the north of Crying lake. This gneiss consists chiefly of coarsely-recrystallized hornblende and grey to white feldspar, with some quartz, a composition and texture which indicates igneous and probably intrusive origin. Confirmatory evidence is found in observed intrusive relations between the gneiss and the actinolite-chlorite schist inclusions. In one instance, dykelets of gneiss were found filling fractures in the schist close to the contact, while angular inclusions of schist were present in the nearby gneiss.

Inclusions of quartz-biotite gneiss occur within the grey gneiss and suggest that the latter is intrusive into the sedimentary gneiss of the southwest end of Assean lake. Different relations are indicated between gneiss and sediments in the vicinity of Crying lake. Here the banding of the gneiss along the north shore of Crying lake dips uniformly to the north at about 65 degrees, whereas the schistosity of the altered greywacke to the south dips steeply south, making an angular discordance of about 35 degrees. No exposures were found along or near the contact. If this discordance of secondary structures can be taken to indicate an unconformable contact, then it must be assumed that the grey gneiss is older than the sedimentary gneiss of the district, or that the altered greywacke and conglomerate to the south of Crying lake represent a metamorphic phase of the Assean Lake series of sediments.

H. C. Horwood has described a tonalite at Cross lake, which lies about 100 miles southwest of Split lake. The tonalite is gneissic and in many respects similar to the grey gneiss. Its chief constituents are andesine, quartz and biotite. Both sedimentary series of the Cross Lake area contain boulders shown to be derived from erosion of the tonalite, and the latter is therefore thought to be pre-Keewatin in age.

Horwood states:

"For the first time, therefore, in the history of North American geology, the floor on which the oldest volcanic and sedimentary formations were deposited has been determined. If the Hayes River group is correlative with the Keewatin series further south, as it is commonly thought to be, then the tonalite must be pre-Keewatin in age. The major unconformity between the Hayes River group and the tonalite places the tonalite as the first known member of a pre-Archean series of rocks."[1]

Although the direct evidence of an igneous unconformity in the Split Lake area is doubtful, the grey gneiss is cut by all the other intrusives of the area, and on lithological grounds it can be grouped with the sedimentary gneiss as constituting one of the oldest rock types.

The typical rock is quartz-feldspar-hornblende gneiss (Plate IB, p. 29). The weathered surface frequently has a yellowish colour and is strongly banded. Feldspar and hornblende occur very often in separate bands, and the gneiss sometimes breaks along foliation planes to give large, thin slabs composed essentially of hornblende. In places the rock retains a granitoid texture and is quartz-diorite gneiss. Locally quartz-diorite gneiss grades into a granulose rock composed essentially of coarse crystals of white to light grey feldspar with some quartz. Near the contact of the granite body to the north of Split lake occurs a fairly extensive mass of rock similar to this but containing numerous clusters of fine, needle-shaped crystals of hornblende.

Some of the hornblende in the gneiss is commonly altered to chlorite; other minor constituents are biotite, sericite and garnet. Masses of pink garnet as large as 1 inch in diameter have been found. These consist of an aggregate of garnet crystals and contain inclusions of other minerals, chiefly quartz. Quartz-mica gneiss is found as small bodies within the grey gneiss but, as previously stated, it is thought to represent inclusions of sedimentary gneiss.

Along the north shore of Split lake, in the vicinity of the granite-grey gneiss contact, the area mapped as gneiss consists of a complex of gneiss cut by dykes and irregular bodies of granite, pegmatite and gabbro. In some of these localities the gneiss does not comprise more than 30 per cent of the bulk of the rock.

A microscopic examination of the quartz-feldspar-hornblende gneiss shows the feldspathic bands to consist largely of plagioclase, about 30 per cent quartz, with hornblende and biotite in variable amounts. The plagioclase varies from albite to labradorite in composition, but most of it is oligoclase. Some feldspar grains show compositional zoning, while the more acid feldspars are slightly altered to sericite.

(1) Horwood, H. C. "A Pre-Keewatin Tonalite," Trans. R.S.C., 1935, Sec. IV, p. 139.

The dark bands have the same constituents but contain over 60 per cent hornblende. Minor constituents are titanite, pyrite and apatite. Titanite may form up to 1 per cent of the rock; sometimes it appears to be partly replaced by ilmenite. The rock is coarsely and evenly grained.

Assean Lake Series

This group includes sedimentary and volcanic rocks which are comparatively unaltered and of which the original nature can usually be readily determined. As a rule, bedding is well preserved in the sediments; crossbedding was observed in a few places. These sediments have a clearly defined contact with the sedimentary gneiss on Assean lake, although the contact is exposed in very few places. Evidence for an unconformity between the two series of sedimentary rocks is as follows:

(1) The extreme difference in degree of metamorphism together with the fact that the contact is not gradational.

(2) The contact is apparently irregular in contour, suggesting deposition of the younger series on the eroded surface of the older.

(3) Slight angular discordance.

Some facts relative to the above were also discussed in connection with the grey gneiss at Crying lake.

Near the northeast end of Assean lake the sediments in the vicinity of the contact of the granite mass lying to the south are baked, highly altered and impregnated with granitic material.

SEDIMENTS:

Sediments of the Assean Lake series are exposed in a continuous belt throughout the length of Assean lake and extend at least another 7 miles to the northeast. The known length of the belt is 30 miles, while the width varies from 1/2 mile to 1 1/2 miles. The southwestern part of the belt is largely under Assean lake. The trend of this belt is roughly north 65 degrees east.

A second belt outcrops about 1 1/2 miles below the portages on Landing river and can be followed along the river to Split lake and on a number of islands of Split lake to Burntwood river which it follows for some distance. Here it appears to unite with the belt of sediments through Assean lake. The total known length is 29 miles, the width is similar to that of the other belt and the trend is east to south 70 degrees east. The two belts of sediments have the same lithology and may represent the limbs of a major fold.

These sediments include quartzite, arkose, greywacke, chert and argillite. Quartzite and arkose are more thickly bedded than the other types, beds usually being from a few inches to a foot in thickness. Greywacke, chert and argillite are often finely laminated and intricately folded on a small scale (Plate IIA, p. 30). The various types of sediment are interbedded and there appears to be lateral variation along the strike from one type to another.

Quartzite varies from a fairly pure variety to arkose or greywacke. Quartzite and arkose commonly have sericite developed along bedding and shear planes. In zones of intense shearing, arkose is sometimes altered to quartz-sericite schist. Fresh arkose is usually a reddish color and is made up chiefly of quartz and red feldspar with minor amounts of ferromagnesian minerals. A common variety of arkose is made up of lens-shaped masses of crushed feldspar and quartz about 1 inch long by 1/4 inch wide. These are closely packed together and separated by films of sericite, giving to the rock a distinctly net-like appearance. Flaser-structure such as this is produced by granulation due to compressive shearing. This rock is interbedded with argillaceous sediments, but within the arkose itself widths up to 20 feet show no bedding.

Typical fine-grained greywacke was seen in thin section to consist of an aggregate of very small grains of chlorite, hornblende, quartz, zoisite, epidote and altered sodic plagioclase. Apatite and magnetite are minor constituents. Chlorite and hornblende predominate and their parallel alignment gives the rock a very fine lamination.

Microscopic examination of typical cherty sediments shows them to contain about 75 per cent quartz, the remainder of the rock consisting largely of mica, of which biotite is more abundant than muscovite. The quartz is present as very small grains; the micas are to some extent in parallel alignment and are present as scattered tiny flakes. Epidote, zoisite and apatite are minor constituents.

Volcanics:

Volcanic rocks interbedded with sediments were observed along the north shore of the long, narrow bay in the central part of Assean lake and extend to the east of this bay. They are fine-grained, massive, dark green rocks and include basalt and andesite. Locally they are slightly schistose with a development of chlorite.

Granitic Gneisses

Quartz-Eye Granite Gneiss:

This gneiss extends in a wide belt through the central and southern portion of Split lake. It is characterized by the presence of blue opalescent quartz, often in well defined rounded "eyes" and is termed "quartz-eye granite gneiss." The age relationship between this rock and those of the Assean Lake series was not determined and, lacking evidence to the contrary, it is quite possible that it is older than and unconformably overlain by the Assean Lake series. However this may be, this gneiss cuts the grey gneiss of Split lake and is itself cut by all other intrusives of the area.

The typical rock is highly siliceous, contains crystals of pink or light grey feldspar and eyes of blue quartz. Commonly a number of quartz eyes appear to have coalesced producing elongate irregular patches of the blue quartz. The rock is gneissic due largely to parallel orientation of chlorite and sericite. In thin section the rock is seen to consist of about equal amounts of feldspar and quartz with about 15 per cent of other minerals, the most abundant of which is hornblende. The feldspars are commonly altered to sericite; orthoclase is not abundant, the greater part being albite or oligoclase. The quartz eyes are very large and, as a rule, consist of only one crystal which shows wavy extinction. The eyes are elongate and somewhat irregular in outline. Biotite and epidote are present in appreciable amounts, and a few early formed pyrite and apatite crystals are seen. With the exception of the larger quartz eyes, the rock is medium grained and equigranular.

An unusual feature of this rock in the field is the presence within it of numerous elongate, boulder-like masses which are distributed over wide areas and give the rock a conglomerate-like appearance. Occasionally, where these masses have been fractured, they are cut by stringers of the granite, indicating that they were present in the magma before cooling. They range in size from four inches to two feet or more, and in composition are basic and highly altered. Some resemble meta-gabbro, others are finer grained and contain actinolite and chlorite. They are either early-formed basic segregations within the magma, or partly assimilated inclusions of a basic rock invaded by the magma. The latter supposition is the more feasible, and the "boulders" are not unlike the much larger inclusions of actinolite-chlorite schist contained within the grey gneiss.

Small veins and stringers of blue quartz identical in appearance with the quartz contained in the granite gneiss were observed cutting the grey gneiss in the area within ½ mile or so of the contact. These veins give supporting evidence that the quartz-eye granite gneiss is intrusive into the grey gneiss.

Younger Granitic Gneisses:

These are somewhat variable granitic rocks, all more or less gneissic. They include minor intrusives of both the pegmatite and porphyry type. They have been found cutting all the rocks previously mentioned, and are themselves cut by basic intrusives.

Granite Gneiss:

The principal occurrences of this rock are along the south shore of Split lake, along the south shore of the narrows of Assean lake and between Assean lake and Hunting river. The typical rock contains pink feldspar, quartz, and biotite or hornblende. Often the ferromagnesian minerals have been largely altered to chlorite. In a few localities granite gneiss grades into grey quartz-diorite gneiss.

A specimen of granite gneiss from the south shore of Split lake was examined in thin section and was seen to consist of about 60 per cent feldspar, 25 per cent quartz, with hornblende making up the greater part of the remainder. About one-third of the feldspar is orthoclase, the balance albite or oligoclase; they are altered with the formation of sericite. Hornblende is to some extent altered to chlorite. Magnetite is quite abundant and a few small crystals of apatite were seen.

A specimen of granite gneiss from the narrows of Assean lake was seen in thin section to have a much higher orthoclase content than that above, and to have mica in place of hornblende. The bulk of the feldspar is orthoclase and microcline, the balance albite; they are only slightly altered. Quartz makes up about 30 per cent, and biotite and muscovite in about equal proportions, 10 per cent of the rock. Titanite and magnetite are present in scattered grains.

Pegmatite:

A dyke-like body of altered pegmatite can be followed along the north shore of the central section of Assean lake. This rock consists essentially of orthoclase which is sometimes shattered, quartz and muscovite. In places muscovite is the predominant mineral and the rock can be called greisen. Such types have a crude gneissic banding roughly parallel in strike to the walls of the dyke. These rocks have the coarseness and irregularity of grain typical of pegmatites. In places they have been fractured and the fractures filled by irregular kidneys and stringers of quartz. Gabbro dykes also cut these rocks.

Fine-Grained, Acidic Intrusives:

Altered, fine-grained, acidic rock, locally called porphyry, underlies a prominent point and islands on Assean lake in the vicinity of the Dunbrack vein (Location B). The rock contains many inclusions of altered sedimentary rock, and the complex is cut by basic dykes. The rock is highly siliceous, dense, and contains much brown mica and some sericite. It is locally gneissic, and occasionally shows development of small pink garnets. While this rock is tentatively grouped as being related to the nearby bodies of granite gneiss, it may well be of earlier, and possibly sedimentary, origin. In thin section the rock is seen to consist of quartz, biotite and feldspar, quartz being the most abundant constituent. Biotite occurs in flakes of different sizes, often bent and broken and as a rule not oriented in any particular manner. Feldspars are orthoclase and acid plagioclase, and are all to some extent altered with development of sericite. Pyrite is a minor accessory mineral. The rock is fairly even grained and the grain size is somewhat coarser than that of typical rhyolite. No definite evidence as to the rock's original nature could be found in the section studied. There is no suggestion of a porphyritic texture.

Basic Intrusives

Dykes of basic rock are very numerous throughout the area. They have been observed cutting all the other rocks with the exception of the granite which lies to the north of Split lake. The rocks are all black, grey or dark green in colour, are usually massive and relatively unaltered. By far the most abundant type is a medium-grained gabbro which locally grades into diorite. Finer grained and usually smaller bodies of basalt and diabase were also observed, while other types noted are peridotite, coarse-grained pyroxenite and anorthosite.

GABBRO:

Gabbro dykes range in width from 1,400 feet down to 1 foot, and some have been followed for several miles along their strike. Only a few are large enough to be indicated on the accompanying map. Typical gabbro is seen in thin section to consist of about 50 per cent orthorhombic pyroxene and 35 per cent basic plagioclase. The remainder is made up of hornblende, augite, and small amounts of pyrite and magnetite. The feldspar is mostly labradorite but some of it is more basic. Some of the feldspar is of earlier crystallization than the pyroxene, and the rock locally has a diabasic texture. The hornblende is the secondary variety uralite, and is present as fringes formed around grains of pyroxene by alteration. Since most of the pyroxene in this rock is orthorhombic, the rock is the variety of gabbro known as norite. Comparison of the mineral content of this rock with that of the pyroxenite described below indicates a definite relationship between the two types.

PYROXENITE:

At the east end of Split lake a square-shaped island about ½ mile in size is partly underlain by pyroxenite. This is a coarse-grained rock which weathers brown to green. In thin section it is seen to be composed almost entirely of orthorhombic pyroxene and augite, the former in the proportion of about 65 per cent. The orthorhombic pyroxene has a schiller structure due to parallel orientation of many minute inclusions, and also contains larger inclusions of apatite. Both minerals contain small grains of magnetite. There are traces of secondary hornblende (uralite). Augite appears to be the last-formed primary mineral in the rock.

PERIDOTITE:

Two isolated outcrops of peridotite were observed in the south bay at the extreme southwest end of Assean lake. The rock is dark green in colour, dense and has a high serpentine content. Tiny stringers of cross-fibre asbestos can be seen traversing the rock in various directions.

ANORTHOSITE:

Anorthosite is occasionally seen in lenticular masses up to 10 feet in length occurring within bodies of gabbro, with which it shows gradational contacts. The anorthosite masses lie near the centre of gabbro dykes 30 or more feet in width and are elongate parallel to the strike of the dykes. The rock is composed essentially of coarse crystals of basic plagioclase, probably labradorite. It appears to represent a residual phase of the gabbro magma, and to have been the last portion of the gabbro dykes to crystallize.

Granitic Intrusives

These are the youngest rocks of the area, and the only ones intrusive into the basic dykes. They are massive, fresh-looking rocks and a gneissic structure is not developed. The deep-seated rocks are biotite granite and granodiorite; related dyke rocks include pegmatite and aplite. On the prominent point of Split lake on which the Hudson's Bay Company post is situated, dykes of the granite were observed cutting gabbro bodies which are intrusive into the grey gneiss. Elsewhere on Split lake pegmatite dykes associated with this granite commonly cut dykes of gabbro (Plate IIB, p. 30). Small, irregular bodies of fresh granite were also observed to be intrusive into the granite gneiss to the north of Assean lake.

Observations made by J. E. Spurr at Paint lake and Wintering lake, about 60 miles southwest of Split lake, are of interest in this connection. Spurr states:

> ". . . . on Paint lake and Wintering lake I found the red granite intrusive into the gneissic and metamorphosed grey granite. This red granite has no gneissic structure, and occurs in the various forms of granite, pegmatite, and aplite. It has a close connection with both ore deposition . . . . and metamorphism (development in the older granite gneiss of garnet, pyroxene, pyrrhotite, etc.)."[1]

GRANITE:

A large portion of the area between the northeast part of Assean lake and Assean river and Split lake is underlain by granite. In the field the granite is seen to be fine grained, pink, and to contain small flakes of biotite. Other constituents are quartz, orthoclase and plagioclase. The rock locally grades into grey granodiorite with increase in the amount of plagioclase present. In thin section the granite is seen to contain approximately 70 per cent feldspar and equal amounts of quartz and biotite. Magnetite and apatite are sparingly present. The feldspar consists of orthoclase and albite, the former in somewhat greater proportion. Except for slight alteration of feldspar to sericite, the rock is fresh. Biotite occurs as regularly distributed small flakes.

(1) Spurr, J. E.: "The Ore Magmas," Vol. I, p. 163, McGraw-Hill Book Co., Inc., 1923.

PEGMATITE AND APLITE:

Pegmatite dykes are very numerous throughout the greater part of Split lake. Only a few small dykes of aplite were noted. Typical pegmatite consists chiefly of orthoclase and quartz, with a little muscovite and occasional small crystals of garnet. The orthoclase commonly occurs in very large crystals. The largest body of pegmatite seen appears to be a marginal phase of the granite and underlies a large part of the point on which the Hudson's Bay Company post is situated. Typical dykes of pegmatite are small and irregular in outline.

On a small island about 1½ miles south of the Indian reserve on the northwest shore of Split lake a stockworks of pegmatite stringers was observed cutting gabbro. The pegmatite consists chiefly of quartz and orthoclase and contains numerous elongate crystals of epidote. Some of the crystals are as long as 1 inch. In the same locality, stringers consisting chiefly of light brown to grey zoisite cut the gabbro.

STRUCTURAL GEOLOGY

The area has been subjected to widespread and repeated igneous activity manifested by the intrusion of large bodies of igneous rock, accompanied by intense folding and faulting of older rocks. As a result the structure of the area is complicated and the detail of the present map does not permit of a final structural interpretation being made

Minor drag-folds are very commonly observed along the length of Assean lake. All the drag-folds observed were found to have the same attitude and, where observations could be made, to pitch at approximately 60 degrees southwest. They were apparently caused by a thrusting movement acting in a general northeast-southwest direction, the effect of which was to displace the northwest side of the zone affected in a northeast direction. It may be of interest to note that in the sheared conglomerate to the west of Four Mile lake the pitch of elongation of the pebbles was observed to be 30 degrees northeast. It is evident that, considered in a vertical plane, forces acting parallel to a pitch of 30 degrees northeast would produce this elongation of the pebbles and would also produce drag-folds pitching 60 degrees southwest.

Thus it appears that thrusting movements were effective over a wide belt in this part of the area. That such movements are of late age is evidenced by the fact that small gabbro dykes known to be younger than the other rocks of the vicinity are affected by the drag-folding and by associated faults. It is possible that these movements were associated with the latest period of granitic intrusion and were responsible for the fracture systems into which mineral deposits were later introduced.

A few of the drag-folds observed along the north shore of the narrows of Assean lake have been subjected to more intense movement than could be taken up by folding, and the folds pass into minor thrust-faults. In competent rocks, such as quartzite, minor faults are common and are associated with only slight folding. These faults strike in a direction nearly parallel to the direction of the narrows of the lake i.e., about north 65 degrees east.

A major fault appears to underlie the narrows of Assean lake. The evidence for the existence of such a fault is as follows:

(1) The impossibility of correlating the geology between one side of the narrows and the other, although the two shores are often no more than 400 feet apart.

(2) Strikes of bedding and gneissic banding towards the west end of the north side of the narrows differ by as much as 30 degrees from the strike of banding in the granite gneiss immediately across the narrows.

(3) Minor faults roughly parallel to the direction of the narrows are commonly observed along the north shore.

This thrust-fault appears to displace the rocks on its northwest side towards the northeast. In view of the extensive drift covering, the fact that evidence for it was not observed elsewhere does not remove the possibility that the fault extends through the entire length of Assean lake and along Burntwood river to the southwest.

ECONOMIC GEOLOGY

Prospecting has been carried on in the area in an intermittent way for a number of years. In 1928 a gold discovery was made in the vicinity of the west channel of Nelson river where the river enters Split lake, and a small rush of claim staking ensued. Gold values are said to occur in narrow quartz veins and stringers. Other claim groups were staked at about the same time near the mouth of Burntwood river, at the mouth of the east channel of Nelson river and in the vicinity of Tea and Copper lakes. A limited amount of exploratory work was done but all of these claim groups have since been allowed to lapse. A group of claims was staked at the northeast end of Assean lake in the fall of 1929, but was allowed to lapse the following year.

Lindal Deposit

Interest was revived in the area with the discovery of the "Lindal vein" (Location A) on Assean lake in April, 1936. A group of claims was staked here by Messrs. J. Dunbrack, G. Green and associates, and other parties staked claims in the vicinity. After a limited amount of exploratory work had been done by the discoverers, the property was diamond drilled by Winnipeg interests under an option agreement. While interesting gold values were had in surface trenches, diamond drilling results were inconclusive and the property was allowed to revert to its original owners. Other interests optioned the property and did further diamond drilling in March, 1937, but again the option was not exercised. The outcrop of the Lindal vein is almost entirely under water when the level of Assean lake is high, so that examination and sampling of the deposit is virtually impossible in the summer.

The rocks in the vicinity of the deposit are sedimentary and have the appearance of greywacke that has been altered with the development of abundant chlorite and brown mica. The rock is schistose, and locally crenulated and drag-folded. Minor, altered, porphyritic intrusives cut the sediments in the vicinity of the deposit. The deposit is said to be of lenticular habit, quartz bodies up to 175 feet in length and 7 feet in width occurring intermittently along the strike, separated by lengths of up to 75 feet of schist containing little or no quartz. The zone has been traced for a length of 600 feet by surface work and diamond drilling. The strike of the deposit is approximately east and west, the dip as reported is steeply south. Examination of material on the dump shows the vein matter to consist of dark grey and cherty to light grey, slightly granular quartz which contains appreciable amounts of galena, sphalerite, pyrite and chalcopyrite. A few thin inclusions of schist are also present in the quartz, and some specks of visible gold were observed.

Dunbrack Deposit

In the late fall of 1937, Messrs. Dunbrack and Green discovered the "Dunbrack vein" (Location B) at a point about 2 miles southwest of their original discovery. Exploratory work was done on the vein during the following winter and the vein was partially opened up by sinking pits through the heavy clay overburden and through the ice of the lake. Surface sampling indicated interesting values in gold. Approximately 2,000 feet of diamond drilling was done to test the vein under an option agreement by Sherritt Gordon Mines Limited in August, 1938. Eleven holes were drilled at 50-foot intervals. Of these, eight consecutive holes showed gold values ranging from 0.12 ounces to 0.98 ounces per ton for core widths of from 1.6 to 3.0 feet. The holes were drilled at angles varying from 31 degrees to 38 degrees and intersected the vein at approximately the 40-foot horizon.

In the vicinity of the vein the underlying rock is an igneous-sedimentary complex. Sediments are the least abundant type and are present as remnants within the intrusive rocks, and of these the bulk comprises greywacke and interbedded chert. The oldest and most abundant intrusive is the fine-grained, dense, grey rock which has been described earlier in this report (see page 23). This rock is cut by dykes of feldspar porphyry, a dark grey, often schistose rock containing numerous phenocrysts of grey plagioclase. The youngest rock is gabbro which occurs in dykes of varying size. Small gabbro bodies are cut by the vein and this fact indicates that all rocks of the vicinity are pre-ore in age.

The vein fills a fracture zone in this complex. Gabbro near the vein is altered to hornblende-chlorite schist, other rocks are altered to biotite and sericite schists. This vein, like the Lindal vein, is not exposed at times of high water. When examined, a 5-foot width of vein matter could be seen under shallow water near the lakeshore. The vein matter consists of quartz and mineralized, silicified schist, the latter being most conspicuous towards the walls. The quartz is light to dark grey in colour and cherty in texture. Much of it contains abundant galena, sphalerite, chalcopyrite and pyrite, with much smaller amounts of pyrrhotite. Visible gold is sometimes seen in the quartz. The vein strikes approximately north 45 degrees east, and dips 80 degrees southeast.

Gold has also been found in a quartz vein on a small island about ½ mile to the southwest of the Dunbrack vein. This vein, where exposed, appears to occupy a fractured zone in gneissic, drag folded, fine-grained intrusive rock. It is similar in appearance and mineralization to the Dunbrack vein, and contains visible free gold. Owing to its location on a small island only a restricted amount of exploratory work has been done on this occurrence.

Other Mineral Occurrences

Mineralized occurrences were observed elsewhere in the area. For the most part they are found within a broad belt running in a northeasterly direction through Assean lake and extending along the upper part of Assean river, and at scattered points on Split lake. Cherty quartz veins and stringers containing galena and sphalerite; veins of grey, glassy quartz containing pyrite, pyrrhotite and chalcopyrite; stockworks of quartz stringers accompanied by alteration and mineralization of the surrounding rock; and mineralized zones of schisted rock, are the most common types of occurrence observed.

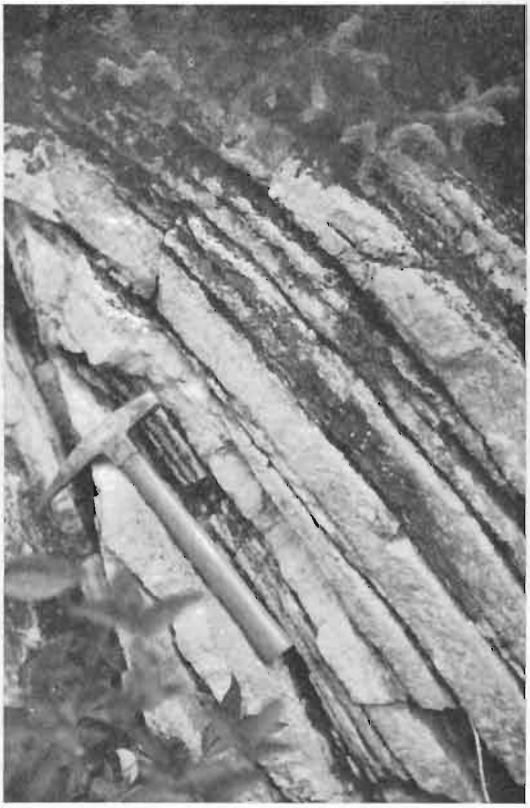
CONCLUSIONS

From the prospector's point of view, it is interesting to note that all but the very youngest rocks of the area have been subjected to igneous intrusion accompanied by deformation and fracturing and by the later injection of quartz veins and sulphide minerals along the channels so provided. This means that large areas of granite gneiss within the area cannot be ruled out as unfavourable ground for prospecting. However, the sediments and lavas of the Assean Lake series probably constitute the most favourable formations, particularly so in the vicinity of Assean lake and Assean river where folding and fracturing appear to have been most intense and where the sediments are cut by numerous small bodies of intrusive rock.

The thick overburden of clay which prevails throughout the area presents a great obstacle both to the finding of new deposits and to the successful exploration of deposits already known. For this reason it is probable that other areas in which favourable rock formations are known to occur but which afford many rock exposures not yet closely examined will prove more attractive to the average prospector in selecting a district in which to work.

PLATE I.

A. Sheared conglomerate (south of junction of Hunting and Crying rivers).



B. Grey gneiss (north shore of Split lake).

Plate II.

A. Cherty sediments of Assean Lake series (island at mouth of Burntwood river).

B. Gabbro intruding grey gneiss and cut by pegmatite (central section of Split lake).

INDEX