PROVINCE OF MANITOBA

DEPARTMENT OF MINES AND NATURAL RESOURCES

HON. C. H. WITNEY
Minister

J. G. COWAN, Q.C.
Deputy Minister

MINES BRANCH

J. S. RICHARDS
Director

PUBLICATION 57-1

GEOLOGY
of the
LYNN LAKE DISTRICT

NE 7, 10, 11, 12, 14 (East), 15, 16; of 64C
GRANVILLE LAKE MINING DIVISION

by

G. C. Milligan

Winnipeg, 1960

Price, $2.00 with maps.

Part of the town of Lynn Lake. The "A" mine and surface plant of Sherritt Gordon Mines Limited, at centre.

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ERRATA

1. The lake at longitude 101°08′30″ and latitude 56°46′, on Map No. 1, is incorrectly labelled Nail Lake. Nail Lake is situated 1¼ miles southwest of that lake, at 101°10′ and 56°45′30″.

2. The contact between Map Units 5 and 11 on Map No. 2 should be moved south from Cartwright Lake to pass through the principal point of aerial photograph 139, near longitude 100°45′.

PREFACE

The preliminary work upon which this volume is based was carried out over a period of five years by six different geologists working more or less independently. The author, one of those engaged in this preliminary work, later spent two complete summers, and parts of two more, re-examining the district, concentrating especially on places where one might find critical data required to settle problems concerning lithology, stratigraphy, structure, and correlation.

Compilation and correlation of the preliminary work and the results of the author's investigations involved a re-study of all earlier field notes, aerial photographs, rock specimens, and thin sections, as well as re-plotting the maps of the entire area.

Of particular interest are the structural interpretations arising out of this study. In addition, new data are presented regarding the uncomfortable relationship between the Wasekwan and Sickle series; a group of intrusive rocks with a wide range of composition has been recognized, for the first time, as pre-Sickle.

A comprehensive listing of mineral occurrence and properties in the district is presented. It sets out all available results of exploratory work done since 1930.

Besides the interpretations and conclusions presented in this work, the mass of factual information in a single volume provides a comprehensive review of the Lynn Lake District that should be of value to geologists, prospectors, and exploration companies alike.

J. F. DAVIES
Chief Geologist

January, 1960

ACKNOWLEDGEMENTS

He who prepares a compilation is in debt to many. My gratitude to many persons for their assistance is not the less sincere because the space here available does not permit individual acknowledgement of the debt. Of some few, however, one must make special mention.

Foremost, of course, are those on whose field work the compilation is directly based. The debt to this group is obvious. Where opinions or conclusions have been used directly, the source is usually indicated by a footnote at the appropriate place. Thousands of observations, and some 3,000 miles of traversing pass, of course, with no other notice than this mention. Though the data were supplied by these men, and they may have been quoted at length, they should not be held responsible for the conclusions expressed herein. In many cases, I know, they will be in hearty disagreement.

To many persons encountered in the field, thanks are due for information and assistance of great variety, and for the good fellowship which always greets the traveller in the bush.

To those who shared the summer seasons: W. Salstrom, J. Robinson, C. Shepherd, D. Brandson and J. Klassen, my thanks are extended for cheerful, patient, and pleasant company, though the flies may have been thick and the swamps wet at times. Special thanks, for regular radio communication, over many days, are due to R. T. Smith and N. Atkinson of the Manitoba Forest Service, Lynn Lake. To N. C. McCoy, R. Paquin, and G. C. Emberley, Manitoba Government Air Service, go thanks for their interest and active cooperation which was of material assistance.

The assistance of the mining companies in the area must be acknowledged. To P. Mathews, of Anglo-Barrington Mines, I am indebted for hospitality and much information. To the staff of Sherritt Gordon Mines, especially A. E. Gallie, G. D. Ruttan, and V. Villet, for information, assistance, and discussion on numerous occasions, I am deeply indebted and grateful.

Thanks are extended to my colleagues of the Mines Branch, for many things: to J. S. Richards, Director, for permission to use this work as a thesis; to G. H. Charlewood, formerly Chief Geologist, for much encouragement and patience. When "I . . . ventured, like little wanton boys that swim on bladders, these many summers" into seas of fantasy, J. F. Davies patiently pricked the airy support of many a half-formed theory. For those hours of discussion, I extend my thanks. Mrs. Louise Kerr and Guy Lavallee performed patiently the task of rendering the manuscript intelligible to the printer. My special thanks go to D. Henderson for many an overtime hour spent drawing the maps and illustrations, and to K. A. Mann, whose patience finally solved the great jig-saw puzzle of the location of traverse lines. Maps 13 and 13A are the work of M. Less; the isometric drawing facing page 118 was prepared by R. D. Downe.

I am indebted also to Professors M. P. Billings, H. E. McKinstry, and J. B. Thompson, for much valuable criticism.

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*In Separate Container.

CHAPTER I

INTRODUCTION

LOCATION AND EXTENT OF THE AREA

The Lynn Lake district, as here described, comprises the country north and west of Granville Lake and the Churchill River. The boundaries of the area are, roughly, the interprovincial boundary with Saskatchewan on the west, and Sickle and Barrington lakes on the east. The north boundary of the area is latitude 57°00′N, the southern limit is 56°30′N. The total area represented by the accompanying geological maps is approximately 3,630 square miles, a little less than half the area of Massachussetts. It is made up of a southern and a northern part of approximately equal size; the northern half is offset to the eastward about 19 miles. This unusual shape results from the omission from the mapping program of a large granitic area in the vicinity of Eden Lake, to the southeast, and of a similar area probably underlain by granite, but covered by much drift and muskeg, to the northwest. Each of these two parts is about 57.4 miles from east to west and 17.3 miles from north to south; the fractional figures arise from the dimensions of the 15-minute "quadrangle" sheets used as units in the field mapping program. The location of the area is shown on the adjacent outline map of northern Manitoba (Fig. 1).

PREVIOUS EXPLORATION AND PROSPECTING IN THE AREA

There is little record of any extensive exploration work in the district, prior to 1930, though track surveys had been made through adjacent areas in the last century.[1] This work was restricted to Reindeer Lake, and the canoe route leading to it, which is to the west of the district here considered. For the same reason, the report by Stockwell[2] on the geology of Reindeer Lake, 1928, is outside the strict limits of this area, though undoubtedly of incidental interest. In this latter report, the description of the mineral occurrences at Paskwachi Bay on Reindeer Lake is included.

During the period 1932 to 1935, officers of the Geological Survey of Canada were engaged in reconnaissance mapping in the area. The results of their work were published in the Summary Report of the Geological Survey and in two map sheets on a scale of four miles to the inch.[3]

More recently, the adjoining country has been mapped on this same reconnaissance scale. The Brochet area, to the north, was mapped by N. R. Gadd whose work was published as Map No. 1001A, in 1950. To the east, the Uhlman

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[1]Tyrrell, J. B. and Dowling, D. B.: Report on the Country between Athabasca Lake and Churchill River, with Notes on Two Routes Travelled Between the Churchill and Saskatchewan Rivers. *Geol. Surv., Canada, Ann. Rept., vol. 8 pt. D, 120 pp.*
Bell, R.: Report on Hudson Bay and some of the Lakes and Rivers Lying to the West of it. (Reporting explorations of A. S. Cochrane.) *Geol. Surv., Canada, Rept. of Prog., 1879-80, pt. C, pp. 1-56.*
McInnes, Wm.: The Basins of the Nelson and Churchill Rivers. *Geol. Surv., Canada, Memoir 30, 1913.*

[2]Stockwell, C. H.: Reindeer Lake Area, Saskatchewan and Manitoba. *Geol. Surv., Canada, Sum. Rept., 1928, pt. B, pp. 46-72.*

[3]Norman, G. W. H.: Granville Lake District, Northern Manitoba. *Geol. Surv., Canada, Sum. Rept., 1933, pt. C, pp. 23-41.*
Map 301A.—Granville Lake Area, 1934.
Map 343A.—Granville Lake Sheet (West Half), 1936.
Map 344A.—Granville Lake Sheet (East Half), 1936.

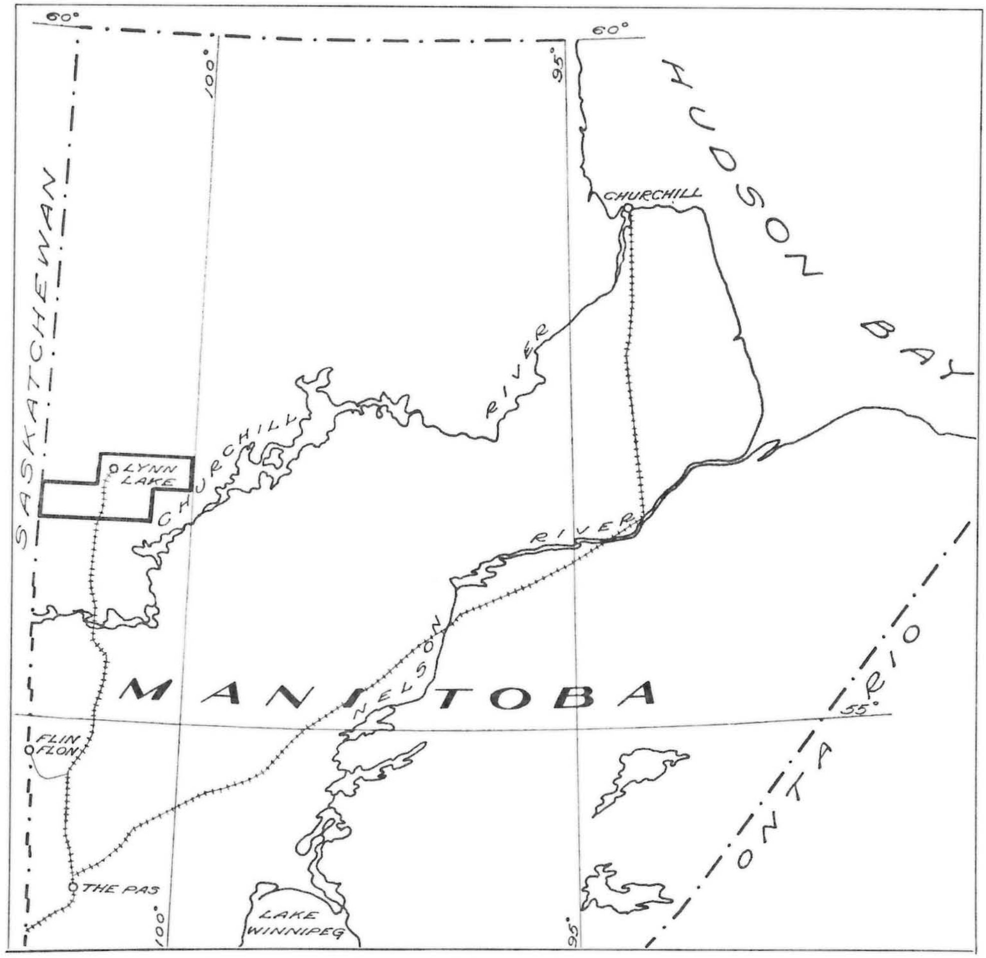

Figure 1—Map showing location of Lynn Lake District and of the individual accompanying map-sheets.

Lake area was mapped by G. M. Wright in 1948; his map was published as Preliminary Map No. 53-12. The Big Sand area to the northeast was mapped by H. A. Quinn in 1955, but has not yet been published (1959).

A further project of the Geological Survey was the detailed mapping of a small area north of Lasthope Lake in 1941. This map, by J. D. Bateman, was published as Paper 45-14, and covers an area which at the time was under active exploration for gold. The detailed work did much to clarify the stratigraphy of the district. (See also page 31.)

The Caribou showing, on Barrington Lake, is reported to have been staked in 1930, but no further staking is reported from the district till 1934. The two best known prospects of this period are the one at Paskwachi Bay on Reindeer Lake, and the gold showing at the south end of Cartwright Lake. The former was discovered by John Highway. Additional staking was done by E. L. Brown and John Drybrough, and by others. Diamond drilling was done in 1928, but there appears to have been no other activity. Details of this can be found in Stockwell's report on Reindeer Lake.[1]

[1]*Geol. Surv., Canada, Sum. Rept., 1928, pt. B, pp. 68-70*

The second prospect, at Cartwright Lake, was staked by Messrs. Hanson and Akers, in 1934, and after being re-staked and passing through several changes of ownership, is still covered by valid claims. Details of the history of this property are given below.

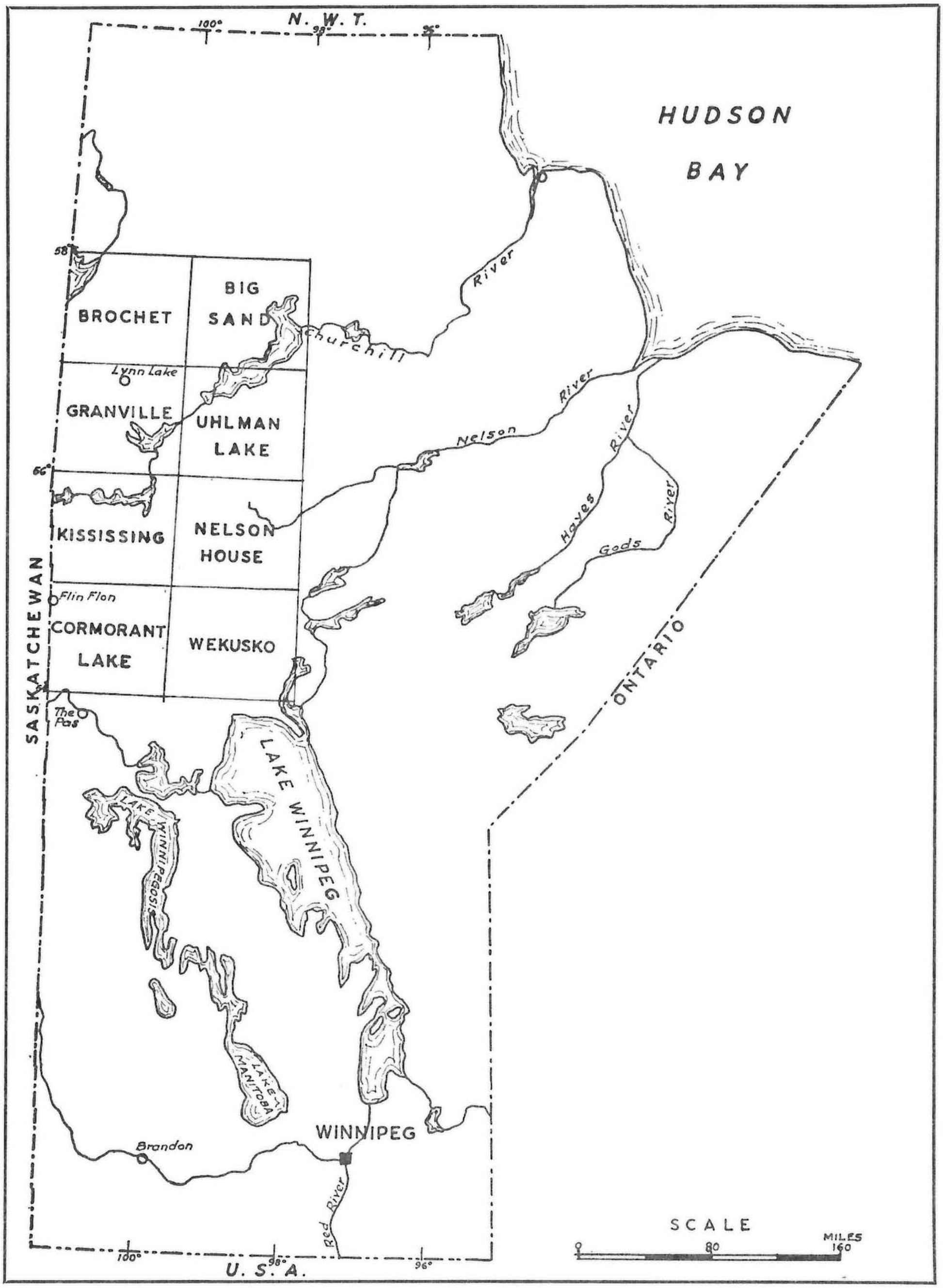

Figure 2—Map showing areas adjacent to Granville Lake area which have been mapped on reconnaissance scales.

The files of the Mining Recorder's office show that a small group of prospectors from Sherridon was working in the Lynn Lake district from 1933 on. Their activities appear to have been centred about Beaucage Lake, Black Trout Lake and Cartwright Lake (Maps 7, 6, 2). Prominent in this group were Stanley Akers, William Hanson, Arthur Beaucage, Jas. R. Cryderman, R. D. Tamlyn and P. Johnson. Many of these men were grub-staked by Peter Durie, of Sherridon. The claim transfers suggest that R. J. Jowsey was also providing support for this exploration.

A number of claims were staked in the vicinity of Beaucage and Black Trout lakes. The details of the many stakings and re-stakings are given below.

Not of this group, but doing some prospecting, were Joseph Boiley and R. Madole. Boiley was running a trap line and doing some casual prospecting from a camp at the south end of what is now called Cockeram Lake (Map No. 2). Madole, who was known as "Dirty Dick", had been involved in the early work at at Sherridon. He was working in the area around Lasthope Lake (Map No. 6) and, in 1937, made the original discovery of gold on the property of Lasthope Lake Gold Mines Limited. He staked the Smoke, Heath, and Nencie claims in that year.

The Lasthope Lake-McVeigh Lake part of the district saw considerable activity between 1938 and 1940, with Central Manitoba Mines Limited and Sherritt Gordon Mines Limited the active companies. Prior to the early summer of 1939, Fred Johnson had staked the Oro group. Eventually staking was completed, between June 1939 and June 1940, on a block of 417 claims covering the ground between Fraser Lake and Moses Lake, and extending southeast to Lasthope Lake. Active in this work were Gordon Linklater and F. D. Cheswright, on behalf of Central Manitoba Mines Limited; and Austin McVeigh, Jas. Sayies, Wm. Morrison and D. Foster for Sherritt Gordon Mines Limited. The claim group was consolidated under Lasthope Lake Gold Mines Limited, a subsidiary of Sherritt Gordon, to form what was, at that time, one of the largest blocks of surveyed claims held by a single mining company anywhere in Canada.

Through the subsidiary company, Sherritt Gordon did diamond drilling on these claims during 1940 and 1941. It was at this time that the immediate area was mapped by Bateman for the Geological Survey of Canada. The map is on a scale of 1,500 feet to the inch, and is restricted to the band of volcanic and sedimentary rocks underlying these claims.

Prospectors ranged the surrounding country during this period of activity, and some work was done in widely scattered places. This included some diamond drilling at the south end of Pool Lake, trenching to the northwest of that lake, and possibly some other places. Gold was the chief interest in all this activity.

Sulphides, in the form of float, had been found in many places, but had no apparent systematic distribution. In 1941, Austin McVeigh finally located a source in the outcrop of what is now the "A" mine, at Lynn Lake.

Late in 1945, following other activity at Ralph Lake, work was begun on this body. The news of an apparently important discovery soon leaked out. However freeze-up was very slow that year and not until late in December was it possible for others to get into that area. When flying was possible after freeze-up, a staking rush developed, and all likely—and much unlikely—ground in the district was staked in a short time.[1]

During the winter of 1945-46, a large number of individuals, and companies large and small, were active in the district. Competition for "open" ground was keen, but under winter conditions most staking was done on the basis of the existing

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[1]For further details refer to: Brown, E. L.: Sherritt Gordon Lynn Lake Project. Notes on Discovery and Financing. *Trans. C.I.M.M., Vol. LVIII, pp. 187-200, 1955.*

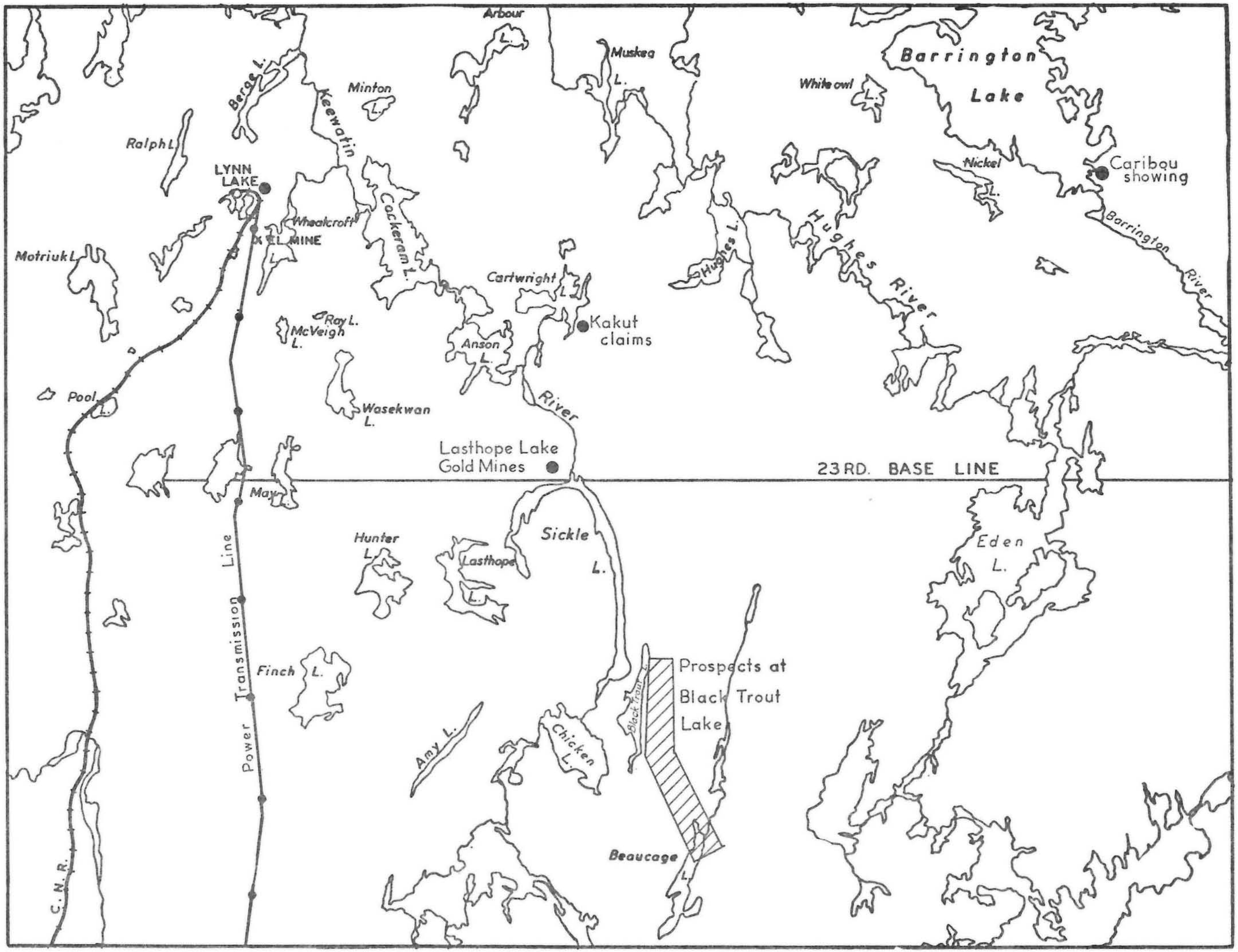

Figure 3—Map showing location of early prospecting activities in the district.

geological map, very often without the staker being able to see what he actually was claiming, because of the snow.

The geological map then available was the four mile-to-the-inch reconnaissance map published by the Geological Survey of Canada in 1936. This map was published in two parts as the Granville Lake sheet, east and west halves, numbered 343A and 344A. It was based on the field work of J. F. Henderson, G. W. H. Norman, and D. L. Downie, of the Geological Survey staff, during the seasons of 1932, 1933, and 1935. Most of the work on the west half was done by Downie, in 1935; the eastern half was explored by Henderson and Norman in 1932 and 1933.

This was, on the whole, a good example of the better grade of reconnaissance work. In places the map was amazingly detailed and complete, but, in other places, as is inherent in the method, there was generalization of the rock boundaries. In consequence, one imagines there were a few chagrined "prospectors" when spring permitted detailed scrutiny of what had been staked in the heat of the rush. In one case, at least, a large group of claims, which presumably had been staked in hope of finding nickel, though well outside the main area of activity, was revealed by the retreating snow to cover several square miles of good quarrying granite.

During the winter of 1945-46, magnetometer surveys were done on many of the claim groups, especially those between Lynn Lake and Barrington Lake and, to a lesser degree, on those lying to the southwest of Lynn Lake. This magnetometer work revealed no obvious orebodies and only a few anomalies were tested by drilling.

Most companies then sat back to await developments at Lynn Lake. Sufficient work was done to hold any claims that appeared to merit subsequent investigation for one reason or another, and major expenditures were postponed until the question of the existence of a mine at Lynn Lake—with the attendant decrease in exploration and marketing costs—might be settled. Those claims whose main reason for existence was the excitement of the staking rush were, of course, allowed to lapse. At Lynn Lake, Sherritt Gordon pursued an aggressive program of exploration by geophysical methods and diamond drilling and, by 1950, had outlined, in eleven orebodies, the fourteen million tons of ore estimated to be the minimum required to carry the cost of a new mine, plant, and railway. Construction began in 1951, and by the time the 144-mile railway connection was completed, late in 1953, the mill was in operation and concentrate was awaiting shipment. To avoid delay, the concentrator and mining plant, along with practically the complete town of Sherridon, had been moved in by tractor train during the preceding winters.

PRESENT EXPLORATORY WORK

To meet the need which had suddenly arisen for more detailed geological maps of the area, the Manitoba Mines Branch began, in 1946, a program of field work which was largely completed by 1950. Preliminary maps and reports are incorporated into, and form the basis for, the accompanying maps. The preliminary maps and the responsible geologists are listed on page 7.

A special petrological study of the Tow Lake gabbro was made by H. E. Hunter, in 1952 and 1953, and submitted as a Ph.D. thesis to the University of California at Los Angeles.

Within an area of this size, where a number of different people were working over a considerable period on the same project, there inevitably arose questions of interpretation. In some cases a question arose in one area for which a satisfactory answer could not be found, because the critical data were not forthcoming until another area had been mapped, possibly several years later. Differences in the units used in mapping also arose, and add to the difficulties for anyone who has to study the district.

Area	Map No.	Geology by	Date of Publication
Lynn Lake....................	46-2	J. D. Allan	1946
Cockeram Lake................	...	J. D. Allan	Not previously published
Hughes Lake..................	47-3	J. D. Allan	1948
Farley Lake..................	47-5	M. S. Stanton	1948
Barrington Lake..............	47-6	G. P. Crombie	1948
Sickle Lake..................	48-6	A. P. Fawley	1949
Lasthope Lake................	49-5	A. P. Fawley	1951
Counsell Lake................	49-4	T. A. Oliver	1952
Wilmot Lake..................	50-9	T. A. Oliver	1952
Dunphy Lakes.................	48-4	M. S. Stanton	1949
Laurie Lake..................	50-7	G. C. Milligan	1951
Outside the present area, but continguous to it:			
Melvin Lake..................	51-5	H. E. Hunter	1952
Beau-Cache Lake[1]............	50-8	G. C. Milligan	1951
MacBride Lake................	55-2	L. C. Kilburn	1956

During this preliminary mapping a lithological, rather than a strictly stratigraphic, basis was deliberately used in establishing the map-units. This was done in the full knowledge that a study of the district as a whole would eventually be made; at the same time, those doing the field work placed their greatest emphasis on petrographic description and, in the published reports, no serious attempt was made to consider the structural or metamorphic history of the district. It was felt that, when the study of the complete district was made, it would cause less confusion, trouble, and wasted effort to have the data on a lithological basis, which could then be interpreted in terms of stratigraphy and geological history. The present work is an effort to make this study of the district as a whole, and to evaluate the earlier "lithological" mapping in terms of the structural and metamorphic history of the area.

The field work specially done as part of the present project was limited to the investigation of specific points and questions, and re-examination of selected outcrops. This was done during the field seasons of 1954, 1955, and parts of 1956 and 1958. No attempt was made to examine, even briefly, all parts of the district, and work was restricted to those places where the preliminary maps indicated particular problems, or the probability of the maximum critical information for the least expenditure of time. A deliberate effort was also made to see a representative selection of outcrops for each unit shown on the preliminary maps. This examination varied greatly in its detail. In one place—Beaucage Lake—some plotting was done using a plane table and a scale of 100 feet to the inch. In most places, outcrops were located by compass and pace traverses in conjunction with vertical aerial photographs on a scale of two inches to the mile. The traverses were run rapidly in some cases, where only broad changes were of interest; in other parts the examination was literally made on hands and knees.

[1]This is the "Beaucage Lake" sheet of the accompanying maps. In 1950, the name Beau-Cache, for this lake, was supplied by local people as the name in use. It was applied in the preliminary report, in the belief that it had been approved by the Geographical Board. In preparing the present map it was found that the name had not been approved and, further, that it might well have been a mis-spelling of the name of Beaucage, a prospector who had formerly worked in the area. The latter name has now been approved by the Board on Geographical Names.

THE MAPS AND MAPPING METHODS

The accompanying geological maps (numbered one to seven) are on a scale of one mile to one inch and are derived from the preliminary maps listed above.

To produce a set of maps of reasonable accuracy and consistency in the present work, it was found necessary to recover all the outcrops by plotting them from the original traverse notes, on a completely new planimetric map made from the aerial photographs. This new base map was made so that it could incorporate control which has recently become available, and so that precautions could be taken to ensure dimensional stability.

Attempts were first made to incorporate the existing preliminary maps directly on to the published 1-mile sheets of the National Topographic Series. It was found however, that the published 1-mile sheets are very difficult to use for this purpose, because of erratic distortion of the paper after printing. Furthermore, the earliest preliminary maps showed such inaccurate topography that it was impossible to locate outcrops on the 1-mile sheets by any process of direct transfer.

At the time some of the preliminary maps were being prepared, between 1947 and 1950, the Topographical Survey was preparing the copy for their 1-mile maps. Through the courtesy and co-operation of that Federal department, ozalid "advance copies" had been made available on the plotting scale of one-half mile to the inch. Some of these had been used in preparing the preliminary maps and were available. However, the dimensional instability of the ozalid paper made them very difficult to use.

The great inaccuracy of the topographic base for the preliminary maps came from a variety of causes. Where the "advance information" map was not available, the procedure used was necessarily different and the resulting preliminary maps varied widely. Primary control, to permit preparation of planimetric maps from the photos, was practically absent from the area at that time. The facilities locally available did not permit accurate photogrammetric bridging across the great distances between points where control was present.

The geologists preparing the maps were forced to resort to such methods as their ingenuity and the available control might suggest. For example, the Wilmot and Counsell Lake sheets (49-4 and 50-9) were produced by a radial line plot from the field photographs; but the only available control was a short length of the 23rd Base Line extending from the east as far as Counsell Lake, and even that was parallel to the longer direction of the photo triangulation. Even less control was available for the Dunphy Lakes map (48-4), and Stanton was forced to fix the boundaries of the area from the 4-mile topographic map, and then fit tracings of the photographs into this frame as best he could. In the northern half of the district the field maps used were the claim maps, which are issued to show the location of mining claims. Where the claims were surveyed these were valuable, because geological detail could be tied on to the surveyed claim boundaries. The claim maps, however, especially where there are few, or no, surveyed claims, are little better than diagrammatic in the matter of position and outlines of lakes and streams—the very items used in fixing the position of compass traverses.

In view of the varied history and accuracy of the preliminary maps, it was found impossible to incorporate them directly into the present work by transferring the outcrops to the existing 1-mile maps and, in the end, all efforts along this line had to be abandoned and a completely new base map was prepared.

The primary control available for the photogrammetric work on the accompanying maps was:

1. The survey of the 23rd Base Line to range 24 W.P.M. This is a closed first order traverse.

2. The survey of the railway to Lynn Lake, which runs from south to north through the central part of the area. This is a first order survey closed on the 23rd Base Line, but open beyond to Lynn Lake.
3. Monumented stadia traverse along the line of the Laurie River and Laurie Lake.
4. Monumented stadia traverse along the line of the Keewatin River and Cockeram Lake.
5. Monumented stadia traverse along the line of Barrington River and Barrington Lake.

These last three are fourth order traverses.

6. Survey of the Laurie River Power Company transmission line to Lynn Lake, which runs north to south through the central part of the district. This is a first order survey and affords some measure of control on the open end of the railway survey, since it also crosses the 23rd Base Line some 6½ miles east of the railway.
7. Monumented traverse through Berge Lake, Goldsand Lake to Vandekerckhove Lake. This is probably a first order survey but is not a closed traverse.
8. Some measure of local control is also provided by claim surveys. Where these form a large block, as to the south of Lynn Lake, the measure of overall control may be significant. These are third order surveys.

   Large numbers of these claims were surveyed before the photographs were taken and the boundary lines, cut through the bush, are clearly visible on the photographs.

It should be noted that, although the control in a north-south direction is very good in the central part of the area, in the eastern and western parts it depends heavily on the fourth order stadia traverses. It should be further noted that good east-west control is lacking west of Range 24 W.P.M., i.e. west of the line of the railway. In consequence the overall accuracy of the map control is probably affected considerably.

The photographs were taken in 1947 by the Royal Canadian Air Force. They are on a scale of approximately one-half mile to the inch and have the usual high quality of R.C.A.F. photography.

The necessary photographic triangulation was done by the Surveys Branch of this department, by means of slotted templates. The control points were taken from the plotting floor on tracing paper and transferred with the minimum of delay to acetate sheeting, 0.005 inch thick. For the Cockeram Lake sheet, the topographic detail was also supplied on tracing paper and copied onto the acetate film. For all other sheets, the detail was taken directly off the photographs onto the acetate plotting sheet, using a sketchmaster. It is realized that this work is not as accurate as that which might be produced by more elaborate equipment and methods, and more experienced operators. On the other hand, it is considered to be a definite improvement over any other available means of locating outcrops and other geological features.

The accuracy of location of the geological features varies considerably from sheet to sheet, depending on the previous history of the work. This is reviewed briefly below, to give some indication of what may be expected from the various maps.

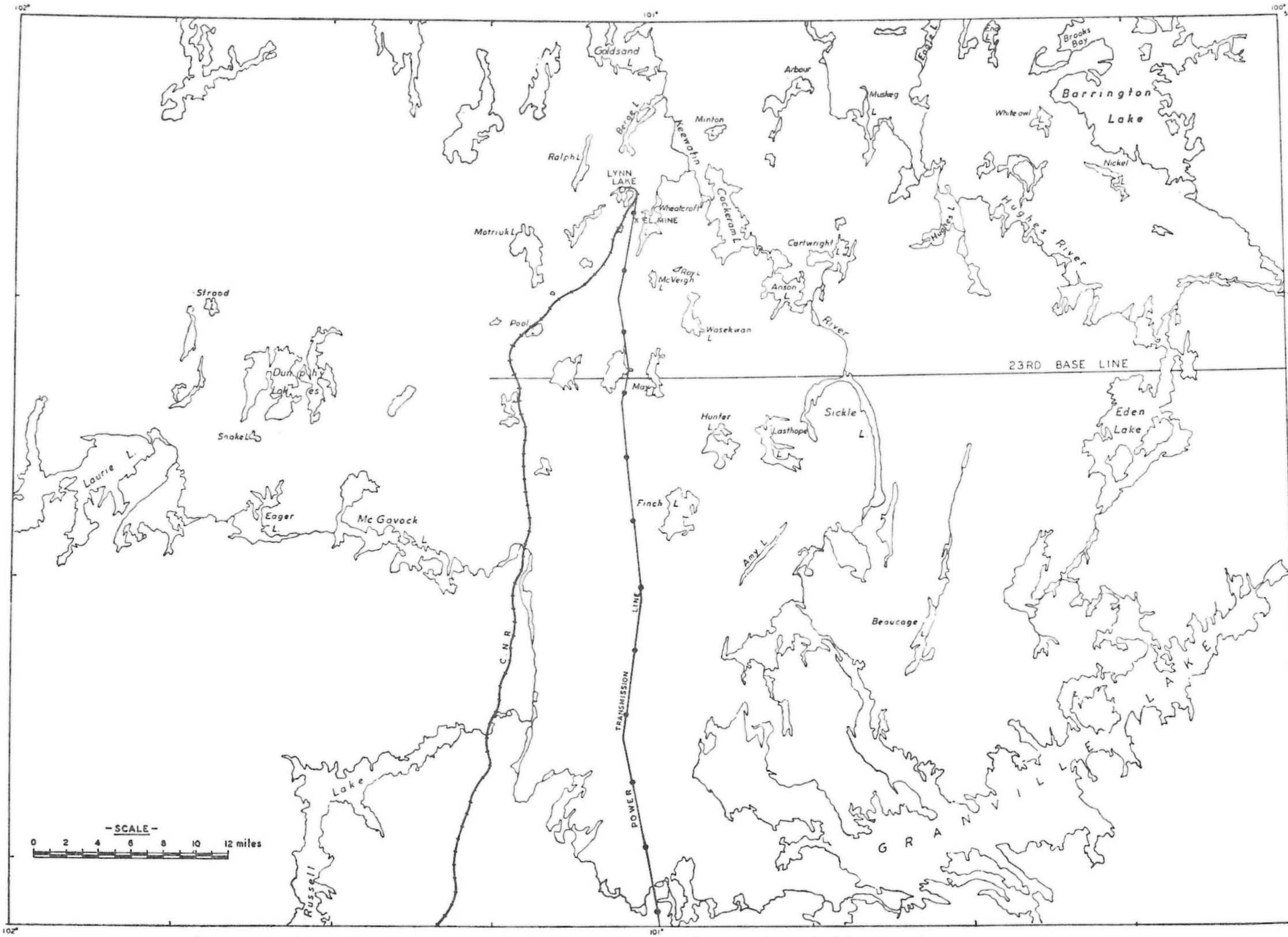

Figure 4—Map showing extent of district and ground control available for photogrammetric maps.

Compass and pace traverses were used in the field as the standard method of locating outcrops. Wherever possible, the traverses started, and ended, on some well-marked topographic feature, such as a lake.

In principle then, if the turning points on the traverses could be recognized on the photographs, it should be possible to recover any outcrop with the aid of the field notes. In preparing the accompanying maps this was done, line by line, for a total traverse length estimated at about 3,000 miles, by checking field notes and field maps against the photographs, using a magnifying stereoscope. The outcrops were plotted directly onto the photographs and transferred to the base map, with a sketchmaster, at the same time that the topography was plotted. It was found that numerous problems arose which affected the accuracy of this method.

The Lynn Lake and Hughes Lake preliminary maps were made by Allan before the district was photographed. He was forced to use very old oblique photography and to plot his results on a base made from the claim maps. In effect, then, his base map had been made by an eightfold enlargement of a map drawn on a scale of four miles to the inch; the results were so inaccurate that it is often very difficult to recognize, on the ground, even the larger features on a lake shore or river. In consequence, in attempting to re-plot Allan's traverses from his field maps, it was often difficult to tell where they began or ended. This difficulty was common to all the field maps made prior to 1948, when photographs first became available. Allan's outcrops were spotted on the photographs by a combination of the compass and pace distances and the running topographic description in the field notes; but his traverses tended to run from one outcrop to the next likely-looking area, and are often difficult to reproduce accurately. It is felt that the locations for outcrops on the accompanying maps are very good in those portions of the area where a geophysical grid system (as at Tulune Lake), or surveyed claims, afforded control. But *persons using sheets 1 and 2 of the accompanying maps, especially the Hughes Lake area (i.e. east half of Cockeram Lake sheet), should expect to find considerable errors in location, where there were no surveyed claims.* A ground check in a few places northwest of Hughes Lake showed that outcrops may be shown as much as 400 feet out of position on the present maps.

When the Farley Lake area (west half of the Barrington Lake map-sheet) was mapped by Stanton, in 1947, the same conditions obtained. However, he followed the practice of running rigid traverse lines and tying all adjacent outcrops or topographic features to the traverse, either by offset or by bearing and distance. As a result, if the beginning and end of a line could be recognized on the photograph, all features and outcrops described in the notes, and any wanderings of the traverse line, could usually be found on the photograph without serious trouble. The outcrops shown on the western half of the Barrington Lake map (No. 3) are probably as accurately located as is possible by a compass and pace method which does not involve actually plotting the outcrop on the photograph in the field.

In mapping the Barrington Lake area, Crombie indicated on his field maps the topography adjacent to his traverse lines, for he was working on the same impossible base maps as Stanton and Allan. His field maps are in essence a compilation of a large number of tiny strip maps. Crombie's field notes were accidentally destroyed by a flood, but this practice of indicating the topography on the field map allowed the majority of his outcrops to be recovered, albeit with some difficulty. Except in the northeastern part of that area, where distinctive topography is less common, it is probable that most outcrops are reasonably well located. Anyone attempting to compare the present map with the preliminary one will note large changes in the part south and west of Tow Lake. This is due to the very severe distortion present in the claim maps Crombie used as a base (Figure 5). Some of the larger outcrops northwest of Hughes River have been checked from low-flying aircraft, and appear to be reasonably accurate. Probably those in the general area of Wellmet Lake are rather inaccurately located.

Figure 5—Comparison of part of a field map (a) with a tracing of the corresponding photograph (b) to show distortion present in the preliminary maps.

With the receipt of vertical photographs for the field season of 1948, matters improved considerably. Over a large portion of the Cockeram Lake area (i.e. west half of Map No. 2), Allan marked his outcrops directly on the photographs. Apparently this was done while on the ground. In the southern part, however, between Wheatcroft and Cockeram lakes, and north of Moses Lake, this practice does not appear to have been followed. In general, however, outcrops on the western half of this map are probably located with reasonable accuracy.

The southern half of the district was all mapped with the aid of photographs which were carried in the field. Standing instructions said that outcrops should be marked on the photographs, or on a transparent overlay, while on the ground. This was apparently the case with Stanton in the Dunphy Lakes area, (Eastern half, Laurie Lake sheet, Map No. 4) for there is very little discrepancy between his outcrops, as shown on the map, and his very detailed notes on distances. Usually this can be explained by errors in pacing on steep slopes. Consequently, exposures shown on this map are probably as accurately located as is inherent in the method, and spot ground checks have shown good results. Errors in photograph reading, of course, may go undetected.

In the western half of the Laurie Lake map-area, very few outcrops were actually plotted on the photographs, while the geologist was on the ground. Usually the beginning and end of the traverse were marked, as were any very distinctive intermediate check points, and the line assumed to run straight between them. Outcrops were then plotted along the line, with the error in the total length of the line distributed proportionally. This technique was the natural result of a lack of experience in photo reading, and undoubtedly introduced some errors. In preparing the present map, the outcrop locations were checked on the photographs and amended under the stereoscope. Re-running a few traverses has indicated that the errors are probably not large, and the accuracy of location is probably reasonably consistent across the Laurie Lake map (No. 4).

In mapping the Sickle and Lasthope lake areas, Fawley apparently used the same technique, for plotting outcrops, as Milligan used around Laurie Lake. The available records show all outcrops and traverse lines plotted on overlays, but it is understood, from one of Fawley's senior assistants, that these were plotted at the end of each day's work, rather than while on the outcrop. Stereoscopic plotting of the traverses directly on the photographs shows, in general, good agreement with recognizable outcrops. Occasionally a lateral adjustment of one or two hundred feet from the indicated line was necessary, after which the details fitted very well. In general, the accuracy of this map is probably reasonably good, and comparable to that obtained on the Dunphy Lakes map.

The McGavock Lake map (No. 5) was prepared from the Counsell Lake and Wilmot Lake maps of T. A. Oliver (Preliminary maps 49-4, 50-9). It must be confessed that there still remain discrepancies in this map, which have not been reconciled and for which the cause is not known. Oliver made his base map from a radial line plot, but with only a small and unsuitably oriented length of the 23rd Base Line for control. Some photographs also have a heavy tilt. There are serious discrepancies in relative directions in the preliminary map, which are probably to be related to these two factors. Ground check showed, in some places, that only the larger outcrops could be located by scaling direction and distance off the preliminary map, and that, to locate smaller outcrops again, it was necessary to re-run the traverse from the original starting point using the bearings and distances recorded in the field notes.

The available records show the traverse lines and outcrops plotted on overlays or directly on the photographs, sometimes both. In some cases there are as many as three indicated positions for a single traverse. Sometimes this obviously represents the difference between a planned traverse and that actually run; in other cases the reason is not known.

There is a further probable cause of error in the accompanying map. It is the uncertainty of the actual scale of Oliver's base map. Outcrops shown on Map No. 5 were plotted on the photographs by measuring, from the field map, along the various traverse lines. In many places, such as northeast of McGavock Lake, where there are abundant large outcrops, it was possible to get good agreement between field map and photographs. In other places, where outcrops are sparse, small, and scattered through large areas of muskeg, as they are north of Wilmot Lake, it was not possible to get a good check from the pictures, or even to recognize the outcrops in some cases. Accordingly, any errors due to the scale of the original field map will have been carried through, and it is possible that some of the locations derived from that map are much in error. Paced distances, as recorded in the field notes, also disagree with those scaled from the new map by as much as twenty per cent. In part, this discrepancy appears to be systematic and to be due to a compass man who consistently under-paced his distances. In many cases, however, it has proven impossible to reconcile distances recorded in the traverse notes with those shown on the field map, and with those on the present map derived from plotting positions shown on the photographs. In general, where abundant, large and unmistakeable outcrops appear on the photographs, the results are probably acceptable; where there are areas of surveyed claims, or other independent control, the outcrops are located within such limits as might be expected on the present scale; but in areas of extensive muskeg, or drift, with sparse, small outcrops, the locations should be considered indicative only, and may be several hundred feet in error. Unfortunately, there are large portions of the area shown on Map No. 5 which have just such poor exposures.

The topographic detail of swamps and drainage channels shown on the accompanying maps is derived entirely from photo-interpretation. It is included partly in the hope that it will help those who may be prospecting in the country to plan their work, but mainly because, in many cases, the topography appears to reflect the structure in the rocks beneath. Attempts to show this by any other means ran into problems of interpretation, and resulted in showing the conclusion, not the evidence. When it comes to matters such as linear topographic features which may be due to one of several causes, I feel strongly that it is preferable to indicate the presence of the feature and avoid the interpretation, unless there is good evidence to suggest the cause. The increasingly common practice of putting an assumed fault down every straight stretch of swamp or shoreline is to be deprecated. In this district, at least, though there are undoubtedly "linears" caused by faulting, several of the definite faults have a very insignificant topographic expression. The Tod Lake fault, for example, is marked on the ground only by a change in the slope, and it is very difficult to see on photographs, even when one knows where it is.

Ground check on the photo interpretation, insofar as the streams and swamps are concerned, has been provided in some places. Most observers make casual notes, at least, regarding topography. Fawley kept rather abundant topographic notes, and Stanton kept a foot by foot description of his traverses. It has been possible therefore to get an independent ground check for the west half of the Barrington Lake map and for the east half of the Laurie Lake map; a less complete check for the Sickle Lake map, and spot checks elsewhere in the district.

Agreement has been good in most cases. Though there have been discrepancies, and errors undoubtedly remain, this detail is offered with a fair degree of confidence.

Drainage channels have been mapped which, in many cases, do not approach open streams or brooks, but are rather wooded hollows or draws which may have a trickle of water or a small rivulet. At the other extreme are streams navigable by canoes.

Swamp and open muskeg also is a broad general classification. At one extreme it includes floating vegetation and open water, absolutely impassable on foot; at the other extreme, muskeg devoid of trees but otherwise good travelling. In this connection a word about muskeg may be in order.

Muskeg as a descriptive term, in this report, is used, so far as possible, in the sense of the original Cree word. There is considerable confusion in the usage of this word; in many cases it is applied to any wet or barren area, including open swamp. During the season of 1955, I was fortunate in having an assistant who spoke Cree, and I made a definite effort to determine what is encompassed by the original word. Muskeg, as used in Cree, describes a type of country covered by moss and labrador tea as the characteristic vegetation, with all the usual accompanying plants. It includes areas where there is, in addition, a considerable growth of spruce, as well as the small, scattered and stunted trees which are characteristic. It does not include dry clay ridges supporting alder bushes, nor does it include open, level, grassy areas supporting pitcher plant, cotton grass and sphagnum, with or without tamarack. These come under the term waskaẏgow, which may be freely translated "swamp", and to which there is usually attached a descriptive prefix in the same manner as in English, e.g. tamarack-swamp, (Waẃ-gē-naẃ-gan was-kaẏ-gow).

MEANS OF ACCESS

Prior to the autumn of 1953, access to the district was by canoe from Sherridon, via Kississing Lake and the Churchill River,[1] or by aircraft from bases at Flin Flon, Cold Lake (Kississing), and The Pas. In the fall of that year, a branch line of the Canadian National Railway was completed between Sherridon and Lynn Lake. At about the same time, Central Northern Airways[2] established a base at Lynn Lake. This has made access to various parts of the district much easier.

At present Lynn Lake, itself, can be reached via the railway or by Transair Limited, which operates a scheduled service connecting with the main airline routes of the country. From Lynn Lake, aircraft service is available on non-scheduled and charter flights. The aircraft normally available are Norseman V, Beaver, and Cessna types, which are the customary aircraft in use for bush flying, and which can be obtained from one or other of several services using Lynn Lake as a base.

Travel by canoe from Lynn Lake to other parts of the area is awkward, because of the direction of the waterways (see Map No. 12). The southwestern part of the district may be readily reached, via Laurie River, from the railway which crosses the river at Lachlan, Mile 156 from Cranberry Portage. This river, with its tributaries, forms the main water route through the western and southern part of the district, and connects with the Churchill River at Granville Lake. The eastern and southeastern parts of the area may be reached, from the railway, by the Laurie River, Granville Lake and the Keewatin and Hughes rivers systems. These parts can also be reached from Lynn Lake—which is the logical source of supplies in the district—via Cockeram Lake and the Keewatin and Hughes rivers. Approaching the eastern part of the area from Lynn Lake has the advantage that travel is down stream, but it involves some long portages. Both the Keewatin and Hughes rivers have some fast water and are very shallow in some other parts. This makes travel rather difficult and slow, and much lining may be necessary. A stretch of country between Counsell and Lasthope lakes is difficult of access by any water route.

A large number of lakes are of size sufficient to accommodate the aircraft in common use. A Beaver or Otter aircraft carrying a canoe on one float can take off from most lakes that are 700 yards in length, and most lakes of the district meet

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[1]Details of this route may be found in *Geol. Surv., Canada, Sum. Rept., 1933, pt. C, p. 23, by G. W. H. Norman.*

[2]Now called Transair Limited.

this requirement. It is, therefore, possible to get to within a mile or two of almost any part of the district by this method.

WATER ROUTES

Aircraft are the customary method used by prospectors, at present, for reaching any part of the area. However, in case a knowledge of the canoe routes through the district should prove to be of assistance or interest, details of known portages and water routes are included as Appendix A. Rather than make an attempt to discuss the routes between specific points, the portages and other features have been tabulated according to their position. The length, position, condition and other notes regarding portages are collected from sources considered reliable. Usually the description is based on the field notes of officers of the Mines Branch; the date and the identity of the authority are indicated in the tabulated summary. In a few cases these portages are not on well-travelled routes, but were cut by the geological survey parties for their own purposes; these also are identified.

The presence of rapids on canoe routes is shown on the face of the maps. Where any information is available about the rapids, it is also tabulated in the appendix. In general, the information available is very sketchy and difficult to evaluate. For example, although the length and condition of a portage is a more or less objective and measurable matter, the running of a rapid is a matter dependent largely on the individual. Because it is rare for more than one or two members of the survey parties to have more than a modest knowledge of fast water, it is probably reasonable to consider that, where they report a rapids can be run, this can be done safely by all but the most inexperienced. Where the information quoted is based on the reports of experienced or skilful persons, that fact is noted.

TIMBER RESOURCES

In common with most of the part of the Precambrian Shield in Manitoba, the Lynn Lake district has an abundant forest cover. The amount of timber available is not as great, however, as its great extent might suggest at first glance.

Growth is slow under the conditions here prevailing and most trees do not survive long enough to reach great size. Occasionally a small stand, usually of spruce, will escape the fires and other hazards and reach considerable size. The largest trees noted in travelling through the area were about 14 inches in diameter, at breast height. The average would be in the order of 8 inches. To give an indication of the rate of growth: a spruce 10 inches in diameter, from Beaucage Lake, was found to be over 383 years old. Members of a survey party counted rings in a smaller spruce from the largest island in Tod Lake, and concluded it was a sapling when Columbus made his famous voyage.

The larger sizes of mining timbers certainly are not available in the district. Small amounts of building material might be obtained however, though this would probably be restricted to light scantling and narrow boards. With the slow rate of growth, an area, once cut over, would be effectively out of production for several decades, at least. During the development of Lynn Lake, the mine was powered by a wood-fired steam plant. For this, firewood was hauled for distances of 15 miles and more.

The Forest Service, of this department, has recently completed an inventory of the forest resources of the province. The following figures on the amount of commercially useful timber available in the district have been supplied from that inventory.

AVAILABLE TIMBER—LYNN LAKE DISTRICT

Type:	BLACK and WHITE SPRUCE				JACKPINE				BALSAM				ASPEN				BIRCH		
	Volume				Volume				Volume				Volume				Volume		
Size:	4″-9″	10″-	Total	Area Acres	4″-9″	10″-	Total	Area Acres	4″-9″	10″-	Total	Area Acres	4″-9″	10″-	Total	Area Acres	4″-9″	10″-	Total
Barrington Lake Tp. 85-92 incl. Range 11-20W incl.	174,201	37,628	211,829	36,372	27,520	3,412	30,932	5,388	6,694	1,480	8,174	Included with spruce and jackpine.	6,259	1,319	7,578	*	3,754	1,155	4,909
Reindeer Lake Tp. 89-92 incl. Range 26-34	31,479	7,579	39,058	5,209	16,095	2,332	18,427	3,907	1,451	297	1,748		3,622	809	4,431	†	1,305	216	1,521
	205,680	45,207	250,887	41,580	43,615	5,744	49,359	9,295	8,145	1,777	9,922		9,881	2,128	12,009		5,059	1,371	6,430

*Mixed woods total 1,347 acres and hardwoods 674 acres.

†Mixed woods total 2,605 acres and hardwoods not recorded.

Volumes are in cunits (=100 cu. ft.)

For the following notes on the vegetation patterns in the district, the writer is indebted to Professor J. C. Ritchie, of the Department of Botany, University of Manitoba. A more detailed discussion will be found in *Canadian Journal of Botany, vol. 34, pp. 523-561, 1956.*

"The area lies within the Northern Coniferous Section (B 21) of the Boreal Forest (following Halliday) or the Southern Spruce Forest Zone of Hustich. Undisturbed areas, bearing mature forest, are of rare occurrence; where they occur, there is a closed stand of black spruce (*Picea mariana*) with the ground vegetation dominated by a carpet of "feather mosses". Much of the region has been burned over by frequent fires, and various secondary communities are found. Certain of these are dominated by well spaced trees of *Pinus banksiana* (jackpine), others are more or less an even mixture of jackpine and white birch (*Betula papyrifera*); older stands show the invasion by black spruce which will eventually resume dominance.

"In this region white spruce (*Picea glauca*) is confined to sites of particularly favourable drainage and aspect. For example, the unusual south-facing slope of a relatively high ridge on the northwest shore of Tod Lake bears a discontinuous stand of well grown trees of white spruce. And a group of relatively rare plants was found on this ridge.

"The flanks bear small cliff and crevice habitats in which certain rare (for this region) plants were found. The open cliff habitats on the south-facing side of the ridge yielded the following group of plants: *Woodsia ilvensis, Schizachne purpurascens, Roegneria violacea, Carex abdita, Arabis holboellii* var. *collinsii, Potentilla pensylvanica* var. *pensylvanica, Oxytropis splendens, Artemisia caudata,* and *Solidago decumbens* var. *oreophila.* These plants were found in thin soil of crevices on the summits and sides of the small cliffs. In moderately shaded sites, on the south-facing side but with some shelter from direct sunlight, the following were recorded: *Cystopteris fragilis* and *Dryopteris fragrans.* In crevices of small outcrop cliffs on the north-facing, shading slopes of this ridge, under a closed canopy of black spruce, the following were noted: *Polypodium virginianum* var. *americanum, Woodsia alpina, Cystopteris dickieana, C. fragilis, Saxifraga tricuspidata, Nephroma helvetica* and *Parmelia stenophylla.* Many of these plants recorded on the cliffs of this ridge were not found elsewhere in the region; they are species of relatively narrow ecological amplitudes, usually confined to such habitats.

"Adjacent to this ridge a small stream which had been incompletely dammed by beavers yielded a local society of plants. Beside the stream in rich muck soil, were *Alnus rugosa* var. *americana*—the only record from the region—*Cornus stolonifera,* and *Populus balsamifera,* while in the rich, wet, shaded soil round the small dam *Thelypteris phegopteris, Glyceria striata* var. *stricta, Mitella nuda, Aralia nudicaulis,* and *Mertensia paniculata* were recorded.

"Willows and alder (*Alnus crispa*) are conspicuous members of secondary, open forests, but they are generally absent from mature spruce stands. Aspen is of local occurrence in the area.

"Many depressions and hollows are occupied by treeless bog or black spruce muskeg. The ground vegetation consists of a thick layer of *Sphagnum,* associated with various shrubs and herbs (commonly, labrador tea—*Ledum groenlandicum,* bake-apple berry—*Rubus chamaemorus,* bog-rosemeary—*Andromeda polifolia,* etc.). The spruces of muskeg are poorly grown trees, seldom exceeding 18-20 feet at maturity.

"Sand plains and extensive outcrop ridges usually bear an apparently mature stand of jackpine, with very little subsidiary vegetation on either substratum. Very local alluvial soils bear stands of well-grown trees of white spruce. Balsam fir (*Abies balsamifera*) was not noted in the region."

WATERPOWER RESOURCES

In an area, such as this, which has only recently been intensively explored, extensive or accurate figures on the water powers are not available. There are numerous falls and rapids on most of the streams of the district, and presumably there are a large number of sites from which very small amounts of power could be obtained. Larger blocks of power, however, require more careful evaluation.

At present, there is only one power development in the area. Laurie River Power Company Limited, a subsidiary of Sherritt Gordon Mines, produces power for the Lynn Lake operation and for the townsite from Laurie River, near Trophy Lake. Power is generated by two Allis-Chalmers units of Francis turbine type, operating under 55-foot head. Each unit is 3,500 H.P. The "No. 2" site, upstream, has a further potential of 7,000 H.P. and a power house has now been constructed. This second plant was put into operation in April, 1958.

There are two further sites on Laurie River, each with a potential of 2,000 H.P.

Water is stored in two reservoirs. These were formed by building a dam at the outlet of Eager Lake to raise the level of Eager, Pyta, Tod and Laurie lakes by about seven feet. A similar reservoir has been formed by a dam at the outlet of Russell Lake. A dam in Loon River diverts that water into the Russell River system.

Power is carried to Lynn Lake over a 45-mile transmission line, at 69,000 volts. The line is capable of handling 18,000 H.P., the total potential of the river.

No reliable data on the power potential of the other rivers of the district are available. The figures below are supplied by the Water Resources Branch of this department, as a brief outline, on the basis of preliminary office investigations of the power resources of the Keewatin, Hughes, and Barrington rivers. They were prepared by W. Naumko, of that branch's engineering staff, who reports:

"No past records of stream flows and precipitation were available on these basins to permit a detailed study of power potential. Consequently, data on adjacent watersheds of similar character were selected and applied to these basins after certain modifications. It is apparent, therefore, that the results of this study are only approximate, and hence subject to argument.

Estimated Stream Flows

"The basins of the Keewatin, Hughes and Barrington rivers constitute an estimated area of 992, 1,422 and 670 square miles respectively. Stream flows on these basins were estimated on the basis of flows and precipitation data of neighboring watersheds and are tabulated hereunder:

Item	Keewatin River	Hughes River	Barrington River
Long Term Mean	370 second-feet	526 second-feet	250 second-feet
Maximum Flow	1,310 second-feet	1,873 second-feet	885 second-feet
Minimum Flow (without storage)	10 second-feet	14 second-feet	7 second-feet
Minimum Flow (with storage)	160 second-feet	228 second-feet	108 second-feet

Estimate of Power Output

"Comparisons of available horsepower, utilizing estimates of minimum flow and long term mean, are listed below, realizing 80% turbine efficiency:

	Keewatin River		Hughes River		Barrington River	
Head (feet)	Minimum Flow With Storage	L.T.M.	Minimum Flow With Storage	L.T.M.	Minimum Flow With Storage	L.T.M.
30	440 h.p.	1010 h.p.	620 h.p.	1440 h.p.	290 h.p.	680 h.p.
40	580 h.p.	1340 h.p.	830 h.p.	1920 h.p.	390 h.p.	910 h.p.
50	730 h.p.	1680 h.p.	1040 h.p.	2390 h.p.	490 h.p.	1140 h.p.
60	870 h.p.	2020 h.p.	1240 h.p.	2870 h.p.	590 h.p.	1360 h.p.
70	1020 h.p.	2350 h.p.	1450 h.p.	3350 h.p.	690 h.p.	1590 h.p.

"If the estimates are in close agreement with actual conditions, it would then appear that the power prospects on the Keewatin, Hughes and Barrington Rivers are not very promising. Small drainage areas and inadequate storage reservoir capacities are the main factors causing low power output. The extent, if any, to which reservoir capacities may be improved is questionable at the moment, as insufficient data make reliable studies impossible.

"The flows indicated above are those estimated for the lower reaches of the streams. Examination of topographic maps suggested that the available heads along the lower reaches offered greater possibilities for power development.

"A possible power site exists immediately below Goldsand Lake in the upper parts of the Keewatin River basin. However, it is believed that the flows would be approximately 50% of those estimated for the lower reaches. It is unlikely that the large storage capacity of Goldsand Lake would alleviate the problem of low minimum flow, because restoration of stored water after depletion by a season of low precipitation would be a very slow process, due to the small watershed controlled above this lake. Any power developments, therefore, would be more suitably situated if located in the lower reaches of the river, where greater head is available for maximum utilization of available water." [At the long series of rapids just above Sickle Lake a head of 60 feet could possibly be attained, but with no increase in storage capacity.—G.C.M.]

"The same argument holds true for the Hughes River. Power development in the lower reaches would be a more practical undertaking, particularly from the viewpoint of greater watershed control and the availability of greater heads. Facilities for water storage control are limited to Wells Lake, located in the central portion of the basin. However, its location, and hence limited basin control, defers its use as a favourable outlet control. A power site immediately below Wells Lake is a possibility.

"Power development on the Barrington River basin is topographically restricted to a site close below Barrington Lake. However, its small drainage area affords little hope for economical development of power.

"A diversion scheme of power development may prove to be the most likely and practical scheme in the Keewatin, Hughes and Barrington River basins. This would involve diverting the waters of one or two of these streams into the third and thus improving somewhat the flow of the power site channel. The feasibility of such works should be thoroughly investigated if additional studies are contemplated. With the information presently on hand, it is very difficult to accurately determine the merits of such a proposal.

"The power outputs as laid down above are for the range of heads as indicated and do not imply that this range is available on each of the three streams. It merely indicates the power that may be expected should such heads and flows be available. These would be confirmed or rejected upon a more thorough investigation.

"If additional investigations are anticipated in connection with this study, it is recommended that stream flow measurements be secured from time to time at critical sections on these streams to provide means for a more precise analysis than that which has been possible here. It is also suggested that a thorough aerial reconnaissance be made in these areas, to aid in selecting possible power sites, and to ascertain where detailed field investigations should be concentrated."

The following further figures, on water powers available outside the immediate area, have been supplied by N. Mudry, of the Water Resources Branch:

"On the Churchill River, field investigations have been limited to the part in Manitoba above Granville Lake. There are two sites:

"At Pukatawagan Falls there is available a 30 foot head which would permit 50,000 h.p. with 60% load factor.

"The 40 foot head available at Granville Falls would permit 70,000 installed h.p. with 60% load factor. Detailed plans of the Granville Falls site are available."

CLIMATE

Though the Lynn Lake district is within the Arctic as defined by the Arctic Institute of North America, the climate is not as rigorous as this might first suggest. With continuing improvement in transportation, building materials, and methods, there is also a gradual movement northward of what might be termed the practical frontier of permanent settlement. Consequently, it is now perfectly practical for a community to operate, with little difficulty or complication, where such would have been excessively expensive or difficult in comparatively recent times. The town of Lynn Lake, itself, is a good example of this. The people of this town live in houses heated by oil, equipped with electrical gadgets, supplied by the usual utilities with water, sewer service, and dial telephones, and protected by a fire department and police. One might say that the only "big-city" amenities now missing are TV and traffic problems.

The climate of the district reflects its position; the continental climate characteristic of the Great Plains is modified by the proximity of the water areas of Hudson Bay. But because this water body is frozen over during winter, its climatic effect is most marked during the summer months. This is notable, for example, in the case of the mean daily temperature in July; along the coast of the bay this is about 50°, a figure about 5° lower than that for Aklavik, on the Arctic Ocean. Conversely, in autumn, the heat stored in the water is released to the air, and the isotherms of mean daily temperature in October are convex northward over the bay.

The high pressure area which covers Central Canada during the winter gives clear weather and light winds. During the summer season, the anticyclone is replaced by an irregular low pressure area, but outside the main cyclone tracks, so that the winds are again characteristically light. However, solar insolation of the summer months causes strong convection, and thunderstorms are of common occurrence.

The climatic factors which most directly influence the design and operation of plants in the district are tabulated below:

WINDS

Mean wind speed is fairly steady through all four seasons at approx. . . . . . . 10 m.p.h.

The computed maximum gust speed. . . . . . . 110 m.p.h.

TEMPERATURES (Fahrenheit degrees)

Mean Annual Temperature. . . . . . . 25 (21 at Brochet)

Mean Annual Maximum. 88

Mean Annual Minimum. . . . . . . —50

Mean Daily Temperature. . . . . . . January −20, July 60

Mean Daily Maximum. . . . . . . January −10, July 70

Mean Daily Minimum. . . . . . . January −25, July 28

Extreme Highest on Record 95

Extreme Lowest on Record. . . . . . . −60

Mean Annual Total Degree Days, 65°F. base. 15,500

(This reflects not only severity of winter but length of the heating season.)

DESIGN TEMPERATURE

*Basis.	1%	2½%	5%	10%
Winter.	−45	−42	−38	−35
Summer.	85	80	78	75

SNOW

Mean Annual Fall. . . . . . . 50 inches

Days with Measurable Fall. 50

Computed maximum snow load, horizontal surface. . . . . . 40 lbs. per sq. ft.

	Oct.	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*April*
Mean Monthly Fall, inches.	6	10	8	5	5	5	6

RAIN

Mean Annual Total Precipitation. . . . . . . (Brochet 16.11) 15 inches

Mean Annual Total, Rain . . . . 11 inches

(of which about 7½ inches falls in the summer season)

Maximum Rainfall in 24 hours . . . . approximately 3½ inches

Fifteen-minute Rainfall to be expected once in 10 years. . . . . . . ¾-inch

[This was well exceeded by a 20-minute fall of 1.5 inches in the summer of 1954.]

	Jan.	*April*	*July*	*Oct.*
Number of Days with Precipitation greater than 0.1 inch.	3	3	6	>3, <6

NOTE: All the foregoing data were derived from the Climatological Atlas of Canada, where the original figures may be found. It should be understood that there was no observing station in the Lynn Lake district until 1953; the nearest station is Brochet, where records only extend for 7 years. The above figures are, in large part, obtained by interpolation on the curves of the Climatological Atlas, which are themselves generalizations from widely scattered stations. An observing station is now maintained at Lynn Lake so that records of increasing value will be accumulated as time goes on. For any design problem using the above factors, reference should be made to the more recent records of the Department of Transport, before proceeding beyond any but the roughest estimates.

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*This indicates the percentage of the time when temperatures can be expected to numerically exceed those specified.

The ventilating air for the mines at Lynn Lake must be heated in winter. The following data on the design are supplied by R. C. Brehaut, consulting engineer to the company:

At the "A" mine, 40,000 cu. ft. of air per minute are supplied through a combination of louvred openings into a mixing chamber in the headframe. Certain openings are equipped with steam coils, and automatic regulation of the louvres maintains at 40°F. the temperature of the downcast air supplied to the working shaft.

In designing the heating system, the average temperature was considered to be 4°F., for the 243 day period from the first of October to the first of June. These dates were considered to be the practical limits of the heating season. The average temperature used was based on records at Island Falls and Brochet for a period of about 4 years. Heating requirements to provide the necessary air at 40°F. were then determined.

The heaters were designed with capacity sufficient to heat the full quantity of air from −20°F. to 40°F. This was considered to be the limit of air heating for practical purposes. When the outside air temperature fell below −20°F. for short periods, the balance was made up by reducing the amount of air supplied.

The system worked quite satisfactorily so long as it was possible to reduce the air supply during extremely cold weather. The introduction of diesel haulage underground prevents reduction of the amount of intake air, and has presented a problem.

TRANSPORTATION

Transportation in the area is provided by float- and ski-equipped aircraft, tractor trains, canoes, and, to a limited extent, automobile and dog team. These forms of transportation are strongly influenced by climate.

Bush aircraft service is disrupted during freeze-up and break-up for a period of three to four weeks, from the time when the first ice makes floats impossible to the time when the ice is thick enough to carry ski-equipped aircraft. There is a comparable disruption for other methods. For dog teams the interval is much shorter, because travel is possible on relatively thin ice; for tractor trains, requiring thick ice, the interval is long.

The following figures may be of use to those whose duties require planning for transportation in the area:

Tractor Trains

Patricia Transportation Company, Ltd., on the basis of seven years experience with tractor trains between Sherridon and Lynn Lake (1947-48 to 1953-54) say that the freighting season begins between the first and third weeks of December, and terminates between the third week of March and the first week of April. They point out that these dates are strongly influenced by weather conditions, both during freeze-up and later in the winter. In general, however, they suggest that one should expect to commence a freighting operation around the third week of December. The operation should be planned to be completed by the end of March.

Flying

The following figures, on the period during which flying was suspended at break-up and freeze-up, were supplied from the records of Manitoba Government Air Service, and apply to their base at The Pas. For Lynn Lake, the freeze-up is a week to ten days earlier in the autumn, and break-up is correspondingly later in the spring:

Interruption of Flying in Spring and Autumn

Year	Break-up	Freeze-up
1949	April 19 to May 5	Oct. 5 to Nov. 24
1950	May 1 to May 20	Nov. 4 to Dec. 1
1951	No Record	Oct. 28 to Nov. 27
1952	April 16 to April 29	Oct. 27 to Dec. 1
1953	April 23 to May 12	Nov. 2 to Dec. 1
1954	May 5 to May 21	Nov. 1 to Dec. 6
1955	April 8 to April 29	Nov. 1 to Dec. 5

On the basis of these figures the earliest date for cessation of flying in the spring would be about mid-April, and in the autumn, about September 25.

Rail service to Lynn Lake is provided by Canadian National Railways, at present on a thrice-weekly basis.

CHAPTER II

TOPOGRAPHY AND GLACIATION

In extensive areas in the southeastern and southwestern parts of the district, and to a lesser degree in the eastern part, the present topography reflects the pre-glacial bedrock surface. In the northern half of the district (except in the east), and in the south central part, much of the pre-glacial bedrock surface exposed by ice action has again been buried by ground moraine, eskers, and outwash sands deposited by the retreating ice. In these parts, a new drainage pattern characterized by swamps and sluggish streams has been established on top of the drift. This new drainage is slightly controlled, but only in a few places, by prominent features of the underlying bedrock.

TOPOGRAPHY

At the present time, the Lynn Lake district shows the broad rolling topography of low relief characteristic of much of the Canadian Shield in Manitoba. Within the district, however, two minor subdivisions can be made, in a very general way. The southern half of the district has notably greater relief than the northern part which is, generally, rather flat with extensive areas of muskeg and swamp.

In the southern half of the district, the central part is covered by extensive deposits of sand with some clay and muskeg. This type of country is especially notable between Hunter Lake and McGavock Lake, and as far north as Story and Wilmot lakes. (See Map No. 12.) Although there are quite extensive areas of swamp in this part, sand ridges are the characteristic feature of the country. These are especially notable along the line of the railway from south of 23rd Base Line to at least Russell Lake, which is well to the south of the present area. These deposits are generally not well stratified but may be quite well sorted, and are probably mostly outwash sands. At one point, just east of the railway near Phoebe Lake, aerial photographs clearly show the edge of the sand; the characteristic "streaky" topography caused by the bedrock can be seen to disappear beneath the steep edge of an extensive sand plain. Other extensive sandy areas are to the north and west of Laurie Lake, to the south of Tod Lake, north of Eager Lake and north of Lasthope Lake.

Certain narrow, steep, winding ridges of sand and gravel, probably eskers, have been indicated on the accompanying maps wherever they were recognized on the aerial photographs. On the surface, these ridges give the appearance of coarse sands with a small percentage of small pebbles. It is rarely, however, that one sees a good fresh section of one of these ridges. It may be that they are actually more poorly sorted than appears, and that the good grading seen on the surface is actually an effect of classification by rain and weathering action. One of the most lengthy of these esker ridges runs southward from Wilmot Lake, across McGavock Lake, and continues on out of the area.

Extensive areas of high rounded bare rock outcrops are also characteristic of the southern half of the district, especially in the southeastern and southwestern parts, though such exposures do occur in a few places in the north. Extensive areas of high land, with good rock exposures, occur south of Lasthope Lake, and in the southwestern part of the district, between McGavock, Conglomerate, Snake, and Tod lakes, and south of Laurie, Tod and Eager lakes. (See Map No. 12.) In some cases, as south of Lasthope Lake and south of Eager Lake, the ridges may rise as much as 400 to 500 feet above the adjacent general lake level. These show the rounding characteristic of glaciated ridges.

The cause of the higher ground in these areas is not apparent. Obviously, it reflects the greater resistance of these rocks to erosion, but why they should be more resistant in these places is not evident. In a very general way the Sickle and post-Sickle rocks form the majority of these ridges, whereas Wasekwan and other pre-Sickle rocks are more readily eroded. However, there are numerous exceptions. The pre-Sickle gabbro east of Sickle Lake forms good outcrop and stands up above the surrounding granite, some of which appears to be the same later granite that, a few miles away, forms the highest point for miles around. Sickle sediments in some places form high ground and show a very close correlation between topography and structure, as in the eastern part at Willis and Chicken lakes, and in the western part at Tod Lake, for example. Yet the band of Sickle sediments lying between Hunter Lake and Naylor Lake supports low ground of little relief.

The actual relief on the bedrock surface is obscured in some cases by a mantle of swamp, sand, clay, and glacial debris which fills the hollows. This undoubtedly accounts for some of the apparent variation in relief.

It is more probable that the relief produced by any particular rock type is a measure, not of any specific resistance of that rock type, but of its relative resistance to erosion as compared to the rocks which surround it.

The northern half of the district has very little relief and large areas of swamp or muskeg are common. The 155-foot headframe of the "A" mine at Lynn Lake can be seen from the top of almost any of the higher ridges in this part of the district. This serves to indicate the low relief of the country, and probably, also, a general concordance of summit level.

In the northern half of the district the greatest relief occurs in the Barrington Lake area; some ridges reach appreciable heights and provide visibility for miles. The actual elevations are probably not great. The ridge overlooking Barrington Lake on the west side was estimated to be about 90 feet high, at the portage trail from White Owl Lake. At Nickel Lake also, the gabbro forms a considerable ridge on the south side of the lake.

Over most on the northern part of the district rock exposures are scarce and small. The western half of the Lynn Lake area (map 1) has extensive swamp and was not mapped for that reason. To the north of Arbour and Minton lakes (Map No. 2), exposures are also practically non-existent.

The mantle covering the bedrock in the northern half of the district has more clay than is characteristic to the south, though there are also extensive areas of sand in the northern area. Whereas the sandy country to the south has much dry ground covered by jackpine, the northern part is predominantly heavy damp clay and boulder material covered by spruce woods and muskeg, and may represent ground moraine.

The present drainage of the area is into the Churchill River through the four main rivers: Laurie, Keewatin, Hughes, and Barrington (Map No. 12). With the exception of Laurie River, these have a general southerly or south-southeasterly direction. It can be shown that, over limited distances, the courses of these streams are controlled by the structure of the underlying rocks, as, for example, Hughes River at Muskeg Lake (100°38′W, 56°55′N) or Laurie River at Eager Lake. But, if the overall courses of these rivers are under structural control, that control has not been recognized.

Control of the topography by the underlying bedrock is evident, in detail, in many places. Sickle Lake is the outstanding example of this feature on a large scale. In very many places, the detailed features of the shorelines of lakes and streams show a very close correlation to foliation, bedding contacts, and faults in the rocks which form the shores. The same control is manifest, in many places also, on the outline of areas of swamp, the course of streams, and even the details of ridges. Outstanding examples of this latter feature can be seen in the Sickle sediments in the southeastern corner of the district at Beaucage[1] and Chicken lakes, and in the mixture of granite and great inclusions southwest of Finch Lake.

[1]Beaucage Lake is just south of Chicken Lake, but is beyond the southern limit of Map 12.

Where the blanket of glacial deposits is thick enough to obscure the bedrock, no structural control can exist, of course. The lakes, in that case, are frequently without any characteristic form, the swamps are extensive and irregular in shape, and drainage is in no particular direction. Often a wet area is drained by several streams, running in different directions.

There is an intermediate stage where, on ground apparently composed of the usual glacial deposits, definite traces of bedrock control seem to show. This suggests that either the mantle of drift is thin at those places, or that the bedrock features there are so unusually prominent that they have not been obscured by the usual mantle of drift.

The detailed concordance of topography with lithology, "long antedating the glaciation and yet undestroyed by that event," has been noted by Flint as a feature which characterizes large areas of the Canadian Shield. For the Lynn Lake district, at least, one must accept the observational fact that there is a detailed correlation, with such exceptions as are noted above for areas where the drift is thick.

This implies that the topography, where extensive bedrock is now exposed, is essentially the pre-glacial topography. This statement must be qualified, of course, by allowance for pre-glacial erosion products which may have previously been present, possibly to considerable depth. Were such not the case, it would mean that the glaciers removed not only the weathering products which may have been present but any pre-existing river valleys as well, and destroyed the established drainage pattern. Further, it would require that during flow, the continental glacier adjusted itself to the details of lithology and structure, regardless of the attitude of the rocks to the general direction of ice movement. Although this may be conceivable for special limited cases, it is difficult to credit as a general rule.

The only alternative is to suppose that the present correlation is post-glacial; but it can be seen, on thousands of glacially polished surfaces, that the post-glacial erosion seldom exceeds one-half inch.

There is also the further implication that this area was devoid of Palaeozoic formations at the beginning of the Pleistocene glaciation.

GLACIATION

No systematic study of glaciation was attempted by the field parties in this work. There are recorded in the field notes only glacial striae, where such were observed, the occurrence of eskers, and occasional notes regarding sands, especially if these latter are prominent or extensive. In brief, there is only such information as might be of direct aid to a prospector tracing float. Any attempt, therefore, to consider here the details of the Pleistocene glaciation is obviously bootless.

The direction of ice movement is recorded on Map No. 12, accompanying this report. The directions are, in most cases, those indicated by glacial striae or grooving. In a few cases, the direction is deduced from chatter mark; there may be one or two based on other features. Field notes, in many places, record directions close to north. Apparently this reflects the observer's recording of the reverse bearing, rather than any indication that the ice actually moved from south to north. The data plotted on the maps are corrected for this.

In general, the glacial ice moved almost due south, especially in the western part of the district. In the eastern half there is a trend, perhaps, to a direction somewhat east of south, especially at Barrington Lake. The actual directions vary from about S 10° W to S 25° E. There is one doubtful case where S 65° W is reported.

The general southward motion would indicate that the glacial ice covering the district was part of the Keewatin glacier. The ground moraine of the northern part of the district is to be attributed to this glacier; the sands and till which cover large parts of the area were deposited during its retreat. The sand deposits were probably laid down in local glacial lakes rather than as a part of the deposits of Lake Agassiz.

There may have been a post-glacial dam on Keewatin River at the foot of the long rapids just above Sickle Lake. The ridge there appears to have had a shallow spillway on the east end which was abandoned when the present channel became dominant. There is a possibility, too, that at about the same time the Keewatin River discharged into Sickle Lake through a channel about a mile and a half west of the present river. Fawley recognized this channel as an old river bed, which apparently carried a large volume of water, but did not mention it in his published reports. Terraces or other features which might be associated have not been reported.

Narrow benches, approximately horizontal, are recognizable on photographs, on the sides of sand ridges near Wilmot Lake. These are not mentioned in the field notes, but may indicate the level of local, small, and temporary, lakes.

At two points west of Finch Lake, similar "benches" are visible on photographs, and appear to be sitting on top of ridges of rock. These "benches" are reported to be composed of gravels.

A gravel occurrence that is rather puzzling can be seen in the pit on the railway at station 1190+00 from Lynn Lake (=6416+00 from Sherridon). Here gravels overlie "unconformably" the crossbedded sands of the pit. Are these a deposit of a separate stage, or the result of some form of stream or beach action?

Extensive lacustrine clays are not reported in the area, nor has recent reconnaissance work by the Manitoba Soils Survey located any extensive area of such clays.[1] This is not surprising, for it is unlikely that Lake Agassiz extended so far north.

The northern boundary of Lake Agassiz was indicated, by McInnes[2], to be approximately along the north side of Churchill River from Pukatawagan to Granville Lake, to Opachuanau and Southern Indian lakes. This he termed the "approximate boundary of lacustrine clay area." Ehrlich, in a 1952 manuscript report to the Manitoba Soil Survey, has followed McInnes in placing the northern boundary of the lake. In Memoir 168, of the Geological Survey[3], Antevs implied that Lake Agassiz may not have extended even so far as the Churchill River. He pointed out that ". . . . . the clays and sands on Southern Indian Lake (McInnes, 1913, p. 86) should not be taken as evidence of this, since they extend to an altitude of about 875 feet and, therefore, probably were laid down in a separate lake standing at a higher level than did Lake Agassiz." According to Antevs, in the same memoir, the final drainage of Lake Agassiz probably occurred by discharge along the general line of the Churchill River, at the junction between the Patrician and Keewatin ice sheets. The land at that time stood at least 430 feet lower than at present; the lowest observed Lake Agassiz beaches are at a present elevation of 828 feet (mile 110 on Hudson Bay railway) and presumably mark the last major halt in the lowering of the lake level. The lowest clay deposits are now at 650 feet elevation. It is therefore very unlikely that Lake Agassiz, in these late stages, ever reached into the Lynn Lake district, where the general elevation is 1,000 feet or more.[4] It is possible, however, that an arm may have reached into Southern

[1]Ehrlich, W. A.: Manuscript Report on "Soil Inspection of the Lower Churchill River Basin and Lynn Lake Areas". *Manitoba Soil Survey, Sept. 1956.*

[2]McInnes, W.: The Basins of the Nelson and Churchill Rivers. *Geol. Surv., Canada, Mem. 30, p. 124A.*

[3]Antevs, Ernst: Late-Glacial Correlations and Ice Recession in Manitoba. *Geol. Surv., Canada, Mem. 168, p. 46, 1931.*

[4]Some lake elevations on 23rd Base Line are: Uhlman Lake, 818.0; S. Indian Lake, 834.8; Churchill R., 843.4; Eden Lake, 868.1; Sickle Lake, 932.3; Story Lake, 1,152.1; Counsell Lake, 1,194.1. Elevations in feet above sea level.

Indian Lake and Opachuanau Lake. The present height of land between Southern Indian Lake and Rat River, the tributary of the Nelson River, is at 841 feet. This is only 13 feet above the level of the lowest Agassiz beach.

Although there are numerous Lake Agassiz beaches, in southern Manitoba, at elevations greater than those prevailing in the Lynn Lake district, they were probably formed at a time when the Granville Lake area was still covered by the Keewatin ice. According to Johnston,[1] the Campbell beaches, for example, were formed when the ice front was on the line of The Pas moraine.

Post glacial uplift has been considerable; of the order of 600 feet in southern Manitoba and northwestern Ontario, according to Johnston's work[2], and 400 feet in the Hudson Bay coastal region. On the basis of his study of the beaches in southern Manitoba, Johnston concluded that the uplift began early in the life of Lake Agassiz; it apparently was accomplished by the tilting of discrete blocks of the country about hinge lines which gradually migrated northward. He has recognized five distinct uplift phases, followed by intervals of stability, the last one being the greatest and concentrated in the Hudson Bay region. Isobases[3] all trend northwesterly, roughly parallel to the coast of Hudson Bay.

In the Lynn Lake district, striae from two directions are reported, on the same outcrop, at three locations. On a point on the south side of Tod Lake striae pointing south and S 18° W are reported, but there is no record of which is the younger. On the east side of Cartwright Lake, Allan reports striae towards south and towards S 14° W, the latter being the younger. To the north of Westdal Lake, Stanton reports movement trending S 05° W and S 25° W, but again the relative ages are not reported. These probably represent minor changes or stages in the ice advance.

A completely anomalous report is found on a map of the area between Barrington and Nickel lakes, by G. M. Brownell. This records movement *from* S 40° E on the GLMC6E mining claim. Brownell no longer has any record which would verify this direction and ensure that it is not merely a slip of the draughtsman's pen. We were not able to confirm this measurement in the field. There are suggestions of such movement south of Nickel Lake, but nothing that can be interpreted with confidence.

If the direction is valid, it must mean that some ice sheet to the south, presumably the Particia, reached as far north as Barrington Lake, because there is very little to suggest that it is a local effect due to topography. If so, this would mark a further extension westward from that recorded by McInnes on the east and south shores of Southern Indian Lake, where he reports striae trending S 70° W. This would be an extension of about 60 miles.

I find in my field notes for 1955, that the description of an outcrop between Ron Lake and Pole Lake—east of Cartwright Lake—carries the following added note: "Glacial Striae 140° true. Heading north ??!!" The importance of this was not appreciated at the time and no further record of the evidence was made. The outcrop is extensive and a subsequent search did not again locate these particular striations. Though others with the same attitude were found, the direction of movement was not evident.

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[1]Johnston, W. A.: Glacial Lake Agassiz, with Special Reference to the Mode of Deformation of the Beaches. *Geol. Surv., Canada, Bull. 7, 1946, p. 11.*

[2]*Idem. pp. 12-16.*

[3]Lines connecting points of equal present elevation on a former beach.

CHAPTER III

WASEKWAN SERIES

General Features of the District

Five subdivisions are recognizable in the consolidated rocks of the Lynn Lake district. The Wasekwan series of volcanic and sedimentary rocks are the oldest. The pre-Sickle intrusive group—which varies from gabbro, norite, and peridotite to granite—invaded the folded and schistose Wasekwan. The Sickle series of sedimentary rocks lies unconformably upon the pre-Sickle intrusions and other older rocks. The post-Sickle intrusive rocks invaded the folded Sickle series. The Kisseynew-type gneisses are, in part, derived by high grade metamorphism of the rocks of the Sickle series and may, in part, also contain some Wasekwan rocks which have been altered by high-grade metamorphism.

The rocks of the district are all assumed to be of Precambrian age. No absolute age determinations have been made on rocks from within this district and the age assigned is really based on the similarity of these rocks to those ubiquitous in the Canadian Shield. In a correlation of Precambrian rocks of Manitoba, based on lithology and sequence, Harrison[1] suggested that the Wasekwan series might be equivalent to the Rice Lake series, in southeastern Manitoba, which is known to be earliest Archaean with an age of about 2.5 x 10^9 years. The Lynn Lake district falls in the "Athabasca Province" of Wilson's[2] proposed subdivision of the Shield, to which he has assigned an age of about 1.8 x 10^9 years.[3]

For the present, the age is given only as Precambrian and no further correlation is attempted.

The structure of the Wasekwan rocks is obscure. Sufficient is known, in restricted areas, to show that the structure is complex, and that folding has been intense, but a district-wide structural pattern has not been recognized. Outcrops are scarce over large areas, and diagnostic features have generally been obliterated.

The structural features of the Sickle series show a pattern of complex folding. In part, the details have been destroyed by high grade metamorphism and batholithic invasion, but a general fold system is recognizable, involving the southern half of the district and extending well beyond it to the south.

The surface features of the area are the result of continental glacial action acting to modify an already existing drainage pattern. This early surface probably reflected rather closely the lithology and structures beneath; it is now largely buried under sands, clays, and other glacial debris deposited during the glacial retreat. The present topography, where glacial drift is missing or thin, is in close adjustment with the bedrock lithology.

The operating copper-nickel-cobalt mines, and known orebodies, are restricted to two plugs of uralitized gabbro at Lynn Lake, in which chalcopyrite, pyrrhotite, pyrite, and pentlandite are associated with shear zones in the gabbro. The gabbro is here tentatively assigned to the pre-Sickle intrusive group. Numerous other prospects in similar rocks show varying degrees of similar mineralization. Other rocks of post-Sickle age also contain copper, zinc and gold; these metals have been reported in some quantity from several prospects. Very minor amounts of lead and molybdenite also occur.

WASEKWAN SERIES

The Wasekwan are the oldest rocks in the district. The series was named by Bateman in 1945, for rocks in the McVeigh Lake area, but has been found to be present in all parts of the district. The thickness is in excess of 18,000 feet.

This series was named by Bateman[4] from the occurrences at Wasekwan Lake which he mapped in some detail in 1940. In that work Bateman made an eight-fold

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[1]Harrison, J. M.: Precambrian Correlations and Nomenclature, and Problems of Kisseynew Gneisses, in Manitoba. *Geol. Surv., Canada, Bull. 20, 1951.*

[2]Wilson, J. T., Russell, R. D., Farquhar, R. M.: Economic Significance of Basement Subdivision and Structures in Canada. *Trans. C.I.M.M., Vol. LIX, 1956, pp. 310-318.*

[3]While this report was in press, Hurley and associates (Mass. Inst. Tech., *Age Studies No. 17*) reported ages of samples from the Lynn Lake area to be 1600-1700 million years, by the A^{40}/K^{40} method. This agrees with other measurements in the "Churchill Province".

[4]Bateman, J. D.: McVeigh Lake Area, *Geol. Surv., Canada, Paper 45-14.* For summary of the geology, see also: Geology and Metamorphism in the McVeigh Lake Area, Northern Manitoba, *Am. Jour. Sci., vol. 240, 1942, pp. 789-808.*

TABLE OF FORMATIONS[1]

Pleistocene and Recent:	Map Unit	Sand, gravel, till and boulder deposits, clays.
		Great Unconformity
PRECAMBRIAN	25	Granitic types of uncertain age.
		Post-Sickle Intrusive Group:
		Late lamprophyre dykes.
	22	Quartz-feldspar porphyry; quartz porphyry.
	19	Pegmatite, aplite; alaskite, pegmatitic and graphic granite. (Some may be of pre-Sickle age.)
	18	Microline granite; fine grained aplitic granite; some alaskite.
	17	Gneissic and massive biotite-hornblende tonalite.
	16	Black Trout Diorite.
		Intrusive Contact
		Sickle Series:
	14	Arkose; quartzite; minor slate bands.
	13	Conglomerate and derived schists; minor interbedded arkose and quartzite.
		Angular and Erosional Unconformity
		Pre-Sickle Intrusive Group:
	12	Biotite granite, leuco-sodaclase granodiorite.
	11	Hornblende-biotite tonalite (quartz diorite); minor amounts of diorite; porphyritic and massive phases.
		11a Porphyritic leucotonalite.
	10	Hornblende-biotite diorite; minor amounts of undifferentiated gabbro; small amounts of sodaclase tonalite (quartz diorite).
	9	Hornblende gabbro, norite, pyroxenite, peridotite; included volcanic rocks.
		Kisseynew-type Gneisses: (May include some Wasekwan)
	24	Quartz-plagioclase-biotite-hornblende gneisses, and much introduced pegmatitic and aplitic material; locally contains garnet or staurolite.
	23	Granitoid paragneiss; undifferentiated granite gneiss; lit-par-lit gneiss; locally contains sillimanite.
	21	Plagioclase amphibolite, probably derived from lime-rich sediments; commonly highly garnetiferous, locally contains anthophyllite.
	20	Muscovite-biotite schist derived from arkose; locally containing numerous pegmatites.
		Intrusive Contact
		Wasekwan Series:
	8	Banded iron formation and magnetite-bearing shales.
	7	Tuff, agglomerate and flow breccia. Minor interbedded sediments and massive or porphyritic flows.
	6	Siliceous and intermediate volcanic rocks.
	5	Massive and pillowed basic volcanic rocks (probably andesite and basalt); some porphyritic and amygdaloidal flows. Minor interbedded sedimentary and pyroclastic rocks.
	4	Impure quartzite. (Some minor interbedded conglomerate and fragmental flows southwest of Lynn Lake).
	3	Intimately interbedded sedimentary, volcanic and tuffaceous rocks; some flow breccia and agglomerate.
	2	Greywacke; minor quartzite, tuffs and interbedded flows.
	1	Conglomerate.

[1]Within the Wasekwan and Kisseynew the units are lithological only, and are not necessarily in chronological order.

division of the Wasekwan series, in which five of the formations are predominantly of volcanic origin and the remainder are sedimentary. Tuffaceous material is present, intermixed with both types. The area mapped by Bateman is, in part, in the southeast corner of the Lynn Lake area mapped by Allan in 1946. In that work, Allan extended the Wasekwan name to include the rocks to the south and west of Lynn Lake, which are continuous with those described by Bateman. Subsequent work has shown that rocks of this type are widely distributed in the district, and can be traced with reasonable continuity. No unconformities, or other major depositional breaks have been recognized, and the whole is called the Wasekwan series.

The thickness of the Wasekwan series recognized by Bateman at McVeigh Lake is given as in excess of 18,000 feet. Extensive duplication by folding is known within the district, but the structural details have so far proven intractable. Until the amount of duplication is known, no reasonable figures for thickness can be given; Bateman's figure can probably be accepted as a minimum.

DISTRIBUTION AND TOPOGRAPHIC EXPRESSION

One of several irregular belts formed by the rocks of the Wasekwan series extends from east of Barrington Lake,[1] through Nickel Lake, Farley Lake, Arbour Lake and north of Cockeram Lake to Ralph Lake. The westward continuation toward Zed Lake is lost under heavy drift and swamp, and exploration has not been continued in that direction. The width of this band varies from about 7½ miles to just over one mile, and the outline is very irregular.

A second narrower belt can be traced from south of Barrington Lake (where it may be continuous with the first), south of Hughes Lake, through Cartwright Lake to the McVeigh Lake area described by Bateman. Thence it extends westward via Wilmot Lake to Dunphy Lakes, and Laurie Lake, where it is apparently cut off by granite about a mile and a half from the Saskatchewan boundary. The width of this belt varies from about one-half mile at Hughes and Cartwright lakes, to nearly six miles at Cockeram Lake and east of Laurie Lake.

A narrow band probably connects the two belts at Hughes Lake, and they are separated by only 1,300 feet south of Frances Lake.

A long narrow extension from the southern belt reaches from Wasekwan Lake to Sickle Lake. There is another, broader, extension south of Cartwright Lake. There is a similar small area near Counsell Lake.

A completely detached area of rocks, of similar lithology, between Black Trout Lake and Beaucage Lake has also been assigned to the Wasekwan. The relations of these rocks to the others in the district are the same as for the Wasekwan series. Specifically, they are older than the large mass of gabbro east of Sickle Lake for which the indicated age is pre-Sickle.

The great irregular belts of Wasekwan rocks may be considered as remnants of the oldest rocks in the area, forming pendants in the later intrusions, for which the Wasekwan must once have formed the roof. There is a suggestion that the broad outline of these pendant remnants is structurally controlled. For example, the long arm extending from Sickle Lake to Wasekwan Lake is the southwest limb of a westward-plunging anticline, according to Bateman. The adjacent synclinal portion is occupied by intrusions between Fraser Lake and Wheatcroft Lake, and the next anticlinal fold, according to Allan, is shown by the Wasekwan rocks on either side of the granite at Berge Lake. At Counsell Lake, also, the two Wasekwan bands are the limbs of an anticlinal fold. It is as if the upper parts of the great upward folds were preserved, while the lower, downward folded parts had been engulfed, or the troughs filled, by later intrusions. Although this general pattern is suggested by the distribution, the scheme does not bear too-detailed scrutiny and only the broader features of the distribution seem to apply.

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[1]*See* Kilburn, L. C.: MacBride Lake Area; *Manitoba Mines Branch, Map 55-2.*

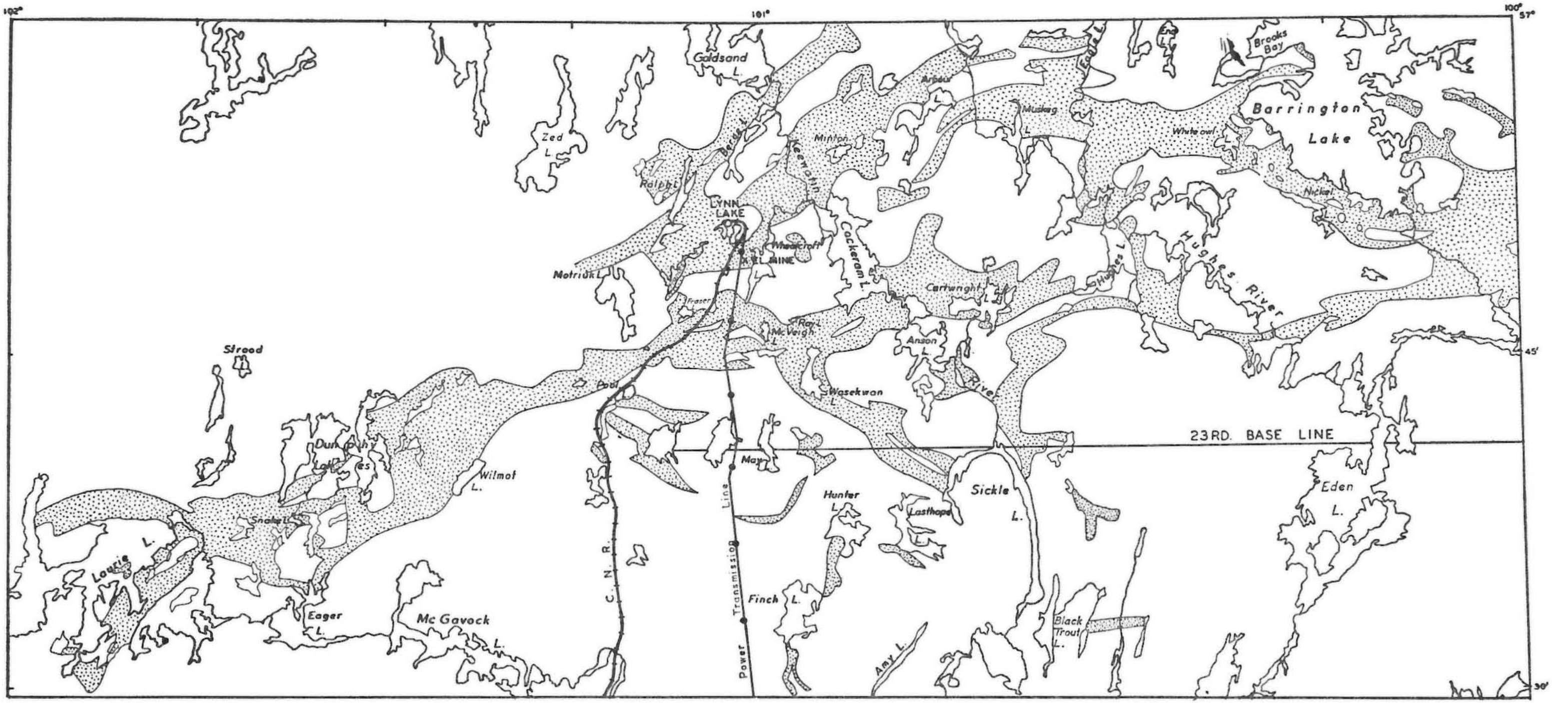

Figure 6—The Distribution of Wasekwan Rocks.

Topographically, the Wasekwan series usually forms low rounded hills and ridges which stand up above the parts of the country underlain by granitic types. The relief is nowhere great in this district, and the greatest relief is not found on Wasekwan rocks. They are, however, sufficiently resistant to give fair to good outcrops, and the Wasekwan series is generally fairly well exposed. Outcrops are seldom extensive, and are mostly quite small though fairly numerous.

RELATION TO OTHER FORMATIONS

The Wasekwan series is the oldest unit recognized in the district. Both its basement and its top have been obliterated by later intrusions and, except for the sedimentary part, which must have been derived from the erosion of either the Wasekwan itself or a still older group, there is nothing to suggest that older rocks were ever present. Wasekwan lavas are invaded by quartz diorite which is itself unconformably overlain by the conglomerate of the Sickle series, and Bateman[1] has pointed out that some 12,000 feet of Wasekwan rocks are missing from beneath the Sickle series north of Lasthope Lake.

PETROGRAPHY

The 8-fold division set up by Bateman has proven unsatisfactory in later mapping. Structural studies are complicated by the lenticular and discontinuous nature of the rock types. In the following, individual types rather than structural units are considered.

The 8-fold division of the Wasekwan, as set up by Bateman, has proven unsatisfactory in the subsequent mapping on a smaller scale. The other workers in the area have all adopted some form of a division into sedimentary and volcanic types, with further subdivision into siliceous volcanic, and pyroclastic rocks, and with another subdivision to cover the intimate intermixture of sedimentary and volcanic types. This is essentially the same breakdown used here.

As pointed out by Bateman, the lithology of the Wasekwan is varied. At McVeigh Lake he found that "individual members are in the form of irregular lenses and local beds", and could not be followed for any distance.

Consequently, structural studies depend upon broad combinations of types as outlined above, rather than on following a single unit. This is especially true in the vicinity of Lynn Lake and to the south, where pyroclastics, sediments, agglomerates, flow breccias and flows of varying composition appear to be intermixed in bewildering profusion. Elsewhere, the various types seem to be more readily separable, though tuffs, especially, appear in varying amounts intermixed with other varieties.

If this apparent complexity around Lynn Lake is real, it implies that conditions of deposition there were different from those elsewhere in the district. The obvious suggestion is that volcanic activity of explosive type was more frequent there than elsewhere. Before this line of reasoning is followed further, however, it should be established that the difference in lithology is real. It may be that the apparent variation is, in part, a reflection of the detail of mapping and, in part, the result of the variations in terminology, skill, and lithological subdivision used by the number of geologists who have worked there.

In the following descriptions of the Wasekwan rocks, the various types and varieties are each considered, rather than the map units as such. This gives greater simplicity and clarity than would any attempt to describe the intermingled rocks of a map-unit. They are not considered in their chronological order.

Conglomerate

Conglomerate is not abundant in the Wasekwan rocks. At Beaucage Lake a conglomerate, composed of quartz and quartzite pebbles in a dark, sandy matrix, is of Wasekwan age. At Ralph Lake and Minton Lake the conglomerates are of different character and the age is doubtful.

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[1]Bateman, J. D.: McVeigh Lake Area; *Geol. Surv., Canada, Paper 45-14, p. 6.*

Beaucage Lake

Conglomerate (Map-unit 1) is not an abundant type in the Wasekwan. Beaucage Lake is the only place where conglomerate can be assigned to the Wasekwan with reasonable confidence, though there is a possibility that the conglomerate west of Ralph Lake should also be included. A narrow band of conglomerate is also reported to be visible in the water on the southeast shore of Frances Lake; this would be of Wasekwan age in all probability. Conglomerate is reported also on old maps of the VX claims south of Fraser Lake, apparently interbedded with the Wasekwan, but it is not mentioned in the report which accompanies those maps.

The Wasekwan age of the conglomerate is in doubt in most of these cases. The individual occurrences are discussed in detail below:

The conglomerate of the Wasekwan, as exposed at Beaucage Lake, shows considerable variation. To the east of the lake, at the mouth of Beatty Creek, the conglomerate is sheared, the pebbles are elliptical to strongly stretched and of a wide variety of materials. The matrix is fine-grained grey arkosic quartzite. At the southern end of this zone the conglomerate consists of pebbles of quartz and quartzite about one inch in diameter, well rounded, and very well sorted, in a darker sandy matrix. The pebbles form 60 to 70 per cent of the outcrop, and most are touching one another so that the glaciated surface looks like a section through closely packed spheres. Near the Y-shaped lake to the east, the surrounding rock is a dark-grey sandy biotite quartzite and quartz-biotite schist which shows strong small-scale contortions and isoclinal folds. The conglomerate bands conform to all these contortions, and the pebbles are much elongated. Recognizable pebbles average about 1½ inches in diameter and are mainly vein quartz and quartzite.

In the most southern band the pebbles are strongly stretched and about 25 per cent of them are quartz. The majority are rather similar to a pebbly quartzite which occurs a few hundred feet to the northwest, but the weathering is different. The matrix is dark and, in places, shows 5 to 10 per cent quartz, with fine hornblende making up the balance.

In none of the outcrops were granite pebbles recognized, although generally they can be identified in the Sickle conglomerate, except where it is most severely sheared and stretched.

The conglomerate at Ralph Lake also shows considerable variety, but does not contain the closely packed spherical pebbles which are such a striking feature at Beaucage Lake. It is discussed further in connection with the Sickle series.

Minton Lake

North of Minton Lake there is a roughly triangular area, shown on Map No. 2 as Wasekwan conglomerate. The identity of this rock is in some doubt. It was described by Hunter, in the field, as breccia and by company geologists as "volcanic fragmental". Describing an outcrop just south of the adjacent double-lobed lake, Hunter noted:

> "Majority of this O.C. consists of a very light grey weathering breccia with fragments greatly elongated. Fragments are small; usual size approximately 1 x ¼ inch. F.S. [=fresh surface] shows fragments and groundmass of quite similar composition—a grey siliceous material very possibly of tuffaceous origin.
>
> "Occurring with this breccia are some areas of darker-weathering rock showing lineation of small feldspar xtls. This is a fine-grained feldspar hnbld gneiss.
>
> "Further small o.c. . . . Breccia here contains larger fragments—up to 2 x ½ inch. . . . The fragments in the breccia give indication of various origins, the majority being of tuffaceous character.
>
> ". . . next outcrop rock is breccia very similar to B195—fragments larger than last o.c. . . . Groundmass is light grey siliceous suggesting tuffaceous origin."

Sample B195 to which Hunter refers, is composed of large, light-grey lenticular inclusions of quartz, feldspar, and sparse biotite in a dark matrix of quartz, feldspar, and abundant black biotite. It resembles very closely some of the Sickle conglomerate.

This area was examined in the course of the present work. Approximately on the location of Hunter's outcrop B195 is an exposure of a fragmental rock that would unhesitatingly be called the conglomerate of the Sickle series except for a greenish black band 12 to 30 inches thick, and definitely interbedded with the conglomerate. It is composed of small clusters of biotite, greenish hornblende and minor feldspar. No apophyses are present in the 10 feet exposed, nor positive chilled margins, though there is a suggestion of this in two places. If this is an interbedded flow in the conglomerate it is something not found in the known Sickle rocks. There is also a 4-inch band of material rich in greenish hornblende, with lenticular patches of epidote and fine-grained felsitic lenses which look like pebbles. In this "conglomerate" the matrix is as B195, described above; the pebbles are quartz, felsite, arkose or granite, and aplite. If these are volcanic ejectamenta, they certainly are varied.

To the west the matrix is darker but still siliceous, and has thin banding, such as might be expected from tuffs. Pebbles of quartz are visible on the weathered surface, but are not especially noticeable on a fresh face.

To the southwest, the outcrops are very similar to those described above. On line 36 of the magnetometer grid over this area, the conglomerate is in contact with a basic rock. This basic rock is coarse grained, very mafic and has a one-inch chilled edge in contact with a greenstone. This might be the chilled top of a flow. The other contact, with the conglomerate, is very irregular in detail but does not cut the conglomerate, which crudely follows the detailed contortions of the edge of the basic rock. Mr. Sugden, who mapped these claims for Dormal Mines Limited, shows fine-grained black dykes cutting the "volcanic fragmental" elsewhere and possibly the basic interband first described (at B195) can be so explained. This explanation does not seem applicable to the present case.

This whole irregular area is mapped as Wasekwan conglomerate, mainly because of the preponderance of siliceous greywacke or arkose and the variety of pebbles and the apparent interbedding of basic flows.

Age Relations

Mines Branch Publication 50-8 considered the question of the age of this conglomerate at Beaucage Lake:

"The Wasekwan conglomerate has been included with some hesitation. It is possible that some occurrences of conglomerate, which have been shown as Wasekwan, are complexly infolded and faulted remnants of the Sickle conglomerate. As a corollary to this, some of the 'Wasekwan' quartzite would be the metamorphosed equivalent of the Sickle series.

"On the other hand, there is a certain dissimilarity in the lithology of the two conglomerates. In places, also, the Wasekwan conglomerate can be traced for 150 to 200 feet along the strike, where it appears to lens out into the lavas, without any noticeable shearing, either above or below.

"Detailed mapping would be required to settle the matter. At present, this conglomerate appears to constitute a discontinuous horizon within the Wasekwan; it may possibly be only a series of interbedded conglomerate lenses separated, one from the other, by appreciable stratigraphic thicknesses."

Since that time, some of the outcrops have been re-examined. On the east side of Beaucage Lake, near the narrowest part of the lake, there is an outcrop which shows:

	Ft.	Ins.
Conglomerate	1	0
Mafic material as in matrix of conglomerate	3	0
—irregular boundary—		
Medium to fine-grained greenstone	2+	
Fine-grained hornblende-rich greenstone.—Flow contact—	2	9
Biotite-hornblende quartzite, massive	6+	

There is a foliation that can be seen faintly on this outcrop, but no sign of a fault. The sediments and conglomerate are definitely a part of the same sequence as the greenstone. Eastward this outcrop continues as mafic Wasekwan sediments with sparse pebble lenses. Southward this can be followed as a siliceous biotite hornblende rock to where it is truncated by the Sickle series (see below p. 82). There now is very little doubt that a conglomerate does occur interbedded with the Wasekwan volcanics, though, perhaps, not all the conglomerate east of Beaucage Lake should be so considered.

Quartz-Mica Gneiss (Greywacke)

Quartz-mica gneiss or schist is the most common Wasekwan sedimentary type. It is composed of quartz, plagioclase, and mica in most cases, but garnet, staurolite, and sillimanite also occur where metamorphism has been intense.

The most abundant and widespread sedimentary type in the Wasekwan is a quartz-mica gneiss or schist, usually referred to as greywacke (Map-unit 2). Typically this is medium to dark grey, often with a decided brownish shade, and sandy appearance. It is composed of quartz and dark brown or black mica in a matrix of grey feldspar; in some cases a white mica is also present. Though quartz may not be readily apparent in the hand specimen it is usually quite abundant. The composition of the rock varies considerably from place to place. Forty to sixty per cent quartz may be present in some places, but in others it may be as low as 20 or 25 per cent. Feldspar is predominantly plagioclase, though a few grains of orthoclase or microcline are reported in some sections. The amount of feldspar seldom exceeds that of quartz, but biotite may be as high as 55 per cent in some sections. Hornblende occurs in some places also.

The mineral assemblage, and the grain size, reflect not only the composition but also the metamorphic grade. The above quartz-mica-feldspar assemblage is probably common largely because it is the stable mineral association over both a wide range of composition and metamorphic intensity. High-grade metamorphism is represented also by garnet, staurolite, and sillimanite in this rock. Of these the garnet occurs most commonly, probably because of the relatively specialized rock composition required to produce the other minerals.

Bedding planes are clearly marked in many places, but in others recrystallization has destroyed the thinner laminae, if they ever existed, and left only the broader compositional banding. Consequently, bedding, as exposed, may range from minute layering to essentially uniform bands several feet, or tens of feet, in thickness.

Impure Quartzite

Impure quartzites are abundant in some places but are not widespread. Biotite, muscovite and feldspar are the usual mineral impurities, but hornblende and garnet also occur.

Impure quartzite (Map-unit 4) is also a common Wasekwan sedimentary type. It is the predominant sediment in the type area at McVeigh Lake, and in the vicinity of Frances, Lynn and Cockeram lakes. It appears to be less abundant elsewhere, and is definitely a minor part of the Wasekwan sedimentary rocks in the western part of the area.

For a very detailed description of the quartzite of the McVeigh Lake area, the reader is referred to Bateman's[1] paper.

The extensive quartzites between Lynn Lake and Frances Lake seem to have less interbedded flow and tuffaceous material than is usual elsewhere. They are well-bedded, fine grained rocks, which weather light grey, buff, or almost white. The fresh surface is fine-grained, grey, and has tiny mica flakes. In some cases, as between Frances Lake and the Fraser Lake gabbro, the biotite forms lenticles or clusters of flakes.

The impure quartzites consist of quartz, biotite, muscovite, and feldspar in order of abundance. In some places hornblende is present as a metamorphic mineral in the quartzite, presumably reflecting a small amount of lime impurity in the original sandstone. A very excellent example of this was seen near No. 1 post of claim L735, west of Frances Lake, where a perfect prism of hornblende, three sixteenths of an inch long, was found at right angles to the foliation in the quartzite. It must have formed after the development of the foliation. Garnet is also present in a few places, and apatite and magnetite occur as accessories.

In some cases the quartzite is a very dark, fine-grained green to grey or black rock, as between Ralph Lake and Stick Lake and, where bedding is well preserved, may easily be mistaken for basic tuffs.

In his description of the sediments in the Lasthope Lake area, Fawley pointed out that:

> "It should be noted that aplitic granite, which closely resembles the quartzite, intrudes the Wasekwan rocks; these intrusives are commonly parallel with the bedding. The aplitic granite, in places, also has a laminated appearance due to parallel shearing, but the false laminations (= shear planes) show distinctly only on glacially polished surfaces."

Phyllitic sediments are reported, by Allan[2], from south of Wheatcroft Lake, where they are interbedded with light-weathering flows and tuffs.

Banded Iron Formation and Magnetite-Bearing Slate

Banded iron formation occurs in a few places in the district and is usually of rather restricted width. The most extensive occurrence is west of Farley Lake (Map 3), but iron formation is also found south of Black Trout Lake, and at Ralph Lake, whence it extends east beyond Barbara Lake (Map 1). It may be present, but not exposed, in other places where there are very strong magnetic anomalies.

Magnetite-bearing slates are associated with the banded iron formation west of Farley Lake, but are not known anywhere else in the district.

South of Black Trout Lake (Map No. 6) the iron formation is composed of 1-inch to 6-inch finely laminated bands of chert, which is black, grey or white in colour. The darker chert is strongly magnetic due to included magnetite dust. Fawley reports biotite (garnet) schists, hornblende quartzite, and biotite-garnet quartzite interbedded with the iron formation, and on the former Ruth claims there are 12-inch interbands of coarse hornblende schist.

A thin section of the garnetiferous iron formation shows excellent micro-bedding, cut by tiny quartz veinlets. It is composed of 55 per cent very fine-grained magnetite and 10 per cent fine-grained quartz (max. grain size 0.02 mm). The balance is very fine-grained amphibole (ca 0.005 mm), which is probably cummingtonite or grunerite. Garnet is not abundant in the section.

Stanton mapped the iron formation and magnetite-bearing slate at Farley Lake, which he described as follows:[3]

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[1]Bateman, J. D.: McVeigh Lake area; *Geol. Surv., Canada, Paper 45-14.*

[2]Allan, J. D.: Geological Studies of Lynn Lake area, *Unpublished Ph.D. Thesis, Massachusetts Inst. Tech., 1948, pp. 24-5.*

[3]Farley Lake Area: *Man. Mines Br., Prelim. Rept. 47-5, p. 9.*

"Much of this formation consists of banded hematite and chert. The hematite occurs as narrow bands from one-eighth inch to one inch wide. The cherty interbeds are thinner, usually less than one-quarter inch thick. The hematite is commonly interbedded with fine-grained, grey to grey-green, siliceous argillite . . . The non-hematitic iron formation is commonly a dark grey to black rock, banded to coarsely tabular, consisting of a fine-grained argillitic matrix containing much magnetite in the form of small octahedra. A sample of this material ran 18.20 per cent iron. The formation at a small outcrop between Gordon and Farley lakes is a grey- to black-weathering rock resembling well-bedded slaty argillites. This rock is likewise high in magnetite, and many individual beds up to one-half inch thick are composed almost entirely of fine-grained magnetite. On the west shore of Farley Lake, a frost heave or "push-up" of mineralized dark grey, fine granular rock is exposed. Its presence as bedrock has been verified by drilling. Thin section examination shows the composition to be about 55 per cent very fine-grained quartz, 25 per cent fine biotite flakes, and 15 per cent fine chloritic flakes. Sulphide forms about 5 per cent of the slide examined. The rock appears stratified in thin section, and is classified as a fine-grained impure quartzite or grit. It is apparently a member of the belt containing iron formation. The argillaceous and quartzitic character of much of this belt suggests the iron formation is, in part at least, of clastic origin. The more argillaceous members have locally been sheared into graphitic schists and garnetiferous graphitic phyllites.

"A strongly magnetic zone occurs in drift-covered country one to one-half mile north of Gordon and Farley lakes. This zone may also be underlain by iron formation, but no outcropping was observed."

Where I examined the banded hematite and chert, west of Gordon Lake, the bands of magnetite and hematite are less than 2 inches thick in most places, but some bands are as much as 6 inches. At that place, the chert is probably about 20 per cent of the rock as compared with the 50 per cent, or thereabouts, which is common in other places (Plate I, A).

A sample of the hematitic material, taken by Stanton, contained 24.85 per cent iron. One taken from the highest grade portion of the outcrop just described contained 37 per cent iron.

"Agglomeratic Sedimentary Rocks"

Included with the interbedded sedimentary and volcanic rocks, at the south tip of the eastern bay of Dunphy Lakes, is an unusual rock which Stanton called "agglomeratic sedimentary rocks", and described as follows:[1]

"Locally, large blocks of basic volcanic material, up to six feet in length, lie in a brown sugary impure quartzitic matrix. Another zone is characterized by round to oval inclusions, from 3 inches to 30 inches long, sparsely and irregularly distributed throughout fine-grained brown to grey sugary impure quartzite or quartz-feldspar-biotite schists. Most of the inclusions have a more resistant acidic rim and a less resistant central portion weathered to a hollow core. The general appearance resembles concretionary structures. The bedding, however, bends around the structures, a feature suggestive of contemporaneous deposition with the sedimentary matrix. In the vicinity of the southeast part of Dunphy Lake these inclusion zones are in close proximity to interbedded sedimentary rocks, volcanic flows, and agglomerates. The structures may thus represent pyroclastic material blown out by explosive volcanism into an area of shallow sedimentation. A third alternative is that the zones represent true conglomerates. If so, it is an unusual type of conglomerate with the following features:

(1) the inclusion material is uniform in type and appears to have a certain concentricity of mineral composition as exemplified by rim and hollowed core; (2) the

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[1]Dunphy Lakes Area: *Man. Mines Branch, Rept. 48-4, p. 12.*

distribution within the sedimentary matrix is sparse and erratic; (3) the enclosing sedimentary rock is uniformly fine-grained. A somewhat similar zone occurs about 1,000 feet south of Snake Lake, but at that point the inclusions consist entirely of buff to pink sugary material containing numerous small hornblende needles. The central portions of these inclusions have altered extensively to pistachio-green epidote. The inclusions are as much as eight inches across, and have an erratic and sparse distribution throughout a grey sugary quartz-feldspar-biotite pencil gneiss, presumably of sedimentary origin."

Amphibolite (Andesite and Basalt)

Amphibolite forms the major part of the Wasekwan series. It was probably derived from mafic lavas, and pillow structures can be recognized in many places. Porphyritic phases are also common. The mineralogy varies from place to place in the district. This is thought to reflect different degrees of metamorphism. Details of mineralogy and character are given below:

These mafic volcanic rocks (Map-unit 5) form by far the major portion of the Wasekwan series, and are found wherever that series occurs. They are commonly called "greenstones", though they are, in most cases, not green chloritic schists but black amphibolites. Similarly also, they are often described as andesite and basalt, though recrystallization has invariably obliterated the original minerals and produced coarse grain. Rather they are called andesite and basalt purely on the basis of their appearace.[1]

The typical "greenstone" of the district is dark grey to greenish black on the weathered surface, which may have retained a glacial polish or have been roughened slightly by post-glacial erosion; the erosion averages about one-eighth inch, or less, in depth, and seldom reaches more than one-quarter inch. The more feldspathic varieties show small white specks of feldspar on the surface. The fresh surface is shiny black, greenish black, grey, or black and white, depending upon composition and grain size. The "basaltic" varieties are composed of 70 per cent or more of black hornblende in crystals varying from about one-quarter inch to very fine. In the coarser and more mafic varieties the rock may be indistinguishable, in hand specimen, from the gabbro or diorite of the district. The feldspar composition reflects the metamorphic grade, but is oligoclase or andesine in most places.

The main difference between "andesite" and "basalt" is the higher feldspar content of the andesite.

There is considerable variation in composition and texture over an area the size of this district. In the extreme western part, at Laurie Lake, the volcanic rocks are typically grey to black or greenish black, medium-grained and with glistening black sub-parallel hornblende needles and flakes of biotite in a groundmass of grey feldspar. Small amounts of quartz and garnet are occasionally visible. Coarse-grained "dioritic" phases occur in places, and very fine-grained varieties showing sub-conchoidal fracture are not uncommon. The weathered surface is typically brownish or rusty in colour.

In thin section these plagioclase amphibolites show 30 to 50 per cent (rarely up to 60 per cent) dark olive-green hornblende, in needles 0.5 to 1.0 mm. long, in a groundmass of finer grained (0.5 mm.) plagioclase and quartz. The plagioclase is commonly untwinned, and the composition ranges from labradorite to andesine (Ab_{42} to Ab_{62}). The feldspar usually forms 35 to 45 per cent of the rock, but may range as high as 65 per cent or as low as 30 per cent, with a corresponding adjustment of the other constituents. Quartz is usually minor or absent, but

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[1]Cook, James, and Mawdsley, (*Geol. Surv., Canada, Mem. 166*) discussing this, defined their basalts as "dark, basic-looking, quartz-free lavas" and andesite as "not so dark, more feldpathic, quartz-free lavas" which is about the sense in which the words are applied in this area. On "greenstone", they comment: "This field term properly applies to the altered basic types "basalt and andesite", but is in many cases applied in practice to any altered lava of basic appearance."

occasionally is as high as 30 per cent in rocks low in hornblende and feldspar. When biotite is present, it occurs in brown flakes 0.5 to 1.0 mm. long, closely associated with the hornblende, which it probably replaces. Garnet, pale pink in colour, is present in rounded grains up to 1.0 mm. in diameter, and it forms 2 to 5 per cent of some sections. The composition of the garnet has not been investigated. The accessory minerals are magnetite, zircon, apatite and epidote, and occasionally pyrite. Carbonate occurs in a few veins which cut the feldspars, but it seems to be a very late mineral.

In the same way, in describing the basic volcanic flows in the adjacent Dunphy Lakes area, Stanton pointed out that the rocks are mainly hornblende (60 per cent) in a "fine-grained granulate aggregate of andesine and some quartz. Accessory minerals are magnetite and apatite." He also noted that, at Snake Lake, except where minor interbeds of tuff and volcanic breccia are present, it is often difficult, or impossible, to distinguish between schistose coarse flows and a schistose phase of the basic intrusive in the vicinity.

It will be noted that brown biotite is a minor constituent in both areas, that chlorite is not reported, and that epidote is reported in accessory amounts only.

In describing the basic lavas of the Counsell Lake and Wilmot Lake areas (Map No. 5—McGavock Lake), Oliver[1] also noted the usual composition of 50 to 60 per cent hornblende, in a matrix of 40 to 50 per cent fine-grained groundmass of plagioclase and quartz. The hornblende is commonly oriented in the plane of foliation, though this is not usually the case farther west. He pointed out that the hornblende is poikiloblastic, sometimes extremely so—mere disconnected fragments in optical continuity separated by aggregates of plagioclase and quartz. Also, Oliver found that in this area twinned feldspars are almost completely absent, and rapid measurement of feldspar composition is therefore difficult. He gives a composition Ab_{57}, calcic andesine, for one sample and another, determined in one of Oliver's slides, has a composition $Ab_{65\text{-}70}$.

Chlorite was noted by Oliver as a common constituent, generally as less than 5 per cent of the rock, but epidote was found in only a few places. According to him, the associated sediments are in the garnet zone of metamorphism.

In the Sickle Lake area, however, Fawley reports that epidote is a common constituent in the volcanic rocks and the plagioclase is calcic oligoclase to sodic andesine. A section from southeast of Black Trout Lake shows blue-green hornblende, altered to biotite which is pleochroic from straw yellow to reddish brown. The feldspar has ophitic texture, and its composition is Ab_{52} An_{48}, apparently more calcic than usual. Another section, from northeast of the last, contains epidote(?) and zoisite, in addition. About the same thing is found in the lavas to the south, at Beaucage Lake, where the plagioclase composition is Ab_{65} to Ab_{55}, and orthoclase is also reported.

In the Lynn Lake area, Allan reports that orientation of the hornblende is common, and he notes that "in many places alteration has replaced the feldspar by a mass of epidote and chlorite". The pleochroism of the hornblende, in a sample from west of Berge Lake, is given as pale yellow—green—greenish blue, which is much the same as reported by Oliver: X=yellowish green, Y=green, Z=deep bluish green.

Although Stanton did not note chlorite or epidote in his sections at Dunphy Lakes, they are both reported in the three sections from Farley Lake for which his descriptions are available. In one, zoisite, epidote, sericite, and chlorite total 10 per cent; in another, 4 per cent; and in the third, epidote and biotite (but not chlorite) total 5 per cent. In each case these are anomalous, because the feldspar is given as andesine-labradorite.

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[1]Oliver, T. A.: Geology of the McGavock Lake Area; *Unpublished Ph.D. Thesis, Univ. of California, Los Angeles, 1951, pp. 15-16.*

This same anomalous association is found in samples taken by Allan in the Hughes Lake area and at Barrington Lake. The sections show actinolite, pleochroic from colourless or pale yellowish to pale yellowish-green to pale blue-green, with large amounts of biotite, chlorite, and zoisite, though the feldspar is calcic (Ab_{52} to Ab_{68}) and no albite is reported. Presumably equilibrium was not reached during metamorphism.

There is a suggestion in the foregoing differences that the grade of metamorphism is higher in the western than in the eastern part of the district: epidote, chlorite, and biotite all are more common to the east.

Flows of both "basalt" and "andesite" may be either massive or pillowed. The pillow structures are found throughout the district, but only in a few places is it possible to get reliable indications of flow tops. The pillow structure is best seen where the action of the waves on the lake shores produces a stain which emphasizes the slight differences between the rim and centre of a pillow. On a surface just exposed from beneath the moss, the interstices of the pillows are often weathered out, but, in general, the pillows are difficult to trace.

Porphyritic amphibolite ("andesite" and "basalt") also occur, at many places. It was found impossible to use this feature for structural purposes; where porphyritic flows are present, many flows are porphyritic and individuals are impossible to follow unless exposure is essentially complete. The porphyritic phases are, therefore, not identified on the accompanying maps. (Pillowed flows are not noted, for the same reason. Even on excellent outcrop at Tod Lake, Map No. 9, it was impossible to follow them for any distance. They appear to be lenticular, and limited in size.)

Flow Breccia

Volcanic breccia is a variation of the mafic flow types. The fragments were probably formed from the break up of the crust of the flow while the main mass was still molten. In other cases no satisfactory explanation has been found.

These rocks differ from the other mafic flows in the large textural features rather than in composition. What has been said above about mineral composition applies equally to these rocks.

Some of the finest examples of flow breccia can be seen on the east side of Ralph Lake, towards the southern end. The matrix of the breccia is about the same as some adjacent fine-grained flows: dark greenish-black, slightly schistose, with hornblende needles just visible to the unaided eye. The foliation flows around the fragments to some extent. The fragments are lighter coloured and have 50 to 60 per cent of rounded feldspar grains, about 2 millimeters in diameter, which give the rock a speckled appearance. Some fragments are green in colour, on the weathered surface, as against the predominant buff to brownish grey of those high in feldspar. Many fragments have an irregular core high in feldspar, or a whole fragment may be such. These irregular patches weather out and produce an irregular pitted surface. Some fragments are as small as 2 inches by 4 inches, on the weathered surface, but some were seen as large as 24 inches by 12 inches. Most of the larger ones do not have cores, but are uniform in texture.

Volcanic breccias, interbedded with most other Wasekwan types, occur in many parts of the district. Though they are found at Hughes Lake and east of Barrington Lake, they appear to be most abundant in the area between Ralph Lake and Cockeram Lake, and certainly such excellent examples as those at Ralph Lake do not occur in the eastern and western parts of the district. But, in working with the notes of the various field parties, I gained the impression that some observers devoted more effort than did others to searching for such types. In some places the fragments and matrix are similar, the breccia is difficult to recognize, and it may be that it is more abundant elsewhere.

Allan suggested that most of the volcanic breccia is flow breccia; that is, it was formed at the time the flow was cooling by break up of the crust and incorporation of the fragments in the part of the flow still molten. Rounded fragments, and fragments of more than one type may be due to bombs falling upon the surface of the flow, or to fragments picked up from beneath and incorporated in the moving flow. The presence of the feldspar phenocrysts (?) is difficult to explain, however, if this is a flow breccia. No completely satisfactory explanation of the origin of this rock type has been found.

Stanton reports white to slightly pink weathering fine-grained rhyolite fragments in a green matrix, a half-mile west of One Island Lake.

Amygdaloid

Amygdaloid is not a common rock type. Stanton reports it from southeast of Leo Lake, where the amygdales are from one-sixteenth inch to one and one-half inches in length, and filled with fine-grained quartz and chalcedony. In the Hughes Lake area, Allan reports quartz and calcite fillings and notes that some pillowed lavas are amygdaloidal. The same is true east of Barbara Lake, north of Moses Lake, and in the original Wasekwan locality at McVeigh Lake. Amygdaloid is reported from a single outcrop north of Lynn River and west of Keewatin River, and from another northwest of Arbour Lake. Lenticular amygdales one-quarter inch to one-half inch by one-sixteenth inch to one-quarter inch are visible in places on the glacially polished surface of an agglomerate-breccia assemblage at the south end of the eastern bay of Dunphy Lakes. Amygdaloid was not reported from the Laurie Lake area, nor from the McGavock and Sickle areas.

Agglomerate

Agglomerate occurs in several places. Fragments are andesite and amygdaloidal andesite, as well as rhyolite bombs and lapilli. Fragments are small in most cases, but some up to 20 inches are known.

Agglomerate is another volcanic rock type which is not extensive in the district, but occurs at several widely separated places. It is found to the north and west of Lynn Lake, northwest of Farley Lake, and at Dunphy Lakes.

The agglomerate northwest of Farley Lake was not seen in the course of this work but, as described by Stanton, it consists of "rounded to sub-angular bombs of amygdaloidal andesite and fine-grained andesite imbedded in an andesitic matrix. In general the bombs are not closely spaced, and are usually less than 8 inches by 4 inches. The size of the amygdales varies considerably in different bombs, and ranges from one-thirty-second inch to one-quarter inch in diameter. Andesitic flows and andesitic flow breccia occur interbedded with the agglomerates."

At Dunphy Lakes the bombs are also amygdaloidal, but there are some rhyolite bombs, and zones with smaller bombs and lapilli.

On the east side of Ralph Lake the groundmass of the agglomerate is dark green with small needles of hornblende. The fragments are light grey or greenish on the weathered surface; most of them are elliptical and a few inches long, but some are up to 20 inches. There is calcite along fractures in the agglomerate. Some fragments are tuffaceous. As hornblende and feldspar develop the fragments become hazy, and in many places are difficult to see.

The agglomerate from the south and east shores of Barrington Lake is apparently very much like that at Ralph Lake, for Crombie says:

"They consist of light-weathering acidic fragments, sub-angular to ellipsoidal in shape, in greenish andesitic flow material. Occasionally a band having an acidic matrix as well as acidic fragments is present. Fragments are elongated to such an extent at some places that the rock has an apparent banding and gneissic texture."

Tuffs

Tuffs are fairly widespread in the district, but, like the other pyroclastic rocks, are not present in large amount. They are interbedded with flows, with sediments, and with other pyroclastic rocks.

Near Eric Lake the tuffs are well developed, and interbedded with porphyritic flows. The weathered surface is dark greenish black to light blue green (5B7/1) where freshly exposed. They are very thinly laminated (half millimeter or less), but the laminae are not ordinarily visible on the fresh surface. The layers are composed of small crystals of hornblende forming thin bands in a mass of feldspar and clinozoisite. Quartz and carbonate fill fractures parallel to the foliation. In other places, biotite and epidote are present. In a few places, the tuffs are coloured light-green and the rock is apparently more siliceous than above.

Siliceous Lavas

Siliceous lavas, variously described as rhyolite, dacite or trachyte in the field, form a very minor part of the Wasekwan series, but do occur in a few places. Bands extensive enough to map occur to the east and north of Hughes Lake; between Ron Lake and Pole Lake, east of Cartwright Lake; between Tulune Lake and Eagle Lake; and in two small isolated areas northwest of Cartwright Lake. Siliceous lavas also are found interbanded with more basic flows in several places, but are too small to distinguish on the maps.

In his summary report Norman[1] describes a quartz porphyry and trachyte band extending along the south side of Chepil Lake and to the southwest for four miles. More detailed work has shown that this band is not continuous, as Norman's reconnaissance work had suggested. Between Ron Lake and Pole Lake, this band is fine-grained, olive grey (5Y 6/1), and very uniform. East of Pole Lake it contains 10 to 15 per cent feldspar phenocrysts about one-eighth inch in diameter. The fresh surface is greenish grey (5GY 6/1), very fine grained, and except for the feldspar phenocrysts, has only scarce hornblende crystals visible under the hand lens. A sample from just northeast of Ron Lake contains green actinolite needles and zoisite bands in a matrix of fine-grained quartz and feldspar (Ab_{52} An_{48}). A small amount of carbonate (three per cent) and magnetite is present. According to Norman, the quartz porphyry has "phenocrysts of quartz and albite in a microcrystalline aggregate of quartz and feldspar with white mica, calcite and a little biotite".

North of Hughes Lake the "rhyolite" is composed of quartz and feldspars, green biotite and sericite, whereas at the east end of Key Lake feldspar porphyry is composed of quartz, albite (Ab_{98} An_2), biotite, zoisite, sericite, chlorite and carbonate, with fine-grained granitic texture.

Trachyte, with rhyolite and dacite, are found east of Hughes Lake and north of Westdal Lake. The trachyte is a fine-grained aggregate of feldspar, zoisite, and quartz, with some fine-grained biotite and chlorite. There is a small amount of biotite and chlorite and about three times as much actinolite in fine needles. Small octahedra of magnetite are present in some places. Sections of the rhyolite, as described by Stanton, show 45 to 60 per cent quartz and oligoclase in a fine-grained aggregate, with a high degree (30 per cent) of alteration of some sections to granular epidote. Pale brown biotite and fine, flaky sericite form 20 to 35 per cent.

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[1]*Geol. Surv., Canada, Sum. Rept., 1933, pt. C. p. 29C.*

CHAPTER IV

PRE-SICKLE INTRUSIVE GROUP

Included within the limits of this group is a wide range of rock types. The most mafic type with extensive distribution is gabbro and norite. From this, the group ranges through diorite and quartz diorite (tonalite) to oligoclase granite and granodiorite, and minor amounts of pegmatite. From the specimens collected by the field parties, it has been possible to recognize some 40 types and variations in this group. For purposes of the accompanying maps, these have been combined in four units which are described below and appear on the accompanying maps as Units 9, 10, 11, 12. Detailed description can be found in Appendix B.

CORRELATION BASIS

Igneous rocks of two distinct ages are present in the district. Various methods of correlation within the two groups were considered and rejected. Visual comparison was finally used as a basis. Correlating thus, between one outcrop and the next, and using observed age relations, the larger igneous units were established and outlined on the maps.

Correlating the various units in this group presents the problem familiar to all who have attempted to distinguish and map units of intrusive rocks: On what basis can the correlation be made?

As a starting point, there are several places where the age relations can be demonstrated; these are discussed in more detail elsewhere. For the present, it is sufficient to state that pre-Sickle intrusive rocks can be recognized in three places (see Map No. 10): (1) near Pool Lake, which is on the railway southwest of Lynn Lake; (2) on the west side of Hughes Lake; (3) at the north end of Sickle Lake. There are other places where the intrusion is probably of pre-Sickle age, though this cannot be demonstrated beyond doubt: (1) on the east side of Black Trout Lake, the gabbro is probably older than the Sickle conglomerate; (2) the sheared granite at Franklin and Foster lakes may be older than the pre-Sickle folding; (3) the granite body north of Laurie Lake may be pre-Sickle, though this is based on an involved, and not very compelling, argument. The intrusions which lie south of the northern boundary of the Sickle sediments can be shown to be post-Sickle in several places, either by direct observation of intrusive relations, or indirectly by the metamorphic effect on the Sickle sediments.

From the definite relations outlined, it is evident that two igneous groups are present in the district. It then becomes necessary to have some basis for assigning any specific body to one group or the other.

The age relationships between various rock types were evidently of special interest to Allan; especially in the Cockeram Lake area, he found many places where such relations can be seen. This, of course, settles the relative ages within those outcrops, but it does not settle the age relations between different exposures. That is to say, while type A may be older than B which is older than C in outcrop number one, and D may be older than in E in outcrop number two, there is no positive way of telling whether D is equivalent to A, B, or C, or is, in fact, even older or younger. There is, of course, nothing new about this universal problem; these things are recited here to reduce the question to its essentials.

Correlation from one outcrop to another is obviously critical. If it were possible to correlate from one place where relations are known to another similar exposure, then the overall sequence of events could be worked out. By the same token, other outcrops could be assigned, also, to the correct age in the sequence so derived. The process would be, in effect, bridging from outcrops of known age, through a series of outcrops where mutual relations were known, to other outcrops of known age.

The basis of correlation should preferably be objective. The obvious basis required is time: rocks which are introduced at the same time presumably come from the same source, and the ideal basis would be absolute age. There is no method for such age measurement which is practical to use on such a scale, nor is there one sufficiently precise for such work on rocks of great antiquity. Direct correlation on a time basis being impossible, various other methods have been evolved. In general, methods are on a chemical basis, and assume that, in a specific magma, the elements will so arrange themselves that either the resulting mineral components will be constant, or that there will be some systematic variation which will be characteristic and recognizable. Such methods as comparison of suites of heavy minerals, of zircons, of trace elements present, of petrofabrics, of associated pegmatites, or a combination of all, have been used.[1] Attempts have also been made to identify a magmatic series by comparison of variations shown by chemical analysis.

These methods, on the whole, leave something to be desired. They involve elaborate procedures, some of which are quite time consuming, to produce data which are not much improvement on the original problem: Zircons or other heavy minerals are correlated on vagaries of shape or composition, trace elements are matched and pegmatites are compared. But, all these features, in the final analysis, are an interpretation of similarities and discrepancies, in which the opinions and preferences of the operator weigh very heavily, especially in deciding what constitutes a significant similarity. Of all, probably the most objective method is one involving manipulation of chemical analyses on variation diagrams, but experience with this has been unsatisfactory. Some years ago, at the Manitoba Mines Branch, an attempt was made to correlate a number of types of granite, from an area in northeastern Manitoba, on the assumption that, if derived from a common source, a plot of the analyses on a variation diagram should show a systematic relationship. Twelve analyses were plotted on a Larsen type variation diagram showing $FeO+MgO+CaO$ against $1/3\ SiO_2+K_2O-FeO-MgO-CaO$. As would be expected from related analyses, all points fell very close to a straight line, except for one which probably was contaminated, and it was concluded that this showed systematic variation. The same relation was found with a selection of Larsen's published analyses of rocks from the batholith of Southern California, which he considered to be a single magmatic series. When it was found, however, that rocks of all ages and as widely separated as those from Pike's Peak, Butte, and Mt. Ascutney also fitted the same diagram, it became obvious that this is an impossible method of correlation.

A suitable and objective method of correlation not being available we perforce fall back on the method used in day to day work by the field geologist; that is, by direct visual comparison. It must be admitted that a more subjective method would be difficult to imagine. However, this is a technique used every day of his life by the field geologist, usually without too much troubling of his conscience.

While this subjective method of comparison is the basis for essentially all mapping, it should be clearly realized that it is a fundamental assumption in the correlations made on the accompanying map. That is, it is assumed that specimens are representative, and that two samples which look the same are, in fact, the same. There will, no doubt, be objections to correlating a granite from Barrington Lake

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[1]See for example:

Stark, J. T. and Barnes, F. F.: The Correlation of pre-Cambrian Granites by means of Heavy Mineral Analyses. *Geol. Mag., 854, Vol. 72, No. 8, pp. 341-50, 1935.*

Morgan, J. H.: Application of Accessory Mineral Methods to the Precambrian Rocks of the Oxford House area. *Ph.D. Thesis, Univ. of Wisconsin, May, 1940.*

Halferdahl, L. B.: Trace Element Studies of Granite Batholiths, Preissac-La Corne Area, Quebec. *M.Sc. Thesis, Queen's Univ., 1954.*

Boos, M. F.: Correlation of Granites. *Abstr.: Bull. Geol. Soc. Amer., Vol. 53, No. 12, pt. 2, pp. 1795-1796, (1942).*

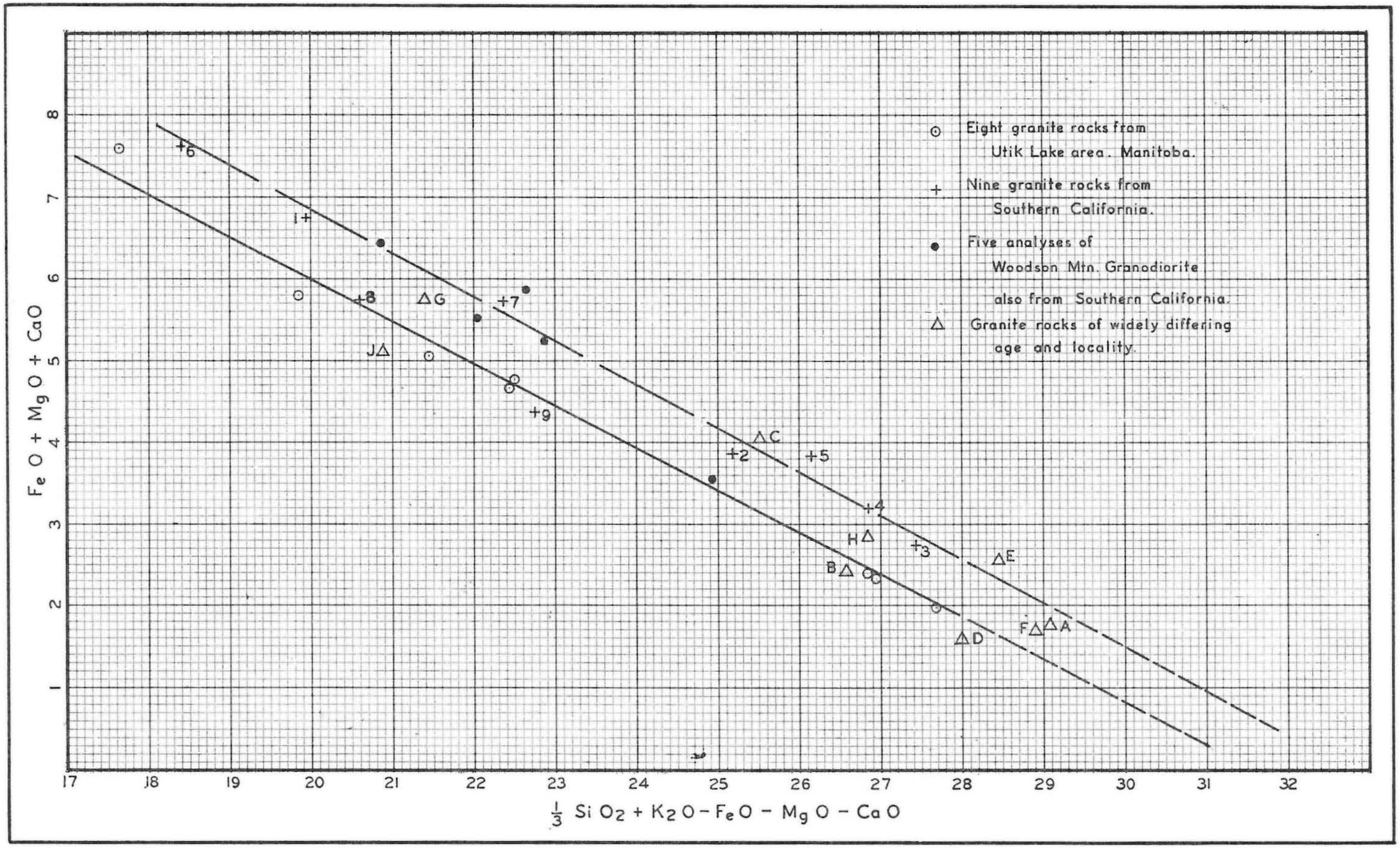

Figure 7—Correlation of rocks by comparison of analyses on a Larsen diagram. The solid line is the best line through points representing a group of Manitoba rocks. (See Man. Mines Branch, Publ. 51-4). The dashed line represents 14 samples from the Southern California batholith. Note that the miscellaneous rocks will fit as closely to the lines as do the points on which the lines are based.

A. Granite, Pike's Peak. B. Granite, Mounting Ascutney. Vt. C. Granite, Pigeon Point, Minn. D. Granite, Florissant, Colo. E. Granite, Crazy Mountains, Mont. F. Granite, Yuha Gap, Calif. G. Quartz Monzoniate, Hailey, Idaho. H. Quartz Porphyry, Butte, Mont. J. Augite Syenite Porphyry, Yellowstone Park.
Analyses A to J are all by W. F. Hillebrand, and are from Clarke's Data of Geochemistry.
Analyses of the Southern California rocks are from Larsen, E. S.: Batholith of Southern California, Geol. Soc. of America.

with one from Saskatchewan, purely because they look alike. But, in all logic, is this fundamentally different from mapping an outcrop on this side of a swamp with one on that side because "they are the same"? It might even be argued that consistency requires this type of correlation, because it is the basis of the field work, though certainly no one would argue that it is a satisfactory method.

Correlating from one outcrop to the next, then, on the basis of this procedure, and fitting in the observed age relations, wherever such were available, a sequence was worked out. Actually, the sequence was established almost within the limits of Allan's Cockeram Lake area (i.e. west half of Map No. 2), though extension eastwards to Hughes Lake and westwards to Pool Lake was necessary. The Cockeram Lake area, accordingly, has come to be considered the type area to some degree, and rocks exposed in other parts of the district have been assigned to age and type groups largely on the basis of comparison with the rocks of that area.

The Barrington Lake Area (east half, Map No. 3) is an exception. Crombie's field notes were accidentally destroyed by a flood before this present work was undertaken. His field traverse maps, and abundant specimens, were available and it was hoped that the intrusive rocks could be sorted out. The attempt quickly showed, however, that the specimens were useless without the notes which recorded their mutual relations and the effort had to be abandoned. In consequence, the basic types in that area have been assigned arbitrarily to the pre-Sickle group, and the granitic types shown as of uncertain age. In short, Crombie's map has been copied without serious changes, except such as are a result of removal of topographic distortion.

The sub-division of the pre-Sickle granitic types of the McGavock Lake sheet (Map No. 5) is, to some extent, also an exception. Relatively few of Oliver's specimen's are now available and the field notes are often lacking in detail. In consequence, the boundaries of units are essentially those laid down by Oliver on the preliminary maps. It is known, however, that there are limited occurrences, at least, of granite of the Berge Lake type (unit 12) to the east of Pool Lake; sufficient details to fix the limits of this are lacking.

PRE-SICKLE GABBRO (LYNN LAKE GABBRO)

Gabbro, including minor amounts of peridotite and norite occur at several places. The distribution is outlined.

Included within this unit, shown on the accompanying maps as No. 9, are the occurrences at Lynn Lake in which the orebodies have been found. It has become customary, as a matter of daily convenience, to refer to these intrusions as the "Lynn Lake gabbro", "the Lynn Lake plug" or the "Lynn Lake intrusive". For this reason, we propose using the name "Lynn Lake gabbro" for this unit, within this report. This recognizes only that that it is an established name of local convenience; it is not proposed as a formal name and should not be considered as such.

DISTRIBUTION AND TOPOGRAPHIC EXPRESSION

The Lynn Lake gabbro, as bodies of appreciable size, is widely distributed within the district. The larger bodies of gabbro, as presently exposed, are within an 8-mile radius of Cockeram Lake, and in the general area of Barrington Lake; with the exception of one large mass at Sickle Lake and another at Dunphy Lakes. There is probably no significance in the distribution, apart from the accidents of post-gabbro intrusions and later erosion.

In the vicinity of Barrington Lake the two major masses are at Nickel Lake, and east and west from Tow Lake. Several smaller bodies nearby are possibly associated with the two main masses just mentioned. A gabbro band is also found to the east of Barrington Lake, towards MacBride Lake. Two small bodies lie between White Owl Lake and Barrington Lake. (These are unusual in that the aeromagnetic map shows an associated magnetic low, rather than the strong magnetic field commonly found with the gabbro. A similar anomalous low appears

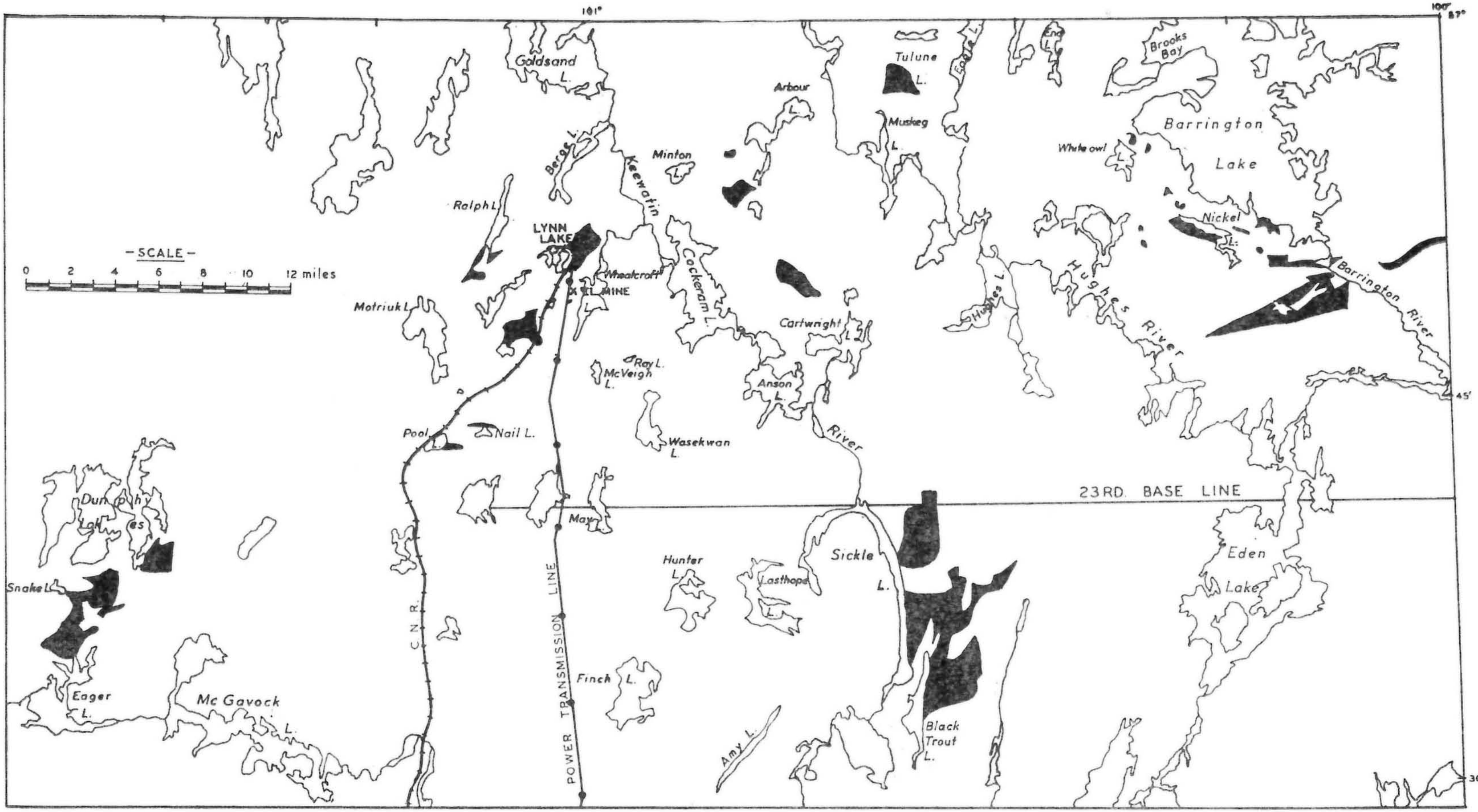

Figure 8—Distribution of bodies of "Lynn Lake Gabbro".

to exist east of the north end of Arbour Lake, but there are no outcrops there and it is entirely possible that the magnetic field may be due to granite or to some other lithological change not evident on the surface.) To the west from White Owl Lake the next major body of gabbro is at Tulune Lake.

In the Cockeram Lake area there are several bodies: northwest of Carr Lake, southwest of Arbour Lake, northeast of Moses Lake, and east of the northern end of Berge Lake.

The Lynn Lake bodies are the only ones, so far, to produce ore, but massive barren sulphides have been found in the large body north of Fraser Lake. There has been some encouragement from the small body near Flag Lake, but not sufficient, apparently, to warrant development. Two occurrences south of Ralph Lake have also been explored to some extent.

In the southern half of the district, there has been essentially no exploration of the large mass of gabbro lying east of Sickle and Black Trout lakes; occurrences north of Lasthope Lake are small. Two plugs were mapped by Oliver at Pool Lake and Mail Lake. These are gradational into the surrounding rocks and are more probably phases of the main pre-Sickle intrusion than discrete gabbro plugs; according to both Oliver and Gregory[1], who have examined them in the field, they appear to owe their mafic composition to absorption of adjacent volcanic rocks.

There is a considerable body of gabbro in the vicinity of Dunphy and Snake lakes. As pointed out below, the mineralogy is similar to that of the gabbro at Lynn Lake, and it has attracted some prospecting activity in the past. It is probable that it is more complex than the simple intrusive body shown on the map, and may include much basalt which has not been distinguished.

In most places, the Lynn Lake gabbro supports rounded ridges which usually stand up some fifty or a hundred feet above the surrounding country. Changes in the topography near the contacts are not abrupt, however. The outstanding exception is the large gabbro mass at Fraser Lake, which is covered by an extensive swamp. It is perhaps worthy of note that at Lynn Lake, though the gabbro supports a ridge on the east side of the lake, the actual discovery outcrop formed a low knoll in a shallow valley which covers the orebodies, and that one of the orebodies is actually under Lynn Lake itself; the El orebody is in an area of shallow muskeg.

CONTACT RELATIONS AND STRATIGRAPHIC POSITION

In general, the gabbro has been found to be younger than the Wasekwan volcanic and sedimentary rocks, but older than all other units in the area. No inclusions recognizable as Sickle sediments have been found in the gabbro, nor have any recognizable gabbro bodies been found to intrude the Sickle. Some doubtful cases are discussed.

Northeast of White Owl Lake is a small plug of gabbro in which foliated "greenstone" inclusions have been found. In one case the faint, but definite, foliation in the inclusion (which is about 10 feet long) is terminated at the contact by massive gabbro. The inclusion has several quartz stringers, which are rare in the gabbro, and some end at the contact. This gabbro has been mapped, by at least one exploration company, as coarse-grained lava. It would appear that it is intrusive and that it probably post-dates the development of foliation in the Wasekwan lavas.

Inclusions of Wasekwan volcanic and sedimentary types have also been recognized northeast of Arbour Lake, northeast of Moses Lake, east of Sickle Lake and Black Trout Lake, and south of Anson Lake. The gabbro has also been observed cutting the Wasekwan rocks in many places: north of Arbour Lake a 50-foot gabbro dyke is gneissic and finer-grained near the contact with Wasekwan. At Dunphy Lakes and Snake Lake certain parts of the gabbro are definitely intrusive,

[1]Gregory, A. F.: Exploration geologist for Sherritt Gordon Mines, who studied this "gabbro" as part of the Mail group of claims.

though there is a possibility that some other parts of the body, as mapped, may be recrystallized lavas. At the south end of Snake Lake, for example, gabbro cuts the rocks to the north and has a 2-foot chilled margin; on the east arm of Dunphy Lakes, it cuts across bedding and sends apophyses into the sediments though, in general, it is sill-like at that place.

The small body of gabbro 2½ miles north of Minton Lake is apparently surrounded by tonalite, and appears on the map as if it were an intrusive plug. But the tonalite is chilled against the gabbro, which is cut by dykes, and there are basic inclusions in the surrounding rock. There seems to be very little doubt about the relative age of this body.

Similarly, the gabbro body 2 miles north of the west end of Cartwright Lake is bordered on the east by granitic types in which there is a zone of abundant basic inclusions adjacent to the contact, as well as numerous dykes of "granite" cutting the gabbro.

The age of the Nickel Lake gabbro is in some doubt. It is intrusive into the surrounding Wasekwan, and is cut by dykes from the granitic rocks to the south. The relations are definite enough, but there is a possibility that some of the granite may be of post-Sickle age. For example, Brownell[1] states that some basic bodies may possibly be younger than the granite. The largest body, and the one to which Brownell specifically refers, is on GLMC 23E mining claim. If this is correct, the "late" gabbro, at least, is probably post-Sickle, cutting a granite belonging to the earlier, pre-Sickle, intrusive group. This would make the age of the gabbro, as well as the main mass of the granites at Nickel Lake post-Sickle, because it is probably reasonable to suppose that all the gabbro is of the same age in this immediate area. At present there does not appear to be enough evidence to settle the matter definitely. Both the gabbro at Nickel Lake and that at Tow Lake have been assigned to the same age as the Lynn Lake gabbro, but it should be noted that there is this element of doubt. On lithological grounds, also, there is a suspicion that some of the "granite" in this immediate area may be of post-Sickle age.

There are a few other places where relations have been reported which apparently contradict the general indications. The evidence in these cases appears to be either self-contradictory, or not definitive:

Southeast of Pyta Lake, Stanton reported gabbro cutting Sickle sediment and, in turn, cut by grey felsite stringers. This immediate area was re-examined in 1956, but no definitive relationship could be found, though the actual contact is exposed.

Similarly, Allan reports a "hornblende porphyry dyke", apparently correlative with the gabbro, which may be chilled against medium-grained quartz diorite. This is on the northwest shore of Cockeram Lake, north of Keewatin River. The note is somewhat indefinite and is quoted verbatim:

"A60—small point.
At north end at water and south up ridge rock is a medium-grained grey granite (diorite).
At west side of point is a band 30 feet wide of hornblende porphyry. Probably a dyke.
—Seems to show chilled border against granite on east.
—On west side at water is a band of grey foliated fine-grained quartz, hbld, biotite rock—probably sediment.
—Going south up ridge.
—Rock is a hbld feldspar gneiss representing alt. volcs.
—Most of the gneiss at top of ridge is grey weathering, less hbldic—probably seds or tuffs—all is finely lineated . . . ."

Though too small to show on the map, this has been assigned to the Lynn Lake gabbro unit, in view of the apparent uncertainty as to its relations, and the general evidence elsewhere in the area.

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[1]In a private report to Nickel Lake Mines, Ltd.

To the northeast of Cockeram Lake, Allan also reports a 6-foot dyke cutting a mixture of lit-par-lit gneiss and granite. At a casual glance specimens from this dyke resemble the gabbro with its flashing hornblende "phenocrysts". The dyke however, has excellent ophitic texture and the "phenocrysts" are long feldspar prisms with excellent polysynthetic twinning.

Basic rocks younger than the Sickle are known in the district—the Black Trout Diorite is the outstanding example. Basic dykes are reported also, cutting the post-Sickle granites, especially north of Hunter Lake and east of May Lake. These are all too small to show on the maps. It may be that this dyke noted by Allan belongs to this late stage in the sequence.

No extensive bodies as mafic as gabbro are known to be definitely younger than the Sickle Series. The large gabbro mass at Tow Lake may be an exception, but lithologically it is very similar to the known early gabbro and, on our present basis of correlation must be assigned to the pre-Sickle. There is at least a possibility that it is of post-Sickle age.

PETROGRAPHY

The common gabbro of the district is a dark green to black, coarse-grained rock. Where the feldspar content is high the rock is speckled or mottled black and white, or greenish white. There is considerable variation in appearance over such a large area.

The rock is commonly altered so that small amounts, or remnants only, of pyroxene, are now present. Forty-five to sixty-five per cent light green to dark bluish green hornblende is now the major dark mineral. $Z \wedge c$ is usually 19° to 21°, but a dark bluish green to brown hornblende does occur, with $Z \wedge c = 26°$. The feldspar content varies from 30 to 45 per cent, and its composition from Ab_{55} to Ab_{40}; the majority of the values available are in the range of Ab_{47} to Ab_{52}. Small amounts (1 to 5 per cent) of magnetite, epidote and chlorite are commonly present, along with 1 per cent, or less, of apatite. Carbonate, chlorite, tremolite, and talc also occur in a few places. Where pyroxene has been preserved, as at Lynn Lake, both augite and enstatite are present along with chlorite and antigorite, in a matrix of labradorite. Hypersthene is present in a few places. Pale blue-green amphibole is probably secondary (uralitic), and this is possibly the origin of most of the hornblende found in the gabbro elsewhere in the district.

In general, it appears probable that the gabbro has been strongly uralitized, possibly at an early stage, so that very little pyroxene is now present. It seems probable also that there has been regional metamorphism to a much lower grade than that represented by the uralitized gabbro. In many places the gabbro shows a mineral assemblage, such as chlorite and epidote, characteristic of low metamorphic grade, in the same section with labradorite and other primary(?) minerals. These are obviously not in equilibrium, and suggest a retrogressive alteration.

Peridotite is present in the "A" mine at Lynn Lake, but has been recognized at only one place on the surface.

In his description of the gabbro at Lynn Lake Allan[1] says:

"In hand specimen it is a massive medium-grained dark-green fresh-looking rock composed of feldspar and amphibole. Locally it has been somewhat sheared. The feldspar is grey to greenish so that a fresh surface suggests a higher percentage of amphibole than is actually present. On an exposed surface the feldspar weathers to a light dusty appearance, and the amphibole stands up slightly. Thin sections show that this rock is a gabbro in various degrees of alteration. In most sections examined, the feldspar is clear and where measurements were possible was determined as labradorite. One specimen from near the discovery on the "dome"—the large outcrop 600 yards north of Lynn Lake—was found to consist of labradorite (Ab_{45} An_{55}), a highly altered pyroxene (probably augite), orthorhombic pyroxene, and considerable chlorite, antigorite and magnetite dust. The plagioclase makes up 30 per cent of the whole. Some of the orthorhombic pyroxene has a slight pleochroism, usually associated with hypersthene, but several determinations indicate that it is optically positive, thus enstatite. This specimen may be called norite or enstatite norite.

"Another specimen, also from the 'dome', in thin section is seen to be a uralite gabbro of 47 per cent labradorite, 52 per cent uralite, 1 per cent sulphides and minor

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[1]Allan, J. D.: Geological Studies of the Lynn Lake Area, Northern Manitoba. *Unpublished Ph.D. thesis, Massachusetts Inst. Tech., 1948, p. 35.*

apatite and clinochlore. The plagioclase is similar to that in the first specimen described, but no pyroxene is visible. The plagioclase shows twinning of the Carlsbad, Albite, and Pericline types. The texture is hypidiomorphic granular (gabbroic), and the ferromagnesian mineral is a pale blue-green amphibole. In places the amphibole is seen to invade feldspar crystals along cleavage planes, and is believed to be secondary and so is termed uralite. Many crystals contain schiller-like inclusions probably inherited from the original pyroxenes they replaced. Some of the uralite has been replaced by chlorite without destruction of the crystal outline."

Other samples examined by Allan showed higher amounts of uralite. Some is a pargasite variety and some is normal actinolite. He suggested that this is similar to the secondary "blue-green hornblende" described by Wandke and Hoffman as of common occurrence at Sudbury[1].

Subsequently to Allan's work, Hunter made a petrographic study of the Lynn Lake plug for Sherritt Gordon, and incorporated his results in an M.Sc. thesis for the University of Manitoba.[2] Hunter classified the whole body as uralite gabbro, probably derived from norite, and identified three phases, based on the percentage and composition of the feldspar, the type of amphibole and the grain size. Hunter's descriptions of the various types, and the relations visible in thin section, are lengthy and will not be repeated here. The interested reader is referred to pages 17 to 38 of his thesis.

The essential additions which Hunter has made to Allan's descriptions quoted above, are: he was not able to find the pargasite reported by Allan; the plagioclase content is given as 25 to 30 per cent, with composition $Ab_{45}An_{55}$ to $Ab_{40}An_{60}$ in his "A" gabbro, which is increased to 40 to 45 per cent in the "B" and "C" phases; in the "C" phase the feldspar composition is Ab_{45} to Ab_{50}; the identification of enstatite and augite is confirmed, and Hunter adds that the enstatite has "iron content approaching hypersthene." [According to Poldervaart's chart the properties listed by Hunter indicate 10 molecular per cent $FeSiO_3$.] But, Hunter implies that the presence of the pyroxenes is limited to two outcrops in the "A" phase (his p. 21) rather than the wider distribution suggested by Allan. Ninety per cent of the ferromagnesian minerals of all phases is actinolite, in grains ranging from minute fibres to large blades visible in hand specimen. Actinolite in the "C" phase is somewhat less fibrous and shows marked pleochroism from bluish-green to yellowish green; this is contrasted with the pale-green actinolite of the "A" and "B" phases, which otherwise differs optically only in having the extinction angle 2° smaller. Insofar as the minor constituents are concerned, Hunter gives: antigorite 5 to 7 per cent in the "A", 7 to 10 per cent in the "B", and 8 per cent in the "C" phase; chlorite 3 to 5 per cent in "A" and "B", and 2 per cent in "C". Remnants of brownish green hornblende, altered to actinolite, occur in small amounts in the "A" phase; the remnants are more plentiful in the "B" phase but are not reported from the "C". Dark brown biotite, replacing amphibole, is reported in amounts up to 15 per cent from the "C" phase, near the gabbro-volcanic contact. There are minute amounts of epidote, carbonate and quartz.

Bands of amphibolite, from 1 inch to 6 inches in width, are reported in the "A" phase and, according to Hunter, bands of anorthosite of similar size are sometimes found associated.

Hunter also presents a table which is interesting in that it shows very clearly the rapid variation in components within the gabbros. It is reproduced on page 56.

The talc fills in areas between actinolite and unaltered pyroxene and replaces the pyroxene. Hunter states (his p. 30) that talc occurs "only in specimens that

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[1]Wandke, Alfred, and Hoffman, Robert: A study of the Sudbury ore deposits. *Econ. Geol., Vol 19, No. 2, p. 177, 1924.*

[2]Hunter, H. E.: Geological Investigations of the Lynn Lake Basic Intrusive Body, Northern Manitoba. *Unpublished M.Sc. thesis, University of Manitoba, 1950.*

have remnants of altered enstatite" [see table below], and where both pyroxenes are present only the enstatite is altered to talc.

Mineral Content of Five Sections from Single Gabbro Outcrop

Section Number	Enstatite %	Augite %	Actinolite %	Talc %	Feldspar %	Chlorite and Antigorite %
359-2-1	—	—	58	5	30	7
359-2-2	—	—	55	3	35	7
359-2-3	10	3	20	38	25	4
359-2-4a	30	20	15	—	30	5
359-2-4b	—	—	45	18	30	7

(All specimens from an area with radius approximately 100 feet. Sections 359-2-4a and 359-2-4b were cut from the same hand specimen).

For the information of field workers, a description of rocks of this unit from other parts of the district is given below, in some detail.

The gabbros show a weathered surface which is dark grey or greenish grey to black, where the hornblende content is greatest; in other cases, the common weathered surface is speckled or mottled black and white or greenish white. The greenish colour is due to the feldspar and is usually quite noticeable where present, though the greenish colour of the feldspar, when seen under the hand lens, is very faint indeed. In some places the hornblende is more resistant to weathering and gives the surface a pebbly or roughened effect, like stucco. In one case, the surface has a characteristic pock-marked appearance due to the weathering out of aggregates of biotite and hornblende, which appear to be derived from hornblende crystals about ¼-inch square. The fresh surface is usually dark grey to brownish black and, in some places, has a bluish or greenish cast due to the colour of the feldspar. Especially in more mafic varieties, prismatic hornblende crystals, 0.1 to 0.5 inch long, give the specimen a characteristic porphyritic appearance due to the flashing cleavage faces. Hornblende content, as estimated, is about 50 to 60 per cent in most cases, but is as high as 80 per cent and as low as 40 per cent. The characteristic large, flashing, hornblende prisms are usually surrounded by a matrix of feldspar containing small amounts of finer-grained hornblende. The rock is generally fresh, but, in some cases, there is up to 5 per cent biotite developed on the hornblende and, in one extreme case, the bulk of the hornblende has been altered to biotite. Feldspar is white or greyish white usually, but may have a greenish or bluish-grey cast. One body, southwest of Arbour Lake, is marked by a feldspar with an unusual mauve colour. In general, feldspar is fresh, well twinned, and forms the matrix for the hornblende. In several places, however, the feldspar shows good ophitic texture and laths up to 0.4 inch long, though these are usually smaller. Feldspar laths are enveloped by hornblende in at least one place. Some epidote is present in a few cases (5 per cent in one extreme case). Traces of pyrite and chalcopyrite are present in about half the samples.

In thin section the gabbros show some variation in composition, but are, on the whole, more uniform than might be anticipated for rocks so widely distributed. Samples from the Lasthope, Sickle, and Dunphy lakes areas contain 45 to 65 per cent light green to dark bluish-green hornblende; 50 to 60 per cent is the most common proportion. The extinction angle $Z \wedge c$, is usually reported as 19° to 21°. A sample from a small occurrence on the 23rd Base Line, east of Counsell Creek, shows dark bluish-green to light-brown hornblende, with $Z \wedge c = 26°$. The feldspar content ranges from 30 to 45 per cent, and the composition from Ab_{55} to Ab_{40}. The majority of the values available are in the range Ab_{47} to Ab_{55}. In the strictest sense, therefore, some diorite has been included with this unit. Small amounts (1 to 5 per cent) of magnetite, epidote and chlorite are commonly reported, along with 1 per cent, or less, of apatite. Titanite and ilmenite (up to 5 per cent) are reported in several samples from the Dunphy Lakes area, but apparently do not occur elsewhere. Pyroxene is reported from the Dunphy Lakes area. In one case, also from there, a few remnants of pyroxene, along with feldspar, quartz, carbonate, biotite, epidote, and sulphides occur in a rock which is 90 per cent dark green hornblende. In another case augite (30 per cent) occurs as optically oriented remnants in a mass of alteration products: chlorite, carbonate, and very fine-grained tremolite and talc. Tremolite and talc, in a felted aggregate, form 90 per cent of another sample; the remainder is magnetite, epidote, sulphide and labradorite. This is included with the gabbro, though it may originally have been ultramafic and is shown on the map as a sub-unit (9a).

Special rock analyses were not made for the present study. The only available analysis of pre-Sickle gabbro is that reported by Fawley, from the Sickle Lake area, and is repeated below:

SiO_2	50.3%	MODE:	
Al_2O_3	16.0	Hornblende	50%
Fe_2O_3	1.8	Feldspar Ab_{50}	45
FeO	7.3	Biotite	3
MgO	9.1	Magnetite	1
MnO	0.17	Quartz	1
TiO_2	0.4		
CaO	11.6		
Na_2O	1.5	NORM:	
K_2O	1.3	ap	0.34
H_2O-	0.05	il	0.76
H_2O+	0.73	ol	7.78
P_2O_5	0.2	ab	12.58 } Ab_{35} An_{65}
CO_2	Tr	an	33.08 }
S	—	mt	2.55
Cl	—	di	19.13 Fe:Mg::28:72
F	—	hy	19.0
		ol	4.43
	100.45		99.65

Sp. Gr. (Pulp): 2.90
Sample No. F71-48   Lab. No. R 7
Analyst: Mackiw; Man. Mines Branch Laboratory.

DIORITE AND TONALITE (QUARTZ DIORITE)

Outcrops assigned to this unit are extensive, and widespread in the district Of the forty varieties recognizable in the intrusions of pre-Sickle age, this map-unit includes those numbered 9 to 23 inclusive, for which detailed descriptions can be found in Appendix B.

DISTRIBUTION

Two large masses of tonalite are found near Cockeram Lake: one, to the east and northeast towards Kay Lake, is composed of types 11 and 12; the other, between Cockeram and Wheatcroft lakes, contains the varieties numbered 9, 10, 11, and 12, with number 15 near Wheatcroft Lake. A smaller mass west of Carr Lake is doubtless a part of the same intrusive.

Figure 9—Distribution of diorite and tonalite.

The quartz diorite is not extensively exposed in the Hughes Lake area. A small body (types 9 and 12) occurs at the south end of Muskeg Lake on the Hughes River; on the east side of Cartwright Lake there is another small body (types 10 and 20). To the south of Cartwright Lake is a large mass extending south to the Keewatin River above Sickle Lake. Both this body and the smaller one to the west of Hugo Lake have been included with this diorite map-unit. They are similar to one another, but differ somewhat from the remainder of this unit, and may well belong with the granodiorite which they resemble in some respects. The body south of Raven Lake probably also belongs to this phase.

In the Farley Lake area there are several bodies of diorite shown in the area of Ellystan and Nickel lakes, and Hughes River. These appear as very large remnants, more or less completely engulfed by the later granodiorite. Between White Owl and Barrington lakes, the diorite rocks are very closely related to the gabbro which is found there; in some places one appears to grade into the other.

In the southern half of the district, less of this type is exposed. There are small areas in the vicinity of Sickle and Wasekwan lakes, but to the south, of course, rocks of this group are buried beneath the later Sickle series. With the exception of a few small bodies, west of Dunphy Lakes, and north of Counsell Lake, this type appears to be essentially absent from the southern part of the district.

CONTACT RELATIONS AND STRATIGRAPHIC POSITION

As for the other pre-Sickle intrusions, the main age relations were established in the Cockeram Lake area, and from there extended and applied elsewhere. The diorite is established as of post-Wasekwan age at several places where it contains inclusions of, or shows cross-cutting relations to, the Wasekwan rocks. The diorite also is younger than the gabbro, but is older than a coarse-grained tonalite (Map-unit 11) which cuts the diorite in several places. There are possible exceptions to the general rule, in two cases where the diorite may be chilled against the tonalite, but the data are ambiguous, at least.

There are many places where the diorite shows inclusions of, or cross-cutting relations to, the rocks of the Wasekwan series. On the small island on the east side of Wheatcroft Lake, for example, the diorite contains xenoliths of gneissic "greenstone" which are cut by dykes from the diorite (pl. I, B). Similar relations can be seen to the east of the central part of Cockeram Lake, and to the east of Huet Lake. This establishes the diorite as of post-Wasekwan age.

The diorite is reported, by Allan, to show a 12-inch chilled margin against the Lynn Lake gabbro, near the south shore of the small, unnamed lake one mile west of Carr Lake. The chill zone is reported to change abruptly to a medium-grained diorite. (Allan mentions the possibility of a composite dyke, but makes no further comment.) He did not preserve a sample, but his description is the same as that for the diorite, which is also present about 500 feet southwest. This diorite type is also found west of Cockeram Lake. There it appears to be the same as, or very similar to, the diorite found at several places northeast of Moses Lake. At the latter locality it may be gradational into the gabbro there; a relation suggested also, by Stanton, to the northeast of the Hughes River. Further, north of the west arm of Cartwright Lake, there is a mixed zone in which there are "greenstone" inclusions in the gabbro and gabbro inclusions, in turn, in diorite. The foregoing indicates the diorite to be later than the gabbro, and, of course, post-Wasekwan.

The diorite, in turn, is cut by a coarse-grained tonalite (Map-unit 11) in several places. Northwest of Cockeram Lake and north of the mouth of Keewatin River, the tonalite is "slightly finer-grained as though chilled" against the diorite, and "probably younger". While this is indefinite, it is reinforced by the distribution of the two types; as sketched by Allan, a tongue cuts into the diorite. Similarly, a diorite type west of Cockeram Lake, identical in appearance with that on Wheatcroft Lake is cut by a white to grey biotite "granite" equivalent to unit 11.

At a number of places diorite is also cut by dykes which appear to be related to the tonalite. These dykes are especially numerous near the boundaries between the two types and, in a few cases, the prevalence of the dykes has been used as an aid in locating contacts between outcrops some distance apart. In general, this sequence is found all over the district, with the tonalite everywhere cutting the older diorite.

There are exceptions to this general rule, however. East of the north end of Cockeram Lake, Allan reports "medium-grained quartz diorite" on the west side of a ridge; sixty feet farther up, the ridge is "grey, coarse-grained biot-hbld gneissic granite. Diorite near contact seems to be finer grained as though chilled against the granite." This contradicts the relations found elsewhere in the same body, though there is a suggestion in one outcrop, to the east, of a later basic intrusion cutting granite.

About a mile east of Carr Lake, Allan's assistant (Hunter) reported that diorite cuts grey gneissic granite, with a definite chilled border. This again appears to contradict the sequence as indicated elsewhere in the area. The note has a confusing reference to volcanic rocks; the relevant part is repeated verbatim, in case anyone should be interested in that immediate area. The outcrop is situated 6,000 feet, on a bearing of 083° true, from the extreme south tip of Carr Lake:

> "B190 . . . . the main part of the O.C. is quartz diorite—with the gneissic granite and porphyritic granite in approximately equal amounts making up about 20% of O.C.
>
> "In one area the three types were found in contact. The diorite cut the gneissic granite with a definite chilled border.
>
> "The contact between the gneissic granite and diorite, and between the porphyritic granite and diorite was marked by a band of gneissic material derived from volcanics—gneissosity parallel to contact.
>
> "No age relation between the porphyritic granite and the other two types could be determined."

The area southwest of Tulune Lake, towards Hughes River, also presents confusing evidence as to age relations. Allan's field notes report a medium- to coarse-grained diorite containing inclusions of gabbro; his assistant reported the diorite on the same outcrop to be cut by "intrusive tongues of gabbro". This outcrop was examined in 1956. The contradiction apparently arises because one observer saw the northwest, and the other the southern, part of a large outcrop; both are correct. The diorite has very numerous inclusions of "greenstone" and gabbro, which range in size from 1 inch in diameter to fragments in excess of 10 feet long. At the same time, dykes of gabbro cut the diorite (pl. II, A). The possibility that these dykes are actually great tabular inclusions is ruled out by the presence of a dyke which has a narrow chilled margin against one of the "greenstone" fragments. In this case there seems to be no doubt that the gabbro dykes represent a basic intrusion younger than the diorite. (See Figure 10.)

A similar conclusion is indicated by gabbro dykes cutting diorite southeast of the south end of Cartwright Lake, though, in this case, the evidence is not so clearly defined.

These post-diorite basic dykes have been assigned to a post-Sickle age, but are all too small to show on the accompanying maps.

On the evidence of basic inclusions and of dykes cutting the Wasekwan, the diorite in the vicinity of Sickle and Wasekwan lakes is younger than the Wasekwan, for which this is the type locality. Its pre-Sickle age, as shown on the map, is dependent mainly on its relations to the "white" granodiorite to the east of May Lake; Fawley[1] reports that the diorite is cut by the "white granite" (his unit 10). This granite is very similar to the granite at Berge Lake (No. 12 on the accompanying maps) which is pre-Sickle on the basis of correlation used for this work. The "white granite" is accordingly pre-Sickle, and the diorite also. This conclusion differs from that reached by Fawley, but contradicts nothing he actually reported.

[1]Fawley, A. P.: Geology of the Lasthope Lake Area; *Man. Mines Br. Publ. 49-5, pp. 16, 19.*

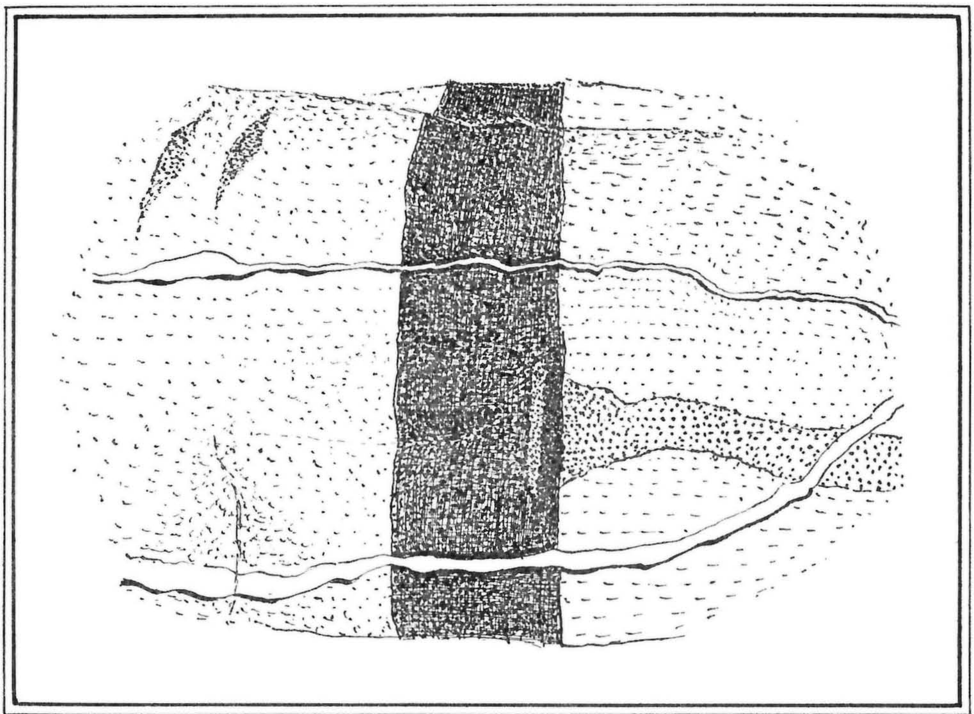

Figure 10 — Gabbro dyke chilled against a "greenstone" fragment in diorite at Tulune Lake
Unshaded areas represent narrow strips obscured by drift. Drawing by C. Shepherd.

There is no evidence that either the diorite or the "white granite" cuts the Sickle sediments, and Fawley based the age of the "white granite" on an assumed consanguinity and gradation in character[1] between the diorite, "white granite" and "older granite". The latter is definitely of post-Sickle age.

PETROGRAPHY

Diorite and tonalite are light brownish to dark grey on the weathered surface, with a speckled appearance due to the ferromagnesian minerals. On the fresh surface black hornblende and biotite form evenly distributed grains in a matrix of bluish grey feldspar. Hornblende is the common dark mineral but it is altered to biotite in many places. Quartz is a minor part but, where present, may be water-clear, smoky, or of a bluish opalescent colour. Thin sections show considerable alteration of feldspar, with development of epidote, zoisite and carbonate. The amount of alteration varies considerably from place to place.

Small bodies of gabbro and of sodaclase tonalite are also included, but are too small to be readily shown on the maps.

The diorite and tonalite are typically light brownish grey to dark grey on the weathered surface, with a speckled appearance often described as "pepper and salt". This description is more apt for the finer-grained varieties. Characteristically the weathered surface has a dark brown stain, probably due to liberated iron. The surface may be smooth to slightly roughened by weathering. In some cases 1/8-inch pits are visible; this pitting is characteristic and readily recognizable. The diorite differs from the gabbro by finer grain and distinctly brownish colour. One variety (No. 13) gives the impression of white spots raised above a black groundmass, and has a coarser grain than is common with this group. Where freshly stripped the surface often shows a distinct greenish-white colour.

[1]Fawley, A. P.: Ibid. p. 18.

The fresh surface shows grey feldspar spotted with black hornblende and biotite. The colour accordingly is usually dark grey, sometimes with a brownish cast.

Typically the rock is even grained and the dark minerals are uniformly distributed. In some cases, however, the dark minerals form irregular aggregates and the fresh surface has a mottled appearance. The usual grain size is about 0.1 inch, or less, and the hornblende and biotite form about 50 to 55 per cent of the rock, on the average. The actual range, as estimated in hand specimen, is from 35 to 60 per cent. Commonly, hornblende forms the larger part of the dark minerals but, in individual cases, biotite may be present to the practically complete exclusion of hornblende, or vice versa. Almost without exception, the biotite is in close association with hornblende, or is in aggregates evidently pseudomorphic after hornblende. Quartz is present in most samples, but rarely in amounts greater than 5 per cent, and often less than three. In some places it is absent. The quartz is water-clear to dark smoky in colour; a bluish opalescent variety is common. Feldspar is white to buff or greyish white, as a matrix for the hornblende, usually shows good polysynthetic twinning lamellae, and in some cases forms phenocrysts. The hornblende shows good prisms in some cases; in others, the rock has good ophitic texture. Grain size in the feldspar is about 0.1 inch, as for the dark minerals, but some samples show grains of feldspar up to 1/4 inch long. The feldspar may occur as aggregates of indefinite shape, or as individual fine laths or prisms, and all intermediate stages. Where the feldspar is translucent, or bluish grey in colour, the rock is dark and gives the impression of a higher proportion of dark minerals than is actually present. The rock is usually massive. Epidote and pyrite are present in some places.

Thin sections of samples from this unit show some considerable variation. Hornblende forms 35 to 60 per cent of the rock; the usual amount is about 50 per cent. Feldspar also varies from about 35 to 60 per cent of the rock, and the composition from Ab_{52} to Ab_{65}. Zoning is present in the feldspar in a few cases, and alteration to epidote, zoisite, carbonate and paragonite is rather common. Epidote and zoisite are reported to form up to 15 per cent of the feldspar in a sample from Hughes River, upstream from Elizabeth Lake; this diorite is almost completely surrounded by a later granite and the severe alteration is probably due to the metamorphism caused by the granite. Probably such a cause explains the other occurrences of alteration; epidote, carbonate and zoisite are reported in many sections, but not ordinarily in amounts greater than 4 or 5 per cent. The hornblende varies in texture, as suggested in hand specimen. In some cases a poikilitic texture is reported, with blebs of quartz and/or feldspar in the hornblende; in others, magnetite is found along lines in the hornblende so that it almost resembles schiller structure. The hornblende occurs in "plates" and flakes, individually and in masses, as well as in feathery, flamboyant aggregates. Colour ranges through yellowish green, green, and bluish green to light brown and greenish brown; $Z \wedge c$ varies from 15° to 26°.

In a sample from near Omega Lake, Stanton describes "a pale mineral forming part of the hornblende crystal and appears continuous with it. Looks like bleached or iron-deficient portion of the hornblende crystals. Does not appear to be pyroxene". In this section the feldspar has the composition $Ab_{60}An_{40}$, as determined by index of refraction on 001 cleavage flakes; the quartz is chiefly as narrow broken veinlets; and there is about 4 per cent apatite as small crystals. In some respects, this appears to be similar to the gabbros at Tow Lake, as described by Hunter.

In most sections reported, biotite is present in close association with hornblende, in amounts ranging from 2 to 10 per cent, but is missing entirely from a few. It will be noted that biotite appears in some hand specimens to the apparent exclusion of hornblende.

Included with the diorites are small bodies of gabbro, one of which, on Ashley Creek, has feldspar as calcic as Ab_{30}. These bodies are too small to show readily on the map. At the other extreme, as in the body extending east from Jim Lake to Brooks Bay of Barrington Lake, is included a rock with 50 per cent albite (Ab_{95}). This would be, in Johannsen's classification, a sodaclase tonalite.

Some of these rocks contain quartz in excess of five per cent, and they are therefore tonalites according to that classification.

For purposes of record, the analysis given by Fawley is repeated below. This sample is from approximately a mile east of Keewatin River, just upstream from the long portage above Sickle Lake. It is unfortunate that this sample should be from this body which, as pointed out above, is not typical of the diorite as a whole. The sample is coarser grained than typical; but it resembles, very closely, samples of the diorite near the contact with the small gabbro body west of Carr Lake, and also the diorite from the small body on the south side of the gabbro at Tulune Lake.

SiO_2	53.4 %	MODE:	
Al_2O_3	16.9	Oligoclase	44%
Fe_2O_3	0.8	Quartz	5
FeO	7.0	Biotite	10
MgO	6.9	Hornblende	30
MnO	Tr	Apatite	1
TiO_2	0.6	Carbonate	Tr
CaO	8.2	Epidote	10
Na_2O	2.9		
K_2O	1.3	NORM:	
H_2O-	0.11	ap	0.67
H_2O+	1.3	il	1.22
P_2O_5	0.3	or	7.78
CO_2	Tr	ab	24.63
S	—	an	29.19
Cl	Tr	mg	1.16
F	Tr	di	7.69
		hy	24.80
	99.71	Q	1.32

Sp. Gr. (Pulp): 2.81
Analyst: Mackiw; Manitoba Mines Branch Laboratory.
Spec. F11-48 Lab. No. R 4

TONALITE (QUARTZ DIORITE)

The rocks of this unit, shown as number 11 on the accompanying maps, comprise varieties 24 to 30, as described in detail in Appendix B.

DISTRIBUTION AND TOPOGRAPHIC EXPRESSION

This unit is the most extensive single type in the district. It is apparently extensive, though poorly exposed, west of Goldsand Lake. Thence, eastward, it cuts off the Wasekwan series, along the northern boundary of the district, to Barrington Lake and probably beyond. From the Saskatchewan boundary, at Laurie Lake, it extends northeast to Motriuk Lake, whence a narrow band extends to Wheatcroft Lake and separates a northern belt of Wasekwan volcanic and sedimentary rocks, near Lynn Lake, from the southern belt of the type locality, at McVeigh Lake and Wasekwan Lake. Widening out again, the granodiorite continues, with its included gabbro, diorite, and small masses of Wasekwan rocks

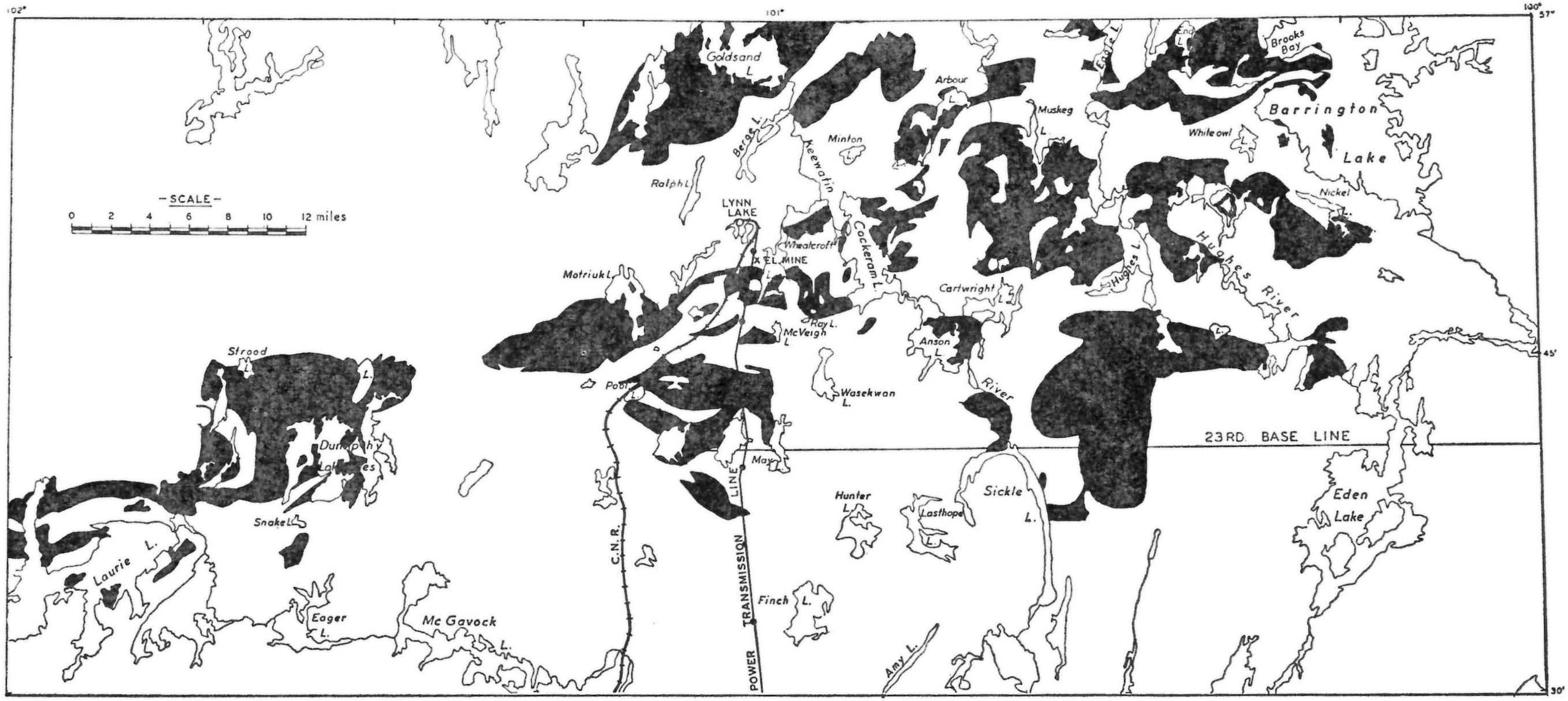

Figure 11—Distribution of tonalite.

around Cockeram Lake, till it extends from Arbour Lake at the north edge to Cartwright and Hughes lakes in the south. It thus separates a northern band of the Wasekwan series from a southern one. These two join, on the east side of Hughes Lake, as a narrow septum separating the granodiorite, to the west, from its continuation eastward to Nickel and Tow lakes, where another band of volcanic rocks again serves to join the northern and southern parts of the Wasekwan. A further area of granodiorite extends eastward from the area of Counsell Lake, to the north of Lasthope Lake, and on to the north and east of Sickle Lake.

There are thus, as exposed on the surface, three irregular, and more or less distinct, areas of granodiorite. Undoubtedly these areas are connected, in depth, into a single mass of batholithic proportions. The Wasekwan rocks, the gabbro, and the diorite are, therefore, to be considered as inclusions or roof pendants in the batholith, albeit they are inclusions of very substantial dimensions.

There may be some of this granodiorite included with the post-Sickle granite north and east of Beaucage Lake; the age of the granite north of Wasekwan Lake, shown as post-Sickle, is also in doubt.

With a lithological unit as extensive as this one, almost all the topography in the district is represented in some degree. In general, however, the granodiorite supports topography of low relief, with gently rolling rounded ridges, and extensive areas of muskeg or swamp. This essentially uniform and featureless character is, perhaps, to be expected as the physiographic expression of the essentially uniform and featureless character of the bedrock itself. The presence of faults and shear zones, and similar linear zones of weakness, has resulted, in this unit as elsewhere, in production of linear topographic breaks, such as straight shore lines and long narrow swamps and such. An outstanding example is the long, swampy, hollow extending south from Muskeg Lake to Cartwright Lake. Local, minor topographic changes usually mark the contact with other rock types. In general, the gabbro and diorite appear to be more resistant than the granodiorite, and to stand up above it as low ridges.

CONTACT RELATIONS AND STRATIGRAPHIC POSITION

The tonalite cuts the diorite (Map-unit 10) in many places. There are also several places where the tonalite, in turn, is cut by a younger pinkish grey granite (Map-unit 12). In at least three places the relations between all three types are shown in a single outcrop.

At Pool Lake, the conglomerate at the base of the Sickle series is unconformable upon a rock which is considered to be a phase of the tonalite. The tonalite, diorite and gabbro must therefore all be of the pre-Sickle age.

Some extensive areas of rocks of doubtful age are also included with this unit. The details of exposures and correlation are given below.

In this unit, with its widespread exposures, there are greater variations in character and greater problems in correlation than with the more restricted types. In some cases, some difficulty was found in assigning a specific sample to a specific variety within this unit, though there was seldom any question about the larger unit itself. Because the time sequence, as carried across the district, depends upon the mutual relations between the many varieties or types, it is dependent, in the final analysis, on correctly assigning individual outcrops to the correct type.

Though the possibilities of confusion are greater than in the gabbro and diorite, one feels that the correlation, and the depending conclusions, are reasonably valid. Samples of a single variety, seen piled together, sometimes show more variation than might be expected, but some care was taken to see that the variations do not exceed those actually displayed by samples either from a single outcrop or for which the correlation is not in doubt.

In general, the tonalite, as exposed between Wheatcroft Lake and Hughes Lake, can be assigned to this map unit without great difficulty; the greater part, in fact, to types 26 and 27, with some of type 25 on the north and west of Cockeram Lake. Within this area, the general rule is that the tonalite is younger than the diorite, which it cuts in many places. Further, to the east of Cartwright Lake, it can be seen with inclusions of diorite and cut by a pinkish grey, very siliceous granite, all in a single outcrop. (One realizes, of course, that inclusions as an age criterion are doubtful in this case; for an inclusion of diorite may be indistinguishable from an inclusion of "greenstone".)

The tonalite, in turn is cut by a pinkish grey to buff granite (No. 12, on the accompanying maps). This can be seen in several outcrops in the Cockeram Lake area as, for example, north of Norrie Lake where a breccia has been so formed; on the east side of Cockeram Lake (pl. II, B); on the west side also where the "pink" granite cuts and includes the tonalite; and at Chepil Lake.

This latter case is especially interesting. On the large hill on the northwest corner of the lake, a fine-grained diorite occurs as inclusions in, and is veined by, a coarser grey tonalite (=No. 29). This in turn is cut by a reddish granite. An inclusion of the diorite in the tonalite, with both cut by a dyke of the reddish granite, is shown in the photograph (pl. III, A). Contradictory relations were reported, by Hunter, near the east shore of Huet Lake. On re-examination, however, careful search showed volcanic rocks cut by grey hornblende-biotite tonalite (=No. 25) and this, in turn, cut by a pink aplitic granite. This too can be seen in a single outcrop.

South of Lynn Lake, in the vicinity of Mail and Pool lakes, the tonalite is unconformably overlain by the conglomerate of the Sickle series. As one of the few places in the districts where such age relations are clearly established, it is of some importance and details of the exposure which establishes the age are given below, in connection with the stratigraphic position of the Sickle series.

This was mapped by Oliver in 1949 as biotite-hornblende quartz diorite, with a contaminated phase of the same thing along the boundary with the Wasekwan rocks to the north. In addition, his map shows two plugs of hornblende gabbro, one at Pool Lake and the other at Mail Lake. This was examined briefly, in 1954; it appeared that, whatever the origin, the "gabbro" at Mail Lake grades into a quartz diorite or tonalite, west of that lake. The change can be seen, without any definite contacts, on a single outcrop. Recently, this area has been mapped in detail by A. F. Gregory, for Sherritt Gordon Mines. He came to the conclusion that the mafic rocks were formed by admixture of Wasekwan volcanic material with the tonalite. Oliver, also considered this a definite possibility. Gregory mapped, at Mail Lake, a much smaller area of diorite than Oliver, and Gregory's work has been followed on the accompanying map, though thin sections show that some gabbro, at least, is present. The quartz diorite or tonalite here belongs to types 25, 26, and 29 of this unit. That portion exposed at the actual Sickle contact, northwest of Pool Lake, is much darker than is typical and is probably, also, a local contaminated phase, as "greenstone" inclusions are present 400 feet north of the contact. In some parts, it is strongly gneissic.

In view of the inclusions of "greenstone", and the relations elsewhere, this contaminated tonalite is probably post-Wasekwan; the Wasekwan contact is exposed 650 feet north of the conglomerate, but no completely definitive relations were found there.

If the tonalite at Pool Lake and Mail Lake is the same as that at Cockeram Lake, as it appears to be, then the diorite and the Lynn Lake gabbro, which are older than the granodiorite, must all be of pre-Sickle age also.

The large body of tonalite extending westward from Motriuk Lake to the Saskatchewan border, has been included with this map-unit also. Though the writer suggested, in 1950, that the grey "granodiorite" north of Laurie Lake might be pre-Sickle in age, the major reason for so including it now is the lithological resemblance to the tonalite between Cockeram Lake and Hughes Lake. In essence, the argument advanced in 1950 was that the granodiorite showed a garnet and a biotite zone of metamorphism, though it invades Wasekwan rocks of higher metamorphic grade; and that the high grade of the Wasekwan might be caused by the granodiorite, while its own low grade was a subsequent effect due to the post-Sickle granite. This argument was never very robust, and has gained nothing in stature with age.

The extensive areas of tonalite in the vicinity of Simpson, Ellystan, Nickel, and Barrington lakes, are also assigned to this unit on the basis of similarity to the rocks to the west, and on relations to the diorite and gabbro. The tonalite is also older than the extensive body of granite along the Hughes River between Simpson Lake and Elizabeth Lake. One should point out, however, that this latter argument may be of no weight. On lithological grounds, mainly, there is a strong possibility, if not probability, that the granite in question is post-Sickle in age; in which case, of course, its relations would have no validity in fixing the age of the tonalite.

West of Barrington Lake, in the vicinity of Brooks Bay and End Lake, there are several varieties and phases which have been included with this map-unit. There is a considerable, and frequently rapid, local variation, and the samples from this area frequently do not fit well into any of the established categories. No evidence was noted which precludes the age assigned, but it should be noted that there is this uncertainty.

PETROGRAPHY

The tonalite is typically light brownish grey, on the outcrop, with the surface mottled by grains and irregular aggregates of hornblende and biotite in a matrix of quartz and feldspar. Dark minerals average about 25 per cent of the rock in contrast to 40 to 60 per cent in the diorite. Quartz is usually about 25 per cent of the rock, but may be higher. Feldspar is similar to that in the diorite, but euhedral crystals are more common and grain size is somewhat larger. The composition is about Ab_{65} An_{35} in most places, but there is a considerable range. Alteration to epidote, zoisite, carbonate and "sericite" is also common.

Samples of each of the types included in this unit are described in some detail in Appendix B. In general the rocks of this unit weather brownish grey, light brown, or buff to very light grey. The characteristic colour is a light brownish grey, which often is dark brown where exposed to the water on the lake shores; some outcrops show a slight greenish cast. The surface often is mottled or spotted with hornblende and biotite, but is not ordinarily pitted to any extent; the dark minerals are definitely in smaller amounts than in the diorites and quartz diorites, and are often in irregular patches. Foliation may occur but is usually local. In one type (27) the dark minerals are not prominent on the weathered surface.

On the fresh surface these rocks are commonly massive, medium grained with black flecks, streaks, or patches of hornblende and/or biotite in a mixture of feldspar and quartz. Dark minerals average about 25 per cent of the rock, but may be as high as 45 per cent, especially in those rocks high in hornblende. As with the diorite group, both hornblende and biotite are commonly present but hornblende is usually less than half the dark minerals and in some cases it is practically absent. Both minerals are black to greenish black. Hornblende may occur as aggregates or individual stubby prisms up to ¼ inch long. Epidote, where present, is closely associated with the dark minerals, especially at contacts with feldspar. Feldspar is greyish white, bluish grey or faintly-greenish white in colour. Prisms of feldspar up to ½ inch are found, but the usual size is about 0.15 inch and a large number of euhedral crystals and "ophitic texture" are common. Polysynthetic twinning is common and well developed. Quartz is abundant; in some specimens as much as 50 per cent, though usually about 25 to 35 per cent. It is characteristically in bluish opalescent grains of irregular shape and widely varying size, but may be transparent, translucent, grey, or honey-coloured. In a few samples it suggests the rounded grains of a sediment, but without any suggestion of bedding features.

In thin sections the rocks of this unit show more variation than might be expected from the hand specimens. This may be, in part, due to a real variation within the unit. In part it may be a selective sampling in the sections; many sections were cut by the field workers to settle some specific question and may be the oddities, rather than the representative material. In compiling the information from a large number of sections it may easily happen that some of the oddities are included.

The sections available show hornblende, green, blue-green to dark green in colour in about half the specimens. It is usually reported as altered to biotite, and, in the two cases reported, $Z \wedge c = 14°$ and $12°$. The amount ranges from 8 to 30 per cent, but is usually about 20 per cent. The biotite is yellowish brown or light brown, olive green, or reddish to dark brown, may be altered to chlorite (especially in samples from the Farley Lake area) and, in a sample from the Sickle area, has very little pleochroism. It also varies considerably in amount; the lowest figure reported is 2 per cent, including the derived chlorite; the highest is 23 per cent, where no hornblende is present; the average figure is 8 per cent, and the mineral is essentially ubiquitous. Plagioclase has the composition of oligoclase or andesine, in most places about $Ab_{65}An_{35}$. The extreme range is Ab_{55} to Ab_{85} with one sample of albite, Ab_{95}; the amount varies from 25 to nearly 70 per cent, but the average is just over 50 per cent. The feldspars may be uniform or zoned, and alteration with development of epidote, zoisite or "sericite" is common. Minor amounts of carbonate are also frequently reported. Interstitial quartz varies widely in amount (5 to 45 per cent), but averages 20 per cent. The epidote resulting from alteration of the feldspars is estimated as high as 20 per cent in some sections, but appears to be most common in the eastern part of the district. In the southwestern part, chlorite is reported with the minor accessory minerals—magnetite, apatite, zircon and sulphides, but in a few sections, from Sickle Lake, it amounts to 10 per cent. Magnetite is usually minor, about 1 to 2 per cent; in a sample from Dunphy Lakes it was estimated at 4 per cent, but it may be that this is overestimated. Orthoclase is ordinarily absent but is reported, in amounts up to 5 per cent, in a few sections.

The only analysis available is of a sample from near where the 23rd Base Line crosses the Keewatin River at Sickle Lake. Like the others, this has been published previously by Fawley, and is merely repeated here:

SiO_2	66.75%
Al_2O_3	14.65
Fe_2O_3	1.60
FeO	4.23
MgO	2.82
MnO	0.12
TiO_2	0.56
CaO	3.61
Na_2O	3.05
K_2O	2.20
H_2O-	0.06
H_2O+	1.04
P_2O_5	0.12
CO_2	—
S	—
Cl	—
F	—
	100.26

MODE:	
Biotite	15%
Quartz	45
Epidote	10
Magnetite	1
Oligoclase	25
Orthoclase	5

NORM:	
or	12.79
ab	25.68
an	16.96
C	1.02
mt	2.32
il	1.06
ap	0.34
hy	12.54
Q	26.82

Sp. Gr. (Pulp): 2.75
Sample No. F26-48 Lab. No. R12
Analyst: I. Spector, Manitoba Mines Branch Laboratory.

It must be noted, apropos of correlation on the basis of visual similarity, that some half dozen samples from the grey post-Sickle granite south of Lasthope Lake could readily pass as slightly gneissic phases of variety 25, of this unit.

GRANODIORITE AND GRANITE (BERGE LAKE GRANITE)

NAME AND DISTRIBUTION

These rocks are shown on the accompanying maps as unit 12, and are described in detail in Appendix B.

The area around the southern end of Berge Lake has come to be considered, more or less, as displaying the typical exposures of this unit, as, for example, on the long point jutting out into the lake there. Dykes and small bodies of granite very similar to "the granite at Berge Lake" occur in the vicinity of the mines at Lynn Lake. In much the same fashion as with the gabbro, "the granite at Berge Lake" has become the "Berge Lake granite" for convenience, and the name will be so used in this report. As with the Lynn Lake gabbro, this name is purely a matter of local convenience; one wishes to avoid proposing a formal name, with stratigraphic connotation, until there is something more definite upon which to base a correlation.

This granite is neither extensively exposed nor widely distributed in the district, and most bodies are relatively small. There are several small bodies in the triangle between Wheatcroft Lake, McVeigh Lake, and the south end of Cockeram Lake. A similar body occurs on the west side of Wheatcroft Lake, about a mile south of the "El" mine. South of Arbour Lake is an extensive area of this granite, which may join the smaller area northwest of Norrie Lake. This latter is rather contaminated by large numbers of inclusions, which were probably derived from the adjacent gabbro and lavas. Six small satellitic bodies are exposed towards Cockeram and Hughes lakes. A small body on Muskeg Lake, and a poorly-exposed body in the bend of Hughes River north of Chepil Lake are also assigned to this unit, as well as the small mass south of the south end of Nickel Lake. Small amounts of this granite also occur on the west side of Chepil Lake and beneath the Sickle conglomerate on the west side of Hughes Lake. Though of some stratigraphic significance, these dykes and small bodies are too small to be distinguished on the accompanying maps. Small amounts of granite also occur near Dunphy Lakes, and east of May Lake.

CONTACT RELATIONS AND STRATIGRAPHIC POSITION

The Berge Lake granite is later than the tonalite, which it cuts, and is therefore younger than all other rocks of the pre-Sickle group. Rocks assigned to the Berge Lake granite occur beneath the unconformity at the base of the Sickle series at Hughes Lake. The whole intrusive group is therefore pre-Sickle.

The correlation of the granite at Hughes Lake with that at Berge Lake is not as definite as is desirable. It hinges on the occurrence, in a single dyke, of rocks lithologically identical with both the granite at Hughes Lake and with other bodies which contain phases similar to the granite at Berge Lake. The evidence is reviewed.

There is doubt about the age of some bodies assigned to the Berge Lake granite. This doubt arises from their similarity to other rocks known to be of post-Sickle age.

The age of the Berge Lake granite is of interest because the granite is considered to be related to the ore occurrences at Lynn Lake.

In the terminology of previous workers the Berge Lake granite is equivalent to Fawley's "White Granite" of the Lasthope Lake area.[1] This correlation is based entirely on lithological resemblance, but does not run counter to any of the relations described by Fawley. It is also equivalent to the "younger granite" of Ruttan[2], on the basis of occurrence at Berge Lake, but not all granite so mapped by him has been included within the present unit—that in the vicinity of Counsell Lake, for example.

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[1]Fawley, A. P.: Geology of the Lasthope Lake Area, *Man. Mines Br. Publ. 49-5, pp. 19-20.*

[2]Ruttan, G. D.: Sherritt Gordon Lynn Lake Project; Geology of Lynn Lake; *Trans. C.I.M.M., Vol. LVIII, 1955, pp. 187-200.*

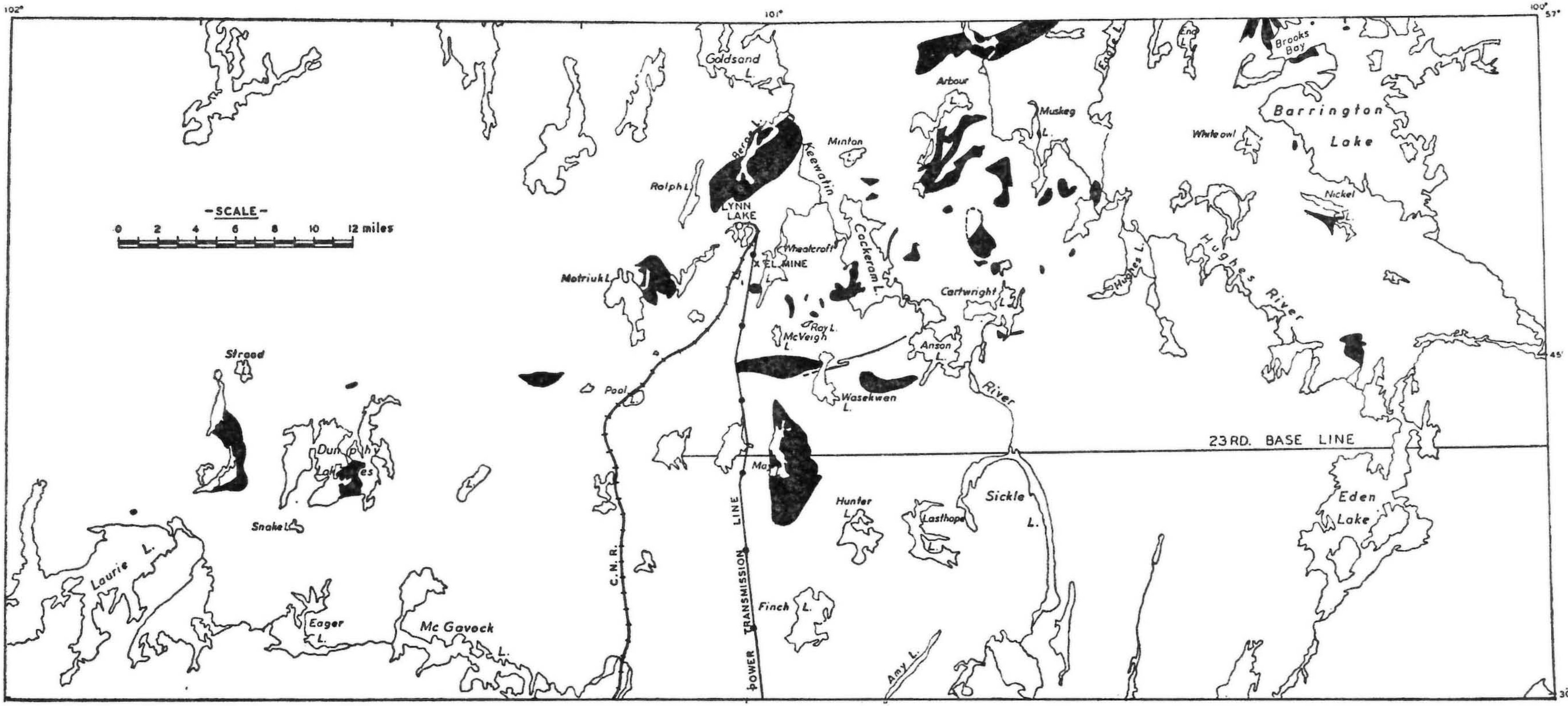

Figure 12—Distribution of "Berge Lake Granite".

The "white quartz-rich soda granite" mapped by Stanton at Dunphy Lakes is included with the tonalite as a special phase (11a) mapped as leuco-tonalite.

The age of the Berge Lake granite is of some importance, because the mine geologists at Lynn Lake attach some significance to this granite in the history of mineralization. Outcrops have usually been assigned to the Berge Lake granite on the basis of age relative to the grey tonalite (No. 11), and similarity of adjacent exposure. There do not appear to be any exceptions to the rule that all "pinkish grey", "pink", or "reddish" granites—the terms almost universally used in the field to describe this unit—are later than the grey diorites, quartz diorites, and tonalites. The problem in correlation comes in separating these late pinkish granites from the still later post-Sickle granites, to which the same description is frequently applied. This problem is especially aggravated in the northern half of the district, where very little rock of the Sickle series is present.

The attempt to differentiate this unit from the post-Sickle granite was made on the following basis: The various types recognizable (and including, incidentally, those of the tonalite and diorite units as well) were tabulated with respect to their relative ages, as shown on individual outcrops. The types which appear to form a single body, either because of proximity, admixture, or because so reported by the field worker, were then combined. From the results the age of individual bodies was assigned.

Phase 32 (see Appendix B) is later than the tonalite, which it cuts at a place on the east side of Wheatcroft Lake (North of Ray Lake), so that the older limit is established. There is some variation within this unit, unfortunately, but the variation does not appear to be any greater than is present within the group of outcrops on the west side of Hughes Lake, where granites assigned to this unit can be seen beneath the unconformity at the base of the Sickle series. This fixes the age of this type.

This correlation of the granite at Berge Lake with that at Hughes Lake is a rather involved story. The argument may be summarized thus: the pink granite south of Arbour Lake contains phases lithologically very similar to the granite at Berge Lake and is in the same relationship to the extensive grey tonalite of the district. This pink granite body is, in other phases (Huet Lake), lithologically identical to a small granite body north of Chepil Lake and to dykes which cut the grey tonalite and its inclusions on the west side of Chepil Lake. A *single one* of these dykes contains rock essentially identical with the pink granite just described and also with the granite (32) beneath the Sickle unconformity at Hughes Lake, though these two types are not themselves notably similar. The variation, in both the dyke and at Hughes Lake, is probably due to contamination by wall-rocks. A detailed discussion follows:

East of Huet Lake is a fairly extensive area of pinkish alaskitic granite, which cuts the grey granodiorite. The sample which was taken to represent this granite is essentially identical in composition, texture and appearance with one from the granite body about ½ mile northwest of Chepil Lake. Both bodies are classed as type 34 (Appendix B). At the same time, no difference was recognized, in the field, between the granite of these occurrences and some of the pinkish granite dykes on the west side of Chepil Lake. But a *single one* of the dykes there contains phases apparently identical with both the granite above described and with the granitic rock which is overlain unconformably by the Sickle series on the western side of Hughes Lake. If these identifications are valid this, of course, makes the whole lot of pre-Sickle age.

The pinkish granite from east of Huet and Arbour lakes also has the same relation to the other pre-Sickle units as does the Berge Lake granite. Traversing southward from Arbour Lake along the meridian of 101° 45′ W, Allan found "a grey biotite hornblende gneissic granite . . . This rock seems to include a fine grained quartz diorite—may be alt. volc." After noting that the outcrop continued for 800 feet, Allan's note continues: "mostly grey gneissic granite, but considerable diorite, pink granite, dioritic alt. volcs." and adds the further information that the granite is chilled against the diorite. The distinction, in the latter part of the note, between "diorite" and "dioritic volcanics" leads me to conclude that he had found some criterion which allowed him to separate the two, and this is reinforced by the further bald statement regarding the age of the granite. This is the same sequence of volcanic rocks, diorite and grey "granite" found elsewhere in the area. Continuing, he described a large hill on which the "north slope is mainly pink gneissic. Top is mainly med. grained quartz diorite which is cut by the granite" [i.e. pink granite?].

The eastward extension into the Hughes Lake area, from Allan's outcrops considered above, is described in the notes of his assistant. He describes a grey hornblende granite with numerous small inclusions, which is evidently the same as the grey granite noted by Allan. His note continues "found o.c. of very pink biotite granite. This rock is quite fine grained and massive. At north end of o.c. the grey gneissoid granite comes in. No definite contact between the two types . . . more o.c. of both pink and grey granite . . . pink granite is becoming coarser grained." The sample of this pink granite is of type 33, i.e. lithologically very similar to the granite at Berge Lake.

Similar relations were found near the east shore of Arbour Lake, where the grey tonalite can be seen cutting the "greenstone" there. Both are cut by a dyke of the pink granite.

This argument is undoubtedly tenuous. Nevertheless, the evidence indicates the possibility, at least, of a pre-Sickle age for the granite and, except as noted below, no contrary evidence has been reported by the field workers. Consequently, a pre-Sickle age has been assigned to the Berge Lake granite on the accompanying maps. It is because of the nature of this argument that the relevant portions of the field reports have been quoted verbatim, so the reader may judge for himself the interpretation placed upon them.

The greatest doubt arises over the varieties numbered 34, 35, and 36. In composition, texture, and general appearance they resemble rather closely some rocks known to be post-Sickle: 35, for example, resembles the porphyritic granite which cuts the Sickle series, southeast of Beaucage Lake; 36 resembles the aplitic granite southwest of Finch Lake, which is post-Sickle; 34, has points of similarity with the Berge Lake granite, and is later than the granodiorite. But all three are present, apparently as inextricably mixed phases of a single large body, along the Hughes River south of Simpson Lake. It is thus possible, on the basis of lithology, that they are post-Sickle in age and it must be pointed out that, in the descriptions given in the appendix, units 34 and 36 could each contain a sample from a body known to be post-Sickle. On the other hand, a dyke which cuts the grey granodiorite at Chepil Lake is one of the samples of type 36, and a phase of this, from the same outcrop, is essentially identical with the pre-Sickle granite (32) from beneath the unconformity at Hughes Lake as was mentioned above. In this case, then, the indication is that 34, 35, and 36 are all variations of the same thing, and the whole of pre-Sickle age.

For the present, the more compelling evidence indicates a pre-Sickle age for these varieties, and they are so shown on the accompanying maps. It should be recognized, however, that there may well be some post-Sickle granite included. The more likely places for this to occur are: southwest of Cockeram Lake, at the outlet of the Keewatin River into Cockeram Lake, the small, dyke-like body west of Carr Lake, and the large area, mentioned above, along the Hughes River, south of Simpson Lake.

The rocks at two widely separated localities should, perhaps, be included with this map-unit, but it has seemed better to include them with Unit 11. In general, it may be said that type 33[1] is the main, or standard, variety for the Berge Lake granite, and it is the variety found at Berge Lake. There is a suggestion that it is also present in the vicinity of Strood Lake, as part of the "white quartz-rich soda granite or leucotonalite" described by Stanton[2]. The larger part of this body, however, is lithologically identical, or very similar, to the porphyritic "granite" east of Goldsand Lake. There is a possibility, then, that the granite at Berge Lake, the leucotonalite at Strood Lake, and the "granite" east of Goldsand Lake are all correlative. The preponderance of the evidence at Goldsand Lake indicates that the "granite" there is a phase of the tonalite—Unit 11 of the accompanying maps. Accordingly, the rocks at both Strood and Goldsand lakes have been so shown, but differentiated as a sub-unit because of the distinctly different lithology. The single outcrop, near Strood Lake, which appears to be more exactly equivalent to the Berge Lake granite, has not been distinguished on the map. Further, the lithology of the major part of the body at Strood Lake appears to be more closely related to Unit 11 than to the Berge Lake granite.

PETROGRAPHY

The Berge Lake granite has a characteristic pink to buff colour and is fine to medium grained. The pink colour is due to pink or reddish feldspar and to hematite staining. Quartz forms up to half the rock and biotite is usually less than 10 per cent. Feldspars are microcline and soda plagioclase; the proportions vary considerably. Alteration is not ordinarily a prominent feature. Hornblende is not normally present.

In the outcrop this rock is almost invariably described as pinkish grey, pink, or reddish grey; it is usually medium to coarse grained and low in dark minerals. In hand specimen the characteristic feature of this unit is the definite pinkish or reddish cast to the surface, which is especially noticeable when side by side with the widespread grey types of the district. The fresh surface is buff to pink in colour; in some cases the rock has a definitely reddish feldspar. The feldspar content, as estimated, is 30 to 70 per cent, in rounded or irregular grains as well as good prisms, up to 0.2 inch diameter; some of it shows good polysynthetic twinning. It is not always possible to tell whether two feldspars are present or not. In some cases a pink or reddish feldspar is distinguishable from the grey; in others the red colour appears to be due to hematite staining. Quartz is water-clear, grey, or bluish and opalescent, and forms about 35 to 50 per cent of the rock. Biotite is the usual dark mineral and is rarely over 10 per cent. In consequence, the weathered surface of the outcrop usually gives the appearance of about equal parts of bluish grey quartz and pinkish white or white feldspar.

The rock immediately beneath the Sickle conglomerate at Hughes Lake is much redder and darker than typical. This colour is probably due to some absorption of older basic rocks, which are present as abundant xenoliths. For a description of this rock see Appendix B, where it is described in detail as type 32.

A thin section of this rock, from the south end of Berge Lake, is medium grained with massive granitic texture, and composed of 19 per cent microcline, 48 per cent albite, 28 per cent quartz and 4 per cent biotite, by Rosiwal analysis. Accessory minerals are zircon, titanite and apatite, with chlorite, epidote and iron oxide as the alteration products. "The feldspars show various degrees of alteration, the microcline being the least altered. Some crystals are entirely altered to a dusty mass of sericite, carbonate (probably) and scattered grains of epidote and zoisite. Some of the larger irregular grains show a shadowy rectangular concentric zoning, with the alteration products concentrated on certain zones. Some untwinned, unzoned, partially altered grains were determined as albite. Edges of some of the plagioclase crystals show vermicular intergrowth with quartz. Biotite is a green

[1]See Appendix B.

[2]Stanton, M. S.: *Man. Mines Br. Prelim. Report 48-4, p. 26.*

variety with associated zircon crystals surrounded by pleochroic haloes. There is some titanite and apatite". This might be considered as representing the typical "granite" of phase 33. In Johannsen's classification this rock is a leuco-sodaclase granodiorite.

A sample collected by Allan from a dyke from the northwest side of Chepil Lake, (see above p. 71) contains 25 per cent quartz, 50 per cent orthoclase and microcline, 16 per cent oligoclase ($Ab_{80}An_{20}$), 5 per cent biotite, and minor amounts of zircon, sphene, sericite, kaolin and magnetite. This is a granite, according to Johannsen's classification. It is one of these dykes which changes so that, in part, it resembles the pre-Sickle granite beneath the unconformity at Hughes Lake.

CHAPTER V

SICKLE SERIES

The Sickle series was named by Norman[1], in 1933, from the occurrences at Sickle Lake. On the geological maps based on the work of Norman, Henderson and Downie (Maps Nos. 343A, 344A of the Geological Survey) the Sickle series is shown in almost the same distribution as on the present map.

DISTRIBUTION AND TOPOGRAPHIC EXPRESSION

The area underlain by Sickle sediments forms two large lobes; one extends south from Sickle Lake to Granville Lake; the other is very irregular and extends westward to Tod Lake. In the Sickle series, south of Counsell Lake and Wilmot Lake, there is a large granite area, with which high grade gneisses are associated. The type locality, and some of the freshest material, is at Sickle Lake and Chicken Lake; the rocks south of Tod Lake are also very fresh in appearance. In the course of the present work, the Sickle series has not been followed south of Beaucage Lake, where the rocks grade into Kisseynew-type gneisses, but Norman suggested that the conglomerate is represented on Granville Lake, some 12 miles to the southwest. He described a biotite gneiss, derived from a fragmental rock, which he implied is very similar to some phases of the conglomerate at Lasthope Lake. Where the writer saw it at Pickerel Narrows, this rock certainly resembles the more strongly metamorphosed phases of the conglomerate.

An isolated synclinal fold of the Sickle series forms the basin of Hughes Lake, and there are a few isolated outcrops on Keewatin River near its junction with the drainage from Cartwright Lake.

About a mile north of Minton Lake, there is an area of fragmental material which might possibly belong to the Sickle series. Its nature and position are discussed in detail above (page 36).

The small exposure of sheared conglomerate, shown on Allan's preliminary map, on a peninsula near the centre of Cartwright Lake, could not be found.

In general, the Sickle series supports a rounded rolling topography rather higher than that underlain by the Wasekwan and granitic rocks. The Sickle conglomerate tends to form ridges and some of the highest ridges in the eastern part of the district are of this rock. The rocks of the Sickle series are relatively fresh in such places as Sickle and Lasthope lakes, and to the south of them; at Tod Lake, Eager Lake and north to Hassett Lake; and, in some measure, near McGavock Lake. At these places, the structural control on the topography is especially notable, due, in part, to the tendency for the rocks to break along bedding planes and be plucked or gouged out by the ice movement. Where the folding and metamorphism have been most intense the rock became more uniformly hard; the greatest relief in the district—south of Eager Lake—is on strongly metamorphosed and folded rocks of the Sickle series (Kisseynew-type gneisses). Detailed control of topography is not as obvious there, but is shown in such features as minor ridges and changes of slopes upon the larger features.

STRATIGRAPHIC POSITION

The Sickle series rests unconformably upon the Wasekwan series and the pre-Sickle intrusive group, though it has not been found in contact with all members of either. It is invaded by a

[1]Norman, G. W. H.: Granville Lake District, *Geol. Surv., Canada, Sum. Rept., 1933, pt. C., p. 30C.*

younger group of intrusive rocks, of which the Black Trout Diorite is the oldest actually found cutting the Sickle series. The Black Trout Diorite was followed by a pink to red porphyritic microcline granite, and probably also by a grey tonalite and other granitic phases.

The unconformity of the Sickle series upon the "pre-Sickle" volcanic rocks was recognized by Norman, and the Sickle was so shown in his 1933 summary report. Norman's primary evidence[1] was an exposure of the contact on the east side of Black Trout Lake, which is apparently the same exposure shown in Figure 1A of Bateman's 1945 paper. This shows the folded Wasekwan schists truncated by the Sickle conglomerate. A secondary consideration, with Norman, was the broad structural relations; the synclinal basin of the Sickle series north of Chicken Lake lies athwart the regional trend of the Wasekwan. Bateman, in 1941, concluded that the Sickle series was unconformable on the argument that as much as 12,000 feet of the Wasekwan section is missing from beneath the Sickle on the north side of Lasthope Lake.

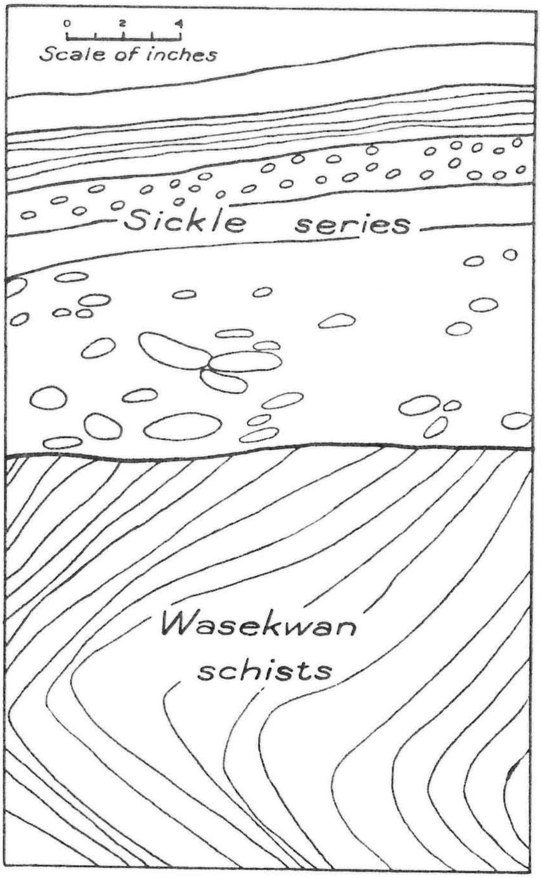

Figure 13 — Unconformity at the base of the Sickle Series. This is Figure 1A of Bateman's 1945 paper, reproduced by courtesy of the Geological Survey of Canada.

At Lasthope Lake an apparent angular discordance suggests an unconformity. To the north of the lake, on the Oro, Smoke, Nencie and other claims, the Wasekwan lavas and the interbedded sediments trend southeastward. This is the type Wasekwan section, mapped by Bateman in 1941. Somewhere in the north part of

[1]Norman, *op. cit., p. 32C.*

Lasthope Lake, or just to the north of it, is the bottom contact of the Sickle series, trending westward from the north end of Sickle Lake. The general direction of Sickle and Wasekwan is therefore strongly discordant and, in the stretch between Lasthope and Sickle lakes, the Sickle must be running almost at right angles to the type Wasekwan to the north. Unfortunately, the contact, in this critical area, lies somewhere under the lake or beneath about a mile of sand ridges and muskeg to the north, and there are no outcrops.

Officers of the Mines Branch working in the district all accepted the unconformity of the Sickle series, but their writings express varying degrees of confidence. Fawley[1], working in the type locality, showed the unconformity on the basis of the presence, in the conglomerate, of pebbles of iron formation "identical in character to some of the iron-formation beds in the Wasekwan series", and because "even where the Wasekwan and Sickle series are in contact with each other, as to the southeast of Black Trout Lake, the Wasekwan sediments have undergone a higher grade of metamorphism than the Sickle sediments". He did point out, however, that there had been movement at the base of the Sickle series in most places. Allan[2], summarizing the evidence at Hughes Lake, wrote: "The relationship is not clear, but there is a suggestion that the conglomerate is lying unconformably on the older rocks. At the north end of Hughes Lake an unconformity is indicated as the Sickle conglomerate is striking east-west and the Wasekwan volcanics are striking north-south."

None of these arguments is really definitive; the most compelling are those of Norman (Bateman's figure 1a), and Fawley (iron-formation pebbles). The missing 12,000 foot section of Wasekwan is conclusive, if it can be shown it is not faulted out, but the contact is not exposed.

In the present work, some time was spent searching for the exposures seen by Norman. In most places along the east side of Black Trout Lake there is a shear zone at the base of the conglomerate. Though the conglomerate strikes north, and the adjacent gabbro has an easterly foliation, nothing is proven so long as there has been movement between. Near the south end of Black Trout Lake, opposite the shaft on the former Hope claims, the conglomerate is separated from the underlying "granite" by a zone of grit (very fine pebbles). No faulting was recognized, but the exposures are not good and the evidence is not conclusive. The "granite", the grit, and the matrix of the conglomerate are very similar. It may be that we have here a "graded unconformity"[3], with the sediments derived from the "granite".

The pebbles of chert, noted by Fawley, would be definitive if they were unique or characteristic, but most iron-formations are remarkably similar. It is strongly suggestive, however, because no iron-formation beds are recognized in the Sickle series.

The presence of granite pebbles in the Sickle conglomerate proves, of course, that there was a source region, eroded to sufficient depth to expose a granite, which was supplying pebbles at the time the basal conglomerate was being deposited. By inference from this, a period of erosion paralleled the deposition of the Sickle and might, to some extent, have preceded it at any specific place. A further inference is that there was a pre-Sickle granite which invaded a still more ancient terrain. Though the significance of the granite pebbles led to efforts to identify the pre-Sickle granite in place, the results were unsatisfactory. Allan was inclined to agree with Norman and assigned a pre-Sickle age to the granite in contact with the Sickle at Hughes Lake but did not consider the relationship as proven. Others

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[1]Fawley, A. P.: Geology of the Sickle Lake Area; *Man. Mines Branch, Rept. 48-6, p. 10.*

[2]Allan, J. D.: The Lynn Lake Nickel Area, Manitoba, *Trans. C.I.M.M., Vol. LIII, 1950, pp. 357-362.*

[3]Pettijohn, F. J.: Sedimentary Rocks, 2nd Ed., 1957, p. 35.

working in the district found no evidence one way or the other and included all granitic rocks in a group, some members of which could be shown to be indubitably of post-Sickle age. Caldwell[1] attempted to correlate pebbles from the conglomerate with granites exposed in the area, on the basis of heavy minerals—principally zircons. His results, in his own verbal summary: "Didn't prove much of anything."

The possible presence of a pre-Sickle granite proves nothing about the age relations between Sickle and Wasekwan rocks. Unless the pre-Sickle granite could be recognized in place, and its relations with the Wasekwan examined, the relative ages of Sickle and granite (or granite pebbles) had no bearing on the relative positions of the Sickle and Wasekwan in the sequence of events. Knowing, however, that there was a pre-Sickle granite and older rock sequence, and with the further suggestion based on metamorphic grade, it was natural to assign different ages, with the Sickle the younger, especially in view of what Norman and Allan had concluded at Hughes Lake.

It can be seen, therefore, that there was room for doubt as to the reality of a Sickle-Wasekwan unconformity, and not all geologists subscribe to the idea. G. D. Ruttan[2], Chief Geologist for Sherritt Gordon, for example, suggested that "there was little time lapse between the deposition of the two series. In the contact area south of Lynn Lake, volcanics and sediments are interbedded to an extent that it is almost impossible to draw a definite line separating the two series."

Ruttan's paper was delivered to the annual general meeting of the Canadian Institute of Mining and Metallurgy in April, 1955. Subsequently, in conversation, Ruttan amplified this suggestion further and expressed his "suspicion" that the Sickle is not only not unconformable upon the Wasekwan but that they are the same sequence; furthermore, the Sickle, so-called, is beneath—and so older than—the Wasekwan. This idea is based upon the consistent northerly dip of both groups, especially to the south of Frances and Counsell lakes. If the groups are, indeed, the same, then the Sickle dips beneath the Wasekwan and would accordingly be the older. The freshness of the Sickle he ascribed, as indicated above, to variations in metamorphic grade over the district. Further, the presence of a conglomerate, possibly interbedded with the Wasekwan rocks, at Ralph Lake, points in the same direction, as does the lack of a good definite unconformable contact or other incontrovertible evidence. The reference to interbedded volcanic rocks and sediments, as quoted above, apparently is to Ruttan's discovery of tuffs, and possibly flows, in rocks mapped by Mines Branch geologists as Sickle. This occurrence is on the "Skid" group of claims on the south side of Boiley Lake, which is adjacent to the railway near Mile 170.

The question of the Skid group will be reviewed below, but this latter point, regarding the presence or absence of volcanic rocks interbedded in the Sickle, is considered to be a serious one from the point of view of rock subdivision and mapping units. On the other hand, it is irrelevant to the question of the stratigraphic position of the Sickle series, because the presence or absence of volcanic rocks from a series has no direct relation to the time of its deposition. It should be pointed out, however, that the presence of lavas has a bearing on the map-units as shown on the maps published by this Branch.

In the type Sickle, as defined by Norman at Sickle Lake, there are no volcanic rocks. Although it was realized that the Sickle sediments had been metamorphosed to high-grade rocks elsewhere in the district,—e.g. McGavock Lake,—no volcanic rocks had been recognized. There are two possible exceptions to this statement: Stanton mapped bands of plagioclase amphibolite, south of Eager Lake, which might possibly have been volcanic rocks, and Downie, in 1935, had described a

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[1]Caldwell, C. K.: A study of the Sickle Conglomerate with Special Reference to the Zircon Content. *Unpubl. M.Sc. Thesis, Univ. of Manitoba, May, 1950.*

[2]Ruttan, G. D.: Geology of Lynn Lake, *Trans. C.I.M.M., Vol. LVIII, p. 193, 1955.*

complex of lavas and conglomerate, at the base of the Sickle on the northwest side of Tod Lake. There is now evidence to show that the conglomerate and lavas are not interbedded (see Map No. 9) and it is possible, if not probable, that Stanton's plagioclase amphibolites are not derived from volcanic rocks.

The Mines Branch geologists had used the presence of lavas as one of their criteria in differentiating between Sickle and Wasekwan, whether such was explicitly stated or otherwise. Sediments by themselves might be Sickle or Wasekwan; sediments interbedded with flows were Wasekwan.

EVIDENCE OF UNCONFORMITY

More definite evidence of unconformity has now been found. The relations can be seen at three places: At Pool Lake, pebbles in the conglomerate were derived from the adjacent quartz diorite which, in turn, is probably of post-Wasekwan age. At Hughes Lake, the conglomerate is in contact with a granite containing mafic inclusions, which are truncated by the contact. At Tod Lake, a characteristic and unusual rock in the Wasekwan series contributed a pebble to the conglomerate of the Sickle series. There are other evidences for unconformity within the district, but they are less definite and, as individual cases, subject to other interpretations.

Pool Lake

On the north side of the large area of conglomerate at Pool Lake, the contact with the quartz diorite to the north is visible on the top of a low hill. At this point the quartz diorite, near the contact, is characterized by the presence of bluish to opalescent quartz phenocrysts. The conglomerate carries pebbles of this rock in addition to smaller bluish opalescent quartz grains and the usual assortment of other pebble types. There is no sign whatever of alteration of the conglomerate at the contact, which is sharp and distinct. The relations are shown by the accompanying notebook sketch (Fig. 14). The quartz diorite, a few hundred feet north, probably cuts volcanic rocks which have been traced eastward with reasonable continuity to the type locality of the Wasekwan at Franklin Lake. I can see no way of interpreting this evidence except to conclude that the diorite is post-Wasekwan and earlier than the Sickle, and that it provided pebbles to the conglomerate at the end of the interval which exposed the quartz diorite to erosion. Here, then, there is not only strong evidence for an unconformity, but at least one phase of the pre-Sickle intrusion in place. The position of this exposure is 540 feet on bearing 346° true from the eastern end of the small lake west of Pool Lake, and is on the east side of the crest of the hill.

Hughes Lake

The relationships between granite and conglomerate at the Hughes Lake locality are not as clear-cut and definite as those just described, though there seems to be no reasonable doubt. During the present work the contact was re-examined. It is visible on the west side of Hughes Lake just south of where the Hughes River enters the lake. This is apparently the same ground as that examined by Henderson and by Allan, but it is probable that more time was available than either of the earlier investigators could spare for this feature. An attempt was made to expose as much of the contact as possible, especially where there seemed a chance of finding critical information.

The granite to the west of the contact contains numerous large and small inclusions of a dark hornblendic material probably derived from volcanic rocks. These inclusions are cut by dykes and stringers of the granite. Neither these stringers, nor any trace of the altered volcanic rocks, is found in the conglomerate to the east of the contact, though some quartz is present. The conglomerate shows no sign of alteration or metamorphism at the contact.

The critical exposure is found near the crest of the ridge on the west side of the lake. At this point, an inclusion in the granite wedges out against the conglomerate contact, and is apparently truncated by it (Fig. 15). There is no sign of schist or

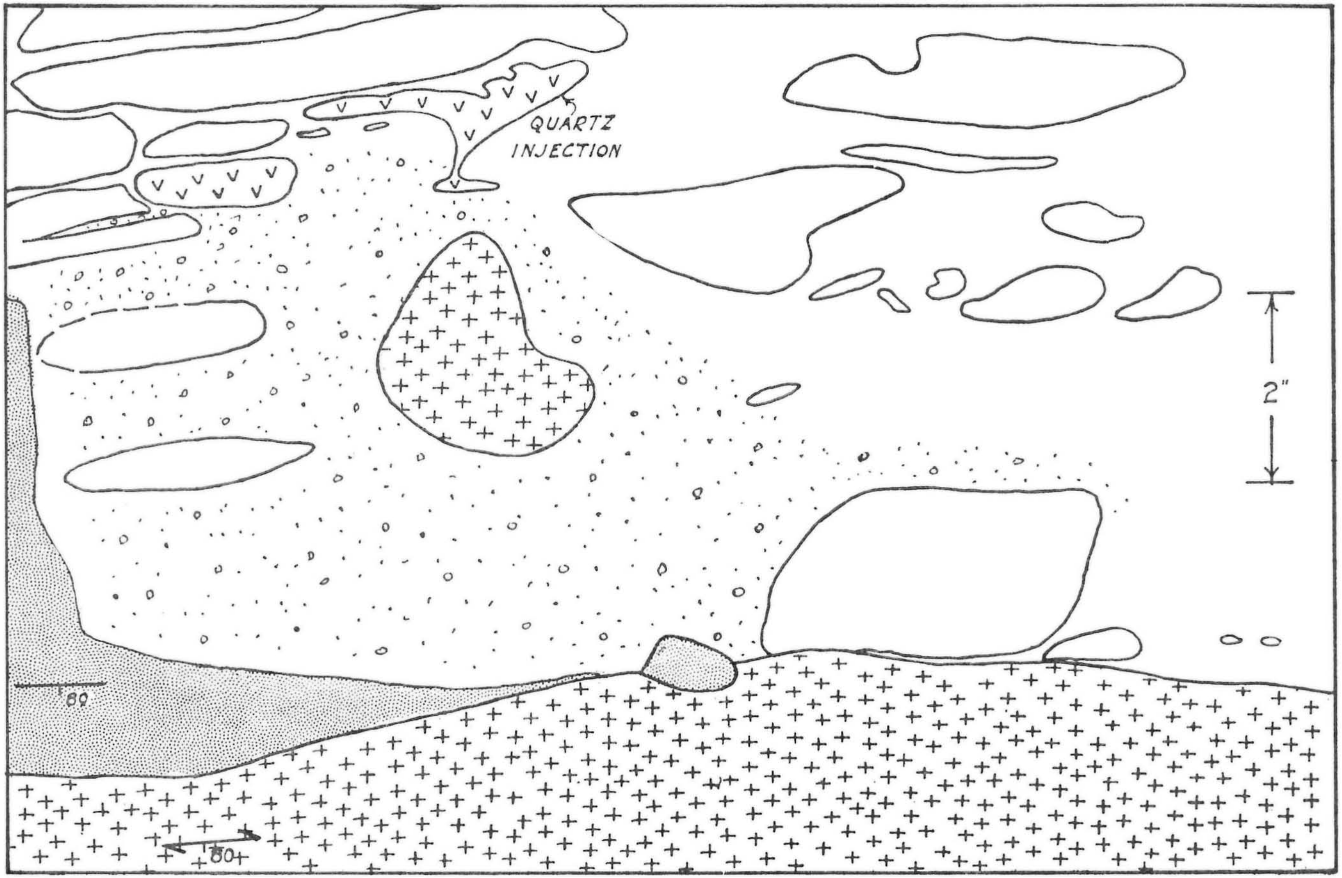
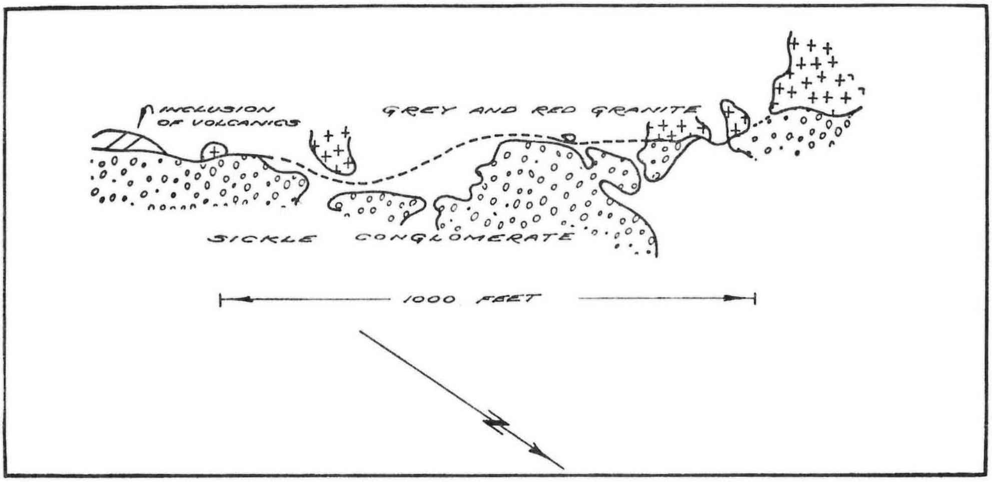
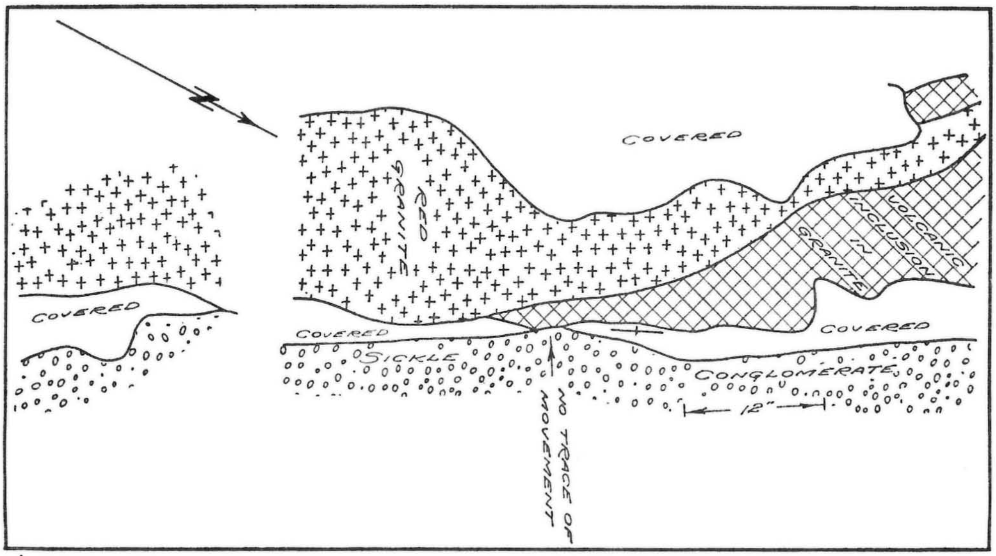


Figure 14 — Notebook sketch of unconformity at base of Sickle series. Near Pool Lake.

other evidence of faulting at the contact, but it should be noted that the actual contact is obscured by a dirt-filled hollow about one inch wide. It was impossible to clean this out with the equipment available. If, as seems very probable, there has been no faulting at the contact, then the only other reasonable explanation of the truncation of the basic inclusion is that it was first eroded and later covered by the conglomerate. There is no sign of weathering of the granite at the contact, and perhaps none should be expected; any clays or oxides which might have been present would presumably have been re-combined and now appear as micas or



a.



b.

Figure 15 — A. Compass and pace map of part of base of Sickle series. Outcrops only are shown. Bedding tends to be more irregular and sorting poorer, in the "hollows" of the granite surface. This is on the ridge just south of "Herman's cabin" at the northwest corner of Hughes Lake.

B. Unconformity at the base of the Sickle series, Hughes Lake. An inclusion of volcanic rocks in the granite is truncated by the contact, with no sign of movement between it and the conglomerate.

other low grade minerals. It is conceivable that the inclusion was originally wedge-shaped, and that the truncation is only apparent. While this is a possibility, it requires the chance conjunction of the contact of the conglomerate and the side of an inclusion in an invading granite magma. The probability of such an occurrence must surely be of a very low order.

Tod Lake

The third place where the unconformity can be seen is on the northwest side of Tod Lake. At this place is the complex band of lavas and conglomerate mentioned by Downie, on the basis of reconnaissance work, as forming part of the base of the Sickle series. In the investigation of possible volcanic rocks in the series, this band was re-mapped in 1955, on a scale of 1,000 feet to the inch (Map No. 9).

The rocks consist of Sickle conglomerate and Wasekwan amphibolite with some quartz-biotite-feldspar rock ("greywacke"). There is no doubt that the bands of amphibolite represent lavas, for pillow structures are present in several places, though no good criteria of flow tops were recognized. The conglomerate is quite typical in some places; in others it has been somewhat altered. In general, the pebbles are rather smaller than usual but, on appearance, there is no doubt that it is Sickle and, further, it is the extension along strike of the conglomerate followed reasonably continuously across the whole district.

A very unusual rock is visible on the south side of an outcrop of "greywacke", west of Laurie River and in the northern of the two volcanic bands. Only a small bit is exposed: about 5 feet long and 2 feet thick. The rock consists of large prismatic phenocrysts (which look like feldspar, but are apparently made up of quartz and feldspar) rectangular to square in cross-section, about ⅛ inch to ¼ inch across and up to 1 inch long, in a basic matrix resembling the lavas. The whole might be described as a diabase, with ophitic texture on a gigantic scale. Only one contact is visible. Whether it is a dyke cutting the greywacke or a very unusual type of flow, is not known.

An outcrop of conglomerate some distance to the west, and near the south shore of the small lake there, shows a large well-rounded pebble of this same curious and characteristic rock. The only way that this could have formed is by the erosion of the material seen to the east. For the moment, it is irrelevant whether this peculiar rock is a lava or dyke, for it is either a part of, or younger than, the Wasekwan lavas, and it is definitely older than the Sickle conglomerate to which it contributed pebbles.

So far as known, this characteristic rock has not been recognized elsewhere in the district. There is a very coarse-grained granite with a somewhat similar characteristic development of feldspar. It is widespread as float but has not been recognized in place.

On the northwest shore of Tod Lake there is a strong angular discordance between the Sickle arkose and the foliation in the underlying Wasekwan greenstone. Details are shown, in the small inset sketch, on Map No. 9, accompanying this report. This has also been interpreted as proof of unconformity.

Other Indications

There are other evidences for unconformity within the district, but they are less definite and, as individual cases, subject to other interpretation.

Fawley, in 1948, pointed out the discrepancy in attitude between the base of the Sickle and the foliation in the hornblende gabbro to the east of it at Sickle and Black Trout lakes. This hinges on the age of the gabbro, and the cause of the foliation in it. It is at least possible that an earlier conglomerate determined the boundary of the gabbro, and that the foliation might be a primary feature.

On the east side of Beaucage Lake there is an angular discrepancy of approximately thirty degrees between the bedding in the Sickle series and that of the

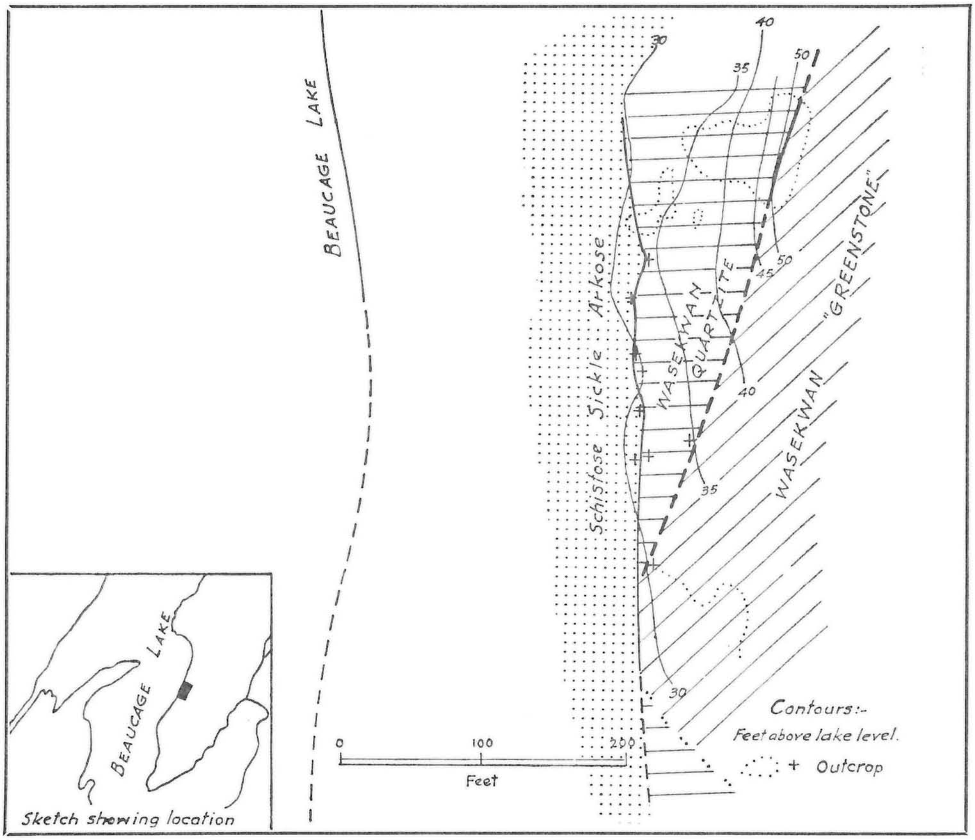


Figure 16 — Possible unconformity at Beaucage Lake. The bedding of the Wasekwan is truncated by the schistose Sickle rocks. There may have been movement at the contact.

Wasekwan rocks to the east (Fig. 16). But, at the contact, the Sickle shows a strong development of muscovite and is quite schistose; there is a strong possibility that this represents movement at the contact. Thus an angular discordance might be produced by means other than folding and subsequent deposition.

Finally, on the east side of Sickle Lake near the north end, just east of the mouth of a creek coming in from the north, there is evidence of relief on the conglomerate contact. The actual contact at the bottom of the conglomerate is not well exposed. However, it was possible, by stripping back the moss at intervals of 5 to 10 feet, to follow the contact with certainty. It runs northward straight and smooth, with no offset greater than a foot, for a hundred feet or more. Then, suddenly, it is offset at least 30 feet east-southeast, after which it continues northward as before. At the point where the change in direction occurs, the outcrop is bare, except for sparse lichens, and the contact is sharp. There is no evidence of movement. Among the large conglomerate pebbles, on the east side of this reentrant (i.e. towards the bottom of the conglomerate) there is a boulder about two feet by three feet as exposed on the surface. The boulder appears to be identical with the granitic material immediately beneath the conglomerate. (See Fig. 17.)

It is possible that the granite is intrusive (though no intrusive relations were seen) and that what appears to be a boulder is actually a section of a granitic dyke connected beneath the surface to the parent granite only a few feet away. It seems more likely and reasonable that the boulder is truly that, and that the abrupt

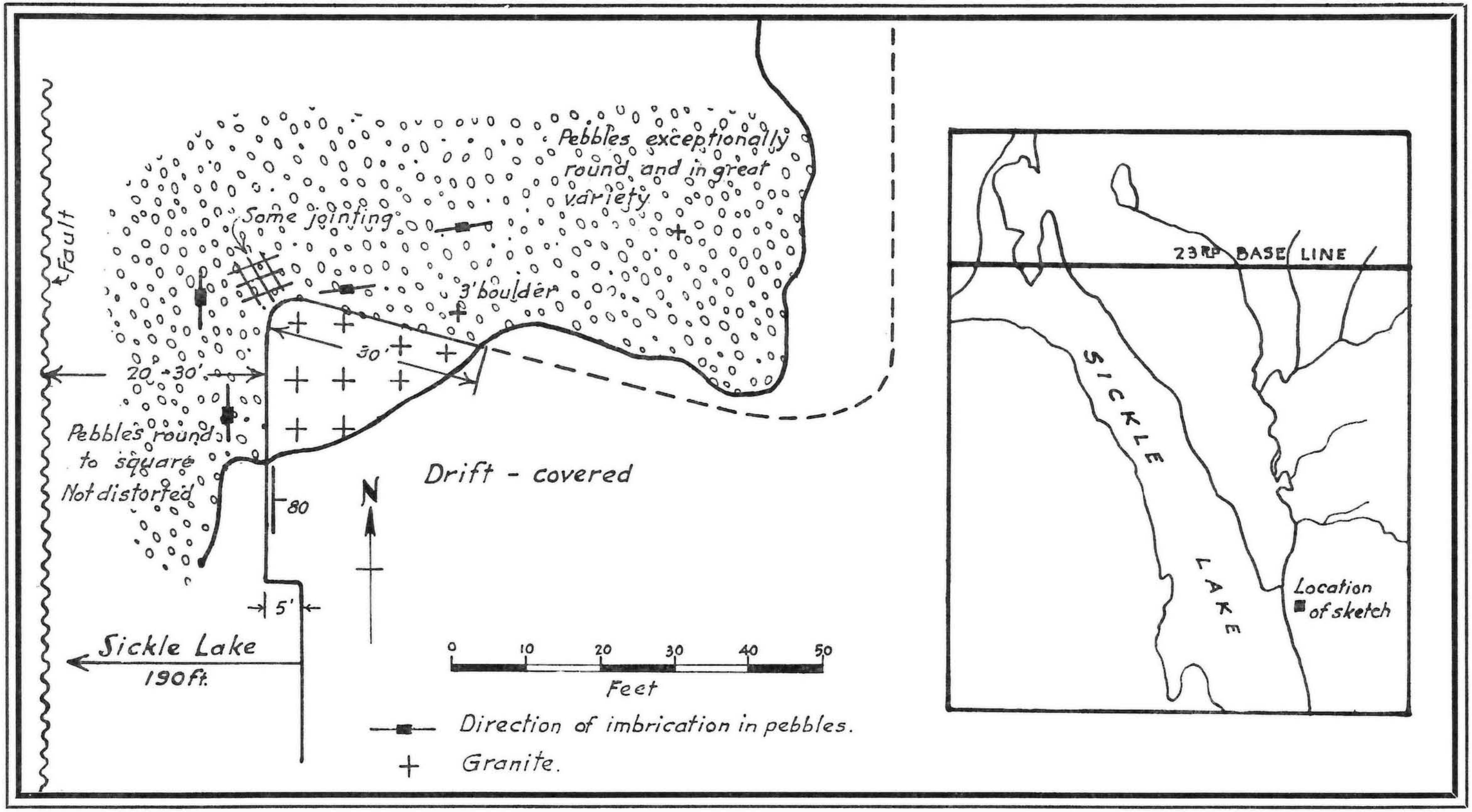


Figure 17 — Possible unconformity of Sickle series at Sickle Lake. A boulder in the conglomerate appears identical with the granitic rock adjacent.

displacement of the contact represents a cliff about thirty feet high, from which the boulder was derived. The conglomerate beds are now nearly vertical, so that the present plan view is an original vertical section. If such is the case the "granite" here is also pre-Sickle in age. On the other hand, a few feet beneath the conglomerate there are two inclusions within the granite and the inclusions appear to be conglomerate. This would, of course, mean that the granite is the younger.

In summary then, the Sickle series is resting unconformably upon a granitic to dioritic intrusion which separates it from the earlier Wasekwan series of lavas and interbedded sediments, mainly greywackes and quartzites. With the two possible exceptions—the amphibolites south of Eager Lake, and the Skid group at Boiley Lake—no volcanic rocks are now known in the Sickle series; in both the exceptional cases other interpretations are possible. The origin of the amphibolites at Eager Lake is discussed below, with the Kisseynew gneisses; the case of the Skid group at Boiley Lake, is discussed under the structure of the Sickle series. Briefly, the rocks on the Skid group are considered to be Wasekwan, and to have been exposed by a combination of post-Sickle folding and faulting. Those at Eager Lake are thought to be metamorphosed limy sediments.

PETROGRAPHY

The Sickle series is composed of metamorphic rocks, as are all other rocks of the district. The lowest grade of metamorphism is equivalent to the biotite zone; at the other extreme, large areas are within the sillimanite zone. Original minerals and the smaller textural features have therefore been obliterated everywhere, and identification of the original rock type depends upon inference based on present mineralogy and chemical composition.

The series is composed of a conglomerate band at, and near, the base, overlain by rocks which appear to have been arkoses, impure sandstones (subarkoses?), greywackes, and shales. Lime carbonate rocks do not occur as such, but are inferred from the presence of amphibolite which is probably the metamorphic equivalent of calcareous shales and marls.

The major portion of the series was probably arkose or a sandy mud. Slate appears as very thin beds in a few places, but is a very small part of the total volume. The amphibolite occurs only in a restricted area south of Eager Lake. The details of mineralogy are given below (p. 90) for the least altered rocks. The most siliceous rock suggests that the original sediment may have been arkosic. The large amount of feldspar, hornblende and biotite in the other rocks suggests the original material may have been a greywacke or a sandy mud. The only available chemical analysis is very similar to a greywacke. However, none of the textural features which have been preserved are suggestive of greywacke: graded bedding is not common; crossbedding, ripple mark, and scour and fill structures are characteristic, and abundant; rhythmic alternation with shales appears to be absent.

CONGLOMERATE

The unaltered conglomerate is composed of 10 to 65 per cent pebbles in a quartz-feldspar-mica matrix. Pebbles average about 1 to 3 inches in diameter, but sizes up to large boulders are present. The pebble materials are quartzite, greywacke, arkose, chert, "greenstone", feldspar, vein quartz, schist and "granite". The conglomerate grades upward into about 1,000 feet of arkose in which there are numerous conglomerate lenses. The conglomerate is not always at the base of the series.

The conglomerate of the Sickle series is composed of 10 to 65 per cent pebbles in a quartz-feldspar-mica matrix and there are lenticular interbands of pebble-free material. Towards the top of the member, the arkosic bands become more abundant and the conglomerate grades into the overlying arkose. The change is abrupt enough that there is ordinarily no problem, in the field, in deciding whether an outcrop belongs to the conglomerate or the overlying arkose. For a thickness of roughly a thousand feet above the conglomerate there are lenticular bands of conglomerate scattered through the arkose. These thin lenses of conglomerate are, in all cases seen, only a few feet thick and, in most cases, the pebble-bearing band can be seen to lens out within the outcrop. They are often less than 20 feet along the length. This conglomerate undoubtedly represents a period of shallow water deposition, for the arkose in the vicinity shows abundant excellent large-scale crossbedding and contortion. One can look at the bedding of an outcrop and almost see the swirling currents.

In his preliminary report, Fawley[1] states that pebble beds were found 2,000 to 3,000 feet above the base. This probably refers to lenticular conglomerate bands

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[1]Fawley, A. P.: *Man. Mines Br. Rept. 48-6, p. 11, and Publ. 49-5, p. 12.*

shown on his maps at Lasthope Lake. These are the same bands described in the preceding paragraph. Conglomerate is present where shown on Fawley's maps, but its importance is greatly over-emphasized on his map by the draughting requirements. Re-examination of the structure at Lasthope Lake has shown these to be just above the basal conglomerate, but repetition by folding has exposed them so they are apparently higher in the section. (See under Structure at Willis Lake.)

The conglomerate is not always the basal member. At Tod Lake, Pyta Lake, Boiley Lake and a few other places, arkose and quartzite are found beneath it.

The pebbles in the conglomerate show a great range of sizes, and sorting varies from fair to very poor. The common pebble size is about 1 inch to 3 inches in diameter, with a fair degree of sorting and, often, quite close packing. Certain places have predominantly large pebbles, with large numbers of smaller ones fitted into the interstices. Usually large numbers of pebbles mean large pebbles but there are many exceptions. On the exposed surface, the pebbles are usually elliptical; quartz is usually better rounded than other materials. In some places, movement has aligned lenticular or ellipsoidal pebbles so the rock now has a distinct foliation. Even where fresh, this is a characteristic feature of the outcrop, though severe deformation, of course, makes it very apparent.

This alignment has been ascribed to stretching of the pebbles, and undoubtedly such has occurred to some extent. But, after examining the conglomerate at many places in the area, the writer is convinced that this feature has been very much over-emphasized, except in the cases of extreme deformation as, for example, adjacent to a fault. The pebbles are elongated and parallel, when seen on a vertical face, but in places pebbles of bedded rocks are found with bedding well preserved. Numerous others are round, and where the length-width ratios are large the pebbles are of such materials as chert, quartzite, and greywacke which were originally bedded. An attempt to measure the plunge of the long axes of "stretched" pebbles, at Black Trout Lake, speedily showed they were in diverse orientations.

The pebbles recognized in an area a few feet square at the north end of Sickle Lake, include quartzite, greywacke, arkose, chert, greenstone, feldspar, schist, "granite", and rhyolite. This includes most of the common pebble types. There are very few dark pebbles, and the outcrops are usually light in colour. Some pebble types—e.g. quartzite and granite,—appear in various colours, and the outcrop frequently has a characteristic reddish-green cast due to pink and brick-red pebbles.

The matrix is usually dark grey, fine grained, and composed of quartz, muscovite, biotite and some feldspar. There is some recrystallization, in that individual clastic grains are seldom recognized even where the conglomerate is fresh. Where strongly sheared the matrix is reduced to a mica schist.

Alteration of the Conglomerate

The conglomerate is strongly altered near the south side of Lasthope Lake. The alteration epitomizes the development of metamorphic minerals in the Sickle series throughout the district. Adjacent to a zone of movement there is some linearity of the pebbles of the conglomerate. As the adjacent, and later, tonalite is approached first muscovite and then muscovite and biotite are found in the matrix and in the pebbles. Still closer to the tonalite, hornblende is developed and, finally, a dark rock resembling the Wasekwan amphibolite is found. In this the excess silica appears as quartz stringers. Pebbles of quartz are recognizable where hornblende is found but all other pebble materials are recrystallized and incorporated into the hornblende-bearing rock.

Severe deformation of the conglomerate, possibly with some additional thermal effects, is shown on a very informative outcrop on the south side of Lasthope Lake. This is just opposite the island in the southeast part of the lake. South from the shore, the conglomerate is fairly normal in appearance, though pebbles other than quartz tend to be a little more elongated than is usual. Two hundred feet from the shore the pebbles are thin (¼ inch to ¾ inch) and elongated, and a plucked joint face shows a marked linearity due to the elongate pebbles. The pebbles are clearly and distinctly recognizable as such.

The first noticeable change is the development of muscovite in the matrix, immediately adjacent to the pebbles, and the appearance of a foliation in the matrix. Within a few feet, muscovite is visible in pebbles of suitable composition, which are a little flatter and more closely packed than usual. Mica is especially abundant in the arkose pebbles and a strong foliation is developed, which may counterfeit bedding. At 380 feet from the shore, the margins of the pebbles lose their identity and become vague. Muscovite flakes were seen growing across the contact between arkose pebbles and matrix, and a small pebble was noted which had been bent into a tiny dragfold. Here there is certainly no argument about deformation of pebbles!

The increase in size of muscovite is accompanied by the more prominent appearance of biotite, but the muscovite appears (and reaches appreciable size) nearer to the lake than does the biotite. (This is also true about ½ mile to the southeast.) At the stage where biotite is prominent (540 feet from shore) many pebbles are still clearly recognizable, but the "matrix" contains numerous lenticular streaks of quartz, feldspar, biotite, or muscovite and biotite, which appear to be the remnants of the more readily metamorphosed pebbles. The biotite-muscovite schist of the matrix surrounds the quartz-feldspar lenses (pl. III, B). A further 100 feet from shore, the lenticular streaks are increasingly common and the quartz pebbles are more lenticular.

In the next 200 feet there are no outcrops but, when next seen, the matrix is altered to a hornblende-bearing rock of siliceous appearance, and the outcrop has a dark colour, like some Wasekwan sediments, though pebbles are still recognizable. After a further 10 feet hornblende is prominent in the pebbles.

Then, in a further 12 feet of continuous and complete exposure, the rock grades from a hornblende-bearing rock with elongated quartz-hornblende pebbles, to a dark hornblende amphibolite without recognizable pebbles, but in which the excess silica appears as quartz stringers and veinlets. Across the exposure can be seen the complete gradation from pebbles 1⅛ inches wide and 12 inches long to those which appear to be stringers. The process appears to be one of drawing out the pebbles. The rock is very dark, almost black, and with little variation. Anyone coming upon this outcrop without studying the preceding ones very carefully, and giving it a glance, as if often done at the speed required by half-mile mapping, would almost certainly call it greenstone with quartz stringers or veinlets.

The nearest outcrop of the tonalite is 660 feet further along the same line.

This whole process is considered to be one of increasing metamorphism, in which the arkosic matrix and pebbles are the first to be affected. As each pebble type, in turn, reaches a state of disequilibrium it joins the evolving "matrix" with consequent bulk and mineralogical changes. The deformation increases the length of each pebble, not by thermal plasticity[1] but by mechanical shearing at first and, as the intensity of metamorphism increases, by chemical reconstitution before it is lost in the matrix. The quartz pebbles are the last to go because they are chemically relatively inert; not until high grade is reached, where the hornblende is formed, does the silica become absorbed in the matrix in quantity. The excess remains as stringers and veinlets.

The exposures just described have been found to epitomize, to a surprising degree, the metamorphism of the Sickle series throughout the district. The muscovite and muscovite-biotite phases, for example, are recognized in many places. Often the schists are much better developed and the grain size much larger and, of course, the areas more extensive. North of Eager Lake, the extensively

[1]Because a temperature high enough to produce plasticity by purely thermal action would produce incipient melting of the whole rock.

developed "schistose granitized arkose", as mapped by Stanton, is considered to be equivalent to the muscovite-biotite phase developed on a small scale at Lasthope Lake and described above. (There is also some undifferentiated material at Eager Lake which appears to be granite.) Similarly, the small area of schistose Sickle sediments at Tod Lake is marked by the presence of muscovite, and is considered to represent a similar development.

The parallel does not always apply strictly and, in some places, some part may be missing. The hornblende-bearing phase of the conglomerate itself was not found only ½ mile east of the section described, though outcrops are present within a hundred feet of the tonalite. Possibly this is due to some vagary of rock composition, or to lack of shearing stress at the time, or to some other factor. At present there is no basis for a conclusion.

Nowhere else in the district was alteration recognized, in the conglomerate, as severe as that found at Lasthope Lake.

CONGLOMERATE OF DOUBTFUL SICKLE AGE

The Sickle age of the conglomerate at Ralph Lake is doubtful. It resembles some parts of the conglomerate known to be of that age, but it by no means resembles the characteristic conglomerate. It does not resemble Wasekwan conglomerate. Contacts are not exposed. Possible structural criteria are considered.

Ralph Lake Conglomerate

On the west side of Ralph Lake, and extending southwest for some two miles or more, is a wide area of scattered outcrops of conglomerate. A few exposures are also found on the east side, between Ralph and Barbara lakes.

This conglomerate is somewhat schistose and weathers dark brownish. The matrix is a brownish grey quartz-mica schist, with coarser clastic grains of quartz (up to 0.1 inch) sprinkled through it, and some reddish streaks, like jasper. Pebbles form about 20 per cent, are mainly about 1 inch x ½ inch, and are mostly a buff felsite or quartzite, with a few small quartz pebbles. At Betty Lake the conglomerate contains, in addition, granitic pebbles, a gabbroic type, a slaty material, and what appears to be an epidotized greenstone. In other outcrops, granite pebbles 2 x 4 inches and even up to 14 x 6 inches on the exposed surface, were found. The large cobbles show no sign of an impressed foliation or stretching, and two were seen which contain blue quartz grains like those found in the basal conglomerate at Pool Lake. The pebbles are considerably elongated, in some other places, so that the length is eight to ten times the width. Allan reports, in addition, pebbles of feldspar-hornblende gneiss, granite gneiss and diorite.

This conglomerate, and the sediments which are to the north of it, was included with the Wasekwan on Allan's 1946 map. He pointed out that it might be Sickle. In 1948, in his Ph.D. thesis, he wrote: "In the past year the writer has had the opportunity to study several exposures of known Sickle rocks, and after comparing descriptions in the literature of other Sickle and Missi formations, now concludes that the Ralph Lake sediments should be classed as Sickle."

Ruttan also shows these sediments as of Sickle age, in his paper to the Canadian Institute of Mining and Metallurgy, mentioned above (p. 78). Like Allan, his main reason for so doing is a resemblance to the conglomerate of the Sickle series, as found elsewhere.

On the accompanying map (No. 1) the conglomerate is shown as Sickle. This has been done, it must be confessed, as much from lack of any better idea as from any conviction as to its age. In the course of the present work most of Allan's outcrops were found, along with a few new ones uncovered in the search for the contacts of the conglomerate. Undoubtedly a description such as the foregoing does read much like a description of some of the conglomerate at, say, Sickle Lake. But in examining the exposures at Ralph Lake, only one was found that actually resembles closely the conglomerate as found to the south. If the area of sparse outcrop is all conglomerate, it also is much thicker than any section of conglomerate known to be of Sickle age. On the other hand, nothing was found to indicate a Wasekwan age, and it does not resemble the Wasekwan conglomerate as exposed at Beaucage Lake. The contacts of the conglomerate could not be found.

Structural considerations give no help towards a solution. The conglomerate might be a synclinal fold—the beds dip steeply towards an "axis" near the north boundary of township 90—but the dip is 75° to 90° and no top determinations are available. The contrasting dips could be explained as variations on the limb of a fold or a monoclinal block.

A syncline in the Sickle series is a possible interpretation. If so, the conglomerate should pinch out to the west, because the fold presumably plunges 65° northeast as indicated by the plunge of pebbles in the conglomerate at Betty Lake. (This is also the same attitude found by Allan for minor structures in the Wasekwan.) In that case the necessary increased width of conglomerate to the east must have been cut off by the fault in Ralph Lake. For this, an upward component of the east side is necessary; but Ruttan[1] indicates the movement was probably an overthrust from the west.

A monoclinal block or a plunging anticline are also possible interpretations of the scant structural data. This requires that the age be Wasekwan—on the present information—since the conglomerate, plunging northeast, is enclosed by Wasekwan.

SICKLE ARKOSE AND QUARTZITE

The larger part of the Sickle series is a thick assemblage of metamorphosed sedimentary rocks. The least altered rocks are in the biotite zone of metamorphism, and are now composed of quartz, feldspar, and biotite. These rocks are described. They were probably mostly arkose originally, but some sandstone, greywacke and a little shale were probably also present.

The maximum thickness recognized is about 9,000 feet. The total thickness is not known.

The least alteration is found at the eastern end of the district at Sickle Lake, and at the western end, at Tod Lake. In the central part is a large area of Kisseynew-type gneisses which are thought to have been derived from the Sickle rocks.

The second division of the Sickle series is a thick assemblage of arkose, with smaller amounts of quartzite and greywacke, and very minor amounts of slate. The original thickness is not known. The greatest exposed thickness, for which the structure is reasonably well known, is at the south end of Chicken Lake, where some 9,000 feet are present. The top is unknown, but the original thickness was doubtless considerably greater than this. Greater widths are present elsewhere, but where the structure is imperfectly known there may be, and probably is, much duplication by folding. The 23,000-foot width exposed between Hassett Lake and Laurie River at McGavock Lake, for example, involves a thickness of only about 5,000 feet of sediments.

The least altered rocks of this division are found adjacent to Sickle, Chicken and Beaucage lakes (Maps Nos. 6, 7, 8), and to the south of Tod Lake at the opposite end of the district (Map No. 4). The arkose and quartzite are typically grey to light brownish weathering, very fine grained and massive. The colour in outcrop varies considerably through such a thickness and area. A mottled brown and green variety is characteristic and a banded purple and green type is common; white, pink, buff and other colours are also found, particularly in the quartzites. Fine black "lines", due to concentrations of biotite and/or magnetite marking bedding planes, are commonly present. Thin bands of black argillite occur in places southwest of Black Trout Lake, and mud cracks were recognized in one place. The bedding may be even and regular with a thickness of ½ inch or less; or the rock may be strongly crossbedded, in some places with swirling cross laminations measuring a foot or more.

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[1]Ruttan, G. D.: Geology of Lynn Lake; *Trans. C.I.M.M., Vol. LVIII, 1955, p. 193.*

Samples from south of Tod Lake contain 20 to 25 per cent brown or pinkish feldspar; in a few places as much as 40 per cent is present. The feldspar and quartz are in grains 0.5 millimeter or less in diameter. The quartz is well rounded and sorted. Up to 20 per cent of biotite and small amounts of muscovite are present. Plagioclase (Ab_{70} An_{30}) and orthoclase are both present in that part of the district. Magnetite, hematite and apatite are accessory minerals. This rock is probably fairly representative of the fresh rocks in the western part of the district.

A sample from Beaucage Lake may be considered representative of the fresh material from the eastern part. The composition varies considerably. Quartz is predominant, as much as 85 to 90 per cent, in grains up to 0.5 millimeter, but averaging 0.02 to 0.04 millimeter, and slightly recrystallized. Biotite is common, but rarely in grains larger than 0.1 millimeter or amounts greater than 5 per cent. Feldspar grains (0.02 to 0.03 millimeter) are mainly orthoclase, microcline, andesine (Ab_{65} An_{35}), and oligoclase (Ab_{85} An_{15}); they are somewhat altered. Minor minerals are magnetite and garnet.

The composition of these rocks suggests "quartz-feldspar-mica schist" as a more appropriate name. They are, however, devoid of any notable foliation, and even break with a sub-conchoidal fracture, in some places. The term schist therefore is hardly appropriate. Mica is not especially prominent in these rocks either, because of the fine grain. For present purposes, therefore, it seemed better to use the names more suggestive of the field appearance of the rocks.

The rocks here described are from the biotite zone of metamorphism and have therefore been recrystallized. The present composition suggests that they were once arkoses or protoquartzites.[1]

A strongly banded brown and greenish grey rock from Tod Lake is composed of layers of quartz and feldspar alternating with layers rich in green hornblende. A thin section of a typical specimen showed 20 per cent of quartz in 0.2 millimeter rounded grains, some of which have wavy extinction. Orthoclase and microcline form about 30 per cent and plagioclase (Ab_{72} An_{28}) about 20 per cent of the section. Some crystals of both minerals are fractured. Hornblende and biotite each make up about 10 per cent of the rock, and closely associated with them is 5 per cent of magnetite. Garnet and apatite, each less than 1 per cent, are the accessory minerals. Two per cent of carbonate is interstitial to the feldspars. The red colour is probably due to clusters of minute grains of hematite scattered through the feldspars.

The character of the sediments of the Sickle series—so far as the original character can now be deduced—suggests that they were deposited in an extensive basin under conditions of gradually deepening but always relatively shallow water. If the amphibolite at Eager Lake represents a zone of limy sediment, this would indicate that the upper portion of the series was probably deposited in deeper water, and may have contained some chemical carbonates. Exposures of Sickle rocks are found over an area approximately 60 miles by 60 miles; the maximum known thickness is about 9,000 feet.

The present data do not permit a choice between the several depositional environments which are possible. Fluvial deposition, deposition marginal to an extensive trench or graben, or even lacustrine deposition are possible suggestions.

The metamorphic grade of the Sickle series varies considerably across the district. Rather than attempt to describe each of the resulting lithological types individually, the mineral assemblages are discussed below, where metamorphism is considered. The major lithological units into which the rocks have been broken for mapping purposes—the Kisseynew-type gneisses—are described briefly for the convenience of those using the accompanying maps.

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[1]See Pettijohn, F. J.: Sedimentary Rocks, 2nd Ed., 1957, pp. 316 and 323.

CHAPTER VI

KISSEYNEW-TYPE GNEISSES

The Kisseynew-type gneisses are a group of medium- to high-grade metamorphic rocks of considerable lithological variety. The larger part probably was derived from the metamorphism of rocks of the Sickle series, but it is probable, also, that some of the gneisses were derived from Wasekwan rocks.

The most suitable method of showing the gneisses on the maps would be to show the stratigraphic units with the metamorphism superimposed. Unfortunately, in areas where the structure is complex, outcrops not abundant, and the lithology not particularly characteristic, we have found ourselves unable to prepare satisfactory maps on a stratigraphic basis. This applies particularly to the McGavock Lake sheet (Map No. 5) and to parts of the southern half of the Laurie Lake sheet (Map No. 4).

For the convenience of prospectors and others who may have to use these maps in the field, the high-grade metamorphic rocks have been subdivided on a lithological basis. It must be stressed, however, that the present lithology is varied—and so must be generalized on the maps—and that it is the result of metamorphism superimposed upon the varied original lithology. In consequence, the map-units do not show the structure, in most cases. For example, the impression given by the map boundaries at McGavock Lake is one of a large easterly-trending unit between two granite bodies. Actually, it is known that, at the western end, this "unit" consists of several overturned folds plunging to the east, and there is reason to believe that, in the central part of McGavock Lake, the bedding strikes north, rather than east as the map suggests. This northerly strike is probably reflected by the numerous points and peninsulas on both sides of the lake. Similarly, the complexity of the structure is suggested by the characteristic and recognizable amphibolite bands south of Eager Lake, though there may be serious errors in the details of that interpretation. Without the unique amphibolite bands, this area would have to be shown as an area of granitoid gneisses with a rather uniform easterly trend, and the complex structures would disappear from the map.

AGE AND CORRELATION

The Kisseynew-type gneisses are believed to have been formed by metamorphism of the Sickle sediments. At such places as Beatty Creek, south of Beaucage Lake; the south side of Laurie Lake; south of Eager Lake; and along the railway near Naylor Lake, the Sickle rocks grade into Kisseynew-type gneisses.

Possibly the high-grade gneisses have been faulted or folded into position, so that they may be of any age, and either older or younger than the Sickle series. If that is so, none of those working in the district has recognized any evidence of this.

South from Beaucage Lake the grain size in the Sickle rocks gradually increases and pegmatite becomes more abundant. At about the southern limit of the mapped area (Map No. 7) the rocks must be classed as gneiss. The actual choice of the boundary must be made arbitrarily.

Similarly, near Naylor Lake, there are Kisseynew-type gneisses which differ from the Sickle arkoses only in that muscovite and biotite are much more strongly developed, pegmatite is abundant and there is a foliation, which in part at least reflects original bedding. Here, however, in an area of poor outcrop, the gradation is not visible, if it exists.

On the south side of Eager Lake, and west of the creek which drains Murray Lake, there are outcrops of recognizable Sickle sedimentary rocks included with the Kisseynew gneisses, evidently as remnants.

On the south side of South Bay of Laurie Lake, the boundary between Kisseynew gneisses and Wasekwan is also arbitrarily drawn. North of the volcanic rocks a number of quartzite bands occur in the gneisses. To the northeast the amount of recognizable quartzite increases and dark feldspathic bands appear. Within a further 3,000 feet the rocks are definitely sediments. The boundary has been placed where the dark feldspathic bands first appear.

It has been suggested, by nearly all workers in the district, that the gneisses are perhaps the equivalent of the Kisseynew gneisses of the Sherridon-Flin Flon area a hundred miles to the south. All have emphasized the strong lithological similarity. In Bulletin 20 of the Geological Survey,[1] Harrison discussed at length the question of the Kisseynew gneisses of the Sherridon area. He concluded (his p. 46) that "age relations are, at present, so far from being established for the Kisseynew gneisses that it is unwise to attempt to correlate them with other rocks in the general region". He did, however, suggest that the Kisseynew gneisses, and those of the Lynn Lake district, might have been the "deep-basin" representatives of a large depositional area, for which the Missi [and Sickle?] represents the marginal continental deposits.

If the Kisseynew gneisses are a metamorphosed complex of different ages, as Harrison points out no correlation with established units is possible. A correlation of time of formation is possible, however, and is implicit in Harrison's suggestion that the gneisses result from the metamorphism of deeply buried sediments of a depositional basin, for the metamorphism was presumably essentially contemporaneous across the basin. This implies, also, that the marginal deposits, Missi and Sickle, are strictly correlative.

In actual fact, the only existing bases for correlation of Kisseynew gneisses and those of the Lynn Lake district are the lithological similarity, and comparison of relations at the edges of a band of granite 100 miles wide. For the correlation to be valid the intervening granite must be shown to be a unit. Actually, the intervening granite area is known only very imperfectly, and any correlation must make assumptions about it.

PETROGRAPHY

All previous workers in the district have divided the Kisseynew gneisses into roughly the same units shown on the accompanying maps. In some cases these have been further subdivided, and the units have been known by various names.

Where the composition of the original rocks varied to some extent, and the metamorphic grade varies considerably, many resulting combinations are possible and boundaries between one and another must necessarily be arbitrary. A possible exception is a very distinctive rock type, such as the amphibolite bands at Eager Lake. Even in this case, however, some discretion must be used, for the mafic rock is interbanded with more siliceous material and the question of placing the boundary may arise.

MUSCOVITE-BIOTITE SCHIST

This rock is characteristically a muscovite-biotite schist. There is a suggestion of layering, but sedimentary features are not abundant. The schist is extensive near Eager Lake. It is considered to be a product of relatively low-grade metamorphism of Sickle sediments in a zone of severe deformation. The potash feldspar is possibly detrital.

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[1]Harrison, J. M.: Precambrian Correlations and Nomenclature, and Problems of the Kisseynew Gneisses, in Manitoba. *Geol. Surv., Canada, Bull. 20, 1951.*

In small bodies this rock type is fairly widespread through the Sickle series. Areas of some extent are found between Tod Lake and Laurie Lake, and south of Tod Lake, but the extensive development of this unit is north of Laurie River, Eager Lake and McGavock Lake.

As shown on maps 4 and 5, this unit (No. 20) is the equivalent of Stanton's "Granitized arkose and migmatite" and of the feldspathic quartzite and arkose of Oliver's McGavock Lake maps. Stanton gives an excellent description which is repeated below:[1]

"The rocks reflect a regional schistosity characterized by an extensive development of muscovite and biotite, which, however, imparts only a weak laminar habit; locally a coarse tabularity resembling bedding has developed. Other points of evidence of sedimentary origin for much of the zone are the local development of knots up to 1½ inches across, composed largely of muscovite, and a few isolated pebbles. The unit has been intruded by considerable amounts of pegmatite in dykes, stringers and irregular bodies. The extensive permeation of the feldspathic quartzite and arkose by igneous emanations has given an igneous appearance to much of the sedimentary rocks, and it commonly proves difficult to distinguish rocks of sedimentary origin from those of igneous origin. Northwest of Kukri Lake much of the belt consists of highly contorted migmatite gneiss, an intimate admixture of sedimentary and intrusive material . . . characteristically, rocks of this zone are grey to pink, and have a friable, coarse, sugary to granitoid texture. Microscopic examination shows that feldspar (both oligoclase and microcline) forms from 40 to 50 per cent of the rock, quartz about 35 per cent, muscovite and biotite about 15 per cent, and that magnetite and apatite occur as accessory minerals. In some specimens, quartz is considerably more abundant than indicated above. The percentage of microcline is appreciably higher than in the feldspathic sandstones, but this may be due to later potash introduction from pegmatitic solutions. A fine disseminated red iron oxide accounts for the colour of the pink feldspathic quartzites."

A reading of Stanton's field notes shows he was much troubled by this unit; he considered it at times to be a sheared and recrystallized arkose; at other times as a "granitized" feldspathic quartzite or arkose. His main objection to shearing and recrystallization is evidently the widespread development of the schist: What sort of shearing could produce that?

Sections through the Sickle series north of Eager Lake, show the structure to be a group of overturned folds lying one upon another. The structural features at Tod Lake show that these overturned folds are probably on the north flank of a major synclinal structure, with its axis under, or north of, Eager Lake and the river. Foliation in the Sickle series, north and south, is strictly parallel to the axial planes of the folds, though the axial planes themselves are folded.

It is suggested that the muscovite-biotite schist is a coarsely recrystallized portion of the Sickle series, formed near the axis of a fold of major proportions and under conditions of metamorphism somewhat less intense than those which produced the stratiform paragneiss south of Eager Lake. It thus has an origin similar to the muscovite-biotite phase found in the conglomerate at Lasthope Lake (see above p. 87), which it resembles closely. The widespread development of the schist is then reasonably to be expected. It must be admitted that this hypothesis is proposed on the basis of very slight acquaintance with these rocks in the field. Nothing found in the careful records of Stanton's field work, however, is incompatible with it.

QUARTZ-FELDSPAR-BIOTITE-HORNBLENDE GNEISS

This is a strongly banded rock which contains up to 50 per cent aplitic stringers. The gneiss is composed of quartz, oligoclase, and biotite with smaller amounts of microcline and garnets. It was formed from Sickle sediments under conditions of high-grade metamorphism

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[1]*Manitoba Mines Branch, Rept. 48-4, p. 15.*

approaching that of the sillimanite zone. It is probable that some of the gneiss west of Laurie Lake was derived from Wasekwan rocks.

This unit (No. 24) has its greatest development at Laurie Lake, near the Saskatchewan boundary, with smaller amounts south of Eager Lake and scattered occurrences southwest of Finch Lake. (See Map No. 10).

At Laurie Lake this gneiss is most commonly a grey to brownish grey rock with a speckled "pepper and salt" appearance, and a sugary or sandy texture. It weathers dark grey or very light grey. Many of the outcrops show alternating light and dark bands; the lighter are high in quartz and feldspar, but low in dark minerals. Abundant aplitic material, both grey and pink, has been introduced in most places, and stringers of aplite, either lit-par-lit or running in all directions, from a large part of some outcrops. The boundary between gneiss and granite was placed where the aplitic material was estimated to exceed 50 per cent of the outcrop.

Thin sections of samples from Laurie Lake show that the main mass of the rock is a quartz-feldspar mosaic with grain size averaging about 1.0 millimeter. Proportions of quartz and feldspar vary widely. Quartz, with wavy extinction, forms 40 to 60 per cent in most sections, but, in some cases is as low as 20 per cent. Feldspar (Ab_{65} to Ab_{82}) forms 40 to 45 per cent of the rock. Potash feldspar is not common. It is usually microcline and amounts to 10 per cent in some sections. Garnet, in amounts up to 3 per cent, is present over a considerable area; similarly, hornblende is a minor constituent over a small area near the Saskatchewan boundary. Brown flakes and shreds of biotite form 15 to 25 per cent of the rock. There is usually some alignment of the biotite, but well-developed mineral orientation is not common.

In the Dunphy Lakes area, Stanton found essentially the same features. His typical material is stated to have 30 per cent biotite in dark brown, strongly pleochroic, and sub-oriented flakes. In other respects, the typical gneiss is about as described from Laurie Lake, insofar as composition is concerned.

Some of this rock at least, was probably derived from metamorphism of Wasekwan sediments. At Laurie Lake, it surrounds pillowed lavas which are typical Wasekwan. It is this gneiss, also, which grades into recognizable Wasekwan sediments, including interbanded quartzite, between Tod Lake and South Bay, Laurie Lake, as was mentioned above under correlation of the Kisseynew gneisses.

In the field there is seldom much question that this gneiss was originally bedded, unlike the granitoid gneiss which often is very difficult to distinguish from a granite.

STRATIFORM GRANITOID PARAGNEISS

This unit (23) is the most extensive of the Kisseynew-type gneisses, and shows considerable variation. It is difficult to distinguish from granite and, in many places, contains abundant stringers and dykes of aplite and pegmatite. In the coarser-grained parts, bands up to several hundred feet thick are recognizable, probably the reflection of former sedimentary units. Northeast of McGavock Lake the gneiss is characterized by quartz-sillimanite knots. Descriptions and analyses are given. It is possible, on the basis of composition, that the gneisses could have been derived from pyroclastic rocks. However, none are known in the Sickle rocks where they are less severely altered. Some diopside-carbonate rock has been recognized; this suggests abnormally high lime content.

The term stratiform granitoid paragneiss, adopted by Stanton in the Dunphy Lakes area, is applied to gneissic rocks, in many places of very granitic appearance, which are believed to be derived from arkose and greywacke by high-grade metamorphism.

The largest expanse of this rock is in the McGavock area. It is found eastward from the west end of McGavock Lake to German Lake and northward to Redwin Lake and almost to Amoeba Lake. A granite plug occupies about 20 square miles of this area, west of the railway.

The larger part of the rocks in the complex structure south of Eager Lake belongs to this unit.

A small area in South Bay of Laurie Lake, and also on the Saskatchewan boundary, is underlain by this gneiss.

In the field these gneisses are light grey or pinkish in colour, of granitic appearance, strongly banded, usually very contorted, and with a large proportion of aplite or pegmatite present. This may be as lit-par-lit stringers and bands, or in cross-cutting dykes; in many places both are present. In many places, also, the aplitic stringers follow around ptygmatic folds in the gneiss (pl. IV,A; pl. V,A). Probably in most of the field work the rock was classed as "granite with inclusions" when the proportion of "igneous material" in the outcrop was much in excess of 50 per cent. Because of the similarity in appearance, the distinction in the field between the granitoid gneiss and the granite often presents great difficulty. The area south of Eager Lake is a good example of this, and in many places the distinction is an arbitrary one.

The granitoid gneisses (Unit 23) *south of Eager Lake* are very similar to some of the rocks between Talon Lake and Tod Lake (Unit 24). In mineral composition and texture the two appear to be identical, but intensity of metamorphism increases southeastward, and the rock is coarser grained and more granitic in appearance east of Talon Lake. Bedding is visible in the finer-grained phases near Tod Lake, but in the more coarsely recrystallized parts, near Talon Lake, it is not so distinct, and only the larger compositional bands of the sediment are recognizable. A coarse, tabular bedding-plane parting is present. The coarser phase was termed a "granulite" by Stanton[1]. It contains 20 to 25 per cent biotite (with or without muscovite and chlorite) in a quartz-feldspar matrix. South of Pyta Lake rocks of this group contain hornblende as the only ferromagnesian mineral. East of Talon Lake, recrystallization has obliterated most primary sedimentary features and the rock is very difficult to distinguish from granite. The granitoid gneisses are, therefore, considered to be the product of metamorphism of the sediments of the Sickle series, and the "granulite" to be a phase intermediate between the granitoid gneisses and the least altered rocks.

South of Eager Lake (Map No. 4) the gneiss is more strongly banded and more granitic in appearance than to the north of Laurie River. A very detailed description of this unit was given by Stanton[2], the substance of which is reproduced below:

"In general, the paragneisses appear to be recrystallized, 'granitized' and injected equivalents of the less metamorphosed feldspathic sandstones and feldspathic quartzites [of the Sickle series (Unit 14 on the accompanying maps)], intruded by considerable igneous material as injection, lit-par-lit, and migmatite gneisses. In many places it is almost impossible to distinguish between an intrusive gneiss and a granitoid paragneiss. Pegmatite intrusions are numerous throughout this area.

"The gneisses are characteristically medium-grained pink to greyish rocks having a granitoid texture. Both biotite- and hornblende-bearing phases occur."

Thin sections of the more granitic-appearing paragneiss, from south of Eager Lake, contain 45 to 50 per cent oligoclase and microcline, 20 to 45 per cent quartz, and up to 25 per cent biotite and/or hornblende, with magnetite, titanite, apatite and zircon as accessory minerals. Oligoclase and microcline are always present; either may be the predominant mineral.

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[1]In the sense used by British petrologists: Cf. Harker, *Metamorphism*, p. 246: "Distinct from the quartzites proper, we may recognize a parallel series of types which, while still rich in quartz, contain also a large amount of felspar . . . By some writers they would be called gneisses, but many of them have neither a notably coarse grain nor any gneissic structure. Following the Geological Survey we use the name 'granulite'."

[2]In *Manitoba Mines Branch Report, 48-4, pp. 20-22.*

Comparison of "Granulite", Paragneiss and Sickle "Arkose" with Other Selected Rock Types

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O +	H_2O —	CO_2	TiO_2	MnO	BaO	P_2O_5	Cl	F	Total	C.I.P.W.	
1 GRANULITE Pyta Lake	65.7	15.8	3.1	1.1	0.3	5.6	1.5	5.1	0.3	0.05	Tr	0.8	Tr	Nil	1.04	Nil	Nil	99.75	I,4,3,2	Some carbonate seen microscopically.
2 RHYOLITE Papa Moa, Te Puke New Zealand	68.95	15.58	2.52	1.30	0.80	3.07	1.59	4.79	0.81	0.34	....	0.40	0.04	....	0.20	....	....	100.39	I,4,3,2	Washington's Tables, U.S.G.S. Prof. Paper 99, p. 245.
3 PARAGNEISS Eager Lake	60.5	18.4	3.4	2.5	0.5	5.4	1.9	5.4	0.4	....	Tr	0.7	Tr	Nil	0.4	Nil	Nil	99.5	I,4,3,2	
4 GRANITE Grafversfors, Stafsjo, Sweden	67.93	16.28	2.85	1.38	0.90	2.8	1.80	5.02	0.53	....	....	0.30	0.07	....	....	....	....	99.87	I,4,3,2	Washington's Tables, U.S.G.S. Prof. Paper 99, p. 245.
5 PARAGNEISS Eager Lake	62.7	13.7	4.3	1.1	0.2	4.6	0.8	8.6	0.3	0.05	0.5	0.7	Tr	2.1	Nil	Nil	Nil	99.65	II,4,3,2	Borders II, 4, 3, 1.
6 DACITE Sweet Hill, Iron Springs Dist., Utah	61.05	16.03	5.42	0.98	3.03	5.40	1.43	5.58	0.81	....	....	....	....	0.08	0.30	....	....	100.11	II,4,3,2	Washington's Tables, U.S.G.S., Prof. Paper 99, p. 359. Only entry in this sub-rang.
7 SICKLE ARKOSE N. end, Sickle Lake	69.9	15.57	1.29	2.36	1.32	2.38	3.28	1.27	0.71	0.15	Tr	1.30	0.06	....	0.24	....	....	99.83	I,3,3,4	Fawley, A. P.: Man. Mines Br. Rept. 48-6, p. 16.
8 GRANITE E. Clarendon, Vt.	67.33	16.20	1.40	2.73	1.31	2.81	3.15	2.14	1.84	....	....	0.80	Tr	0.05	0.16	....	....	99.92	I,3,3,4	Washington's Tables, U.S.G.C. Prof. Paper 99, p. 103.
9 TYRRELL'S AVERAGE GREYWACKES	68.1	15.4	3.4	3.4	1.8	2.3	2.6	2.2	2.1	....	....	0.7	0.2	....	0.2	....	....	102.4	......	Tyrrell, *C. R. Reunion Intern. pour L'Etude Precambrian, 1933;* quoted by Pettijohn, *Sedimentary Rocks, 1959, p. 250,* with the comment that Fe_2O_3 should probably be 1.4 and the total should be 100.0.

Analyses 1, 3, 5 are from Stanton, M.S.: Man. Mines Branch, Rept. 48-4.
Analyses 1, 3, 5, 7 are by Vladimir Mackiw, Mines Branch Laboratory.

An analysis[1] of the hornblende-bearing "granulite" from south of Pyta Lake (Map Unit-24), is compared below with two others, of rocks of similar appearance, from the granitoid gneiss. It is unfortunate that Stanton chose to analyze the hornblende-rich part of the "granulite" rather than the more common biotite-bearing variety, (p. 94).

It has been suggested that the paragneisses might also be derived by metamorphism of tuffs or other pyroclastic material. To assist in locating comparable data the above analyses were used to calculate the norm, just as if they represented igneous rocks. It is interesting to note that, within the limitations peculiar to the C.I.P.W. classification, the rocks represented by analyses 1 and 3 are the same. The position of analysis 5 in class II appears to be due to the large amount of lime and barium, relative to the amounts of alumina and FeO. The norm contains both calcite and hematite, in addition to 5.8 per cent wollastonite.

As is shown in the table, analyses have been reported in the literature for igneous rocks sufficiently similar to fall in the same sub-rang in the C.I.P.W. classification. Therefore, it appears that, so far as the analyses indicate, the paragneisses could be formed by the metamorphism of pyroclastic materials of similar composition. At the same time, the superior analyses listed by Washington, in U.S.G.S. Professional Paper 99, show only analyses 2, 4 and 6 as representative of their respective groups. This suggests the possibility that these particular types are not especially abundant as igneous rocks. Taking into consideration, in analysis 5, the higher proportion of lime (relative to alumina) and the increase in ferric iron when compared with analysis 3, there is a further suggestion that some of the source material for the paragneiss contained more lime than is characteristic of the lower part of the Sickle series (analysis 7).

This also has been inferred from the presence of amphibolite in the same area, south of Eager Lake. The high potash of analysis 5 may reflect original detrital feldspar or, possibly, introduction of potassium. The lower proportions of lime, soda and potash in the "arkose" are reflected in the decrease in normative feldspars, as shown by its position in Order 3 of the C.I.P.W. classification.

The analysis of the "arkose" from Sickle Lake is very similar to that of the granite from Vermont. The likeness is a great deal closer than is that between these two analyses and any others tabulated by Washington for the same subdivision in his tables. If an arkose is to be defined as " . . . derived from a granite and having the appearance of granite", then arkose would appear to be a not unsuitable source for the rock shown in analysis 7. At the same time there is a remarkable similarity between analysis 7 and Tyrrell's average greywacke, which is shown as number 8.

In the large area north of McGavock Lake (Map No. 5) this gneiss differs a little from that to the west. A characteristic feature is the presence of quartz-muscovite-sillimanite knots. Harker[2] describes similar rocks in the Highlands of Scotland, and his lucid prose can hardly be improved upon for a description of the gneisses in the vicinity of the Lynn Lake railway.

"The sillimanite-gneisses of the Highlands are often of as coarse grain as the gneissic granites which are in many places intruded among them; and, where the latter have been injected in 'lit-par-lit' fashion, it is not always easy to discriminate the two rocks, except by the presence of the distinctive streaks of sillimanite. The other common minerals are quartz, garnet, light and dark micas, oligoclase or some near variety of felspar, and not infrequently orthoclase. These, however, are not uniformly mingled, but show a strong tendency to segregate into lenticles and streaks with a common orientation. There are lenticles and knots of quartz crowded with sillimanite needles, others mainly of garnet with interstitial quartz,

[1]Stanton, M. S.: *Man. Mines Br., Rept. 48-4, p. 17.*

[2]Harker, A.: *Metamorphism;* Methuen & Co. Ltd., London, 1950, p. 229.

and inconstant bands very rich in mica, which also often contain sillimanite. On a weathered surface the quartz-sillimanite-knots show in relief with a characteristic dead white colour and silken lustre (*'Faserkiesel'* or *'quartz sillimanitisé'*)."

The knots in the McGavock Lake area are more resistant to weathering than the coarse-grained matrix, and they stand out as elliptical knobs a quarter of an inch above the weathered surface. They are 1 inch to 2 inches long, ½ inch to 1 inch across and may form as much as 20 per cent of the surface of some exposures. They form a twisting contorted pattern across the outcrop. Where the sillimanite ellipsoids are not present, large flakes of muscovite, or clusters of flakes of muscovite are usually abundant. Characteristic also, in the cuttings along the railway line, is the abundance of pegmatite and aplite in association with the muscovite or sillimanite knots. South of Amoeba Lake several outcrops suggest that the number of the knots increases towards, and adjacent to, the pegmatitic stringers. Sillimanite knots are found also at Laurie Lake, but the rock in general is more strongly banded and more granitic in appearance. (See pl. VI, A).

The main part of the rock[1] is composed of about 25 per cent microcline and orthoclase and 25 per cent calcic oligoclase or sodic andesine, in grains from 0.5 to 1.0 millimeter. Quartz (35 per cent) occurs as fine grains with the feldspar, and in larger aggregates of quartz. Biotite and muscovite total 15 per cent.

In the knots the mica is all muscovite and occurs as long, wavy layers in a matrix of quartz. In some there is a high percentage of sillimanite in clusters of tiny needles. Muscovite and sillimanite "stream" around the quartz grains (pl. VI, B).

There is neither feldspar nor biotite in the knots and the contact with the main mass of rock is sharp. A sillimanite knot from south of the west end of McGavock Lake has the following composition as reported by the Mines Branch Laboratory:

SiO_2	77.20%
Al_2O_3	13.29
Fe_2O_3	1.88
FeO	0.32
MgO	0.43
CaO	0.26
Na_2O	0.61
K_2O	4.40
H_2O+	1.23
H_2O-	0.16
TiO_2	0.26
P_2O_5	0.04
MnO	0.01
	100.09

Sp. Gr. 2.764 Sp. No. M358-54 Lab. No. R81
Analyst: McKay, Manitoba Mines Branch Laboratory.

No biotite was visible in the specimen, but there was obviously something more than quartz, muscovite and sillimanite present. If all the FeO and MgO is assigned to biotite, and all the remaining K_2O to muscovite, the oxides present are the equivalent of 60 per cent quartz, 23.5 per cent muscovite and 4.4 per cent biotite. There remains only enough alumina for 0.7 per cent sillimanite. This total of 88.7 per cent does not account for the Fe''' nor for the lime and soda. There is not enough Fe'' reported to account for the Fe''' as magnetite.

[1]This description is based largely on T. A. Oliver's unpublished Ph.D. thesis, from which most of it was extracted.

At Talon Lake, Stanton found a limited exposure of pyroxene-carbonate rock In hand specimen, this is equigranular, brownish grey, and with faint dark green parallel bands from 1 millimeter to 8 millimeters thick. A thin section shows 42 per cent oligoclase and microcline, 20 per cent quartz, 10 per cent titanite, 20 per cent diopside(?), and 8 per cent carbonate, magnetite and apatite. The pyroxene occurs as pale green blocky crystals, very slightly pleochroic, in a matrix of medium-grained plagioclase and quartz. Carbonate[1] is common; magnetite and apatite occur sparsely. The titanite is reddish brown to brown, with very high index of refraction. Some crystals are anisotropic, though much appears isotropic in section; the isotropic grains may be optic axis sections. [Index of refraction measurement in oils shows the mineral to be anisotropic and with the index >1.830, which eliminates all but andradite and the iron-bearing garnets as possible alternatives.]

PLAGIOCLASE-AMPHIBOLITE

Bands of hornblende-plagioclase gneiss occur south of Eager Lake. They are probably the metamorphosed equivalent of lime-rich bands in the upper part of the Sickle series.

Bands of hornblende-plagioclase gneiss (Map-Unit 22), up to 500-700 feet thick, are found south of Eager Lake, where they serve as markers for the very complex structure there. Typically, this rock is medium grained, black and white, ("salt and pepper" appearance), and composed of black hornblende and granular plagioclase with minor quartz. In some places the rock is massive; in others, it shows banding suggestive of bedding. In one place Stanton found "ovoid concentric structures" about 12 inches by 7 inches, which he though might represent pillow structures in a volcanic flow or concretions in a sedimentary rock. Otherwise nothing was noted suggesting a volcanic origin for this rock.

An outcrop near McGavock Lake is described in some detail in Stanton's notes, and is apparently reasonably typical:

"Dark grey slightly garnetiferous hornblende-feldspar gneiss . . . In places contains more garnet, but in general, garnets not abundant. Very distinct tabularity. The gneiss commonly has massive hornblende lenses and bands, usually less than 2 inches wide, and lensy rather than continuous. The hornblende bands coarse hornblende containing garnet. The greyer mater. [?] consists of feldspar, quartz and hornblende. Possibly derived from sediment high in ferromagnesians. In places garnet quite abundant."

On the south shore of Eager Lake, west of the larger island towards the west end, hornblende-feldspar bands can be seen in the Sickle sediments. The sediments parallel the shore and are isoclinally folded, with folds 10 to 15 feet across. In this are two mafic bands containing epidote and chloritized (?) hornblende. On the flanks of the small folds, the bands are 2 inches to 3 inches thick, which is increased to 2 feet on the crests, and they parallel each other around the folds. Thinner bands are also present. A flow only a few inches thick seems very unlikely indeed; a thin impure calcareous band appears more reasonable, and would produce the hornblende-feldspar assemblage when metamorphosed. The structural detail is still too confused to permit a definite conclusion on whether the Sickle series may grade into more argillaceous and calcareous phases, in this part of the district.

At least some calcareous rock is present at approximately the same stratigraphic horizon, at Talon Lake, and the presence of some lime in the sediments of this part of the Sickle series is also suggested by the analyses quoted on page 96.

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[1]The carbonate is twinned on the rhombohedron $(10\bar{1}1)$.

CHAPTER VII

POST-SICKLE INTRUSIVE GROUP

Intrusive rocks, ranging in composition from gabbro and diorite to granite, invade rocks of the Sickle series in the eastern part of the district. Granitic types form several large bodies within the area of Kisseynew gneisses, to the west. Granite which may belong to this group is present north and east of Hughes River; its age and possible correlation were discussed above, when the pre-Sickle granite was considered. Gabbro at Tow Lake may be of this period also, but has been mapped with the pre-Sickle sequence for reasons also given above.

The oldest rock of this group is the Black Trout Diorite, which cuts the conglomerate of the Sickle series. It is, in turn, cut by tonalite and granite. Pegmatite and graphic granite, believed to be associated with the granitic rocks, are probably the youngest rocks, and are certainly post-Sickle. It is probable that the folding of the Sickle series preceded the emplacement of the intrusive.

Gabbro dykes, of doubtful age, may be a part of this group, and older than the Black Trout Diorite.

RELATION TO OTHER FORMATIONS

The oldest unit positively recognizable in this group is the Black Trout Diorite. On the west side of the lake from which it is named there are inclusions of Sickle sediments, 50 to 200 feet long and 30 to 50 feet wide, within the diorite. Similar inclusions of conglomerate, some very large, can be seen in the diorite on the east side of a long, shallow lake, the second south of Black Trout Lake. In the vicinity of Beaucage Lake, the diorite occurs as sills at several stratigraphic horizons in the Sickle; locally it breaks across from one horizon to follow another. South of Beatty Creek, on the east side of the lake, a 50-foot band of diorite branches so that it cuts the Sickle conglomerate in various directions, a condition which rules out any possibility that it is a recrystallized flow interbanded with the conglomerate. At Lasthope Lake, the large plug of diorite, in the bottom of the "U" of the lake, has a 20-foot, fine-grained margin which also dykes the Sickle series.

The diorite to the east of Beaucage Lake is cut by stringers and dykes of pink granite, so that the age of the granite is definitely established. This is the same pink porphyritic microcline granite mapped by Fawley in the southern part of the Sickle Lake area, and a part of the same mass.

In his summary report,[1] Norman states: "The large bodies of granitic rocks lying on either side of the Sickle Lake syncline and its continuation to the south definitely cut the Sickle rocks and are younger than this series," but he does not detail his evidence. The relations recited above are probably those which established, for Norman, the age of the granite to the east of Beaucage and Sickle lakes. Not all granite east of Sickle Lake is post-Sickle, however, for in one place the conglomerate lies upon the eroded surface of the "granite".

There are two types of "granite" west of the Sickle Lake syncline: a grey, massive to gneissic tonalite, which Fawley called the "older granite"; and a pink aplitic microcline granite, which he called the "younger granite". The grey variety, near the south shore of Lasthope Lake, contains inclusions of the Sickle conglomerate. (A more accurate description would say that a dyke completely surrounds a large fragment of conglomerate, for it has been little disturbed.) The conglomerate is also cut by 2-foot dykes of grey tonalite about 2 feet apart. The grey tonalite, in turn, is cut by the "younger" pink aplitic granite southwest of Amy Lake, in the area of the type Wasekwan section south of Dufresne Lake, and northeast of Finch Lake.

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[1]*Geol. Surv., Canada, Sum. Rept., 1933, pt. C. p. 38C.*

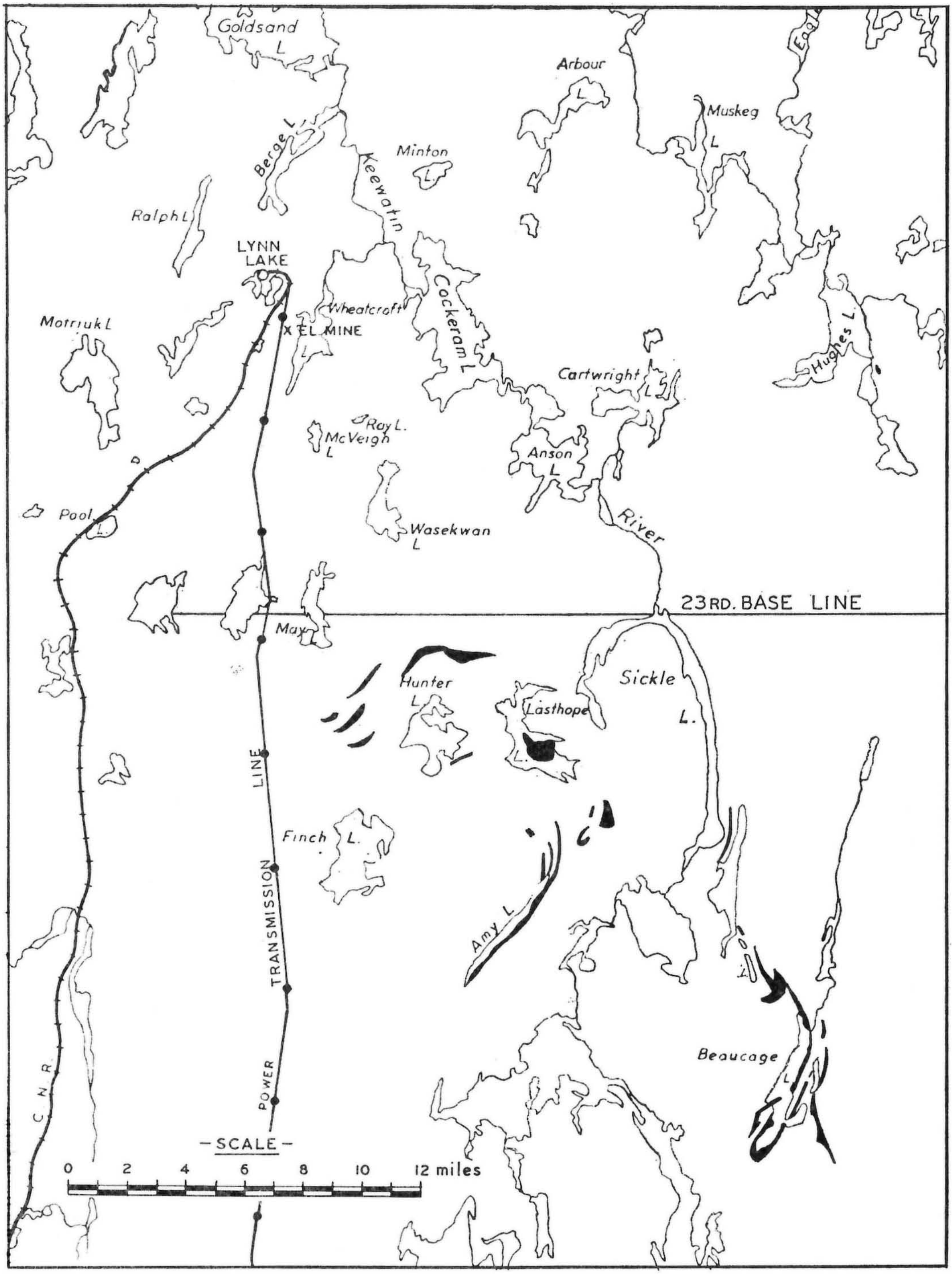

Figure 18 — Distribution of Black Trout diorite. Note small body south of Hughes Lake. It is possible that other masses of this rock have not been recognized, especially where there is no direct proof of post-Sickle age.

South of Wilmot Lake and eastward, south of Naylor Lake, there is a narrow basic band containing some anthophyllite and cordierite. Oliver ascribed these to iron and magnesium expelled from the granites immediately adjacent.

BLACK TROUT DIORITE

DISTRIBUTION AND TOPOGRAPHIC EXPRESSION

The Black Trout Diorite was named, by Fawley, from its exposures at Black Trout Lake, in the southeastern corner of the district (see Map No. 6). The diorite can be followed south from there to Beaucage Lake (Map No. 7) at the southern limit of the area covered by the present maps. Another long dyke is on the east side of Amy Lake, reaching north towards Lasthope Lake, and a third, rather poorly exposed, runs from north of Cloverleaf Lake to south of May Lake. A plug of diorite forms a prominent hill, in the bottom of the "U" of Lasthope Lake. Other dykes, cutting the Wasekwan volcanic rocks, may be present but not recognized. The diorite usually forms high ridges and has such a marked topographic expression that the edges of the diorite sills are often marked by scarps or very steep hillsides.

PETROGRAPHY

The diorite is fine to medium grained and characteristically has an altered appearance. It is composed of oligoclase, quartz, and biotite pseudomorphs of hornblende. Magnetite is abundant enough to cause strong magnetic anomalies near the diorite.

The Black Trout Diorite is characteristically medium grained, massive to faintly gneissic, dark grey, and weathers brownish grey. It is composed of aggregates of black biotite (which, to the naked eye, look like hornblende crystals), in a matrix of grey feldspar. The characteristic feature of the diorite is its altered appearance. Where fine grained, as on the west side of Black Trout Lake, the rock is dark brownish black. The fresh surface has the appearance of very tiny flashing needles, which the lens shows to be abundant biotite flakes.

There is sufficient disseminated magnetite to cause strong magnetic disturbances adjacent to the diorite. Compass bearings taken over the diorite have been found to be in error by as much as 130 degrees, and routine compass and pace traverses, over extensive diorite, are practically impossible.

Analysis of Black Trout Diorite

SiO_2	54.9%	MODE:		
Al_2O_3	14.0	Quartz	10	
Fe_2O_3	3.8	Feldspar	60	Ab_{68}
FeO	7.6	Biotite	20	
MgO	3.8	Sphene	5	
MnO	Tr	Magnetite	2	
TiO_2	1.9	Pyrite	1	
CaO	5.6	Epidote	2	
Na_2O	2.7	Zoisite	Tr	
K_2O	2.4			
H_2O-	0.07	NORM:		
H_2O+	0.7	ap	3.02	
P_2O_5	1.3	il	3.65	
CO_2	Tr	or	14.46	
Cl	Tr	ab	23.58	
F	Tr	an	19.18	
		mt	5.57	
	98.77	di	1.4	
		hy	17.8	
Sp. Gr. (Pulp): 2.86		Q	12.48	

Analyst: Mackiw, Man. Mines Branch Laboratory

Under the microscope, the rock is generally fresh in appearance, with but slight alteration of the feldspars to sericite. Quartz forms about 10 per cent, in grains up to 0.5 millimeter; feldspar forms about 30 to 35 per cent of the rock, is mainly oligoclase (Ab_{90} to Ab_{75}), and is zoned. Orthoclase is relatively minor in amount. Biotite, in fresh brown laths up to 0.5 millimeter long, is the dominant dark mineral, and it forms 25 to 40 per cent of the rock. Hornblende ($Z \wedge c = 15°$) may constitute as much as 15 per cent of the whole. Pyrite and magnetite (2 to 3 per cent) are closely associated with the dark minerals, and apatite is a minor accessory. At least some of the biotite has been formed by alteration of the hornblende. Fawley reports, in the Sickle Lake area, 50 to 70 per cent of feldspar. A chemical analysis of Black Trout Diorite is given by Fawley, in Report 48-6, and is repeated above.

GREY TONALITE

This unit is that described by Fawley as "older granite" in his preliminary report 49-5. On the accompanying maps, Fawley's boundaries have been followed rather closely, on sheet 6; the correlation on the McGavock sheet (Map No. 5) is based, so far as possible, on the lithology as described by Oliver. Unfortunately, few of Oliver's samples are now available and detailed petrographic description is often missing from the field notes. In consequence, the correlation on the McGavock map should be considered tentative only. Within the limits of the Sickle Lake map, the characteristic quartz ridges on the weathered surface were, apparently, the dominant features used by Fawley for identification. This feature has also been found on granitic rocks known, or suspected, to be pre-Sickle, so that some pre-Sickle "granite" may have been included, in error, within this unit; the body of granite extending north from Dufresne Lake is one of those for which the age is doubtful.

DISTRIBUTION

The largest mass of undoubted post-Sickle tonalite is that south of Lasthope Lake (see Maps Nos. 5 and 6). This has been extended westward to Phoebe Lake and Redwin Lake. Smaller bodies are found north of Hunter Lake, and between Wasekwan and Dufresne lakes.

On Map No. 5, Oliver's units and boundaries are followed to a great extent; partly on the assumption that the rocks are essentially homogeneous within each area, and partly from lack of sufficient data to make changes. The aplitic granite south of Lasthope Lake (Fawley's younger granite) has been correlated with Oliver's aplitic granite because of lithological similarity. This is known to be the younger granite at Lasthope Lake and in consequence, Oliver's other units have been assigned to an earlier part of the same general period. It is probable that considerable quantities of metamorphosed sediment have been included within this unit, and it is possible that some "greenstone" may also be present. In view of the nature of the country south of Finch Lake, where differences can be followed, this seems very likely.

PETROGRAPHY

The tonalite is generally strongly gneissic with the foliation marked by streaks of mica. Hornblende and epidote are both present in many places. Quartz characteristically weathers in relief to give a rough surface. There is considerable variation in feldspar content, especially microcline and orthoclase. The tonalite north of McGavock Lake may be a different unit than that at Lasthope Lake.

In outcrop this rock is generally strongly gneissic, though in places it is massive. The weathered surface has a characteristic roughness due to differential weathering; the quartz is more resistant than the other minerals and stands out as narrow ridges about 1/8 inch high. The rock is medium to coarse grained in appearance with white patches of feldspar, and irregular streaks of mica, on the weathered surface.

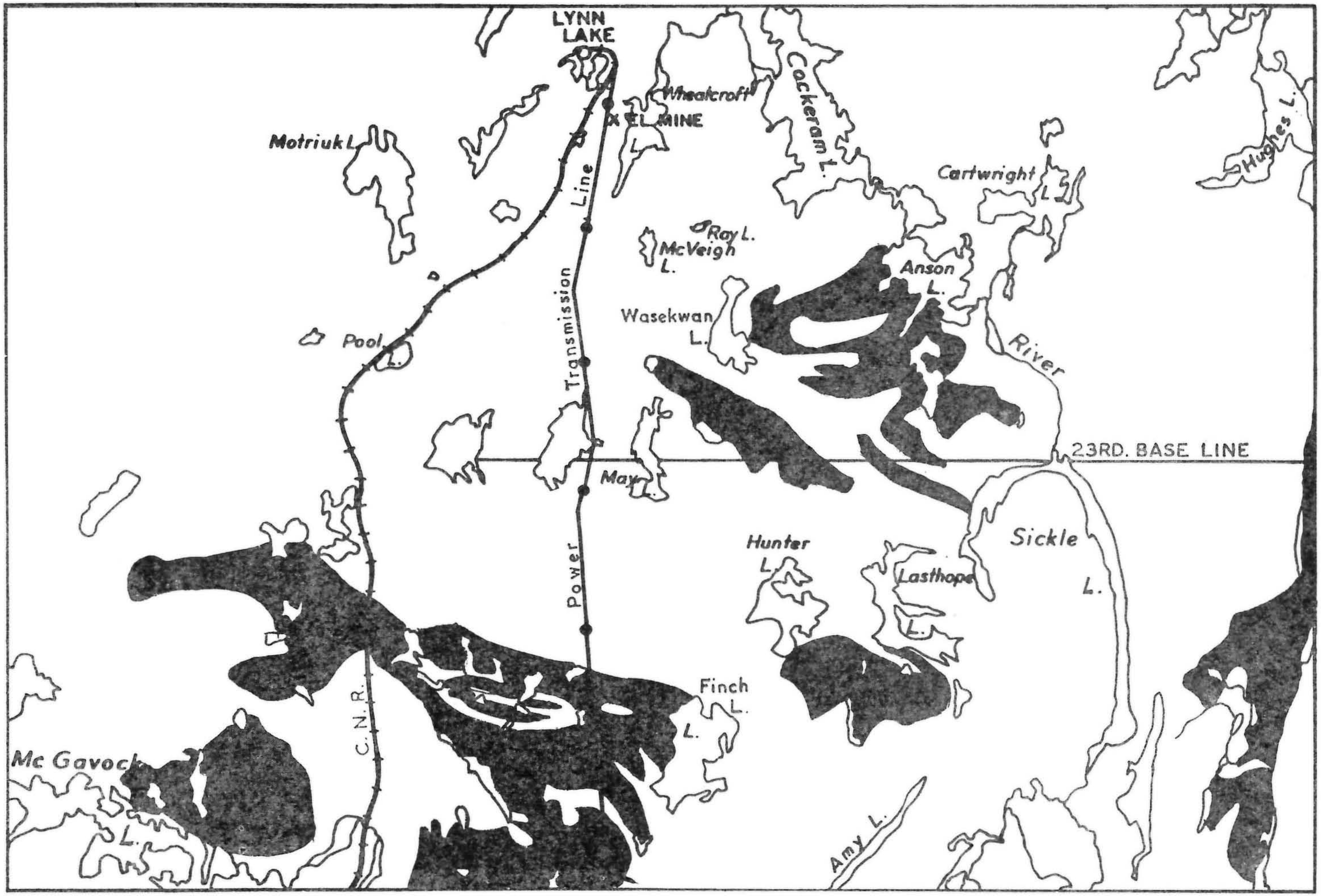

Figure 19 — Distribution of post-Sickle tonalite.

The fresh surface, where seen south of Lasthope Lake, is mottled grey and black, strongly foliated, with 20 to 40 per cent hornblende and biotite, and 5 to 10 per cent reddish feldspar intermixed with the blue grey plagioclase. The feldspars, in some places, are about 5 millimeters long, and the rock has a somewhat porphyritic, or *augen* texture. Hornblende crystals and aggregates also reach 5 millimeters as stubby aggregates of more slender crystals. Epidote is visible, under the hand lens, in many places.

Fawley[1] notes that the composition varies widely, especially regarding silica: "The quartz content may change within a few feet from a trace to 40 per cent; in general it averages about 12 per cent. Hornblende and/or biotite make up to 10 to 40 per cent of the rock; the remainder is predominantly feldspar . . . The feldspars, generally basic oligoclase, are considerably altered to epidote and some sericite; orthoclase is rare." He also stressed the granulated nature of the quartz grains and of some of the feldspars.

In describing the granitic rocks assigned to this unit north of McGavock Lake, Oliver considered that the textures, as seen in thin section, resemble those of a metamorphic rock rather than the typical igneous rock. Further, his description indicates 35 per cent microcline and orthoclase present in that area, as against the minor amounts noted by Fawley in the Lasthope Lake area.

The composition of this unit, north of McGavock Lake, as given by Oliver[2] is: 35 per cent microcline and orthoclase, 25 per cent oligoclase, approximately Ab_{85}, 35 per cent quartz, and 5 per cent biotite. The feldspar averages about 1.5 millimeters in grain size, and commonly has albite twinning. Perthite is present, but is not common. Quartz occurs as fine grains (0.3 to 0.5 millimeter) and coarse aggregates up to 5 millimeters in diameter. Biotite is in shreds and flakes, pleochroic from light yellow-brown to dark brownish black, almost opaque.

The differences in composition between the tonalite north of McGavock Lake and that from the Lasthope Lake area, suggest that these may be, in fact, different rocks. As a matter of fact, Oliver suggested[3] that the tonalite in the "south dome" is derived "by the mobilization and partial fusion of the granitized [Sickle] sediments" and that it was emplaced as an "igneous diapir", invading the rocks from which it was derived. It must be admitted that in the present maps the correlation with the post-Sickle tonalite at Lasthope Lake is not as good as could be wished.

GRANITE AND GRANODIORITE

This unit is equivalent to the "younger granite" as defined by Fawley in the Lasthope Lake area. In large part it is aplitic or porphyritic, though massive phases also occur.

DISTRIBUTION AND TOPOGRAPHIC EXPRESSION

A large mass of this granite occurs east and south of Finch Lake, and extends southwestward. A smaller area forms the "north plug", north of McGavock Lake, and it is also found south of McGavock Lake. There is a large area of this granite east of Beatty Creek and Beaucage Lake and apparently extending far to the east. A small amount is found on islands in Laurie Lake near the Saskatchewan boundary, and on the north side of the lake there is a larger area. Small bodies are present in the high-grade area south of Eager Lake.

Topographically the expression of this rock seems to vary with the surrounding material. East of Beatty Creek it forms high, bald, rounded ridges, the edges of

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[1]*Man. Mines Br. Publ. 49-5, p. 19.*

[2]Geology of the McGavock Lake Area, Northern Manitoba. *Unpubl. Ph.D. Thesis, University of California, Los Angeles, 1950, p. 75.*

[3]*Ibid., p. 82.*

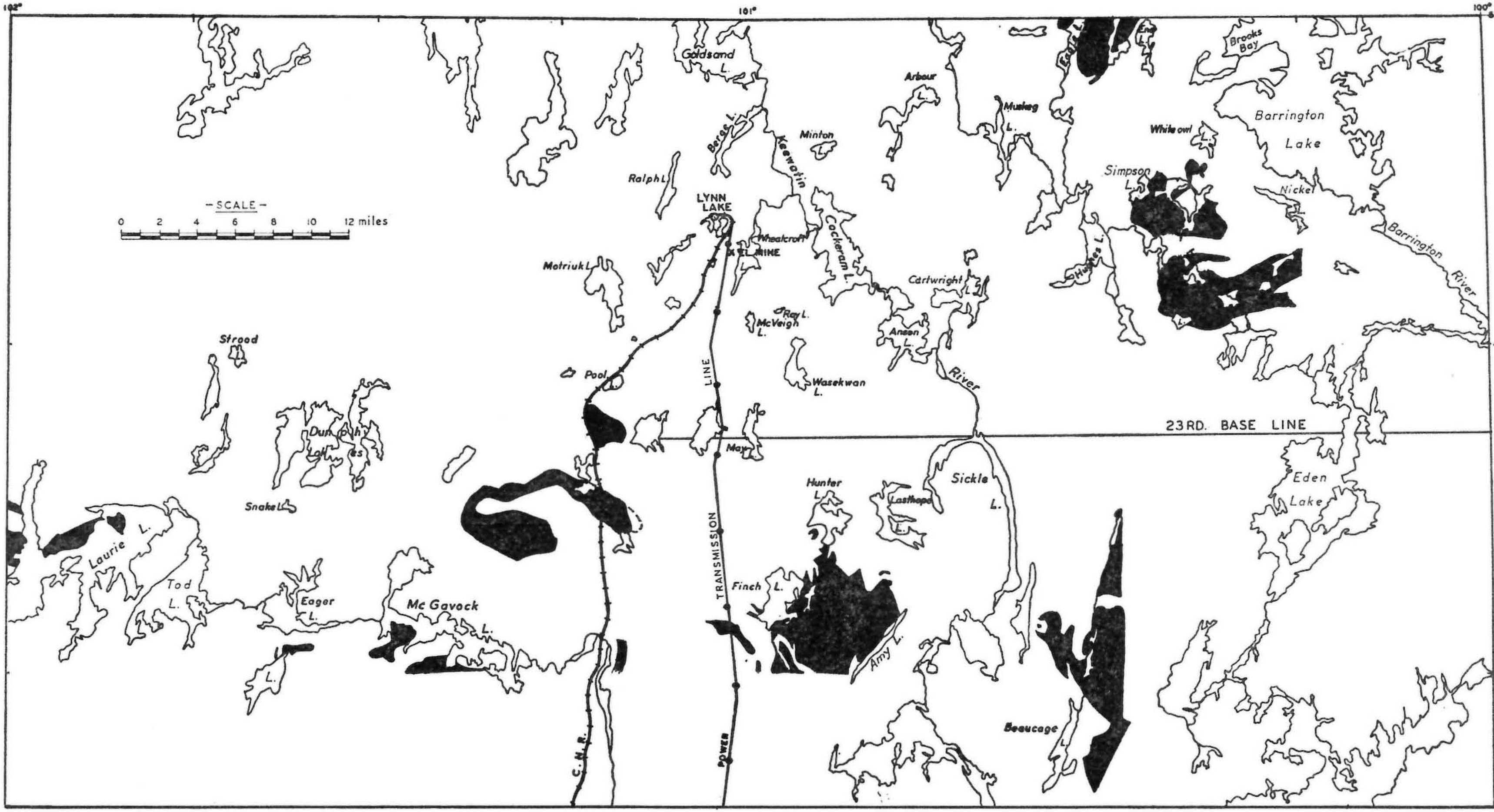

Figure 20 — Distribution of post-Sickle granite.

which follow quite closely the contact of the granite, so far as it can be defined. This feature is clearly visible, on aerial photographs, east of Beaucage Lake. South of Finch Lake, also, the ridges are high and bare, with the great inclusions of greenstone and sediment marked by shallow hollows and valleys, but the contrast with the grey tonalite is not great and extensive areas of drift and muskeg are also present. The same may be said of the area north of McGavock Lake, where there are both good exposures and areas of low relief. It seems probable that the actual relief is determined largely by the nature of the surrounding rocks, with a general tendency for the granite to be more resistant and to support the higher ground.

AGE AND CONTACT RELATIONS

The granite is well established as younger than the Black Trout Diorite and the tonalite, in the southeastern part of the district. The age of the rocks assigned to this unit in the central part of the area is doubtful, however, and they may be gradational into the tonalite.

The granite east of Beaucage Lake (Map No. 7) can be seen cutting the Black Trout Diorite, which establishes the age as definitely post-Sickle. This mass of granite extends northeast, where it was mapped as "microcline granite" by Fawley, east of Beatty Creek. South of Beatty Lake there is an area of poor exposure and confused relations, where some grey granitic gneiss is found. This may represent the earlier post-Sickle tonalite, or may be some other unit entirely. Because of the apparently limited extent, and poor exposure, this has not been differentiated on the maps.

In the Lasthope Lake area, the pink aplitic granite invades the Kisseynew-type gneisses, the Wasekwan and Sickle series, the Black Trout Diorite and the grey tonalite ("older granite"), according to Fawley.

The extension of this unit into the area of Naylor and Patton lakes is based on lithological similarity; Oliver's map boundaries have been followed in extending this unit into the "north dome", southeast of Wilmot Lake (Map No. 5).

In this part of the area, there can be little doubt of the post-Sickle age; the age relative to the grey tonalite, however, is based on the relations found for the aplitic granite south of Lasthope Lake. This is the reverse of the age assigned by Oliver in his work. His reasons are not clear. In the thesis quoted above, he says on page 89:

"The foliation of this [gneissic biotite[1]] granite in its long extension into the central part of the plug is parallel to that in the aplite, and it remains parallel as it swings to the southeast. At the southern end of the plug, however, this is not the case, for here the gneissic granite definitely appears to have intruded the aplite (Plate 10)."[2] He further says, on page 90: "Sharp contacts between the two types of granite in this plug were not found. In two localities where the exposures are excellent, however, it was possible to walk from aplite to gneissic granite over a distance of 100 or 200 feet. There appeared to be an insensible gradation of the one type of granite into the other. One of these localities is near the southern end of the plug, where the gneissic granite appears to be intrusive into the aplite as indicated by the marked difference in strike of the foliation of the rocks in the two bodies."

This intrusive relation appears to be based on an area about three miles east of Redwin Lake, where the attitude of the gneiss changes rapidly. One finds it difficult to see how the variation has much bearing on the mutual ages, unless the foliation be considered marginal, and so outlining the direction of motion of the granite, after the fashion of the school of *granittektonik*. This is a valid age criterion only if it can be shown that the foliation is due to such motion, and not, for example,

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[1] = grey tonalite.

[2] Plate 10 is a mosaic of four aerial photographs, covering that part of the area, and numbered A10944-16, 17; A10945-222, 223.

the foliation of included Sickle sediments. In this case, there is some evidence to suggest that considerable amounts of Sickle are present in the tonalite there, and a few small outcrops have been so shown on Map No. 5.

In the Laurie Lake area (Map No. 4) the age of the granite is assumed from its massive character, from the intrusive relation with Kisseynew-type gneisses probably derived from the Sickle series, and from the presence of pegmatites cutting the Sickle series and believed to be related to this granite. It will be readily apparent that none of these criteria is very compelling, and that the assigned age really rests on the identification of the pegmatites with the granite. A more reliable relation is definitely needed but so far none has been identified. A narrow band of pegmatitic granite cuts the Kisseynew-type gneisses, east of Laurie Lake at the southern margin of the area, but there is strong reason to suspect (Tod Lake fault) that the gneisses at that place are derived from Wasekwan, rather than Sickle, rocks.

The granite south of Eager Lake is post-Sickle, without much doubt, but differs in character from the typical aplitic granite from east of Finch Lake.

PETROGRAPHY

In this unit, which is defined fairly closely by the age relations, there is a notable variation in content of dark minerals, either hornblende or biotite; large variation in the amount of potash feldspar, and in its mode of occurrence; variation in texture from aplitic and medium grained to porphyritic; and some variation in the composition of the soda-lime feldspars. The differences are probably due to the presence of several varieties or sub-types. These may be reflections of differences of age, and origin. The rocks are considered to be intrusive, rather than the product of metamorphism.

The character of this granite varies somewhat across the district. East of Beatty Creek and Beaucage Lake, it is pink to brownish red, with large feldspar phenocrysts scattered in a matrix of finer feldspar, quartz and small flakes of biotite. South of Lasthope Lake the rock is fine grained, pink, very low in dark minerals and, in places, is difficult to distinguish from fine-grained Sickle arkose. The same difficulty in separation is also present south of McGavock and Eager lakes, but both the granite and the gneisses are coarser grained there. At Laurie Lake the granite is light in colour, as at Lasthope Lake, but with more biotite and with feldspar grains commonly 2 or 3 millimeters long.

Beaucage Lake: In more detail, this granite east of Beaucage Lake is pink to brownish weathering, appears fresh, and contains irregular aggregations of black biotite about 2 millimeters in diameter. Some of the quartz is dark, and the feldspar has a definite pinkish colour.

A thin section of a specimen which is considered typical of the porphyritic phase is composed of 15 per cent quartz, in grains as much as 5 millimeters in diameter, 45 per cent orthoclase, 10 to 15 per cent microcline, and about 25 per cent sodic plagioclase ($Ab_{88}An_{12}$). Biotite amounts to 3 to 5 per cent. The feldspar grains are slightly altered to kaolin, and some contain finely divided hematite. Close to the margin the granite is more definitely grey in colour and has 10 to 15 per cent biotite with a decreased amount of potash feldspar. The accessory minerals include apatite, 1 to 2 per cent hornblende, and a little clinozoisite.

The margins of the granite mass are fine to medium grained and, for 1 to 2 miles from the contact, the rock is not porphyritic, but does show variations in composition. Included in this part is a brownish grey phase containing 30 per cent orthoclase and 20 per cent microcline, in fine grains, and 40 per cent kaolinized plagioclase of the same composition as that of the main mass. Biotite and quartz each amount to about 5 per cent. This may be a marginal phase of the main mass.

Also, there is a granodiorite phase which contains 25 per cent quartz and has the proportions of the feldspars reversed, as compared to the porphyritic granite, (plagioclase, $Ab_{90}An_{10}$, 45 per cent, microcline 10 per cent, orthoclase 15 per cent.)

This phase contains less than 5 per cent biotite and some muscovite. The orthoclase is altered to kaolin in irregular patches. This rock may represent a marginal phase of early consolidation, or it may be a separate intrusion, although intrusive relationships were not recognized.

Sickle Lake: In the Sickle Lake area, Fawley described this same mass as having similar appearance but with oligoclase increased to 40 per cent; microcline and orthoclase, combined, only 25 per cent; biotite, 10 per cent; with minor amounts of epidote, muscovite, kaolin and apatite. He published a chemical analysis of a sample from east of Beatty Creek and approximately on the north boundary of township 87:

SiO_2	70.8 %
Al_2O_3	17.2
Fe_2O_3	0.6
FeO	0.8
MgO	Tr
CaO	2.7
Na_2O	1.4
K_2O	5.1
H_2O+	0.25
H_2O-	0.1
CO_2	Tr
TiO_2	0.3
P_2O_5	—
S	—
Cl	—
F	—
	99.31

Sp. Gr. (Pulp): 2.65
Analyst: Mackiw, Man. Mines Branch Laboratory
Spec. No. F170-48 Lab. No. R 2

MODE:	
Quartz	25
Microcline	20
Orthoclase	7
Oligoclase	40*
Biotite	3
Epidote	5
Magnetite	Tr
Muscovite	Tr

NORM:	
ap	—
il	0.61
or	30.02
ab	12.05
an	13.34
C	4.49
mt	0.93
hy	0.4
Q	37.14

On the basis of the above mode, this rock is a granodiorite or sodaclase granodiorite, in the classification of Johannsen.

Lasthope Lake: In his published description of the "younger granite" at Lasthope Lake, Fawley emphasized the fine grain, massive nature and absence of dark minerals. On the basis of three of his thin sections, the quartz content ranges from 25 to 50 per cent; microcline and orthoclase from 20 to 50 per cent, with 35 per cent microcline in one of the sections and 30 per cent orthoclase in another. Biotite, pleochroic from straw yellow to dark olive-green, almost black, forms 3 to 5 per cent, and there are additional minor amounts of muscovite, epidote, and traces of magnetite, chlorite, and pyrite. One sample shows 50 per cent plagioclase, but in the others it is missing.

Hunter Lake: A small granite boss, on the southwest side of Hunter Lake, has been shown on Map No. 6, mainly on structural grounds. This was mapped by Fawley as Kisseynew-type gneiss, and, it must be acknowledged, is compositionally unlike the aplitic granite: 30 per cent quartz; 8 per cent biotite, dark brown to almost black; 15 per cent microcline; 1 per cent magnetite, and 50 per cent plagioclase, Ab_{60}[!].

*Fawley identified feldspar as oligoclase. Some, at least, is albite.

Wilmot Lake: The aplitic granite southeast of Wilmot Lake has, according to Oliver, an average composition which falls within the range given above by Fawley's sections: 40 per cent potash feldspar, 25 per cent calcic albite to sodic oligoclase, and 35 per cent quartz, with 1 per cent biotite. Some sections show layers made up chiefly of quartz, suggesting the possibility of relic bedding planes.

McGavock Lake and Eager Lake: In describing the granite to the southwest of McGavock Lake, Oliver pointed out[1] that the composition is extremely variable. In the northern part it is medium grained, poorly foliated and aplitic, whereas it has a more normal granitic appearance to the southwest. The composition of this "granite", as given by Oliver, is very similar to that given by Stanton for the small bodies south of Eager Lake, which are obviously a part of the same structural unit. Stanton described[2] them as follows:

"Pink granite and granite gneiss . . . occur as poorly defined bodies within the stratiform granitoid paragneisses . . . The difficulty in locating contacts is due to the strong lithological similarity between many of the igneous and sedimentary gneisses. The zones mapped as granite and granite gneiss within the southeast part of the map-area commonly indicate nothing more than areas in which igneous character appears to be dominant over sedimentary. Some of the areas mapped as granite and granite gneiss undoubtedly include considerable granitoid paragneiss; others appear to be essentially igneous. The rocks are characteristically medium grained and distinctly pink. Microscopic examination of a specimen from the small granitic nose near the extreme [southwestern tip of McGavock Lake], indicated the following mineral content: feldspar, 50 per cent, dominantly oligoclase with a minor amount of microcline probably not exceeding 3 to 5 per cent; quartz, 40 per cent; biotite, 10 per cent. An appreciable amount of fine red iron oxide is disseminated throughout, and gives the distinctive pink colour to the rock. From mineral content this rock again falls into the granodioritic . . . group [in Johannsen's classification]."

Laurie Lake: Finally, in hand specimen the younger granite at Laurie Lake, is medium (1 millimeter) to coarse grained (3 millimeter) and has a distinct pink to reddish brown colour. It is typically completely massive; foliation, believed to be primary, appears only near the contact with surrounding rocks. Quartz, pink and grey feldspar, hornblende, and biotite are all clearly visible under the hand lens.

A thin section of a sample considered typical of coarser-grained material showed 30 per cent of microcline, 15 per cent of fractured orthoclase, and about 27 per cent of plagioclase ($Ab_{85}An_{15}$), in grains averaging 1.5 millimeters in diameter. Quartz amounts to 25 per cent, in grains up to 2.5 millimeters in diameter, and in a few places occurs as myrmekitic intergrowth. Biotite in small, greenish, unoriented flakes, amounts to 3 per cent.

Probably there are several varieties or sub-types included within this unit; these may reflect differences of age, origin, or possibly metamorphism. With the information and samples now available, no ready subdivision appears to be possible; the area covered by the McGavock Lake map (No. 5) would be critical.

There is a further suggestion of this in some of the age relations noted in the Lasthope Lake area by Fawley. There are such notes as one describing the "older grey biotite granite", with basic inclusions, and both cut by grey aplitic granite which in turn is cut by pink aplite and pegmatite. Or another, indicating that the "older grey granite" is cut by white aplitic granite; or still another, showing the older grey granite cut by a trap dyke and both cut by grey aplitic granite—thus raising a question as to the age of this particular "older granite". These limited exposures have been included with the two major units and would require more careful consideration to bring about further subdivision.

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[1]*Unpublished Ph.D. Thesis, Univ. Calif., Los Angeles, 150, p. 94.*

[2]*Man. Mines Branch, Rept. 48-4, p. 27.*

LAMPROPHYRE DYKES

Lamprophyre dykes are noticeably scarce in the Lynn Lake district. They have been reported, in all, from 14 places, but always in very limited numbers. Fawley reported the largest number from the general area of Wasekwan, Young and Hunter lakes (Map No. 6). Most of them were found cutting Wasekwan rocks, or gabbro, though three are reported to cut the "older granite", i.e. the post-Sickle grey tonalite. In the same general area, Bateman also noted[1] that trap dykes cut the "later granite", and are displaced by small faults. A further 3-foot dyke cuts Wasekwan(?) rocks south of Lasthope Lake.

An analysis of a trap dyke, intruding the grey post-Sickle tonalite south of Dufresne Lake, is given by Fawley and repeated below:

SiO_2	52.43%
Al_2O_3	16.84
Fe_2O_3	2.63
FeO	8.51
MgO	4.33
MnO	0.23
CaO	8.55
Na_2O	2.20
K_2O	2.10
H_2O+	1.05
H_2O-	0.06
TiO_2	1.01
P_2O_5	0.13
	100.07

Spec. F375C-49 Lab. No. R 15
Analyst: I. Spector, Man. Mines Branch Laboratory

In the *Sickle Lake area* (Map No. 6), to the east, Fawley's notes mention only two dykes. One is on the west side of Keewatin River south of the long rapids and the other to the east. The second is only 6 inches thick.

In the *Beaucage area* to the south, Milligan found only one small dyke, cutting Sickle sediments (Map No. 7).

In the *Counsell Lake area* (Map No. 5) also, undoubted dykes are not common. Two small dykes are reported from the north of the outlet of McGavock Lake, and it is noted that one is cut by pegmatite. Another exposure north of the centre of McGavock Lake, was identified as dykes in graphic granite, but the description continues: "dykes highly folded and not continuous, in places, but form long lenses of 200 feet . . . some graphic granite occurs in lenses within the diabase." This sounds more like an inclusion within the granite. The "dyke" of hornblende-mica schist shown south of Phoebe Lake on map 49-4 has been combined, on the accompanying map, with several similar small outcrops into an irregular area of Kisseynew-type gneisses. At Dunphy Lakes, Stanton found a single 3-foot black dyke cutting grey biotite granite. None were noted in the Laurie Lake area.

North of *Ron Lake* (Map No. 2), Allan noted narrow black dykes cutting the acidic flows there, and another was noted cutting most of a large outcrop of diorite on the east side of the long valley running south from Muskeg Lake. Basic dykes are also found cutting the diorite and gabbro near *Tulune Lake*, as noted above (p. 60). (At Tulune Lake felsite dykes are also present, and apparently late in

[1]*Geol. Surv., Canada, Paper 45-14, p. 26.*

the sequence.) Allan used the presence of these dykes in the western part of the gabbro body at Tulune Lake, and their absence from the eastern part, as a basis for the suggestion that the two parts are separated by a fault and that the western part represents a lower horizon in the gabbro.

A post-granite dyke, 1 mile west of *Omega Lake* (Map No. 3) is reported by Stanton, as well as a few cutting Wasekwan volcanic rocks.

Narrow dykes of porphyritic basic rocks are reported to cut other types, including granite, in the *Barrington Lake area.* It is impossible to assign an age for these dykes because of uncertainty as to the identity of the granites there. The description, as given by Crombie[1], follows:

"The diorite porphyry contains fairly crowded phenocrysts of feldspar as large as one-fifth inch in a fine-grained matrix of felted amphibole needles and feldspar. A gneissic texture is not uncommon. Feldspar phenocrysts also occur in the andesite porphyry dykes, but they are generally smaller, one-sixteenth inch or less. The groundmass of the andesite porphyry is more dense than that of the diorite porphyry, and amphibole needles are not visible. Distinction between the two rocks is not easily made, but where they occur together, as on the property of Barrington Lake Copper Mines Limited, near the southeast extremity of Barrington Lake, the andesite porphyry dykes are seen to cut the coarser diorite porphyry dykes. East of Barrington Lake numerous basic dykes cutting the granite are similar to the andesite porphyry dykes, though some contain no feldspar phenocrysts. The dykes seem to follow definite fracture directions in the rocks, and themselves contain fractures that are sealed with quartz and scattered biotite flakes. A few grains of chalcopyrite were observed on such a seam in an andesite porphyry dyke."

Most other lamprophyre dykes are also reported as porphyritic. At Omega Lake, Stanton noted ⅛-inch plagioclase phenocrysts in a fine-grained hornblendic matrix and, at Lasthope Lake (Map No. 6), Fawley noted 1/16- to 1/4-inch hornblende crystals in a chloritic groundmass. The dykes at Tulune Lake are fine grained and massive, as are those east of Sickle Lake.

Among the dykes noted at Tulune Lake is a most unusual one, 2 inches thick, cutting gabbro. It has a dark hornblende core and white feldspar margins which cut the core (pl. VI, B). One is at a loss to explain this dyke. There is evidently some connection between the core and the margin, but it seems a little too fortuitous to assume that one dyke localized another later, felsitic one; and even more preposterous to assume that some form of segregation was acting.

All basic dykes known are too small to show on the maps.

QUARTZ-FELDSPAR PORPHYRY, QUARTZ PORPHYRY, FELDSPAR PORPHYRY AND FELSITE

Siliceous porphyry dykes have been reported from several places. Most are too small to distinguish on the accompanying maps. The age of the dykes is not known with any certainty. Relations are complex, and it is possible that several ages of siliceous dykes may be present.

Apart from porphyritic phases of the main intrusive units, several porphyry bodies were outlined by the original field work. The largest bodies found were those noted by Stanton in the Farley Lake area (Map No. 3), and were described by him as follows:[2]

"The porphyry and felsite rocks have been mapped as post-granitic intrusives, but there is strong probability this may not be the case. In the present map-area they have been found cutting only pre-Sickle volcanic rocks. Boulders of felsite and quartz-feldspar porphyry in the Sickle conglomerate may have been derived from

[1]*Manitoba Mines Branch, Prelim. Rept. 47-6, p. 12.*

[2]*Manitoba Mines Branch, Prelim. Rept. 47-5, pp. 14-15.*

these bodies, and if so, the porphyries and felsite are pre-Sickle[1] in age and probably related to acid flows of the pre-Sickle volcanic rocks. Again, the rock types grouped together as porphyry may be of more than one age or mode of origin.

"The body lying one and one-half miles northwest of Gordon Lake is a white-weathering, light grey feldspar porphyry consisting essentially of closely packed phenocrysts of feldspar with interstitial chlorite or chloritic biotite. The quartz content is low.

"The body to the west of Simpson Lake is a grey to dark grey rock varying from fine-grained felsite to quartz porphyry and quartz-feldspar porphyry. There is no distinct contact between the porphyry and granite, and it is possible the zone represents a chilled border phase of the granite. The granite in the immediate vicinity is grey and fine-grained, and resembles the granite near Susan and Pump lakes. The volcanic breccias and greenstones partially enclosed by the porphyry are cut by narrow dykes of fine-grained grey felsite.

"The small quartz-feldspar porphyry body one mile north of Nickel Lake is a grey- to pink-weathering rock with feldspar and quartz phenocrysts up to one-quarter inch across. This rock may represent a rhyolite porphyry flow or a feeder body to pre-Sickle rhyolite flows."

In the vicinity of Cartwright Lake (Map No. 2), Allan also noted quartz feldspar porphyry, east of the east bay of the lake, as irregular dykes and small masses cutting rhyolite, which is itself porphyritic in places.

Intrusive quartz-feldspar porphyry is reported by Allan from the south shore of Chepil Lake (Map No. 2) but the writer was unable to find it. To the east, along Hughes River, Allan reports an irregular mass of quartz porphyry and feldspar porphyry intruding Wasekwan rocks, as does a white-weathering feldspar porphyry southeast of Key Lake.

South of Barrington Lake (Map No. 3) two persistent bands of rhyolite and quartz porphyry follow the formation trend, and two bodies of porphyry are found at the southeastern extremity of Barrington Lake, west of Webb Lake. Smaller masses occur on the east side of Barrington Lake. "A few narrow 'rhyolite' dykes cut late basic dykes, but their relation to the large bodies of rhyolite and porphyry that are generally intruded by the basic dykes is not known."[2]

Quartz-feldspar porphyry and quartz porphyry intrusions are also present in the Lynn Lake area, according to Allan.

The quartz porphyry at West Eric Lake (Map No. 2) is based on three exposures, more or less in line, along the west side of the Elb 187, 188, 190 claims. If these outcrops represent a single body it must be of rather irregular shape, and extending from northeast to southwest, more or less under the intersection of the airport runways.

The felsite at the west end of the outcrop at the outlet of West Lynn Lake is, according to Allan,[3] porphyritic in part. "It apparently intrudes quartzitic sediments, and as the two rock types are not greatly unlike in appearance, the true extent of the felsite is not definite." The felsite is not, in fact, recognized by the Sherritt Gordon geologists.

On the east side of Ralph Lake a small body of quartz porphyry is visible on the shore ½ mile south of the sand beach, but is a little too small to show on Map No. 1. The porphyry is grey, with elongated white or pink feldspar and blue quartz phenocrysts which are a little better developed away from the contact. The adjacent greenstone may be a little more siliceous at the contact. In thin

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[1]It will be noted that on the accompanying map the granites in question have been shown as pre-Sickle in age.

[2]Crombie, G. P.: *Manitoba Mines Branch, Prelim. Rept. 47-6, p. 11.*

[3]Allan, J. D.: *Unpubl. Rept. in Mines Branch files; 1947, p. 39.*

section, according to Allan[1], the feldspars can be seen to be highly altered and the quartz grains show strong wavy extinction; the groundmass is very fine grained, mainly quartz with small flakes of biotite. It may be that this is an early intrusion, deformed with the Wasekwan, though the evidence for intrusion is not entirely compelling.

A fourth body, west of Franklin Lake is similar.

PEGMATITE, APLITE, GRAPHIC GRANITE

DISTRIBUTION

Pegmatite and graphic granite occur, in a few places, in bodies large enough to be shown on the maps which accompany this report. In most places these bodies are irregular dykes, in a general sill-like attitude and of limited extent. Southwest of German Lake, however, there is an area with a number of fairly large outcrops of graphic granite. These have been shown as if the whole area were underlain by graphic granite. If such is the case, it is an exceptionally large mass of such material; it may be that the outcrops, actually, are individual small bodies which invade the Kisseynew-type gneiss.

There are large bodies exposed on the north shore of Laurie Lake and on Laurie River upstream from Tod Lake; in the extreme southwest corner of the district, at the Saskatchewan boundary (Map No. 4) and on the east side of Beaucage Lake (Map No. 7), in addition to the places already mentioned.

Pegmatites, in dykes too small to show on the one-mile scale, are very abundant. The locations are shown on the accompanying two-mile map, Map No. 11.

The pegmatite in many cases, if not most, as reported on Map No. 11, is a coarse-grained quartz-feldspar mixture intruding the Sickle sediments as very narrow sills and dykes. These are, in many places, only a few inches thick.

The larger dykes are several feet across and are composed of quartz, feldspar, and muscovite or biotite mica in small amounts. The grain size may become extreme and, in a few places, individual feldspar crystals as much as two feet across can be seen where a cleavage face gives a reflecting surface for the sunlight.

Books of mica up to two inches across have been reported from southwest of Beaucage Lake and north of McGavock Lake, but these are not abundant, and those seen are not of economic importance.

The simple quartz-feldspar-mica mineralogy has been reported from the larger dykes, whereas the tiny veinlets and stringers in the gneisses are essentially quartz and feldspar. The "rare" pegmatite minerals have not been reported. It is the writer's experience that a certain familiarity with the pegmatite minerals is necessary before one can distinguish readily between, say, cleavelandite, amblygonite, spodumene, and feldspar. One strongly suspects that the pegmatites were not examined with sufficient care to be sure that these minerals are absent, even from those portions of the dykes which were actually seen.

AGE AND ORIGIN

The distribution of the pegmatite, as reported in the field notes, is shown on Map No. 11. It is immediately obvious that there is a pattern to the distribution. Because the majority are found in the Sickle series or its metamorphosed equivalents, it is obvious that they are post-Sickle in age. It does not follow, however, that all pegmatites are of the same age, or even all post-Sickle.

Possible explanations of the origin of the pegmatites are suggested by the evident restriction to the Kisseynew-type gneisses, which are the metamorphic

[1] *Ibid.*

equivalent of the Sickle series. If a rock of the composition of the Sickle sediments were raised to high temperature, it is possible, at least, that the quartz and feldspar would become mobile. This would be especially true if water were present.

One possibility is, then, that the pegmatites were derived by incipient melting of the Sickle rocks and the "sweating out" of the quartz and feldspar parts.

A second possibility is that the pegmatites are derived from the granitic masses which they surround. If the granitic rocks are not of magmatic origin, this second possibility does not apply.

Decision is perhaps unwise, with the data presently available, but some points may be reviewed. The rocks of the Sickle series, at Sickle Lake, have been severely deformed without being metamorphosed beyond the very lowest garnet zone. Surrounding the "granites", however, the rocks are all in the sillimanite zone of metamorphism. So far as structural evidence goes, depth of burial, intensity of deformation, and other conditions must have been similar in both parts of the area. The increased intensity of metamorphism in the central part of the area is therefore ascribed to thermal effects, due either to the exposed granitic rocks or to some intrusive mass at no great depth. Accordingly, whatever may be the immediate mechanism of formation of the pegmatites, the ultimate cause appears to be addition of heat from below. Decision on whether that came about due to intrusions below, or from burial to regions of high temperature, must wait until the structural details can be solved for the central part of the district.

CHAPTER VIII

STRUCTURE

GENERAL

In describing the structure of the district, so far as it is now known, the Sickle series is considered first. This is done partly because it is the better exposed, and so better understood, and partly because the history subsequent to consolidation of the Sickle should shed some light on the present structural pattern in the Wasekwan, and other pre-Sickle rocks.

In general, the Sickle series is considered to have been deposited in a basin probably much larger than the present 35 mile by 50 mile area in which exposures are found, and in which were arkose, sandstone, greywacke, and possibly shales and some limy beds. A large part of the presently exposed Sickle series is marked by crossbedding, scour and fill, mud cracks, and other features which imply deposition under shallow water. The presence of shale and more limy deposits implies an increasing depth of water, if the deposition was under normal marine conditions. So far as known, there was no volcanic activity, though this conclusion is, in part, based on structural interpretation and is, in part, the result of field criteria.[1]

The remnants of the Sickle series have been severely folded, wherever it has been possible to work out the structure, and even more severe deformation is suspected elsewhere. In the Sickle Lake-Lasthope Lake-Amy Lake area, the structure shows a synclinal basin, with subsidiary folds on one limb, the whole of which has been folded transversely. In the Tod Lake-McGavock Lake-Pyta Lake area, the general structure is a large overturned syncline; on the northern limb is a series of plications piled one upon another and plunging eastward; the southern limb has a series of gentle open folds, plunging northward towards the axis of the major syncline, but themselves cross-folded and compressed till they become isoclinal as the axis is approached, in the vicinity of Eager Lake.

Considering the district as a whole, the basin of Sickle deposition was deformed by a major compressive force, probably acting over a restricted width and in a northeasterly direction through Lasthope and Sickle lakes. If the Kisseynew-type gneisses be included (as the metamorphosed equivalent), the present remnants of the Sickle rocks form two large lobes (Fig. 21). One extends southward from Sickle Lake to Granville Lake, where a fragmental rock at Pickerel Narrows may represent the base of the series. The other extends westward beyond McGavock Lake, and to the south of Laurie Lake. The space between the two lobes is occupied by granitic rocks. The "granite", in large part at least, was emplaced subsequent to the folding. It may have been the active agent which caused the folding, or it may merely have occupied the space created where the sedimentary rocks were bent by the folding.

The hypothesis of a single force acting on a narrow front through Sickle Lake explains indirectly the structures found in both of the great lobes just mentioned. The action of such a force requires that all the country south of Tod and McGavock lakes should move northeastward, on the southern side of that lobe. (A rough model of the whole process can be made by pushing a table cloth diagonally across the table with one hand.) The northerly component of this northeastward dragging action would develop a group of folds with an easterly trend. The overturned syncline through Eager and Tod lakes is considered to be such a fold which has been itself bent by a continuation of the same eastward movement.

Similar effects, with a northward trend to the folds, should occur in the Granville Lake lobe, but exploration in that area is not of sufficient detail, as yet, to show if they are present.

In the area about Sickle Lake there was severe crumpling, with the development of a number of folds across the axis of the main thrust. There is some cross-folding, which is most clearly seen just east of Lasthope Lake.

The fracture pattern which should result in the Wasekwan to the north and east, has not been recognized. There is a suggestion of it, in a few places, in linear topographic features and in late gabbro dykes but this is, at best, no confirmation. On the other hand, the major faults recognized, around Lynn Lake for example, have a movement the reverse of that anticipated from the history of the Sickle series.

The structural picture of the Wasekwan is still very unsatisfactory. This is due to complexity and, in part, to lack of good outcrop and reliable marker units which can be recognized with confidence.

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[1]Presence of flows implied Wasekwan age, so it is really a circular argument to use this to draw conclusions about volcanic activity. See above p. 79.

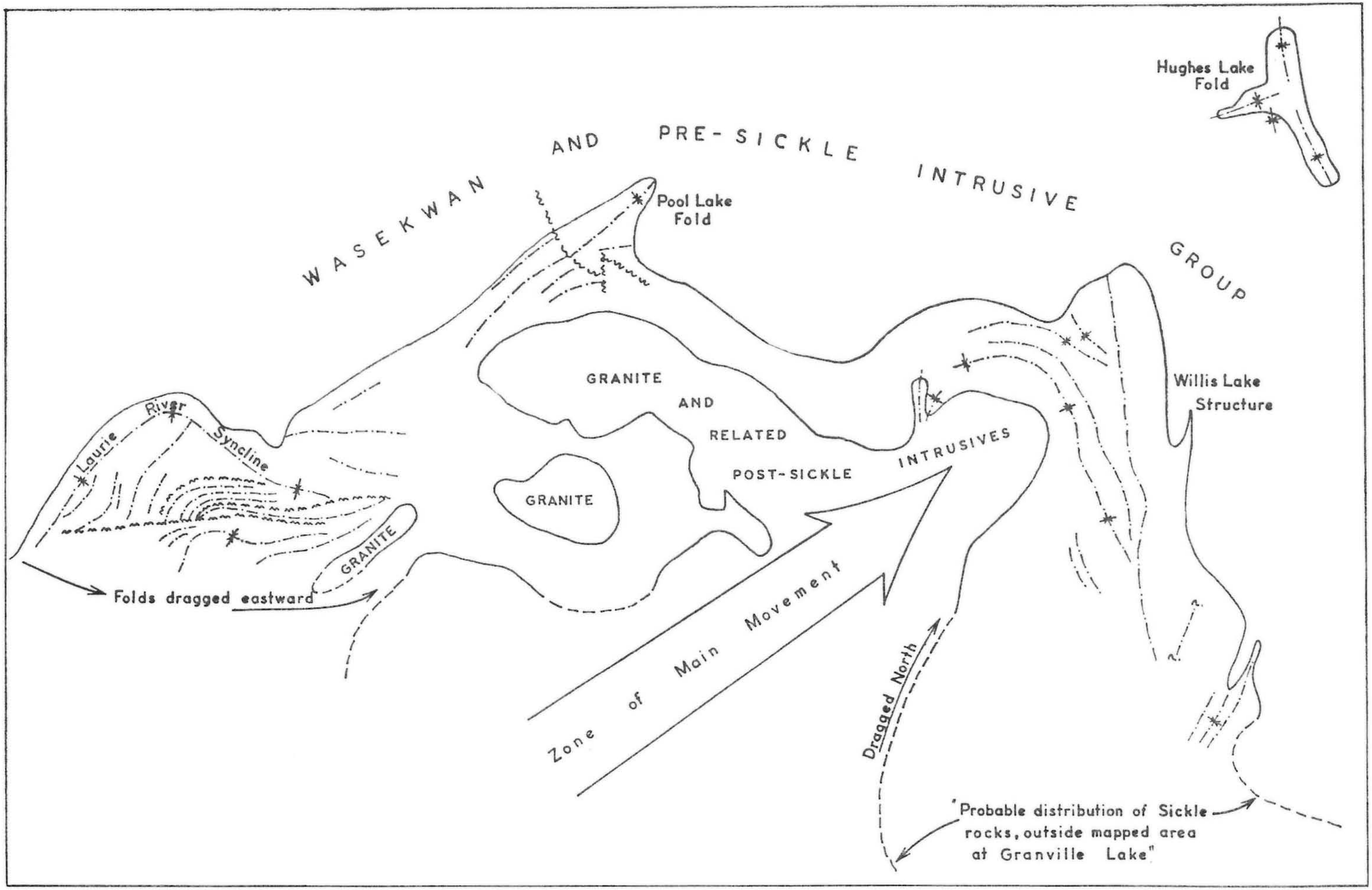


Figure 21 — Diagram indicating how the present distribution and structure of the Sickle rocks might result from a single major folding movement. The northeastward movement in the main zone produced a crumpling of the Sickle rocks in the Willis Lake structure; the dragging effect on the flanks of the two lobes produced subsidiary "cross-folds".

ISOMETRIC DIAGRAM

SHOWING

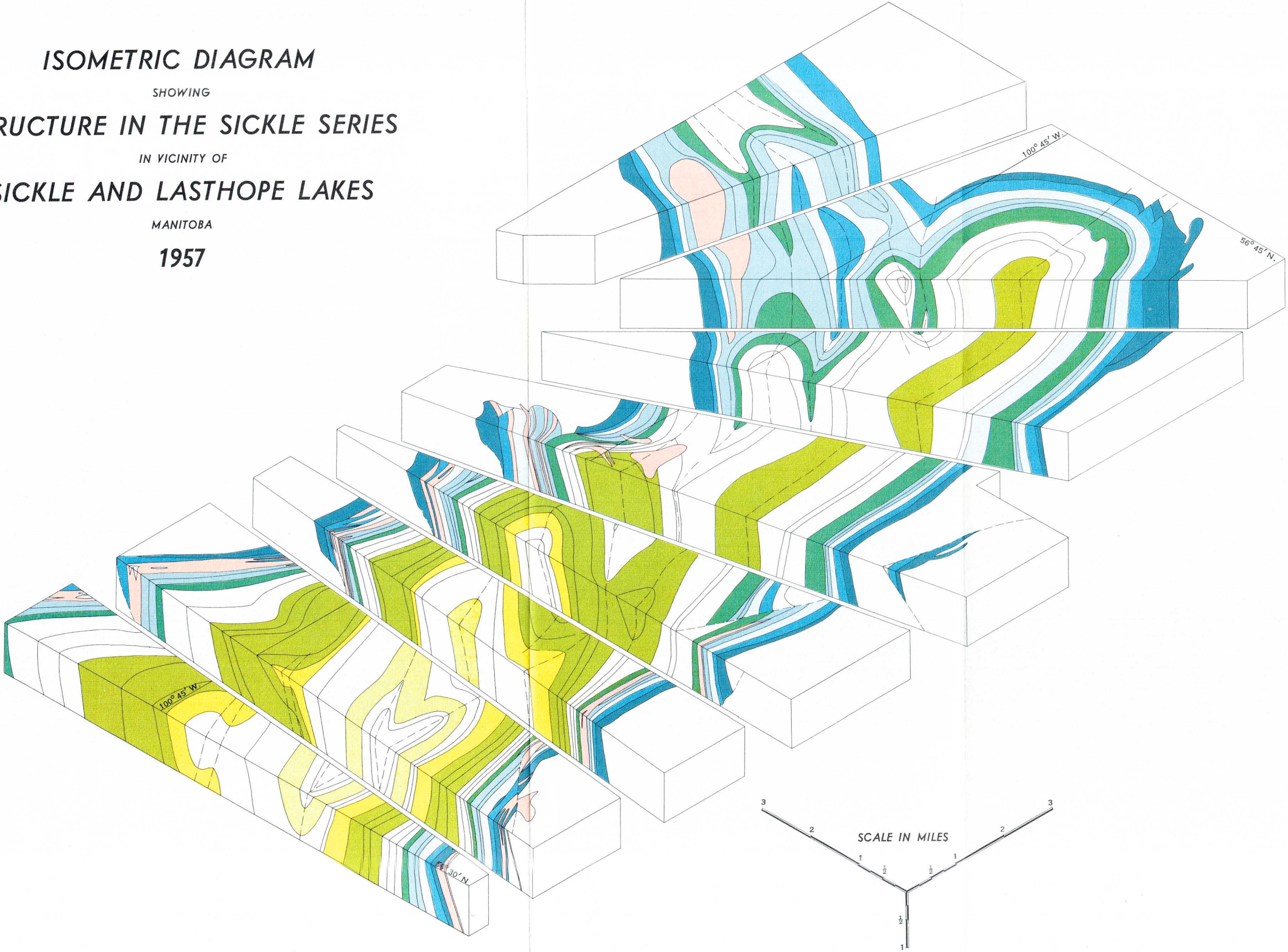
STRUCTURE IN THE SICKLE SERIES

IN VICINITY OF

SICKLE AND LASTHOPE LAKES

MANITOBA

1957



WILLIS LAKE STRUCTURE

The Willis Lake structure can be considered to consist of a synclinal basin trending north and south, but with the northern part strongly bent to the westward. The right angle bend is accompanied by the development of a number of subsidiary folds on the southern and western (i.e. inside) flank of the basin. The structure is considered to be due to a single thrust directed northeast over a limited front near Lasthope Lake. Tension fractures and peripheral faults are anticipated on the outside of the folded basin. The structure cannot be followed west of Hunter Lake.

An outline of the structural pattern in the Sickle series, at the type locality, is shown, on Map No. 6, by the traces of the axial planes of the folds recognized there. It will be noted that the centre of the basin of the main fold is occupied by Willis Lake, and it is therefore proposed to call this the *Willis Lake structure.* Within this term is included the complex of folds in the Sickle series between the granite-gabbro mass east of Black Trout and Sickle lakes and the granite lying southwest of Lasthope Lake; it includes the Sickle series underlying, and west of, Lasthope Lake.

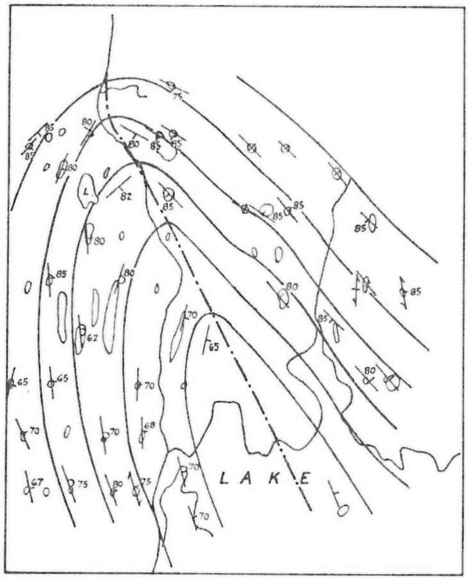


Figure 22 — The use of trend lines in outlining structure. Lines are drawn as nearly as possible in the position which would be occupied by beds. Area at NW Corner, Chicken Lake.

The details of the Willis Lake structure were worked out by using trend lines. (See Fig. 22.) That is, lines were drawn on the map as if they represented bedding planes, and all recorded information on attitude and lithology was taken into account. The trend lines obviously do not represent actual bedding planes, but are believed to approximate the bedding quite closely. From recorded minor features, such as drag folds and lineation, the attitude of fold axes was determined; these were checked graphically by the technique of intersection of bedding planes near the axis. It was then further assumed that, for distances up to about half a mile, the elements of the curved surface of a major fold are parallel to the axis. From this point it is an elementary exercise in descriptive geometry to find the intersection of any "bedding plane" (as represented by the trend lines), with the plane of a section. A series of vertical sections was drawn approximately normal to the structural trend. These are shown on the accompanying illustration.

Synclinal Basin, Willis Lake

The dominant structural feature is a doubly-plunging syncline. The northern and eastern margins are outlined by the curve of Sickle Lake; the eastern margin is offset to the northeast by a fault, and forms the eastern side of Black Trout Lake. The basal conglomerate, on the margin, can be followed through minor faults to Beaucage Lake, where a further eastward displacement occurs. The axial plane of this fold, as indicated by beds facing each other, is near the middle of Willis Lake, whence it bends slightly east and continues southward through the eastern part of Chicken Lake.

A mile and one-half south of the 23rd base line the fold plunges 70° to the south, and the opposite flanks are essentially parallel; the plunge decreases northward and near Sickle Lake is about 50° south. At Willis Lake no reliable figure for the attitude is available, but at the place where the Keewatin River crosses the axial plane the axis plunges 47° in a direction S 10° E.

The highest point in the fold, stratigraphically, is near the centre of Chicken Lake. At the south side of that lake, the axis plunges 65° in a direction N 20° W. The south shore of Chicken Lake follows very closely the bedding in the Sickle series and outlines the southern trough of the synclinal basin.

The development of this fold further south is not known. The area covered by the Beaucage Lake map is on the overturned eastern flank of the syncline, and the first disturbance of the regular trend of the bedding is found south of the outlet of Beaucage Lake. Sufficient area to define the structure there has not been mapped.

Subsidiary Folds on Western Flank

Within the explored area, the western flank of the synclinal basin outlined above has three subsidiary folds superimposed. North of Ghost Lake an eastward bulge of the bedding in the Sickle rocks develops, between Ghost Lake and Sickle Lake, into a fold which is about 2,000 feet from trough to crest, and in appearance resembles a drag-fold. It plunges S 35° E at 35°, at its shallowest.

A synclinal fold runs northwestward from Chicken Lake. The trough of the fold must merge into the synclinal basin at Chicken Lake with a shallow southerly plunge. No data are available under the lake, of course, but the adjacent anticlinal axis plunges 85° south, just east of where the Keewatin River enters Chicken Lake. At the northwest end of the lake, east of the outlet, the axis of the syncline plunges N 80° E at 78°.

Northwestward the limbs of the fold close in so that it becomes almost isoclinal. The plunge remains practically constant for at least a mile, so the isoclinal fold is slightly overturned toward the west. No notable change is visible except a further compression of the fold (with some thinning?) as the axial plane bends northward parallel, more or less, to Lasthope Lake, though the attitude of the axis must undergo considerable change.

The attitude of the fold is completely changed east of the south arm of Lasthope Lake, where reliable data are next obtainable. Near the narrowest place between Lasthope Lake and Bagshaw Lake, the axis of this synclinal fold plunges N 30° W, on the basis of bedding intersections. The direction, at least, is confirmed by linearity in the conglomerate on the south shore of Lasthope Lake, where the plunge is 50° to the northwest. The synclinal fold, confirmed by top determinations at several places, is therefore inverted at this point, and has the attitude of an anticline.

The fold is again reversed within the next mile. A bay of Lasthope Lake follows the northern edge of the Black Trout Diorite mass and the axial portion of the fold is exposed at the eastern extremity of the bay. Fawley reports linearity plunging

60° in a direction N 60° W; the bedding can be seen to swing from N 30° E to N 15° W in a distance of 120 feet. The axial plane, as indicated by schistosity in the outcrop, strikes N 70° W and dips 85° N; the schistosity is well developed close to the nose of the fold, but elsewhere it is virtually non-existent. Bedding is almost at right angles to the schistosity, as would be expected. Formation tops show that the syncline is once more right side up, and plunging northwest. The reversal of the fold must take place very close to the end of this arm of the lake. At a point approximately 1,500 feet east and 2,000 feet north of the end of the lake, there are drag folds, with axes plunging 30° southeast, on the north limb of the fold.

Thence, the syncline continues westward across Lasthope Lake (of which the shape reflects the underlying structure) so far as it has been possible to follow the structure with certainty.

The anticline complementary to the syncline just described follows it quite closely through its gyrations. The reversal of attitude east of Lasthope Lake occurs at about the corresponding point, but it appears to persist as an inverted fold, (i.e. with the appearance of a syncline) a little farther to the south. It is inverted as far south as Fredette Lake; at Willis Lake the axis is nearly vertical.

This fold runs out, and disappears in the synclinal basin, at Chicken Lake. It is implicit in this that a relatively extensive area under the lake has nearly horizontal bedding.

The third fold subsidiary to the main synclinal basin structure lies southeastward through the western extremity of Sickle Lake. Comparatively, this is a normal plunging syncline but the plunge is reversed near where the discharge of Lasthope Lake enters Sickle Lake. The main basin structure is evidently the structural control on the northern part of Lasthope Lake.

The details of the Willis Lake structure are shown in the isometric diagram facing page 118. The structure shown incorporates all relevant field data on attitudes of bedding, linear features, drag-folding, and lithology. There are no anomalous records, so far as is known.

Origin of Willis Lake Structure

If we now back off a little farther, and look at the structure as a whole, we find it is an elongate, northerly-trending, doubly-plunging syncline, which may be considered as bending westward at the northeast end of Lasthope Lake. The small anticlinal fold at the extreme west of Sickle Lake is a crumble on the northern flank.

This feature, then, is a series of wrinkles (Fig. 23) extending both ways from the major bend of the structure, which is, more or less, in the vicinity of Bagshaw Lake.

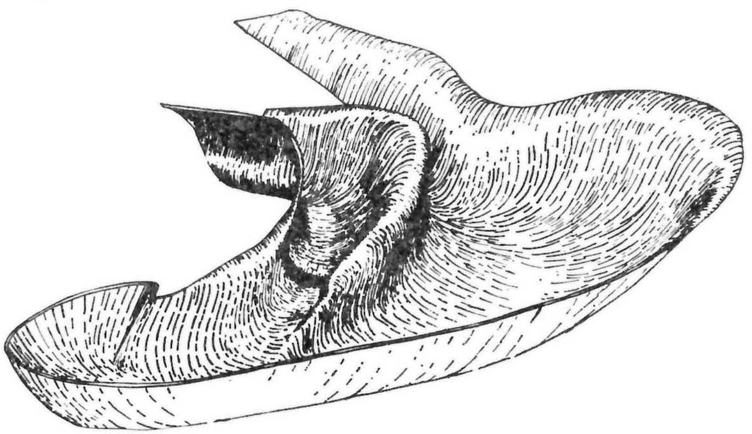


Figure 23 — Sketch to illustrate the folds of the Sickle conglomerate in the Willis Lake structure.

The development of the Willis Lake structure might be considered in two steps: the compression of the original basin of deposition into a series of folds of common attitude, and the subsequent cross-folding about a vertical axis, by forces acting more or less at right angles to the first stresses. The interval between these separate events may have been short or very long.

The same result could be achieved by a single relatively concentrated force, acting in a northeasterly direction. The original basin of deposition would then be analogous to an indefinitely large horizontal sheet or plate, subjected to a concentrated load acting horizontally, i.e. parallel to the plane of the sheet. In these circumstances the sheet is constrained on the flanks of the applied force, and a series of crumples develops around and ahead of the thrust. It is to be noted that the crumples plunge away from the thrust line and must die out as they reach the neutral axis[1] of the sheet. The active forces, therefore, insofar as the Willis Lake structure is concerned, must have been directed northeast through Bagshaw Lake or thereabouts.

This rather involved description can be reduced to a simple model by using one hand to slide a tablecloth across the table; or by taking a sheet of paper in both hands, thumbs together, and twisting, as in Plate VII, A. In passing, it is worth noting that in working out this structure several plasticine models were used to clarify the outcrop pattern of the bedding; it was found that several thin layers of plasticine, separated by "onion-skin" paper, when bent as described above reproduced rather exactly the Willis Lake structure, including the number of folds and the direction, but not the amount of their plunge.

The single period of deformation appears to explain adequately all the available data, and is the hypothesis preferred here. To postulate two separate and distinct periods of folding seems to be a gratuitous complication of the issue. One realizes, of course, that simplicity and truth are not synonymous, and that because the explanation is simple does not constitute proof that it is correct.

Regardless of the mechanism postulated, the mechanics of the result is the same, for a limited area. As pointed out above the country north and east of Sickle Lake will be in tension because of the great bend at Lasthope Lake. The result to be anticipated should be the development of normal faults radiating outward from the north end of Sickle Lake, and a complementary set of tangential thrust faults centred, more or less, at the same point[2]. The area of this development should extend as far as the next fold of comparable dimensions in the Sickle series. The Sickle sediments exposed at Hughes Lake probably represent the bottom of such a fold. It is probably pointless to speculate further, at this stage.

Westward Extension of Willis Lake Structure

To follow the Willis Lake structure westward beyond Lasthope Lake has proven intractable, so far. It is obvious that complex folding requires for its recognition and solution better outcrop than is present around Hunter Lake. In addition, the metamorphic grade is slightly increased—muscovite schist is developed west of Hunter Lake—and criteria of bedding attitude tend to be obliterated. Certain general features can be recognized, however:

In the southwest corner of Lasthope Lake, the conglomerate is resting upon greenstone and mixed tuff and sediments, which are believed to be Wasekwan.

[1]That is, the plane of zero strain. The term is borrowed here, by analogy, from engineering mechanics where it is defined as the "line, in the cross-section of a beam or column in a state of flexure, in which there is neither tension or compression".

[2]Unless the rocks were soft enough to deform plastically. The rocks in question are granitic types, gabbro, and amphibolite. The garnet zone is the highest grade of metamorphism directly associated with the folded sediment. Plastic flow of the rocks seems unlikely, therefore.

At the southwest corner of Hunter Lake a similar situation exists and, in a greenstone outcrop to the southwest, there is a suggestion of pillowed lavas. If the hornblende-feldspar gneisses at Hunter Lake are Wasekwan lavas, as they are here considered to be, then the Sickle series must extend very little farther south than Hunter Lake and the north end of Finch Lake. It further follows, as a probability, that the gneisses southwest of Finch Lake are Wasekwan derivatives. However, the Kisseynew-type gneisses northwest of the lake resemble the Sickle rocks very closely and are probably derived from them. Small amounts of Sickle, at least, have obviously been displaced by the granite, but probably this does not amount to more than a few hundred feet.

A similar line of argument can be applied north of Hunter Lake, where the greenstones and gabbro, if correctly identified, indicate the basement rocks, even though the conglomerate appears to be absent.

Sickle sediments, therefore, extend westward from Lasthope Lake as a band about 20,000 feet wide. Top determinations are sparse but conglomerate lenses are present south of the creek connecting Hunter and Lasthope lakes, as would be expected, and the strata face north, at least within 2,000 feet of the creek. The south limb of a syncline can then reasonably be supposed to lie south of the creek. Some distortion of bedding by the diorite plug to the east is to be expected.

The axial plane of this syncline has been placed just north of the creek. There is a certain temptation to place it south of the creek, because of the reversal of dip there, but there is no counterpart on the eastern shore of the lake, unless there is a fault in the lake. The further suggestion in the schistosity, that the axial plane should swing across Hunter Lake to the fold in the extreme south corner is obvious.

The larger fold around the granite boss, southwest of Hunter Lake, is an anticline, by definition. The syncline adjacent, marked by the contorted conglomerate, must then be inverted and plunge 60° southwestward, on the basis of intersecting bedding and schistosity.[1] That is, the fold in the Sickle rocks plunges beneath the Wasekwan amphibolite to the southwest. The close folding, represented by this overturned plunging syncline and the adjacent anticline, probably resulted from buckling when the 20,000-foot width of sediments was bent from west to south and then west again, north of Finch Lake.

One assumes that the attitude of the anticline is essentially parallel to that of the adjacent syncline. It is obvious, therefore, that there has again been a marked change of attitude from the normal westward-plunging folds at Lasthope Lake.

The obvious correlation of the two southernmost synclines, across Hunter Lake is probably not justified. The structure is plainly becoming more complicated in the western part, and data are absent in the interval. It has therefore appeared best not to make the correlation, though recognizing the possibility.

The northern part of the band of Sickle sediments appears also to be a unit, and to be the northern limb of the syncline centred over Cloverleaf Lake. Such tops as are observable, show that there the beds face to the south, and the dip is uniform. Lack of outcrop, however, probably removes any justification for extending the fold much beyond Garbutt Lake.

The attempt to carry the whole structure farther west has been fruitless. North of Finch Lake there is a fair amount of outcrop but no information on bedding tops. An inspection of the aerial photographs suggests that there are tight isoclinal folds, perhaps a quarter of a mile across, in the large outcrop north of the creek which connects Eaton Lake with Hunter Lake, but there is now insufficient evidence to demonstrate such folds. From the few measurements of schistosity, it is evident that the axial planes of the folds run northerly, to the west of Hunter Lake, but are

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[1]A field note reports plunge on the long axis of pebbles in the conglomerate as 90°. This is interpreted as being controlled by the movement which developed the schistosity, rather than a linearity parallel to the fold axis, because the latter is impossible in beds dipping only 60°.

trending westerly in Range 23W, near the edge of the Sickle Lake map-area-Further deductions do not appear justified. The western side of Hunter Lake has been the limit to any reasonably valid detailed structural speculations.

The Sickle series, or recognizable equivalents, widens southeastward from Last. hope Lake and extends for at least 28 miles, if Norman's identification of the conglomerate at Pickerel Narrows is correct. It also extends westward for at least 35 miles, to Tod Lake, with increasing width; along the line of the railway there is an exposed width of eight miles, at least. This might be viewed as two great lobes widening outwards from the narrow connection between them at Lasthope and Finch lakes.

This represents the Sickle rocks now remaining after erosion. No doubt the original basin of deposition was much more extensive, and may even have extended far beyond the limits of the Lynn Lake district.

LAURIE RIVER SYNCLINE

The Sickle series, in the whole area between McGavock Lake and Laurie Lake, can be considered to consist of a great overturned syncline, which is here named the Laurie River Syncline. The trough of this great fold lies along the northwest side of Tod Lake, and is bent southeast through McWhirter Lake and the north end of Eager Lake to Laurie River near McGavock Lake. The syncline, east of Tod Lake, is overturned so that its axial plane dips north at less than 30 degrees; at the same time it plunges eastward at 10 to 25 degrees.

The northern limb of this overturned fold is itself composed of two smaller folds piled one upon another. Because of the eastward plunge the smaller folds show in outcrop only in the area between Pyta and Conglomerate lakes. Westward they have been eroded away; eastward they disappear beneath McGavock Lake. The southern limb of the Laurie River syncline has superimposed upon it a number of minor folds which, near Tod Lake, trend northward towards the trough of the syncline, where they die out. It is probable that in the eastern end of the fold, near Eager and McGavock lakes, the compression has been greatest. The minor folds of the southern limb are isoclinal there, and have themselves been folded. They plunge eastward at approximately 20 degrees.

There are also faults, probably of large displacement, south of Eager Lake.

At the western extremity of the district the folding can also be deciphered in the vicinity of Tod and Eager lakes. The rocks south of Tod Lake are very similar to those southeast of Chicken Lake, and are, in some places, the least altered Sickle rocks in the district.

The folds outlined on Map No. 4 were derived by the same technique as was used in the Willis Lake structure. They incorporate bedding features measured in the field, the recorded attitude of minor folds in five places, such structures as are clearly visible on aerial photographs, and the correlation of topography and structure.

On aerial photos it is possible, in a number of outcrops, to see the attitude of beds and layered features. Where these are visible they were plotted on the map and integrated with the field measurements already plotted. In many cases it was possible to correlate photographic features with field measurements, and so exercise a measure of control on the photo interpretation, while simultaneously using it to extend the field data. In doing this, it became evident, in many places, that there is a close correlation between the topography and the underlying structures; as, for example, on the Laurie River between Tod and Eager lakes. In outlining the folds, then, the topography was used as an indicator to supplement the other data.

Folds at Tod Lake

The interpretation which results shows a series of folds, trending northward, between Talon Lake and the south end of Tod Lake. As they approach the Laurie River, the folds are bent eastward towards Eager Lake. A vertical section, normal to the trend of the folds, through Murray and Tod lakes (Fig. 24) shows that the folds are upright and open. They plunge north-northeast at 10 to 22 degrees. As the folds swing eastward, the plunge increases in some places, and one mile west of Eager Lake drag-folds show the plunge to be 27 degrees east. The folds also are compressed more closely, south and west of Eager Lake. There the strike of the opposing limbs is approximately parallel, though there is some divergence of dip which indicates that the axial planes dip steeply north. Five of the "trend lines", which closely approximate the bedding, are shown in Figure 25.

The small, gently plunging, open folds just described, are considered to be in the nature of minor crumples on the *southern limb* of a great overturned syncline, which may be called the *Laurie River syncline*. The axial plane of this major fold lies near the northwest shore of Tod Lake, the trace of the axial plane bends southeastward through McWhirter Lake towards Laurie River east of Eager Lake. Where it is bent at the north end of Tod Lake, the fold plunges northeast at about 45 degrees. The muscovite-biotite schist and minor granite (Map-unit 20) near Eager Lake are considered to form, in part, a schistose central zone where this great fold is most severely deformed. On the north side of the axial plane, there is no trace of the small folds of the southern limb, and no reason to expect such. They would disappear in the trough of the major syncline.

The folds on the south limb of the Laurie River syncline cannot be followed south of Tod Lake. Several assumed faults are shown on Map No. 4. They mark the boundaries of blocks, within each of which there appears to be folding which cannot be correlated with adjacent blocks. Further south there seems to be no trace of the northward-plunging folds.

The faults south of Laurie River and west of Eager Lake are based on study of aerial photographs. In this area, the exposures are fairly good, the field data are

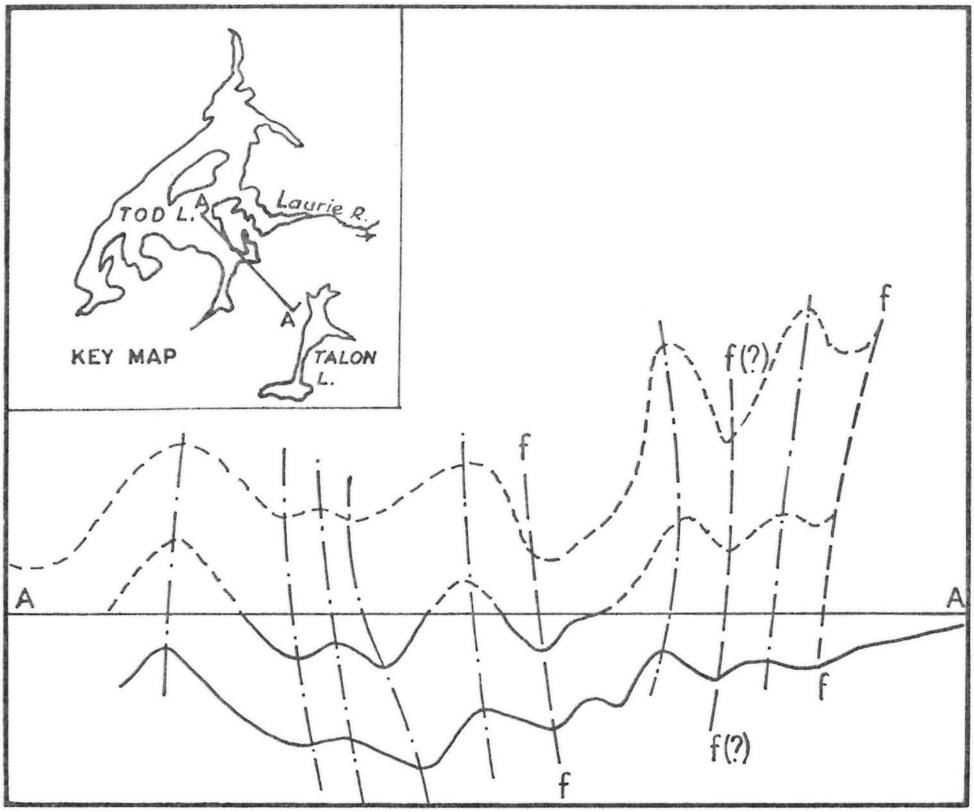

Figure 24 — Vertical section across Sickle series between Murray and Tod Lakes. f-f indicates fault.

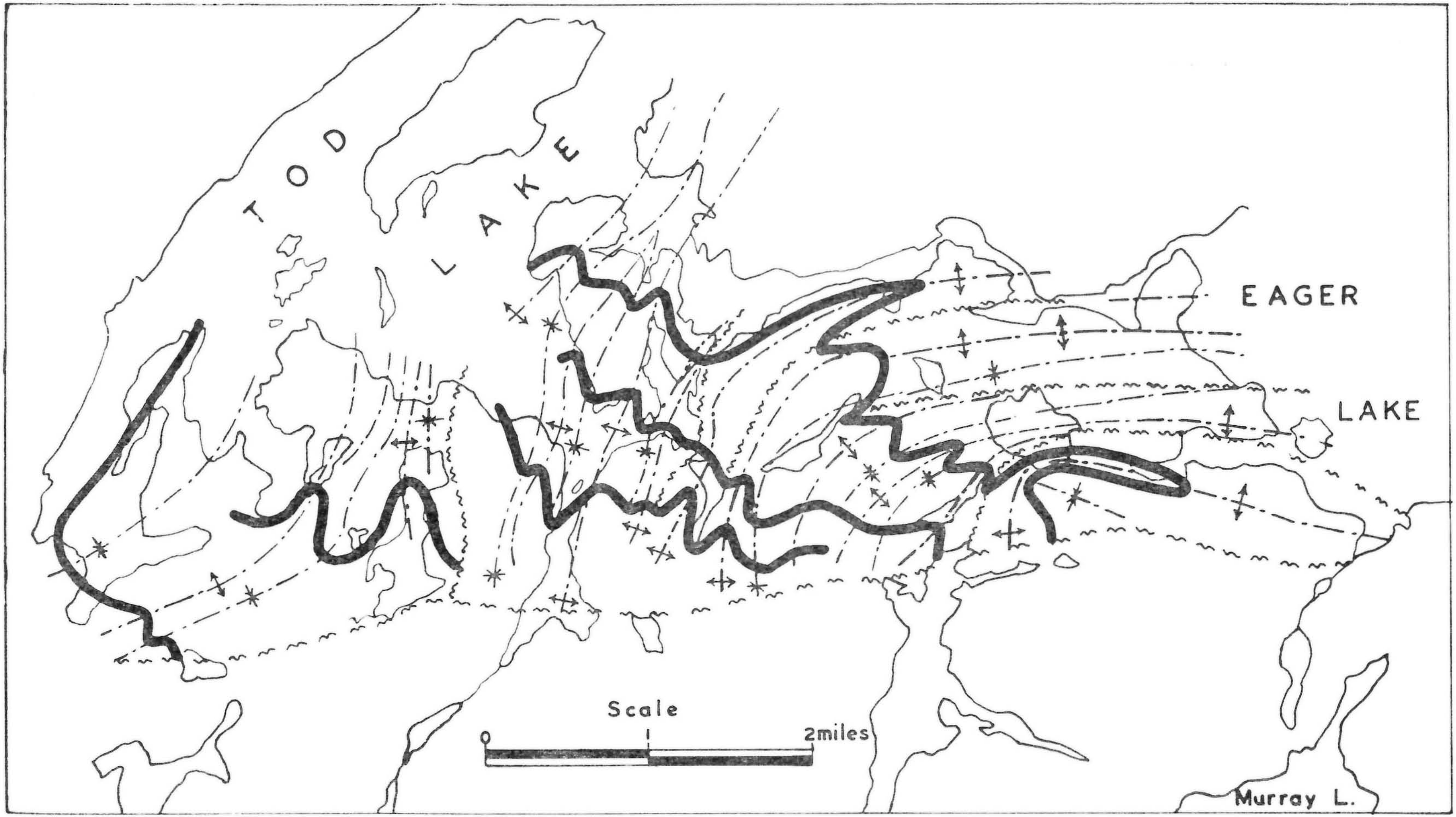

Figure 25 — Folding in the Sickle series, as shown by "trend lines" between Tod and Eager Lakes.

abundant, and the bedding is visible on the photographs in many places. The faults shown on the map were placed where there is an abrupt change in the attitude of the bedding, usually with a change in photograph texture across the break. It will be noted that most of these occur at, or near, the bottom of synclines wherein the flexure has been severe.

The *northern limb* of the Laurie River syncline is well marked by the conglomerate band. It shows that the north limb of the fold is nearly vertical between Laurie Lake and Tod Lake, and faces south. Near McWhirter Lake it dips about 45 degrees north and is overturned.

On the northern limb of the fold also, but north of Tod Lake, the conglomerate has been repeated by faulting. Because of the plunge of the Laurie River syncline, the conglomerate extended farther northward beneath the present land surface. The northwestern part of the fold has been sliced off at depth, and repeated on the surface by the Tod Lake fault. It is a reverse fault which dips northward at 55 to 75 degrees. The north side was displaced nearly due south, and upward at 55 degrees or thereabouts, according to the slickensides and minor crumples in the schist of the fault zone. The fault is discussed below (p. 150). Strong foliation in several places on the straight northwest shore of Tod Lake suggests there may be another fault there.

The portion of the overturned north limb which was cut off in depth by the overthrust was brought up, and repeated at the surface. Because of the flexure in the fold, between Tod and McWhirter lakes, the faulted portion is shaped like a thin wedge sliced off the side of the fold. This is reflected at the surface by the thin band of conglomerate which pinches out between Laurie River and Hatchet Lake. Because it was sliced off the side of the fold, the conglomerate, brought up from depth, is separated from the main mass of Sickle by a nearly constant thickness of Wasekwan rocks. The net slip on the Tod Lake fault is not known, but is probably substantial.

Details of the geology on the north side of Tod Lake are shown on Map No. 9. It will be noted that there is a thin band of finer-grained sediment between the conglomerate and the underlying Wasekwan. The conglomerate is not everywhere the basal member of the Sickle series. Similar arkosic lenses beneath it are known at Pyta Lake and at Black Trout Lake (Map No. 6).

Folds at Pyta and Conglomerate Lakes

There are a number of plications on the north limb of the Laurie River syncline, north of Eager Lake. Two sections through Hassett, Conglomerate and Kukri lakes are shown in figure 26. They indicate that, at the west end of McGavock Lake, the axial plane of the Laurie River syncline dips about 30 degrees north, and that the north limb of that great fold is composed of two overturned anticlines, one above the other. The whole assemblage plunges northeastward. It is shown in diagrammatic form in figure 27.

In preparing the diagram, changes have been made for the sake of clarity. The axial planes of the individual folds are shown as vertical, instead of with the actual dip of 30 degrees north. The folds are also drawn plunging uniformly to the east at 25 degrees. Actually the plunge of the folds varies somewhat: east of Kukri Lake the plunge is east at 25 to 30 degrees, at Hassett Lake it is 17 degrees northeast, and near Pyta Lake it is 30 to 38 degrees in a direction N 30° to 50° E.

Folds South of Eager Lake

South of Eager Lake there is an extensive area of complex folding. As described above, the minor folds on the southern limb of the Laurie River syncline are open and plunge gently north between Talon Lake and Tod lakes. North of Talon Lake the folds are bent eastward, and they are more tightly compressed. Further eastward, south of Eager Lake, the folds are in an area

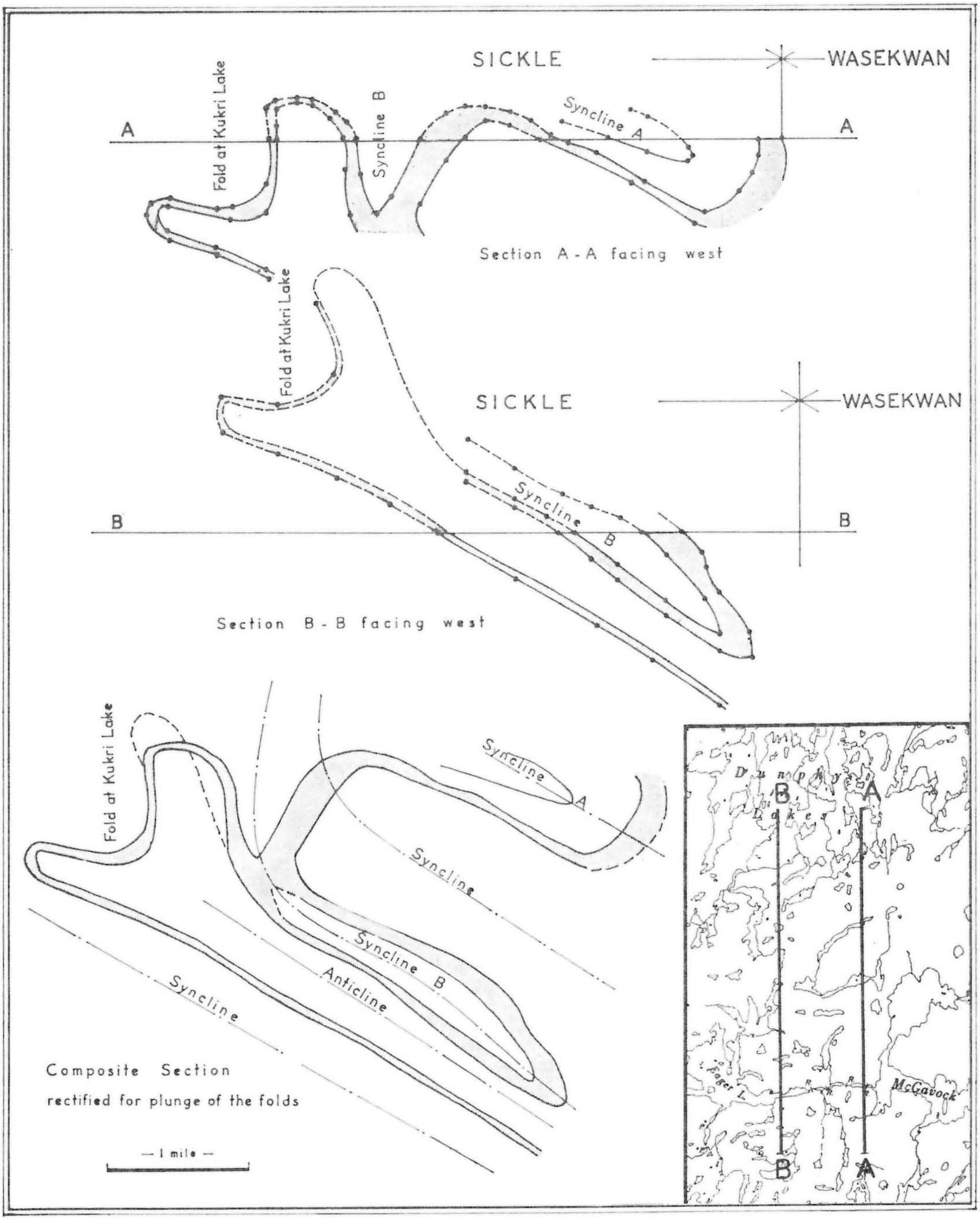

Figure 26 — Two vertical sections through the Sickle series between Pyta Lake and Conglomerate Lake. Each shows a portion of the folded conglomerate layer. In the lower diagram the two sections are combined to show the complete fold. Horizontal and vertical scales equal.

of still more severe deformation, where they are isoclinal and also cross-folded. The zone of bending of the fold lies through Murray, Talon and Tod lakes (Fig. 29). The beds involved in the most severe folding are stratigraphically higher than those in other parts of the Laurie River syncline.

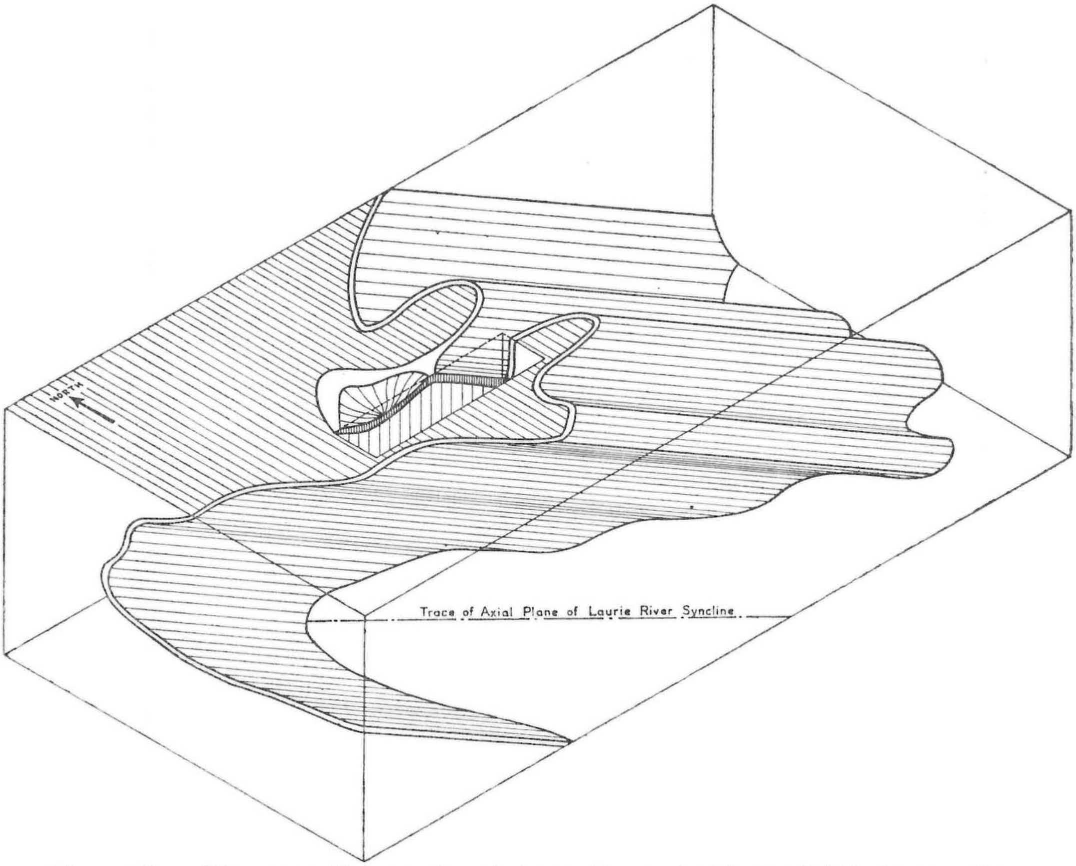

Figure 27 — Diagram to illustrate the relative position and attitude of folds between Pyta and Conglomerate lakes. The folds are a part of the north limb of the Laurie River syncline. Axial planes dip approximately 30°N. For simplicity the folds are shown plunging uniformly 25°E. Actually there is some variation in direction and amount of plunge.

On the preliminary maps[1], Stanton showed the area south of Eager Lake as underlain by a dome-shaped structure with a small core of granitic rock. In the course of the present work, his interpretation was found to be inconsistent with the evidence from north and west of the supposed dome, especially that from north of Talon Lake. The idea of cross-folded isoclinal folds, shown on Map No. 4, is offered as an alternative possibility.

The area in question was mapped by Stanton on traverse lines spaced about 1,000 feet apart. Much of the structural interpretation hinges on what has happened in the space between the traverses. When the ground actually seen in the field is plotted from the traverse notes, it is found that the present interpretation is feasible, though it is impossible to prove it to be the actual case. To solve this structure satisfactorily will probably require mapping in great detail, the establishment of criteria for the recognition of the individual amphibolite bands, and "walking out" each of them so that questions of correlation are settled as definitely as possible.

[1]Stanton, M. S.: *Manitoba Mines Branch, Map 48-4.*

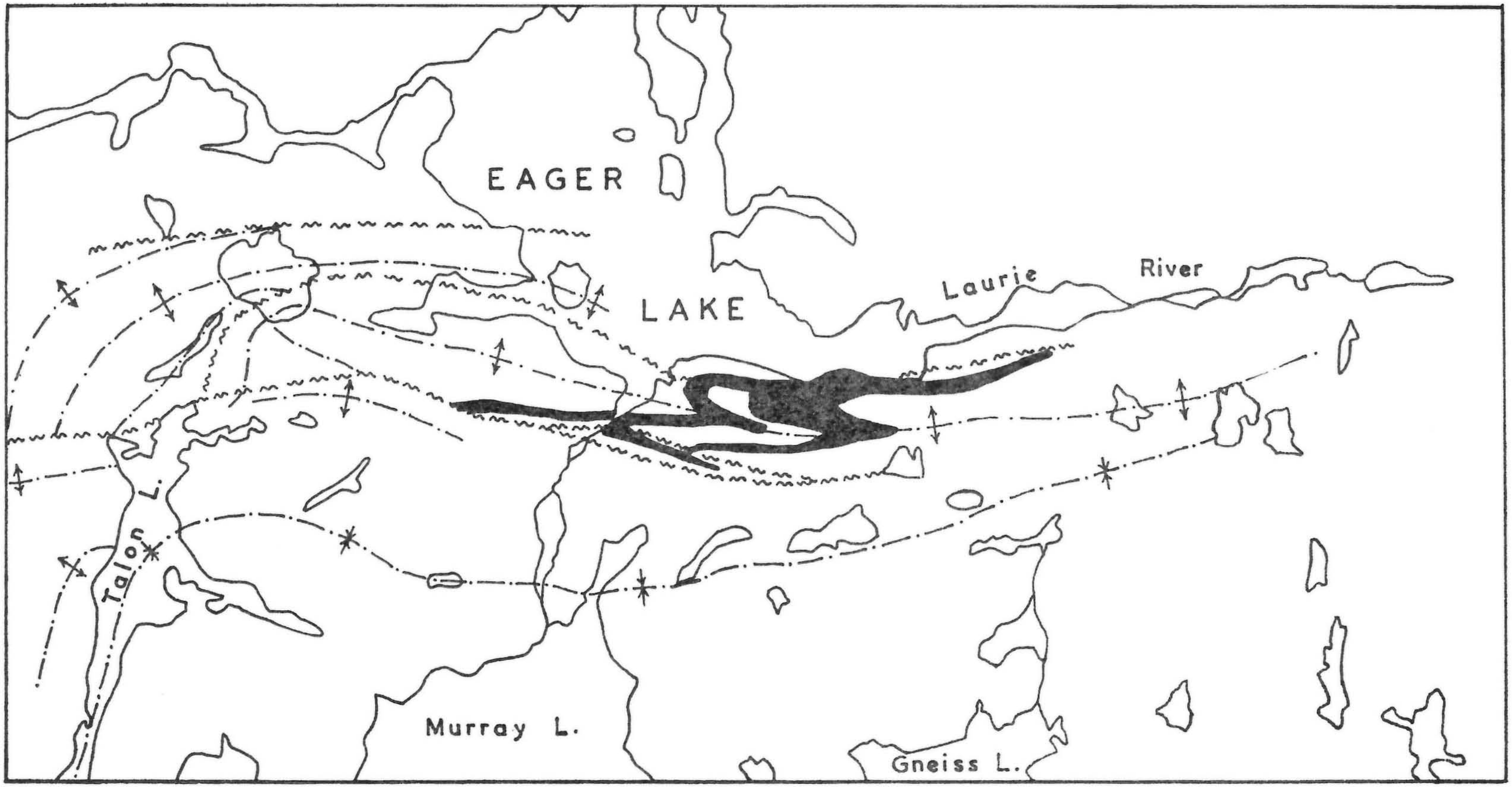

Figure 28 — An amphibolite band is closely folded and shows the continuation of the folding from west of Eager Lake.

The amphibolites can be shown to be very closely folded, in some places at least. An anticline, which crosses the mouth of the creek connecting Murray Lake with Eager Lake, is reflected in the outcrop of two bands of amphibolite east of the creek. One contact of the lower (i.e. western) of the two bands has been traced. It is found that the amphibolite doubles back upon itself, as shown in figure 28, and that the fold is plunging eastward at 10 degrees. This is also the clearest demonstration we yet have that the folds of the Sickle north of Talon Lake actually do extend into the zone of amphibolites south of Eager Lake.

The present interpretation of the structure is shown in its essentials in figure 29. The dominant feature is a syncline which has bent through almost a right angle at Talon Lake. In this it conforms to the folding of the other folds on the south limb of the Laurie River syncline. The flanks of the fold are roughly parallel, as is indicated near the granite north of Murray Lake.

Details of the structure in the whole section south of Eager Lake are not satisfactory. This is especially true within about a mile of the south shore of the lake and the river, but the picture is also confused on the east side of Talon Lake. No direct evidence, such as drag-folds or lineation, is there available to indicate the attitude of the fold. Various estimates of plunge, based upon bedding attitudes, are widely different. It seems probable that, just east of Talon Lake, the axial plane of the syncline of figure 29 dips north at about 60 degrees, and that the bending of this fold has produced local inversion and westward plunge. The great variety in estimates of plunge at that point probably reflects the widely changing attitude of the fold within a small space. Fifty-five degrees is the steepest westward plunge indicated.

In general, the syncline and all its attendant minor folds plunge eastward at approximately 20 degrees. At the western end, however, the structure is more complex. It appears from scanty data at the south end of Talon Lake that the syncline there plunges about 45 degrees north. On the east side of the lake, where two thick layers of amphibolite mark the bend in the axial plane, the plunge is to the west, and the fold is therefore locally inverted. In that part, the attitude of the fold changes rapidly, so that the plunge is 60 degrees northeast at a place only 900 yards east of the lake, and decreases rapidly to the eastward.

The eastward continuation of the folds from north of Talon Lake, as indicated in figure 28, explains the general pattern of the amphibolite bands on the south side of Eager Lake and Laurie River. Not all the folds are represented and it is probable that some have been cut off by faulting.

The extent of the faulting is not known. Most of the faults shown on Map No. 4 have been assumed because of the apparent termination of amphibolite layers. Faults are visible at several points on the shore line of Eager Lake.

The displacement on some faults may be considerable. There is apparently a distinct change in the character of the rocks on opposite sides of the Laurie River. There is also a considerable thickness of Sickle beds between Tod Lake and McWhirter Lake, which is apparently missing east of Eager Lake. It is, at least, possible that the country north of Laurie River has been thrust over that to the south. The fault beneath the power dam at Eager Lake, and another about 1,000 yards south, are the most likely locations for such movement.

The foregoing outline implies that there should be an anticline or dome between Talon Lake and Murray Lake. It appears probable that the severe folding which has occurred in the vicinity of Talon Lake will have produced more fracturing and faulting than has yet been recognized. It is known that there is in the Lynn Lake district sulphide mineralization which is later than the folding of the Sickle series, and recently some gold has been found in quartz veins cutting the Sickle rocks themselves. Therefore, it would probably be a worthwhile project to examine

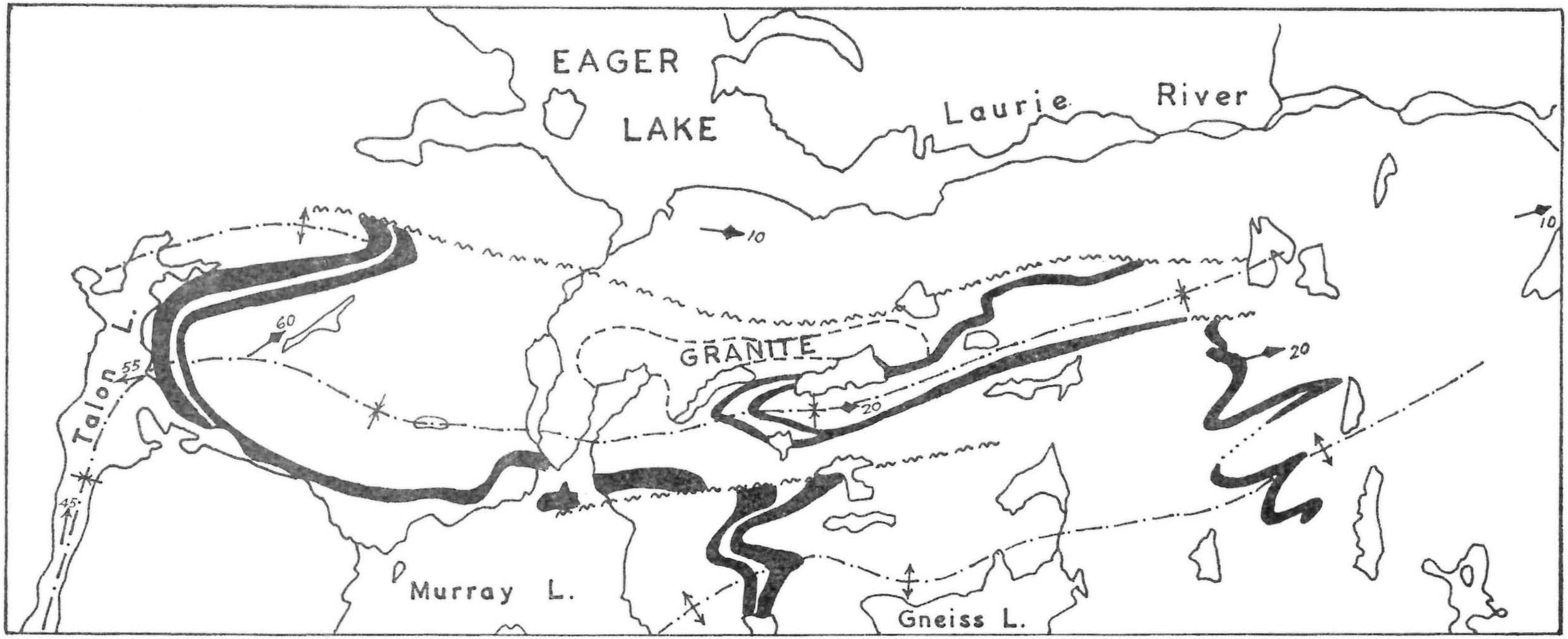

Figure 29 — The dominant feature of the complex south of Eager Lake appears to be an isoclinal syncline which is indicated by the selected amphibolite bands. The syncline is bent at Talon Lake, possibly because of eastward motion of the country to the south. Correlation across faults is doubtful. Arrows indicate plunge of the fold.

that part of the area more carefully to see if fractures may have developed to form potential channels for the introduction of ore minerals.[1]

Origin of the Laurie River Syncline

The effect of the smaller folds on the south limb of the syncline was a reduction of the distance between the points now occupied by Talon Lake and South Bay of Laurie Lake. The folds must therefore be the result of some force tending to compress that part of the area. Further, the bending of the smaller folds at Talon Lake, and to the west, also indicates movement from west to east. At the same time, the overturned folds at Pyta and Conglomerate lakes, the isoclinal folds south of Eager Lake, and the overturning of the Laurie River syncline itself, all indicate compression of the country from north to south.

The question arises: Did all this result from a single episode? Or was a large overturned syncline first formed and then buckled by later forces acting from a different direction?

The structure observed can be explained as the result of a single episode of folding, and this is the explanation preferred here. At the same time it must be recognized that this is largely a matter of preference, and that we have found no objective criterion which would permit one to distinguish one process or the other as having operated.

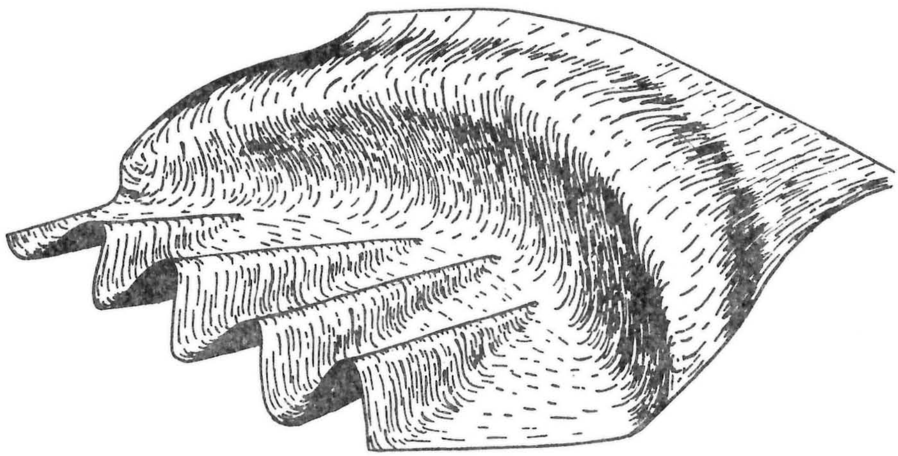

Figure 30 — Sketch to illustrate development of the Laurie River syncline. Eastward dragging of the country south of Tod Lake produced the smaller folds. The large sheet of Sickle sediments accommodated itself by developing the large "cross-fold" as shown.

The Laurie River syncline is thought to be due to a single period of movement, during which the country to the south of the mapped area was moved east and north. Such a motion would compress the country around Laurie Lake against that at

[1]For the information of anyone who may, in future, be involved with the structure of this part of the district, in the course of the present work the following hypotheses were weighed in the balance and found wanting:

1. The Sickle series between Tod Lake and McGavock Lake forms the northwest edge of a large basin, folded on its northern edge and extending far to the east and south, with a dome formed in it south of Eager Lake; *or*,

2. Regional folding is such that all folds plunge about 30 degrees east; *or*,

3. There is a dome structure south of Eager Lake, with an anticlinal cross-fold trending diagonally across it about west-northwest; *or*,

4. The "dome" may be a synclinal trough, plunging east, with a subsidiary anticline developed in the trough. (This requires that the westward plunge of the anticline, *relative to the syncline*, should be low, so that the net plunge of the anticline is to the east.)

McGavock Lake, and would develop the folds found west of Talon Lake. (See Fig. 21, p. 118.) Such local shortening of one part of the thick layer of Sickle sediments would form the Laurie River syncline as a compensation mechanism (Fig. 30). Further deformation would probably result in continued eastward dragging, and the bending of the folds already formed. The northward component of the motion produced the folding of the upper (northern) limb of the Laurie River syncline. Such a single northeastward movement would be anticipated if the Willis Lake structure, to the east, was formed as we have supposed.

POOL LAKE FOLD

At Pool Lake, and along the railway to Boiley Lake (Map No. 5), there are considerable changes between the structure shown on the accompanying map and that shown on Oliver's preliminary map. The major changes are the removal of an assumed fault[1] through Pool, Monique, Boiley and Naylor lakes, and the recognition of a synclinal fold in the Sickle series at Pool Lake. Two more tight folds are assumed to have been present originally to the north and west of the Pool Lake syncline. They are now eroded away east of a thrust fault through Boiley Lake, but have been brought up from depth and appear, west of the fault, at Wilmot Lake.

On the preliminary maps (49-4), Oliver shows an assumed fault running north up "Bones Creek",[2] passing to the east of what is now called Boiley Lake, through the chain of three lakes there, and thence northeastward. The obvious reason for the introduction of this assumed fault is the abrupt termination of the Sickle series—coming from the west—against two bands of Wasekwan lavas to the east. Whatever else may be its merits, if it exists at all it must lie a little to the west of the indicated position in the lakes. Diamond drilling near the north end of Monique Lake has shown that the same volcanic rock types continue at least 600 feet west of the railway; that is, at least 1,000 feet beyond the assumed position of the fault.

Northwest of Pool Lake, (at A, Fig. 31) the conglomerate of the Sickle series faces south, and is underlain by tonalite (quartz diorite) and Wasekwan rocks which outcrop to the north. The details of the unconformity are related above (p. 79). The conglomerate is coarse grained, and with very little to suggest the tops of the beds, but the presence of the unconformity places the attitude of the northern edge of the conglomerate beyond doubt.

At the southern edge, the conglomerate faces north. Excavation for the railway right-of-way exposed an outcrop of conglomerate with coarse-grained matrix and sparse pebbles, and a 12-inch band of crossbedded arkose, in which the beds face north (pl. VII, B). This outcrop is near the shore of Monique Lake, and is in the ditch at station 6889+00 north from Sherridon, i.e. about 470 feet south of the "point of intersection" on the curve at Mile 170.24, (B. in Fig. 31).

The wide exposure of conglomerate to the north is therefore a synclinal fold, and the outcrop pattern indicates that it is a slightly overturned fold plunging to the southwest. There is, therefore, no need to suppose a fault in the lakes to explain the abrupt termination of the conglomerate against the Wasekwan. Rather, it is a case of two basic bands, which mark the flanks of a Wasekwan syncline, disappearing beneath a syncline in the Sickle series. The axes of the two folds are almost at right angles, which fact is, in itself, a further demonstration of the same unconformity visible on the north edge of the conglomerate.

It was largely on his observation of flows and tuffs in rocks mapped as Sickle, on the south shore of Boiley Lake, that Ruttan based his opinion that the Sickle and Wasekwan are all a part of the same series.[3] The writer agrees with him on the character of the rocks exposed on the south side of Boiley Lake. The rocks are

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[1]In his Ph.D. thesis (*U.C.L.A., 1950*) and the accompanying maps, Oliver refers to this as the Rodmac-Patsy Lake fault, from unofficial lake names which he had applied.

[2]i.e. approximately along the line of the railway from Drybrough station.

[3]Ruttan, G. D.: Geology of Lynn Lake, *Trans. C.I.M.M., Vol. LVIII, p. 193, 1955.*

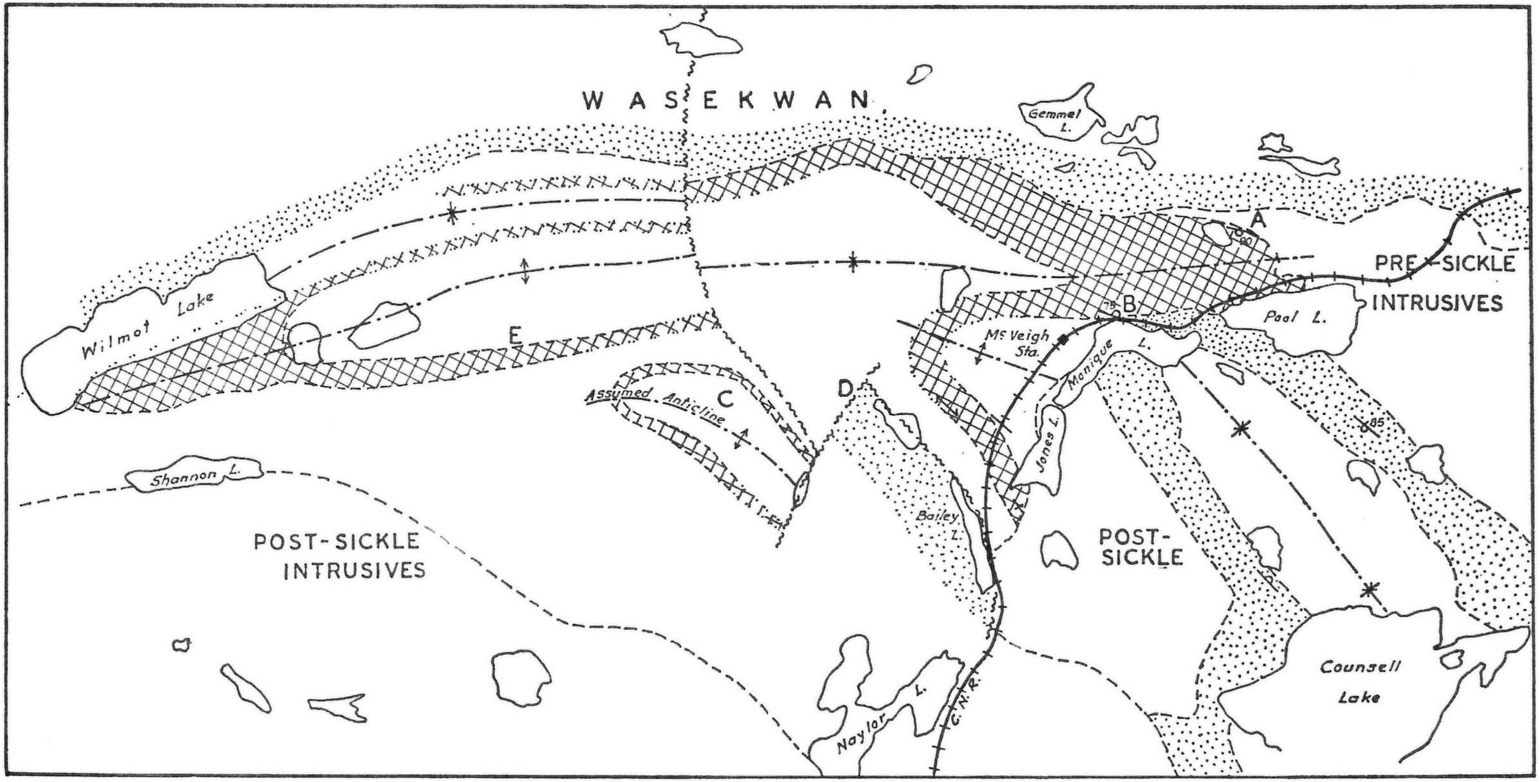

Figure 31 — Map showing the main features of the Pool Lake fold. For explanations, and significance of the letters, see text, pp. 133-137.

cut by shear zones, are reduced to schists in places, and are difficult to identify with any certainty. They do, however, appear to be pyroclastic rocks, at least in part, and to contain some basic material which may well be flows. In the field, Oliver apparently considered these to be flows within the Sickle, for his notes show he saw definite flows, just west of Boiley Lake. His assistant, traversing at Boiley Lake, reported abundant secondary amphibole, garnet and bronzite (?), though his notes do imply he thought the strongly banded rock to be sedimentary. In his published report, Oliver explained these rocks as formed by high-grade metamorphism of sediments.

The inclusion of these volcanic rocks with the Sickle would ignore the direct evidence of unconformity which is visible a few miles to the north. Ruttan was not aware of this evidence at the time his paper was published.

The explanation offered on Map No. 5 assigns both the sedimentary and the volcanic rocks to the Wasekwan, and indicates that these rocks have been elevated by a thrust fault which trends northwest through Boiley Lake.

There are exposures of coarse Sickle arkose west and south of Jones Lake and two outcrops show Sickle conglomerate containing quartz-diorite boulders (1 foot by 2 feet) with blue quartz phenocrysts similar to those seen at A, figure 31, (see p. 79). The pebbles form a large part of the conglomerate, which is definitely not sheared in a northerly direction. A rather unsatisfactory measurement of the conglomerate shows vertical bedding, striking westward, top not available. The direction is confirmed by another exposure, in a small rock cut on the railway west of Jones Lake, where there are sparse 2-inch pebbles. West of Monique Lake, as noted above, there is arkose with sparse pebbles. Sandy conglomerate is also reported from west of the track.

The agreement on the direction of bedding, within the scattered outcrops, indicates that there must be a westward change in direction somewhere west of Monique Lake. The obvious possibility is that there is an anticline, with the axis running east through the south end of Monique Lake.

This implies that the conglomerate thins out and becomes lenticular, and that some arkose, at least, is beneath it. There seems to be no reasonable postulate which will explain the observed bedding direction, if the conglomerate is considered to be strictly basal and therefore somewhere under Monique and Jones lakes. It is known that the conglomerate has arkose beneath it in other places, as at Conglomerate Lake, for example.

An anticline is a necessity south of the syncline at Pool Lake. This follows from the fact that the Sickle series continues to the east. The anticline near McVeigh Station meets this requirement.

The structure indicated on Map No. 5 for the poorly exposed area between the railway and Wilmot Lake is based primarily on the following considerations:

1. The outcrops northeast of Wilmot Lake are sparse and show arkose with sparse pebbles, and some pebble beds.
2. Directly east from Wilmot Lake there is a "zone" of conglomerate bands, intermixed with finer-grained Sickle rocks. The bands are of good conglomerate, but are thin; in many ways they resemble the zone of conglomerate lenses above the basal conglomerate in the Willis Lake structure. This "zone" of conglomerate lenses can be followed eastward for about 12,000 feet. It also appears west of the large swamp about 1 mile west of Boiley Lake. In two separate exposures the beds are reported to face north.
3. The large plunging synclinal fold at Pool Lake apparently grades on both limbs, into coarse-grained sediments, with pebble beds and lenses of conglomerate.
4. There is no recorded outcrop of conglomerate between Hassett Lake and the southwest end of Wilmot Lake; the group of outcrops at the outlet of Wilmot Lake are, in fact, described as pebbly quartzite or just quartzite.

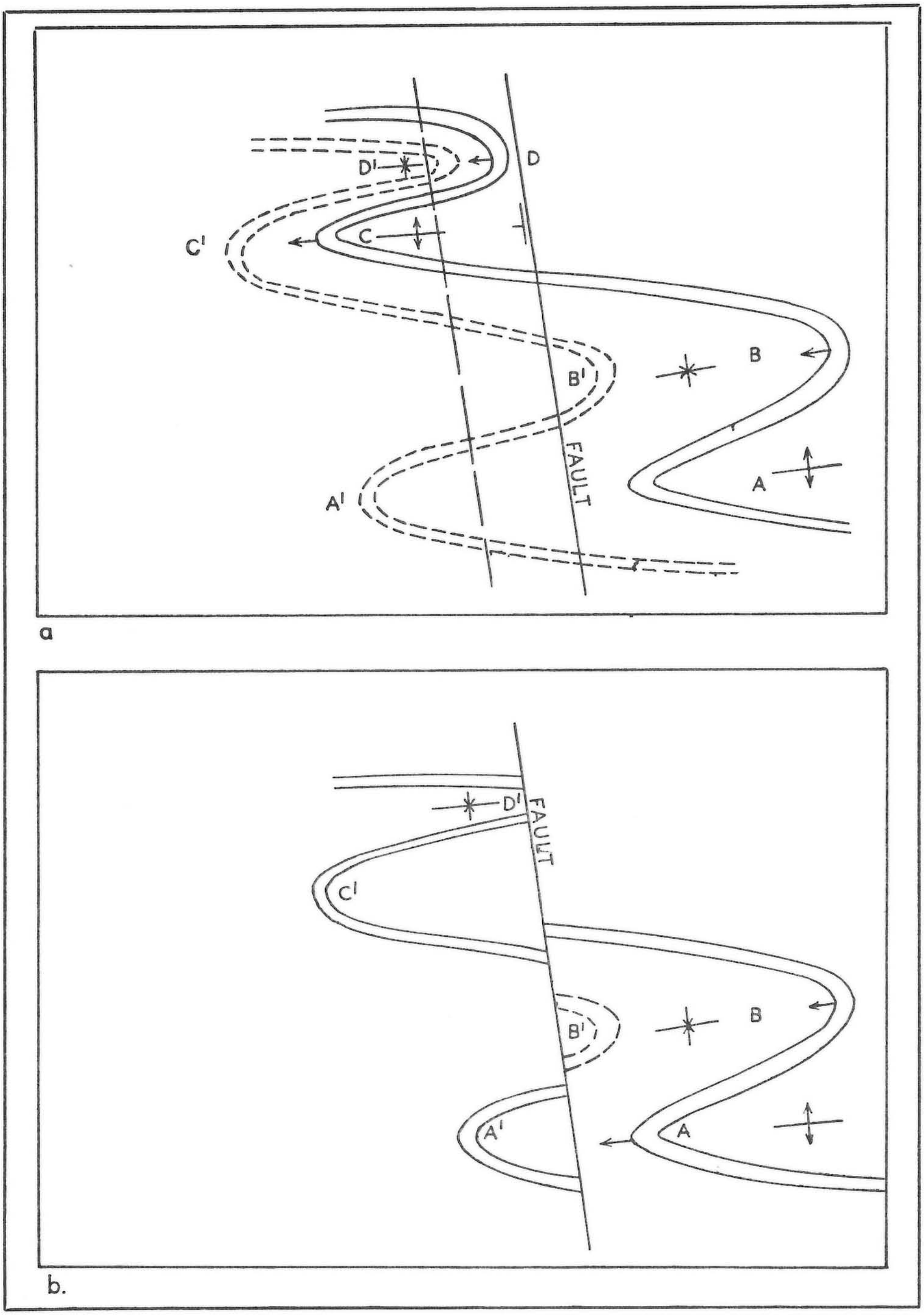

Figure 32 — A. Diagrams illustrating the origin of the structure at Pool Lake. ABCD represents the outcrop of the folded conglomerate. A'B'C'D' is the trace of the same fold on a plane at a lower level. Fault is similarly indicated on the lower level.

B. The rocks on the left are thrust over those on the right. The outcrop that results does not show the nose of fold at D. Also, A' becomes an elevated remnant isolated from the rest of the bed.

In figures 32A and 32B are shown in diagrammatic form the essential features of the structure here proposed as an explanation of the relations found in this part of the district. It is assumed that there were an anticline and a syncline to the north of the syncline now exposed at Pool Lake. The plunge on the folds was to the southwest and the original outcrop pattern was as shown diagrammatically in figure 32A. The trace of this fold on a horizontal plane at some greater depth would be that indicated by the dotted lines in the figure. If the folds are cut by a thrust fault, which dips westward at less than the plunge of the folds and passes east of D on the surface, then the nose of the fold at D will not appear on the surface on either side of the fault plane, and the outcrop pattern will be that shown in figure 32B. This idea can be applied to the present case.

Assuming a westward plunge on the anticline near McVeigh Station, in conformity with the syncline at Pool Lake, both folds must be cut in depth by the fault in Boiley Lake. This is a thrust fault which dips south, according to the scanty direct evidence at Boiley Lake and the presence of Wasekwan rocks on the south side of that lake.

The northward and eastward movement on the fault must expose, on the present surface and on the hanging-wall side, a deeper part of the folds. The anticline shown west of the uplifted Wasekwan, at C in figure 31, is considered to be the repetition of the plunging anticline from near McVeigh Station. The Wasekwan is displaced northward by the fault to the west of Slush Lake, (D, in fig. 31) but this does not alter the general picture.

At Wilmot Lake, according to this view, there is a syncline underneath the lake; the 3,000 foot width of conglomerate south of the lake is due to repetition by an anticline; there is a reversal of plunge in the folds west of Wilmot Lake; the conglomerate zone extending east from the lake (E, in fig. 31) is the usual conglomerate horizon near, but in this case not at, the base of the Sickle series; and conglomerate in the Pool Lake syncline grades into pebble beds and conglomerate lenses on both flanks.[1]

The idea, in addition, indicates that the folds between Wilmot Lake and Pool Lake are the counterparts of those at Conglomerate, Hassett, and Kukri lakes which are exposed once more by the reversal in the plunge of the whole lot. Otherwise, there would remain the question why conditions sufficiently severe to produce a complex overfold at Hassett Lake should change, in the course of three or four miles along strike, so that only relatively open and simple plunging folds should be found at Wilmot Lake.

The complexity of this idea is therefore only apparent. It can be seen that all that is involved is a simple change in the attitude of folds already known to be present to the west. Inasmuch as there is a northward decrease in the plunge of the folds at McGavock Lake (from 30° to 17°) it is, perhaps, not entirely surprising that the plunge should be reversed a little farther to the north.

A disturbing feature of the whole structural picture is the apparent complete absence of conglomerate from the north side of the Sickle series between Boiley Lake and Lasthope Lake. There are known to be pebble bands and conglomerate lenses at both ends and it may be that conglomerate never was deposited there. It seems strange, however, that it should be missing over this stretch and be essentially continuous elsewhere for a great many miles.

HUGHES LAKE FOLD

The Sickle series, at Hughes Lake (Map No. 2), is not exposed over a sufficiently large area to enable one to draw extensive general conclusions. The conglomerate forms the larger part of the outcrop, the beds are vertical to steeply-dipping and face towards Hughes Lake. The series here forms an irregular synclinal trough.

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[1]On the north flank the *strike* length involved in the gradation is a minimum of about 14 miles.

The synclinal trough is complicated to some extent. At the north end of Hughes Lake the fold obviously plunges steeply south, with the axial plane somewhere near the centre of the lake. The beds on the south side of the lake face north, and on the north side of the southwestern bay they face south. There is therefore, a synclinal axis in that bay, and it must trend northeasterly. Furthermore, the beds face west on the west shore of Stan Lake. There must, therefore, be a minor flexure, at least, in the vicinity of Bog Lake, and it must trend northwest.

There are at least three synclines, then, all trending towards Hughes Lake, and there is a suggestion that another lies along the east side of Hughes Lake and through Stan Lake. (This may be the continuation of that at the north end of the lake.) This suggests that the Sickle series here represents the bottom of a large synclinal fold which had at least 3 subsidiary flexures. Further speculation as to the extent and significance of these, is probably unjustified.

Further folds in the Sickle series were anticipated above, (page 122) where the Willis Lake structure was discussed. Unless the conglomerate at Sickle Lake marks the edge (as distinct from the bottom) of the basin of deposition, the Sickle series must originally have extended north and east. Folds similar to that at Willis Lake are therefore to be expected. It seems reasonable to assume that the exposures at Hughes Lake represent the bottom of such a fold.

The very limited occurrence south of Cartwright Lake has not been related to this picture. The available information is so scanty that speculation is without profit. It may be pointed out that Allan considered the conglomerate to be older than the granite immediately east; if this is so the age as shown on the map must be amended. Allan was definite about this in his published report[1]: ". . . the contact of conglomerate and granite can be seen. The granite is dark grey, hornblendic at the contact, and intrudes the conglomerate." The relevant field note says: "The conglomerate appears to be more highly altered and contorted than before. Granite is very dark and hornblendic. A few masses of granite apparently intruding the conglomerate." The exposures were re-examined in 1955 and 1956. I could find the actual contact in only one place and did not see the intrusive relations Allan reported. The relations are, in fact, indeterminate where seen, and the age of the adjacent granite has, in effect, been determined by the relations at Sickle Lake.

RALPH LAKE

The conglomerate at Ralph Lake, if it is of Sickle age, must represent the bottom of a syncline, similar to that at Hughes Lake, and plunging westward. The adjacent Wasekwan must conform to this.

SUMMARY OF SICKLE LAKE FOLDING

The folding of the Sickle series may be summarized:

The Willis Lake structure is in the form of a major synclinal basin bent through about ninety degrees. Three smaller folds are developed on the inside of the bend and plunge away from it. The structure as a whole is consistent with the folding of a depositional basin by a single thrust applied on a relatively restricted frontage.

The structures between Hunter Lake and the Lynn Lake railway are obscured by high-grade metamorphism of the sediments of the Sickle series. The same is true of a large part of the area north of the Laurie River, where recognizable horizons are missing. For a small area northeast of Wilmot Lake the Sickle conglomerate provides a recognizable marker.

At Pool Lake a syncline is probably succeeded to the south by an anticline. The faulted and uplifted parts of these folds, as well as two more, plunge westward past Wilmot Lake. The plunge is reversed west of the lake and the same structure, if not the same individual folds, is recognizable between Hassett Lake and Laurie River. The folding doubtless persists south of Wilmot Lake, but is obscured by metamorphism and granite.

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[1] *Manitoba Mines Branch, Prelim. Report 47-3, p. 8.*

Between McGavock Lake and the west end of Tod Lake there is a very large synclinal fold here called the Laurie River syncline. The northern limb occupies roughly the whole area north of Laurie River and Eager Lake; it is composed of a group of overturned folds piled one upon another. The southern limb is composed of a larger number of open folds plunging towards the axis of the major structure. As the axis is approached the minor folds are closer, the folding is more intense, their direction changes to parallel the major folding and, south of Eager Lake, the folds of the south limb are pressed tightly together and are isoclinal. Thrust faults occur on the south shore of Eager Lake, near the centre of the Laurie River syncline. There may have been extensive movement on these faults.

The shortening of the southern part of the Laurie River syncline, by northerly trending folds, is consonant with a northeastward movement of all the country to the south. This would be expected if the Willis Lake structure were due to a general northeastward thrust of the country southwest of Lasthope Lake and Finch Lake. An overturning, and bending, of the northern limb of the Laurie River Syncline is apparently a necessary result of the shortening of the southern flank.

FOLDING OF THE WASEKWAN

Folding of the Wasekwan is complex, exposures are scarce, and units are difficult to follow. Tentative explanations are offered for the structures of certain restricted areas, but over-all correlation has not yet been found possible.

As was mentioned above, it was hoped that a study of the folding of the Sickle series would help to an understanding of the structure of the older Wasekwan. In practice, this hope has not been fulfilled.

The Wasekwan folding is apparently complex, as might be expected because it had already been folded at least once before the Sickle series was ever deposited. At the same time, exposures are poor in many places and recognizable stratigraphic markers are missing. General types, such as pyroclastic rocks can be followed in some places, but with no great confidence that any particular outcrop has been correlated with the proper adjacent horizon. Suggestions of local structures are indicated on the accompanying maps, but no over-all interpretation has even been attempted. The local folding is summarized below, starting in the southwest.

FOLDS AT LAURIE LAKE

The dominant structure at Laurie Lake is an anticline in the Wasekwan rocks. It plunges eastward at about 45 degrees, and has probably been faulted near the crest of the fold. The fault is inferred from the presence of schist coinciding with abrupt changes in lithology, abrupt changes in the attitude of bedded rocks, and apparent offset of the larger rock units. The movement on the fault appears to be in excess of 16,000 feet.

Folding of the Kisseynew-type gneisses, south of Laurie Lake, is correlated with the development of the Laurie River syncline.

The outcrop of the Wasekwan rocks on the north, east, and south sides of Laurie Lake (Map No. 4) suggests a plunging fold. It will be readily recognized, of course, that the outline of the Wasekwan, as such, is determined by the granite contacts, not by folding. However, the wide bands of sedimentary rocks, on the north side, show the direction of bedding, and the few measurements at the east end of the lake show a change in direction indicative of a fold. Minor features, such as drag-folding and lineation, are not abundant, but such as are present plunge to the northeast at 40 to 60 degrees. This, together with the outcrop pattern, indicates that the Wasekwan here forms, in general, an anticlinal-*shaped* fold, about 4 miles across at the widest part and plunging to the northeast. Reliable top determinations are wanting on the north side of the lake, so there is an element of doubt as to the identity of the fold. It is further complicated by the probable fault along the south shore of the lake.

Folding and Faulting at Laurie Lake

The structure shown on Map No. 4 is basically this plunging fold, but it is complicated by a possible fault of large displacement. The presence of the fault is indicated by the following features (see fig. 33): (1) The area of quartz-biotite-feldspar gneiss (Map-unit 2) at the east end of Laurie Lake (A in Fig. 33) is considered to be the general equivalent of the wide band of similar gneisses east of South Bay (at B). In both places the rocks are relatively unaltered. (2) There is a notable difference in appearance and in grade of metamorphism between the rocks at B and those at C, on the other side of the supposed fault. (3) The amphibolite on the island at D is possibly correlative with that at South Bay (E); and the high-grade Kisseynew-type gneisses west of the bay (at F) would then be the equivalent of those in the extreme southwest part of the area (G), and in Saskatchewan.

The general effect of all this is to suggest the presence of a fault with an apparent horizontal displacement of about 5 miles. The line of the discontinuities noted above crosses the Caimito claim group, and this supposed fault may conveniently be called the *Caimito fault*. The indicated horizontal displacement is undoubtedly very large and, even if the fault is cutting longitudinally through a fold which has a plunge as low as 40 degrees, the net slip would be in excess of 16,000 feet.

There is some direct evidence of the location of the Caimito fault, other than that outlined above. There are several outcrops of very schistose rock coinciding with an abrupt change in lithology east of South Bay (between B and C in Fig. 33). Also, along the south shore of the lake (at H) for about three miles from the outlet, there is schist and pencil gneiss, especially on points which project northward into

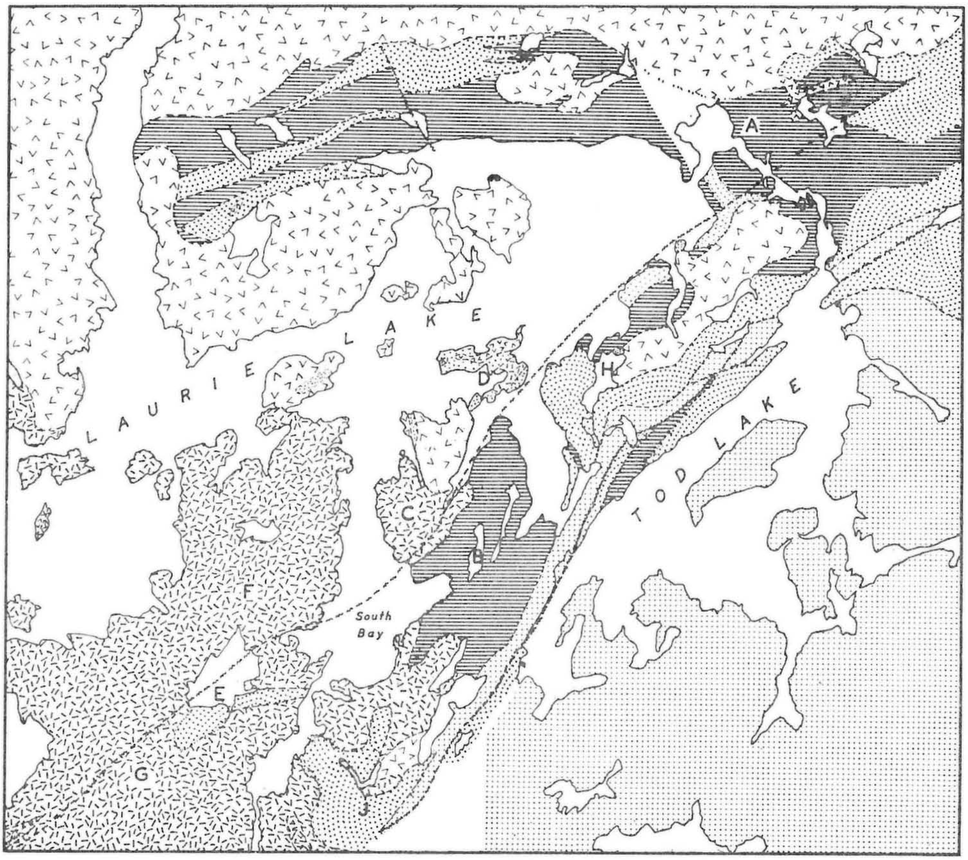

Figure 33 — Map showing probable folds in the Wasekwan rocks at Laurie Lake. For significance of letters see text, pp. 141, 142.

the lake. The lineation of the gneiss plunges north at 55 degrees. Further, there is an abrupt change in the attitude of the sedimentary rocks east of the river (near A in Fig. 33).

Folds South of Laurie Lake

The Wasekwan rocks also reflect the folding of the Sickle series. There is some indication of this (near H, fig. 33) where a small fold of the conglomerate in the Sickle is duplicated in lavas of the Wasekwan. Similar post-Sickle folding of the Wasekwan is indicated south of South Bay of Laurie Lake.

The Wasekwan amphibolite is folded, as shown at J in figure 33. This fold plunges north at 55 to 60 degrees. If the flow tops are correct, where reported near the Tod Lake fault, the fold must be an inverted anticline. At present there is no confirmation of this top determination. The Kisseynew-type gneisses conform to this fold in the volcanic rocks, but, to the west of J, the plunge is rather shallower—only about 30 degrees.

The post-Sickle age of the fold in the Wasekwan and the gneisses depends on a consideration of the post-Sickle folding. It can be assumed that the Sickle series originally extended north of its present boundary at Tod Lake. When the Laurie River syncline was formed, an anticline must have developed on its northern side, to accommodate the part of the series lying north of Tod Lake. It is probable that the fold in the Wasekwan and in the Kisseynew-type gneisses, at J in figure 33, is that anticline. The Wasekwan rocks would already have been folded once, prior to the deposition of the Sickle sediments. The last deformation, superimposed upon the earlier, resulted in a very complex fold pattern.

The age and origin of the Kisseynew-type gneisses are called in question by the foregoing. On page 92 it was indicated that some of the gneisses in this area may be derived from rocks of Wasekwan age. The Kisseynew-type gneisses at South Bay grade into the Wasekwan sedimentary rocks (near B in Fig. 33). This, and the presence of the pillowed lavas within the area of the gneisses, indicates that the gneisses were derived from the Wasekwan rocks by intense metamorphism.

Folds West of South Bay

The faulted equivalent of the gneisses, at F in figure 33, appears to be, in general, a large fold of anticlinal shape. Detailed examination of outcrops and photographs shows, however, that the folding is complex and that there is probably considerable isoclinal folding. Some of the folds appear to be up to half a mile across, but attempts to follow them or integrate them into a consistent pattern have so far been unsuccessful.

FOLD NEAR HATCHET LAKE

The fold shown near Hatchet Lake is based on only three outcrops, and the necessary recurrence of amphibolite due to the Tod Lake fault.

The eastward continuation of Wasekwan folding, as shown north of the Tod Lake fault and east of Laurie River (Map No. 4), is obviously highly speculative. It is determined mainly by what happened to the Wasekwan south of the fault. The small flexure immediately east of the river is, of course, based on the diverging bedding in two outcrops, which appears to be confirmed by the others just south of the Caimito fault. The extension of the sedimentary band eastward beyond Hatchet Lake is based on a single exposure, and on a reasonable assumption of the displacement on the Tod Lake fault. That is, the northward-dipping Wasekwan amphibolite north of McWhirter Lake is necessarily repeated by the faulting. The folds of the amphibolite north of McWhirter Lake are an integral part of the structure at Snake Lake.

FOLDING AT SNAKE AND DUNPHY LAKES

Scanty data suggest that a large anticlinal fold lies west of Snake Lake. The same structure may also occur east of the lake but recognition is complicated by a mass of gabbro and by high-grade metamorphism.

The fold southwest of Snake Lake, as shown on Map No. 4, is again derived from scanty observations. South of Hatchet Lake, on several outcrops, the greenstones show a consistent easterly strike and moderate northerly dip. Just east of McWhirter Lake, the strike is northerly, but whether this is confirmed by the foliation to the northeast is a matter of opinion. (The topography has a definite northerly trend also, but this is parallel to the ice movement, and may be partly glacial in origin.) This is the basis for the anticlinal-shaped fold shown on the map, and such lithological information as is available fits smoothly into this picture. Farther northeast the same fold may be reflected in the shape of Snake Lake.

Between Dunphy Lakes and Hassett Lake is a complex area of gabbro, amphibolite, pyroclastic and sedimentary rocks, the latter more abundant towards the south. Any attempt to unravel this complex runs foul of the relation between bedding and foliation. In many places, where both are recognizable, they are essentially parallel, and it is evident that those working in the field considered this to be so even where one or the other is not visible. In effect, it was assumed that the foliation in layered rocks was parallel to the bedding. In the Sickle rocks, to the south near Eager Lake, this is certainly not the case and the foliation is strictly parallel to the axial plane of the various folds. Does the "foliation" recorded in the field data represent axial plane schistosity, or a banding residual from the bedding in these strongly recrystallized rocks, or the presence of shears, or all three? At this stage there appears to be no way of distinguishing adequately.

The structural picture is further complicated by the presence of the gabbros. Stanton's field notes show that, in many places, it was difficult to decide whether an outcrop represented a gabbro or recrystallized basalt. It is possible, in fact, to trace what appear to be tightly folded basalt bands in what is here mapped as gabbros, in parts of the area south of Snake Lake, and in other places to the east of it and north of Hassett Lake. But, there is no doubt that some of the gabbro is truly intrusive, because dyking relations and chilled margins can be seen in several places; at the south tip of Snake Lake, for example. An attempt was made to identify the "basalt" bands. After some effort, it became evident that there is insufficient objective evidence to justify the attempt.

At present it appears that, if there are large folds south of Dunphy Lakes, they are isoclinal. There are smaller folds, as at Fox Lake, and it is possible that the "anticline" west of Snake Lake may persist south of Dunphy Lakes in a compressed form cut up by the gabbro. Neither reliable top determinations nor characteristic beds are present and, at this stage, further speculation is pointless.

WILMOT LAKE

North of Wilmot Lake the rocks are interbedded volcanic and sedimentary types, but exposure is very poor and the structure is not known.

North of Wilmot Lake the structure is not known. In fact, exposures are so scarce immediately east of Dunphy Lakes, that one does not feel justified in suggesting what rock types may be present. So far as the scattered outcrops indicate, the Wasekwan is composed of interbanded volcanic and sedimentary rocks. To the west the bands are narrow and the intermixture quite intimate; the same is true east of Gemmel Lake. In between, i.e. to the north of Wilmot Lake, the bands are thicker. So far as known these wider bands are stratigraphically above the more intimate layering. It is possible, however, that the greater apparent thickness is due to the paucity of outcrop.

FOLD AT COUNSELL LAKE

A syncline in the Wasekwan rocks is truncated by the unconformity at the base of the Sickle series.

The remnants of a fold are recognizable in the Wasekwan at Counsell Lake. Top determinations in each of the two bands west of the lake show that they face each other. (See Fig. 31, p. 135.) The intervening granite is therefore occupying the bottom of the former syncline, which is overlain by the Sickle series west of Pool Lake. It is perhaps worth hazarding a guess that the granite, around Pool and Mail lakes, is also occupying the site of the anticline which was formerly adjacent; the flows east of Gemmel Lake face north.

FOLDS AT FRANCES-COCKERAM-LASTHOPE LAKES

The area south of Frances Lake, and that from Cockeram Lake to Lasthope Lake (Maps Nos. 1, 2, 5, 6) can conveniently be considered as a unit. It was suggested in the preceding paragraph that an anticline probably once lay northeast of Pool Lake; this agrees with the broad outlines of the structure as deduced from the surrounding area.

From his study of the type Wasekwan at McVeigh Lake, Bateman concluded that the dominant fold is a westward plunging anticline which was overturned from the north. He did not find any direct evidence of the sequence of beds, and he pointed out:[1]

"In the pillow lavas of Divisions E and H, for instance, the pillows are so deformed that no reliable determinations of the tops of the flows could be made . . .

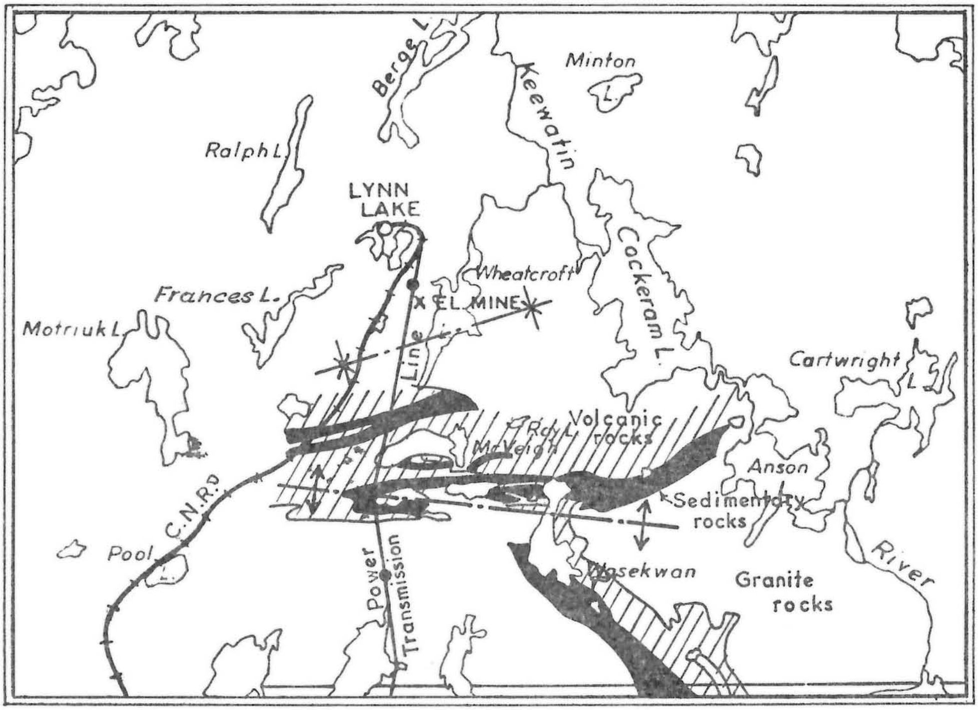

Figure 34 — Map showing outline of anticline in the vicinity of Wasekwan Lake. After Bateman; redrawn from G.S.C. paper 45-14 with some modifications.

[1]*Geol. Surv., Canada, Paper 45-14, p. 23.*

A large fold [was determined] in which the pitch of the structure on the north arm of the area was found to be to the west, and on the south arm to the northwest. Determinations of pitch were made by recording the angle of plunge of deformed features such as breccia fragments and stretched pillows, and by the plunge of the long dimension of prismatic metamorphic minerals, such as hornblende."

"The pitch of small drag-folds was also found to be in agreement with the information recorded in this manner."

The anticline mapped by Bateman, through Foster and Franklin lakes, can be carried westward; the northward-facing beds near Gemmel Lake would then represent its northern limb. It is implicit in this that the anticline there is still overturned slightly from the north, for the beds southeast of Pool Lake dip steeply north, but face south. The direction of movement on such drag-folds as are recorded at Gemmel Lake is consistent with an anticlinal axis to the south. But, if it be assumed that the axes of the drag-folds parallel that of the major structure, the plunge is to the northeast at 55 degrees, rather than to the west as indicated by Bateman's structure.

The adjacent syncline to the north probably ran through Fraser Lake to Wheatcroft Lake, in the vicinity of Muter Creek. An irregular band, predominantly quartzite, outlines this fold. The quartzite extends from the south end of Wheatcroft Lake to Fraser Lake, and thence via Frances Lake, Lynn Lake, and north of Wheatcroft Lake. That it is a syncline rests on a top determination north of Eileen Lake, which was reported by W. L. C. Greer on a map of the former Fraser claim group. Bateman also noted that the synclinal axis probably passed near the Faust 147 claim. There is a smaller fold on the nose of the syncline, west of Fraser Lake.

An anticlinal axis was shown from the south end of Ralph Lake to the north end of Eric Lake, on Allan's preliminary map. Study of that map shows that the location of this axis is dependent upon a band of interbedded tuff, flows, and sediments east of Ralph Lake.

The repetition of beds is not evident on Map No. 1. In part this is due to the different subdivision of the Wasekwan which has been used, and in part, it is due to difficulty in locating Allan's outcrops. Because of this doubt as to the position of Allan's outcrops, those shown on Map No. 1 are drawn largely from maps submitted for assessment work, wherever such maps are available. The band of sediments, flows and tuffs reported by Allan was not recognized on the assessment maps, or if so, was not separated. At least one of the three outcrops mapped by Allan is predominantly flow material, and it may be that Allan's unit was not recognized by the others mapping there.

It may be that the mixture of sediments, tuffs and flows at Margaret and Sheila lakes is the equivalent of the pyroclastic rocks and breccia at Ralph Lake, for there is a high proportion of tuff southwest of Margaret Lake. There is also no doubt that, at the west side of the Incon 8 claim, the flows strike southeast and dip 65 degrees southwest.

This all suggests that there may be an anticline about where Allan placed it but, if so, considerable gradation of rock types and complication of the structure must be present north of Motriuk Lake.

If the conglomerate at Ralph Lake is Sickle in age, it implies that it must be the bottom of a syncline plunging west, and the Wasekwan should conform. Of course, this does not require that the bedding in the Wasekwan should conform to the syncline in the Sickle, for the volcanic rocks had already been folded once before the Sickle was deposited.

Two bands of iron-formation have been recognized north of Barbara Lake approximately on the extension of such a fold. This might indicate repetition or they may be two separate horizons. There are no data to permit a distinction.

An anticline underlies Farley Lake, with the crest of the fold marked by a band of iron-formation. The fold may extend as far west as Muskeg Lake, but this is doubtful. A syncline and an anticline are also recognized north of Hughes Lake and a similar structure is suggested on the east side of Hughes Lake. A fault through Stan Lake is indicated by abrupt changes in attitude and lithology.

At Farley Lake (Map No. 3), the geologists of the Sherritt Gordon staff suggested there is a syncline through Gordon Lake. This is based on the repetition of tuffs, amygdaloidal andesite and agglomerate north and south of the lake. The pillowed lavas, however, suggest that the northern band faces north, and the fold must therefore be an anticline. A wide band of iron-formation between Farley Lake and Key Lake marks the centre of the fold.

This is consistent with the structure indicated north of Hughes Lake; at any rate the whole can be fitted into a unit. A band of tuff and agglomerate can be followed, through scattered exposures, almost as far as Arbour Lake. This band is on the southern flank at Key Lake, but must be very near the crest of the fold. A similar band south of Farley Lake can be followed southwest towards Hughes Lake, thence eastward again to disappear beneath the Sickle conglomerate at the north end of Hughes Lake. This is the outcrop pattern of a shallow syncline and

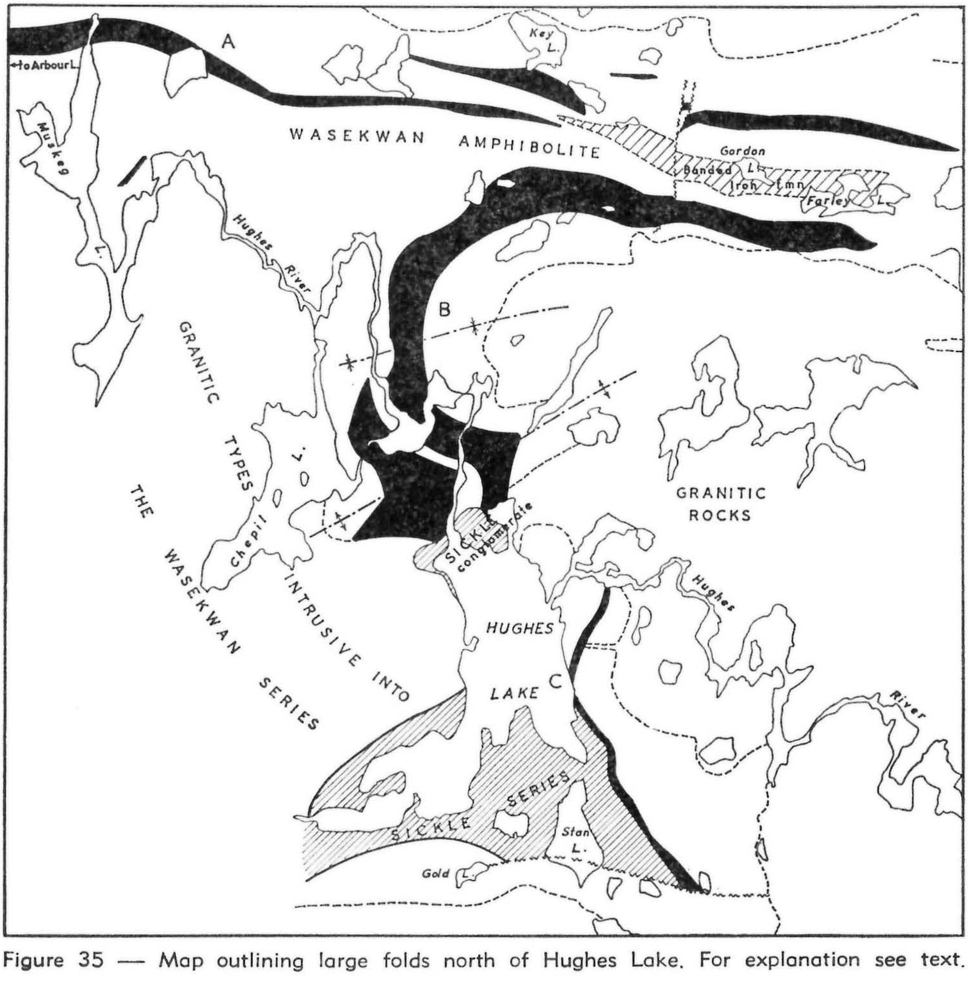

Figure 35 — Map outlining large folds north of Hughes Lake. For explanation see text.

its companion anticline; the axis of the former trends northeastward from near the outlet of Chepil Lake. The recognition of this fold again depends on a few scattered outcrops and measurements of attitude, and may be seriously in error.

The existence of the long band of pyroclastic material extending west to Arbour Lake is very doubtful. It is dependent upon a few widely scattered outcrops. Furthermore, at Key Lake it appears to be on one flank of an anticline. If this is so, the axis of this anticline (at A, in fig. 35) diverges from that of the adjacent syncline (B) so that they are eventually miles apart. The intervening space is now largely filled by granitic rocks. It is not impossible that the folds have been separated by this amount, and that the granite either occupied the space or was the active agent in the separation. Until better continuity is available through outcrop, the above should be considered only as a not unreasonable postulate.

It is probable that the continuation of the structure is seen in the belt of pyroclastic, and intermediate and basic volcanic rocks on the east side of Hughes Lake at C, figure 35. The generally uniform trend there can be established with fair certainty on the basis of lithology alone, though there is probably some interfingering of the rock types.

There is an abrupt change in the attitude of the flows, and termination of the Sickle conglomerate, at Hill Lakes. This is thought to be due to a fault cutting across the south end of Stan Lake. South of the fault the attitude of the rocks remains fairly constant as far westward as Gold Lake and Gap Lake. Southwestward to Belleau Lake and Keewatin River the band of greenstone is narrow and no structures are recognized.

BARRINGTON LAKE

Folding at Barrington Lake is not understood. There is a suggestion of a fold near Leo Lake, but otherwise the Wasekwan west of Barrington Lake appears to be uniform in attitude. Barrington Lake is underlain by granite, and the country to the east is granite with some large roof pendants of Wasekwan rocks, mostly pyroclastic, but there is a suggestion that a fold may once have occupied the area of the lake. East of the area it has been suggested that there are two ages present within the rocks here mapped as Wasekwan. No evidence of such was recognized within the present district.

It has been suggested that amphibolites south of Tow Lake may be repeated near Wellmet Lake, on the opposite side of a great fold, but there is little concrete evidence of this.

A belt of greenstone up to 3 miles wide extends southeastward from Farley Lake along the south side of Barrington Lake. In large measure, the outline of the latter lake is controlled by the contact of the greenstone with the granite which underlies the lake. No definite or characteristic horizons have been recognized in this belt, and so far as known it is monoclinal, however unlikely that may be.

There is a suggestion of folding in one place, in addition to the anticline in the centre of the belt at Farley Lake. East of Leo Lake there is a small crescentic body of diorite. Adjacent to it there is some porphyritic andesite and amygdaloid, and it is possible that the diorite is actually a sill outlining the crest of a fold. If such is the case, there are no bedding data to substantiate it, and the foliation does not follow the bedding, for it continues without disturbance.

East of Nickel Lake, there is an increasing proportion of pyroclastic material and minor amounts of rhyolite. So far as can be seen, these are interlensed with the more usual basic lavas.

The attitude of the formations is changed on the east side of Barrington Lake, and the trend is northerly—at least near the outlet of the lake. Coupled with the presence of basic lavas on the islands, although the shore is mainly pyroclastic rocks this suggests there may be a fold at the southern extremity of the lake. If so, its axis should run northwest. It must be recognized that there is very little to suggest such a fold east of Barrington River.

Barrington River marks the boundary between the general easterly trend of the Wasekwan rocks south of Tow Lake and its southeasterly trend near July Lake, to the east of the river.

According to Kilburn[1], the age of the Wasekwan rocks south of July Lake differs from that of the rocks east of Spider Lake. The basis for separation was largely difference in metamorphic grade. There is nothing in the Barrington Lake area to suggest that there is any appreciable break in the deposition of the amphibolites; nor is there such anywhere else in the district.

The major part of the area east of Barrington Lake is granite containing small disconnected bands of greenstone up to 3 miles long and from ¼ mile to 1 mile in width. No definite structural pattern is recognizable in these, and they probably represent fragments, or pendants, of the roof-rock surrounded by the granite. There is a suggestion of a large fold around the northwest side of the granite boss in Twp. 91, Rge. 17, but lack of outcrop to the east prevents fitting it into any general pattern.

In his preliminary report,[2] Crombie suggested that the greenstone on the south shore of Barrington Lake might be the same as that south of Tow Lake, with the intrusions at Tow Lake occupying the central portion of a fold. Or, he suggested, the complex of greenstone south of Tow Lake might be correlated with an area south of Wellmet Lake, which he also mapped as a complex. This latter implies that there is a large folded structure with two horizons of greenstone. The central part of the fold, represented on the shore of Barrington Lake, would be considered to close between there and MacBride Lake; the outer belts of greenstone complex should then close somewhere east of the present map-area. If they do meet, it is not in the next 10 miles,[3] and reconnaissance mapping beyond that does not indicate such a structure.[4] For the present, perhaps the chief virtue of this latter concept is as a mnemonic for the distribution of the greenstones in this part of the district.

South of Brooks Bay, on the northwest side of Barrington Lake, there is a band of greenstones, about half a mile wide, which is probably connected to that east of Farley Lake; the foliation reported in this band is consistently eastward, with a steep northerly dip. Near the eastern end is a detached bit of greenstone which is similar, but in which the foliation trends southeast. It is very probable that these two bands are the remnants of a fold, but there is no indication of its nature.

FAULTING

Faulting in the district is reviewed. Because of the difficulty of recognizing faults, as well as distinguishing their age, it has not been possible to solve the regional fault system. The more prominent individual faults are discussed below. Faults expected to develop because of the post-Sickle folding have not been clearly recognized.

The study of faulting in this district encounters the problems common to all such detailed reconnaissance mapping in Precambrian areas of this type. These are of two main types, observational and analytical.

The observational problems are essentially those of recognition. They involve such things as: the distinction between strong foliation or schistosity related to folding, and that adjacent to actual faults; the recognition of a fault when no good marker horizons are present; the recognition of early faults which have been healed by subsequent metamorphism or filled by quartz veins and similar things. Others

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[1]Kilburn, L. C.: MacBride Lake Area; *Manitoba Mines Branch, Publ. 55-2, 1955.*

[2]*Man. Mines Br. Rept., 47-6.*

[3]The possibility is suggested, at least, by Kilburn's mapping (*Mines Br. Publ. 55-2*) but north and east of MacBride River the greenstones are now much cut up by later intrusions, and they are apparently not extensive farther east.

[4]Wright, G. M.: Uhlman Lake Area; *Geol. Surv., Canada, Paper 53-12.*

could be listed. A major consideration also is exposure; very frequently the line of weakness along the fault has been a cause of deeper glacial erosion, and the site is now occupied by swamp, muskeg, or lake. Topographic features may suggest faults, and are an aid in tracing those for which the presence has been established, but they can be due to many other features. The weakness due to an early fault, as in the first deformation of the Wasekwan, for example, will almost surely be decreased or obliterated by subsequent metamorphism and deformation. It seems reasonable therefore, to infer that the faults which show strong topographic expression are relatively recent, and belong to the last period of deformation to affect the area. The analytical problems apply equally to any area, but are aggravated by uncertainties of observation such as are suggested above. It is only rarely that a reliable age can be assigned to an individual fault, and it therefore is invalid to apply statistical methods to deduce the directions of forces and movement. It is questionable too, whether the attitude of a fault at any particular point necessarily bears any *direct* relation to the regional deforming stress. Rather, the fault is the reaction to the local stresses near the point of rupture; any analysis of the fault must take into consideration the local folding and other indications of local deformational forces. This is not to deny that a specific fault, in the ultimate analysis, may not be due to a general regional stress.

Because of the uncertainties of observation, reliable records of faults are rare on the accompanying maps. Most of the longer faults shown on the maps are assumed as the last means of explaining structures otherwise unreasonable. The location is usually determined by observations at a few places along the length. Any attempt to systematize the few observations and indicated faults is probably useless, if not worse. Under the circumstances, the best alternative appears to be brief individual description of such faults as are known or suspected.

One will note that faulting or shearing is reported on individual outcrops in many places. Only rarely can these be correlated one with another, and they are simply reported for what value they may have as individual observations.

CAIMITO FAULT

At Laurie Lake, the Caimito fault has been assumed for reasons indicated above when discussing the folding of the Wasekwan rocks there. Briefly the reasons are: (1) the marked change in lithology and metamorphic grade across a zone of schists east of South Bay, (2) the abrupt change in attitude and lithology on opposite sides of the fault east of Laurie River, (3) the abrupt termination and apparent displacement of the greenstones south of South Bay, (4) the apparently similar displacement of Kisseynew-type gneisses in the extreme southwest of the area, (5) the presence of pencil schists in outcrops on the south shore of the lake, toward the eastern end.

It is not an unexpected consequence of the ideas of post-Sickle folding outlined above (p. 133) that there should be a fault parallel to the Tod Lake fault, and north of it. The Sickle series must originally have extended to the north, beyond the limits of the present exposures. When the Laurie River syncline was formed, an anticline would of necessity also form to the north, i.e. on the outside of the northern limb of the Laurie River fold. The anticline would be under tension parallel to its axis, because of the stretching around the outside of the fold. This could, in general, be relieved in three ways: (1) the development of yet another syncline to the north, (2) thrusting of the Laurie River Syncline beneath the country to the north, or (3) a combination of these two. It is therefore not unreasonable to suppose that the Caimito fault was formed as a result of the development of the Laurie River syncline. On the fault the north side apparently moved upward at about 55 degrees, and almost due south. This direction is the same as that on the Tod Lake fault. To suppose the same ultimate cause implies, of course, that the two faults are of essentially the same age.

TOD LAKE FAULT

The Tod Lake fault has also been discussed in connection with the folding. It strikes northeast and dips north at 55 to 70 degrees. Its recognition depends on the repetition of the Sickle conglomerate, and it is shown as a definite fault at the upper (i.e. southern) edge of the repeated portion, though it can be seen, in fact, at only two places on the shoreline. The direct evidence there visible, and linearity in adjacent rocks, indicates that the north side moved upward at 55 degrees, and almost due south. The Sickle is therefore thrust over the Wasekwan. This comes about because the fault cut the side off an overturned fold.

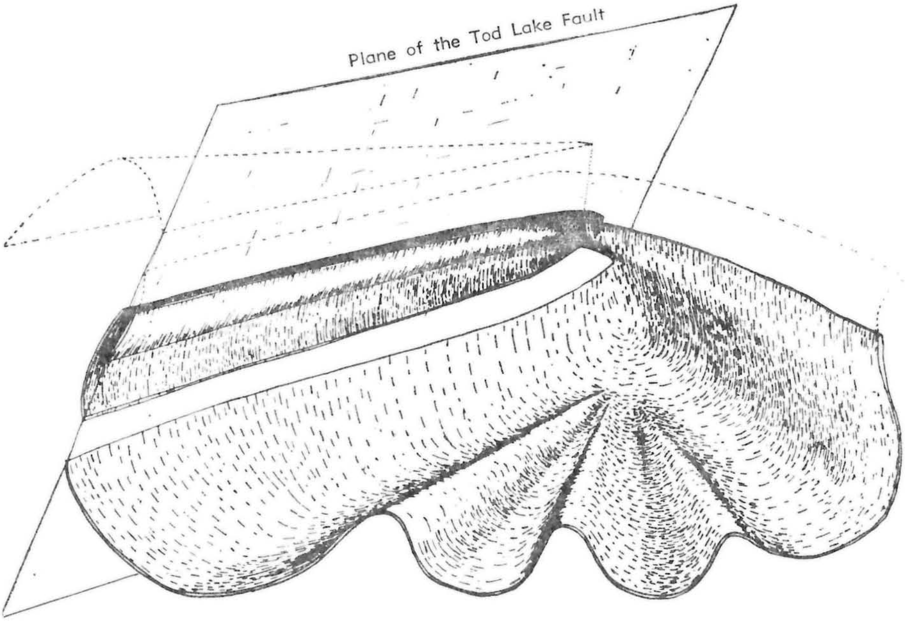

Figure 36 — Diagram showing the relations between the conglomerate of the Laurie River syncline and the Tod Lake fault. The fault cut a slice off the overturned northwest limb of the syncline; the upward displacement has repeated the conglomerate at the surface. Portions eroded from above the level of the present surface are indicated by dashed lines.

The solution of the Tod Lake fault for net slip has so far proven intractable. The effort has been concentrated on the area immediately northeast of the north end of Tod Lake, as offering the greatest possibility. It may be that, by assuming a parabolic or cylindrical shape for the nose of the fold there, an approximation could be obtained, but no direct method has been found.

The axis of the fold was determined, by the method of intersecting beds, using two separate sets of outcrops. One gave a plunge of 43° at N 28° E, the other 44° at N 45° E. An axis, assumed to lie between these directions, when projected downward will pierce the plane of the Tod Lake at a point N 28° E from its position on the surface, and at a horizontal distance of about 2,900 feet. Assuming a due south and upward displacement of 55° on the fault, the piercing point would appear on the surface with a net slip of 3,500 feet. This must be the order of the minimum net slip; it produces a horizontal displacement of 1,300 feet in a direction N 55° E, i.e. towards Hatchet Lake. A minimum reasonable horizontal displacement is probably between 6,000 and 6,500 feet. This suggests that the net slip may have been of the order of 17,000 feet.

OTHER FAULTS NEAR LAURIE LAKE

An assumed fault trending northwest is shown on the north side of Laurie Lake. The reason for the assumption is obvious: a wide band of sedimentary gneiss runs straight into an equally broad band of amphibolite, across a swamp only 200 yards wide. The assumption of right hand movement is based on a single outcrop of sedimentary rock on the shore of the small lake at the north end of the fault.

Between the Tod Lake and Caimito faults, there are several places where movement in the amphibolite is indicated south of South Bay. The major displacement is that which offset the amphibolite bands, though there are probably several other shear zones within the amphibolite itself. It is probable that a fault also follows the east side of the lake, southward out of the area.

FAULTS AT EAGER LAKE

Several faults have been assumed southwest of Eager Lake. In only rare cases is there direct field evidence for any of these faults. They have all been located where the bedding undergoes an apparent disruption or very abrupt angular change, and have been based on a careful study of the aerial photographs in combination with the field evidence. The larger bedding features are usually visible in the pictures and outcrops are reasonably abundant. It is probable that the movement was not large on any of them.

South of Eager Lake, essentially the same technique was used, but the structure is patently more complex and the assumed faults are offered with much less confidence. Faulting is known under Laurie River, at Eager Dam; at several places along the south shore of Eager Lake (pl. VIII, A), and schist or shear zones were reported from the traverses south of the lake. There is, however, much room to doubt whether the observations are correlated properly on the map. The amphibolite bands form ridges and can usually be followed on the photographs with the aid of the traverse notes. Where such features terminate abruptly, or appear to be displaced, faulting is assumed, if it seems necessary and is consistent with the other data.

Study of cross-sections shows that there is probably a very considerable fault movement between the north side of Laurie River and the south.

FAULTS AT POOL LAKE

The general structural pattern west of McVeigh Station to Wilmot Lake has been discussed in some detail above (p. 134). The northwesterly thrust fault through Boiley Lake is located on general considerations: the presence of the Wasekwan rocks south of the lake, with very strong development of schist in prospect pits near the 23rd Base Line; minor movements visible on the lake shore, all of which are thrus s dipping steeply south; the presence of a wide zone of schist in a drill hole on the east side of the lake; and the apparent displacement of Wasekwan sediments 2¾ miles west of Gemmel Lake.

OTHER FAULTS IN THE SICKLE SERIES

To the eastward, in the Sickle Lake area (Map No. 6), no break of major length has been recognized. There is a displacement of the Sickle conglomerate northeastward from the south end of Sickle Lake; this is the largest and longest fault recognized. The horizontal displacement is about 10,000 feet, and on the basis of slickensiding the motion was almost horizontal. Structural considerations suggest, however, that there was some vertical movement, and that the slickensides represent only the last motion. The net slip is not known.

Smaller displacements are also indicated near the north end of Sickle Lake and south of Black Trout Lake.

The unusual disruption of the Sickle series between Amy Lake and Lasthope Lake might be termed a fault. It is more in the nature of a splitting and separation of the sediments by the late granite than a break on a single surface.

It is probable that there is a fault in the Sickle series near the south shore of Lasthope Lake.

Numerous small shears and faults are present but most of these have not been followed for any distance. The most important, economically, are those carrying auriferous quartz veins north of Lasthope Lake.

FAULTS NEAR LYNN LAKE

At Ralph Lake (Map No. 1), the fault extending northeast towards Barbara Lake was found by drilling, very early in the exploration of the area. The termination of the conglomerate in the lake suggests that this fault is the same as that leading southwest toward Motriuk Lake. The part of the fault south of Ralph Lake was located by magnetometer work; just south of the lake it has been confirmed by drilling done by Falconbridge Nickel Mines. Under the name of the Laurie River fault, Ruttan[1] extends this fault southward through Motriuk Lake, Monique Lake and thence to the Laurie River near Drybrough Station (Map No. 5). If it is as long as this, it is certainly one of the major features of the district but, in view of the somewhat different interpretation placed on the structure near McVeigh Station, the writer has not felt justified in extending it so far.

The faults in the vicinity of the mine, including the Lynn Lake fault, are not reported in the field work of officers of this branch, nor in any of the maps ordinarily available. Those shown on Map No. 1 have been "plagiarized" from Ruttan's map and paper quoted above, in which he states they are all steeply dipping faults, thrust from the west.

Early maps of the Elb claim group show a fault through West Lynn Lake and following a topographic low through Flag Lake almost to Franklin Lake. In many places this appears to be without displacement, but a short section of it is shown on Map No. 1, south of Flag Lake, where there appears to be some displacement of sedimentary rocks relative to the volcanic types to the west.

A fault extending north from Wheatcroft Lake and along the north-south section of Keewatin River is called the Eldon Lake Fault, by Ruttan. On Map No. 2, (Cockeram Lake) considerable displacement is shown. Inspection of the map will show that other interpretation of the outcrops is possible at the south end, but at the north end truncation of a pyroclastic band appears to be real enough. The direction of movement is not known, though the disappearance of unit 7 west of the fault at Dot Lake, indicates that the amount of movement is substantial.

MUSKEG LAKE FAULT

A fault of great length is shown, on the Cockeram Lake map, extending from Raven Lake south to Cartwright Lake. The fault is reported[2] to be visible in the northwest corner of the Tulune Lake gabbro body and to have a displacement of about 400 feet; the east side moved south. The long topographic linear of Muskeg Lake is an obvious suggestion for the location of the fault, but there is grave doubt of its presence there, and at the north end of the lake there appears to be little or no displacement, though a considerable thickness of schist is present at the extreme southern tip of the lake. Strong foliation is also found in the diorite outcrops

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[1]Ruttan, G. D.: The Sherritt Gordon Lynn Lake Project; Geology of Lynn Lake. *Trans. C.I.M.M., Vol. LVIII, 1955, pp. 192-193.*

[2]Company report submitted for assessment work, 1947.

immediately to the east, at the southern end. The linear feature continues southward as a straight, narrow, and swampy depression with steep walls, almost to Pole Lake. Igneous rocks are notoriously poor guides to fault movement, but the diorite west of Hugo Lake has a good northerly foliation, appears to end abruptly against the valley, and the greenstone contact to the south is offset. Allan suggested[1] that there is probably a branch of this fault in Cartwright Lake, where there is considerable evidence of shearing in several directions.

A fault along the south shore of *Pole Lake* seems to be related to that just described. The fault can be traced from south of Ron Lake, along the south shore of Pole Lake to the centre of the east shore of Cartwright Lake, where it is marked by a shear zone about 35 feet wide, cutting pillowed andesite. There the zone is composed of schist which has white knots of quartz and feldspar standing up on the weathered surface. Other knots are fine grained and resemble acid lavas. The adjacent pillowed lavas are more strongly schistose than usual, and quartz veins increase in number and size adjacent to the shear zone. A similar rock is visible near the south shore of Pole Lake, where the differential erosion of the "fragments" led Allan to describe it as "weathering like a conglomerate". The fragments are from ½ inch to 2 inches x 4 inches; some are dark and very fine grained, some appear rhyolitic, and some are angular white fragments, square in section. In part, at least, the matrix is very high in calcite, which is presumably introduced because no other calcareous rocks are known within miles of this occurrence.

A sheared quartz-feldspar porphyry in the southeast corner of *Cartwright Lake* has received some interest as a gold prospect. The porphyry dyke is irregular and branching, and has many sedimentary inclusions. There has been severe movement in these inclusions, which are usually very schistose. Whether movement antedates the dyke or not, there has also been movement within the porphyry. There are many quartz veins from 1 to 2 inches up to 2 feet thick, normal to the plane of movement in the porphyry and in the inclusions. The sheared dyke is roughly parallel to the shear zone at Pole Lake, but whether or not the two are related is unknown. Is it entirely fortuitous that it should be on the extension of the post-Sickle fault north of Gap Lake?

GOLD LAKE—STAN LAKE

A shear zone at Gold Lake has also been drilled. This was done in an attempt to locate the source of angular boulders which returned high assays in gold. Drilling west of Gold Lake failed to locate the gold-bearing shear zone nor did drilling east of the lake locate the mineralization seen in surface outcrop, where pyrite, chalcopyrite, gold and galena are reported. North of Gold Lake is a large outcrop, shown as greenstone on Map No. 2 but called diorite and granodiorite by Allan. At its southern edge, some 200 yards from the lake, it is quite schistose but becomes gradually more massive to the north. The rocks south of the lake are also sheared. A fault was inferred east of Stan Lake, to explain the abrupt termination of the Sickle conglomerate and the acid volcanic rocks, and it is probable that the shear zone at Gold Lake is a part of the same break.

BROOKS BAY

Two parallel faults are shown south of Brooks Bay, Barrington Lake (Map No. 3). They were found by Stanton on several traverses, and are marked by zones of rusty chlorite schist. Because the strike of the faults is very close to that of the greenstones, and no marker beds are recognized, the sense or amount of movement is not known.

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[1] *Man. Mines Br. Rept. 47-3, p. 14.*

KEY LAKE

Several shears are reported in the greenstones east of Key Lake (Map No. 2). They trend east-northeast and roughly northwest, but have not been followed any distance.

Between Gordon Lake (Map No. 3) and Key Lake there has been displacement of the banded iron-formation and of the pyroclastic rocks. The displacement coincides with a stream and valley extending northeast from Narrow Lake. It is probable that there are several branches to this break, and that in the Wasekwan rocks there is a "drag-fold", about 3,500 feet across, in which is the group of shears reported in the last paragraph; presumably all these features are related. The amount of displacement on the fault is not known, but the motion appears to have been in the sense indicated on Map No. 3.

NICKEL LAKE

There have been several suggestions that the steep-sided valley at the east end of Nickel Lake (Map No. 3) marks a fault and that the lake occupies a fault valley. Drilling in the valley, near the creek, has shown that greenstone and schist are underlain by reddish and grey granite. It may be that the granite followed a weak zone caused by faulting. On the south shore of Nickel Lake, a schist zone strikes S 75° E; there has been drag-folding and incipient faulting which indicate that the south side moved west. This is in a granitic rock, presumably a dyke, and may be related to movement under the lake itself.

TOW LAKE FAULTS

Numerous faults and shear zones are shown in the vicinity of the Tow Lake gabbro (Map No. 3). These have been copied directly, with only minor changes, from the detailed work of Hunter at Tow Lake.[1] For some of the faults the evidence is obvious: displacement of the zones of the gabbro, as on the *south shore* of Tow Lake; displacement of recognizable Wasekwan units, as west of June Lake; or abrupt termination of units, as south of Barrington River. For other cases, the displacement is negligible and the fault is apparently located on the presence of strong foliation in the adjacent rocks, as east of Marsh Lake.

For the fault on the *north side* of Tow Lake, Hunter's field evidence was very limited. It is based on a foliation in an outcrop at the west end of the lake, and on an offset in the "B" zone of the gabbro; the latter is not necessarily present. Diamond drilling to test an electrical conductor beneath the lake at the outlet end, however, has confirmed the presence of the fault, which is marked by a considerable breccia and gouge zone. It dips to the northeast.

LINEAR TOPOGRAPHIC FEATURES

There is a very prominent linear topographic feature which extends from east to west along the southern edge of the area covered by the Barrington Lake map (Map No. 3). It is occupied by Barrington River; the Hughes River at Adam Lake, and south of Elizabeth Lake; and passes south of One Island Lake. At the eastern end, the underlying rock is granite with a foliation parallel to the linear. In the greenstone band south of Elizabeth Lake, Stanton reports shearing at several places, and noted that crumpling, contortion, and the injection of white quartz stringers and pink felsite were frequent accompaniments. He suggested that the fault at the south end of Stan Lake may be a part of this feature. It may be inconsistent to map an assumed fault through Muskeg Lake on such evidence as is available, and not do so in the present cases; nevertheless, the writer has not felt justified in so doing on the strength of the details listed above.

In discussing the folding of the Sickle series, it was pointed out above that a system of radial and tangential faults might be expected north and east of Sickle

[1]*Man. Mines Br., Prelim. Rept. 53-5, p. 17.*

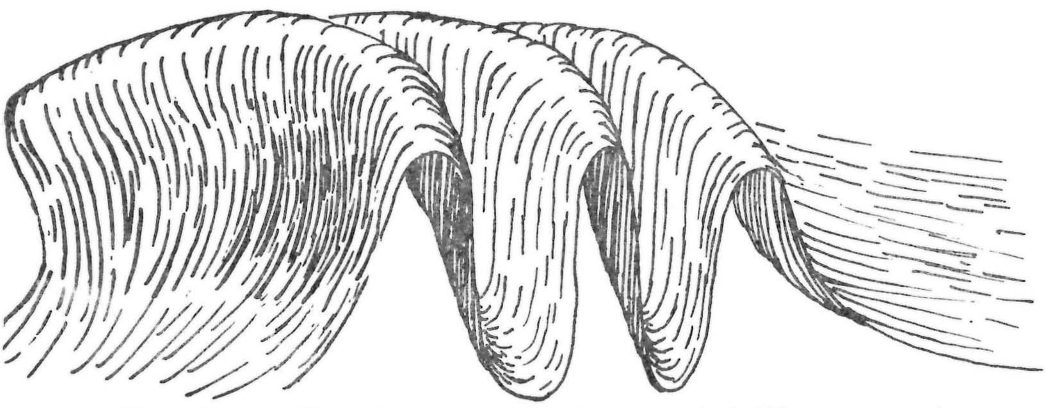

Figure 37 — Diagram illustrating compensation for a crossfold. When one anticline is cross-folded, other parallel folds develop to relieve tension on the outside of the band.

Lake. It will be obvious from the foregoing brief remarks on faulting, that he would be a brave man indeed who would argue that such a system has been demonstrated by the scanty evidence available; or that such a system is suggested. Because such faults, if they exist, must be post-Sickle, it may be that they have not been much obscured by metamorphism. It is probable that topographic depressions are associated with many faults because the faults are late events and the resulting zones of weakness have not been obliterated by subsequent activity. It is therefore not irrelevant to enquire if linear topographic features are present in the directions expected, while realizing, at the same time, that the presence of such features proves nothing about faulting.

It is worth enquiring, also, how far such faults might extend. One can argue that the country to the north and east must be in tension. But, it is obvious that a sheet of sediments, several thousand feet thick, and extending for many miles will not relieve such a stress by simply tearing open like a sheet of paper. The tension can be relieved by a series of folds parallel to the flanks of the main Willis Lake structure, as in figure 37. This has the effect of relieving the tension on the outside of the arc both by reducing the distance across the flanks and by shortening along the axis of the arc. Whether tension breaks will develop, and how far they will extend probably hinges, therefore, on how complete the folding may be. It seems likely that, as the possibility of radial faulting decreases with increasingly close folding, the tangential thrust faults should become more prominent.

An inspection of the accompanying maps shows that there are some linear topographic features in the expected direction. Such can be traced, for example, northeast from Narrow Lake to Jim Lake, and from Gordon Lake to Brooks Bay and beyond. Shorter features with a northeasterly orientation are fairly common, as at Ellystan Lake and south of it. When it is considered that elsewhere the post-Sickle intrusions probably followed the Sickle deformation, the validity of these last features becomes questionable because they are in possible post-Sickle granites. Faulting such as that indicated at Tow Lake, and possibly at Nickel Lake, would, however meet the requirements for the expected movements.

The most abundant topographic features suggestive of radiation from Sickle Lake are found in the Cockeram Lake map-area. Such features as the Muskeg Lake linear, Hughes River east of Arbour Lake, and Eagle Lake are obvious. There are many others marked by small swamps, stretches of river and lake, and other small features in combination. The two running from the east side of Cockeram Lake to Arbour Lake—one through Carr Lake and the other about a mile west—are prominent examples of this latter type of feature.

The whole of the district can be seen at a glance on the accompanying 2-mile map-sheets (such as Map No. 12). It will be noted that there is a definite northerly trend to the grain of the country north of the Sickle contacts. This pattern is broken by the northwesterly trend of Keewatin, Hughes and Barrington rivers.

If there is anything in the suggestion that the linearity is due to post-Sickle deformation, the pattern suggests that the control is on a much larger scale than here considered. That is, the folding of the Sickle is due to a regional compression more or less east and west. Or, the whole exposed area of deformed Sickle sediments represents the bottom of a complex synclinal fold, of which the Hughes Lake syncline is another smaller and simpler example. In general, one should probably conclude that any identification of radial and tangential faults with the topographic features is wishful thinking, at least at present.

One notes that the Keewatin River runs tangentially into one major Sickle syncline and the Hughes River into another. Is it possible that these two rivers mark a structure controlled by the Sickle folding?

CHAPTER IX

METAMORPHISM

GENERAL

The basic concepts of metamorphic zones are reviewed.

It will be obvious that the metamorphism of the rocks of the district must have followed a fairly complex pattern. The Wasekwan rocks have undergone an early period of folding, followed by igneous intrusion. An interval of erosion, gradual uplift, and exposure is represented by the unconformity at the base of the Sickle series. This was followed by the deposition of the Sickle sediments, folding, and another period of magmatic activity. The Wasekwan, therefore, was subjected to two periods of folding and igneous activity, while the post-Wasekwan rocks were exposed to at least one.

The standard method of presenting the metamorphism of an area is based on the concept of zoning. This was developed in the Scottish Highlands by the pioneer work of Barrow, and amplified by Tilley and Kennedy.[1] It is based on the recognition of "zones" of metamorphism, the boundaries of which are marked by the appearance of certain index minerals.[2] The established zones and index minerals are those developed in the pelitic schists: shales and greywackes. For the method to be workable, an extensive development of these rocks is necessary, but such widespread distribution of suitable rocks is not found in the Lynn Lake district. The same problem has been encountered in numerous other places, of course.

The facies concept has been developed as an attempt to overcome this difficulty. The basic principle in the facies concept is that the mineral assemblage resulting from the metamorphism of a given rock is determined by the composition and the intensity of metamorphism, i.e. by the composition, temperature, and pressure. If the conditions surrounding a given rock are changed, the minerals present will be changed or rearranged to those in chemical equilibrium with one another under the new conditions. It is found that for any specific composition, under a given range of temperature and pressure, the number of minerals which can exist in equilibrium is quite small, and that the number can be found by application of the "mineralogical phase rule".

It also follows from the basic premise that a rock of given composition, regardless of its origin, will form a constant mineral assemblage when in metamorphic equilibrium in any specific facies. For example, an andesite lava, a diorite intrusion, or a sediment of the same bulk composition, when in the amphibolite facies should all be composed of hornblende, plagioclase feldspar, anthophyllite, and biotite, with or without quartz, regardless of the origin of the rock. The same rocks under conditions of lower intensity, in the albite-epidote amphibolite facies, would be composed of hornblende, albite, and epidote, with almandine, biotite and quartz as possible minor constituents. Barrow's zones of metamorphism are, then, a special case applied to sediments of a limited range of composition.

In the Lynn Lake district the variety of rock types is rather limited, and the resulting mineral assemblages are correspondingly restricted. The volcanic rocks are restricted almost entirely to the more mafic varieties—probably they were

[1]Kennedy, W. Q.: Zones of Progressive Regional Metamorphism in the Moine Schists of the Western Highlands of Scotland; *Geol. Mag., vol. 86, pp. 43-56.*

[2]The index minerals are, in order of increasing metamorphic grade: chlorite, biotite, garnet, staurolite, kyanite, and sillimanite.

Zone	Mineral Changes		Facies
1. Chlorite	calcite-ankerite chlorite epidote albite		Greenschist
5. Garnet	Al-Actinolite	Epidote oligoclase	
6. Staurolite-Kyanite	Al-Actinolite	Epidote oligoclase: andesine	Epidote-amphibolite
7. Sillimanite	Hornblende (Diopside-garnet-epidote possible)	Andesine: Labradorite	Amphibolite
8. Extreme Contact	Pyroxene-Olivine	Calcic plagioclase	

A more detailed summary of the mineralogy and changes of the mafic rocks is given by Harker. This, in combination with data given by other sources, has permitted the compilation of the following mineral assemblages from the literature. The numbers are arranged in order of increasing intensity and correspond to those plotted on the map.

Number shown on map.	Approx. Zone Equivalent	Mineralogy	
1.	Chlorite	Calcite-albite-chlorite schist	Chlorite green-brown at higher limit. Actinolite sparse.
2.		(Calcite)-*epidote*-albite-chlorite	Albite porphyroblastic. Hornblende as needles in chlorite.
3.	Biotite	Epidote-(chlorite)-*biotite*-(hornblende)-albite (Ab_{100-90})	Chlorite+calcite+epidote→hornblende. albite→calcic. Biotite greenish brown.
4.		Epidote(*Zoisite*)-biotite-hornblende-(chlorite)-*albite-oligoclase*(Ab_{90-85})	Hornblende blue green. Harker notes that zoisite may appear.
5.	Garnet	(Epidote-Zoisite)-(Garnet)-*Hornblende*-(biotite)-*oligoclase* (Ab_{85-75})	Hornblende blue-green. Biotite greenish brown. Epidote-zoisite usually only in lower range.
6.	Staurolite	Biotite-hornblende-(garnet?)-*oligoclase-andesine* (Ab_{75-65})	Biotite brown, hornblende green.
7.	Sillimanite	*Brown* hornblende-(biotite)-*Andesine* ($Ab_{65 \rightarrow}$)	Some green hornblende persists. Diopside-garnet-epidote also possible.
8.		*Brown* hornblende-decreasing feldspar. (*Pyroxene*-Olivine)-feldspar.	

originally mainly andesite and basalt. The sedimentary rocks are also limited in type or extent: there is no great compositional variety in the Sickle series and the Wasekwan is of limited area. Limestone or dolomite which did not have abundant siliceous impurities has not been recognized, though reported to be present to the west, in Saskatchewan; shales and their equivalents are a very minor part of the whole, and restricted to beds a few inches or feet thick.

It should be possible to utilize here the basic idea of metamorphic zones by applying it to the mineral assemblages present in these rocks of relatively restricted composition. The andesites and basalts, and their intrusive equivalents, the diorites and gabbros, are fairly extensively exposed in the northern half of the district. According to the facies concept, they should show similar mineral assemblages at the same metamorphic grade. The Sickle series is widespread in the southern half of the district, though of a composition, unfortunately, which does not produce an especially diagnostic or sensitive mineral association.

Rather elaborate description would be necessary, if one were to show the metamorphic grade and mineralogy now found through the district. Because metamorphic rocks have no recognized and established classification, such as is applied to the igneous rocks, description involves a recitation of the minerals present, and there is much to be said for both the necessity and the virtues of this practice. However necessary the method may be, one finds that several pages of the distinctions between, say, quartz-microcline-plagioclase-muscovite-biotite gneisses and quartz-microcline-plagioclase-epidote-muscovite-biotite gneisses can become confusing, or even soporific.

To avoid this exhaustive description, and present the data as briefly as possible, the accompanying map (No. 14) was prepared. Basically it shows zones, or grades of metamorphism. The basis for the map is outlined below. In essence it is the presentation of metamorphic zones by a method analogous to contouring. It is considered to be a graphical method of showing the metamorphic grade at a glance, rather than any serious argument that it shows isopleths of metamorphism. It is probable, in principle, that such could be drawn, but many of the mineral assemblages recognized, at present, cover such a wide range of conditions that such fine distinctions are not possible. As pointed out above, there are probably at least two different periods of metamorphism represented in the area. The map, of course, does not distinguish these clearly.

THE UNITS OF THE METAMORPHIC MAP

The changes which occur with increasing intensity of metamorphism are reviewed from the literature.

Shales, or their metamorphic equivalents, are not abundant in the district. It has not been possible, therefore, to correlate directly the established system of metamorphic zones with the mineral assemblages of the rocks of the district. Accordingly, the assemblages reported in the literature from other places where such direct correlation is possible, have been used to establish the units used on the accompanying map.

MAFIC ROCKS: ANDESITES, BASALTS, AND EQUIVALENTS

For the mafic rocks, basalt, andesite and the equivalent intrusive types, the major changes can be summarized in the diagram on page 158.

The essential features of this are the increasing tolerance for calcium shown by the feldspar with increasing intensity of metamorphism, and the gradual development of hornblende from the other components of the lower grade rocks. The epidote, $Ca_2(Al,Fe)_3(OH)(SiO_4)_3$, supplies the calcium which goes with the albite already present to produce the calcic feldspars at higher grade. The carbonate present combines with the chlorite, $Mg_5(Al,Fe)(OH)_8(Al,Si)_4O_{10}$, and epidote to produce the aluminous actinolite, $NaCa_2(Mg,Al)_5(OH)_2(Al,Si)_8O_{22}$. Further combination under increasingly intense conditions of metamorphism produces more calcic feldspar and a very complex amphibole, hornblende.[1]

Another of the sources drawn upon was a study of metamorphosed "greenstones" at File Lake, Manitoba. In that area Currie[2] was able to correlate the minerals of the volcanic rocks directly with the metamorphic zones in the surrounding sediments. He found for rocks at about the garnet-biotite boundary, the mineralogy here attributed to Unit 4, but without zoisite. At slightly higher grade, he reports green hornblende, plagioclase, minor epidote, no garnet or clinopyroxene [=clinozoisite?]. But in both cases the albite content given for the feldspar is much below that indicated above. The ranges given by Currie are Ab_{74-70} for the first assemblage, and Ab_{70-64} for the second. The explanation of the high calcium content found by Currie is not known. It may be that in that area the greenstones were a little higher than normal in CaO, which has been taken up in the plagioclase. For rocks in the sillimanite zone he found conditions essentially as in Unit 7, including the feldspar composition; garnet and clinopyroxene [=diopside?] are reported from one group of rocks in this zone.

ARENACEOUS SEDIMENTS AND QUARTZITES

The arenaceous sediments are not sensitive indicators of metamorphism because most of the common minerals appear at low grade and persist to high grade. Much assistance was obtained from a published study of the Missi Series, which resembles the Sickle Series quite closely.

Ambrose made a careful study of the metamorphism of the Missi series[3] in the Flin Flon area. In that study he recognized three main mineral assemblages, corresponding to the established metamorphic zones:

1. Chlorite Zone: Quartz-chlorite-albite-epidote-sericite.
3. Biotite Zone: Quartz-chlorite-muscovite-biotite-epidote-albite.
5. Garnet Zone: Quartz-biotite-muscovite-garnet-plagioclase.

In the biotite zone equivalent, the feldspar has a composition Ab_{94-92}, and the green biotite increases in percentage with increasing grade. In the garnet zone, the feldspar is oligoclase-andesine (Ab_{72-68}), and the pleochroism of the biotite is: X=yellow-brown, Y=Z=dark brownish green to black.

The assemblage reported by Ambrose for the chlorite zone is similar to that described by Harker and others. Any detrital potassium feldspar tends to be converted to sericite, the hornblende and biotite to chlorite. The argillaceous and potassium-deficient nature of the Missi Series is reflected in the absence of microcline or orthoclase in the garnet zone, and the development of oligoclase-andesine. (Sufficient potassium to produce potash feldspar is incompatible with garnet, for

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[1]It is perhaps worth repeating the general formula for hornblende as given by Larsen and Berman, to emphasize the great complexity of this mineral and its "catch-all" ability to include a variety of elements. They give, for the amphiboles:

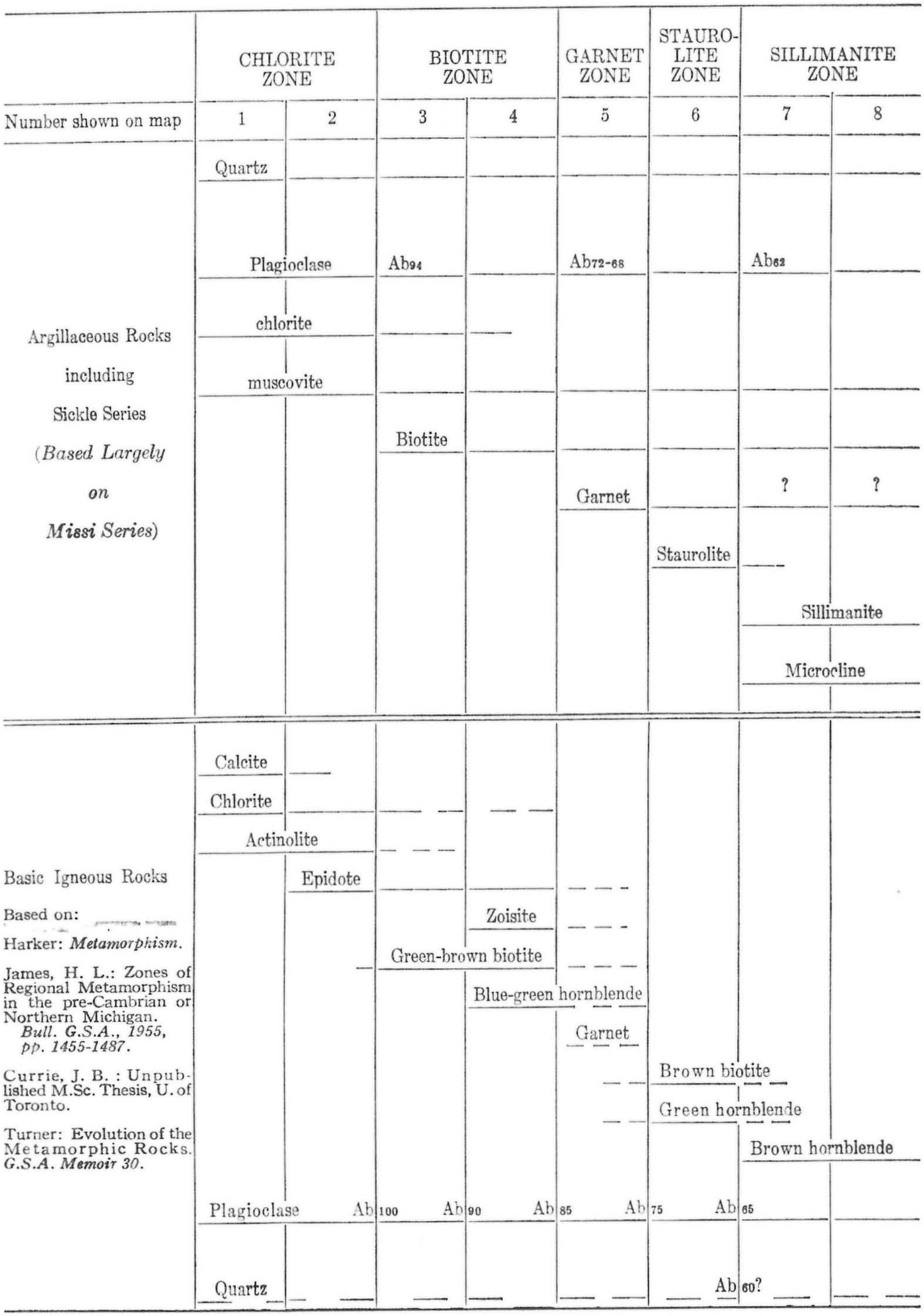
$$(Ca,Na)_2Na_{0-1}Mg(Mg,Al)_4(Al,Si)_2Si_6O_{22}(O,OH,F)_2,$$

in which K may replace Na in part, and Fe″, Fe‴, Mn and Ti may replace more or less Mg and Al.

[2]Currie, J. B.: Zones of Metamorphism in the Greenstones of the Morton Lake Area, Manitoba. *University of Toronto, Unpubl. M.Sc. Thesis, April, 1947.*

[3]Ambrose, J. W.: Progressive Kinetic Metamorphism in the Missi Series near Flin Flon, Manitoba. *Amer. Jour. Science, Fifth Series, Vol. XXXII, pp. 257-286, 1935.*

MINERAL ASSEMBLAGES IN THE COMMON ROCKS OF THE LYNN LAKE DISTRICT



the two would unite, in the presence of water, to give mica.) The association is that ordinarily expected from the shales or greywackes in the higher intensity parts of the garnet zone. It is not surprising that the Sickle series shows a similar mineralogy. The similarity of the two groups of rocks has struck everyone who has worked with both, and the character is also suggested by the analysis quoted above.

In rocks originally quartz sands, very little change can occur except a recrystallization of the quartz to produce quartzite.

The mineral assemblages used in establishing the zones are summarized in the table on page 161.

PRESENT AREA COMPARED WITH DATA FROM THE LITERATURE

The metamorphic grade was determined for some 500 thin sections according to the scheme outlined above. The results are plotted on Map 14. In drawing up this map, the reported presence of such minerals as garnet, sillimanite and epidote in hand specimens or outcrop was also taken into account, as well as any comments which had been noted by the field workers as to areas or rock types which appeared to be of similar grade. The presence of epidote is indicated by "E" alongside the station point. In the same way garnet is indicated by "G", anomalous feldspar by "F", and carbonate by "C".

It will be readily apparent that the differences are not great, from one to the other of the above units. For this reason definite, and somewhat arbitrary, limits have been set on the composition of the feldspar; considerable weight has been given to the colour and relations of the hornblende and biotite; and the presence of the italicized minerals (See p. 158) has been taken as critical for each unit. Nevertheless, it will be obvious that assigning an individual rock to a unit is subjective in some measure. The minerals shown in brackets may not be present or may appear in minor amounts.

So far as could be judged the above ranges of feldspar composition agree reasonably well, as a general rule, with those feldspars actually found in association with the respective mineral assemblages. The limit of Ab_{65} set on Unit 6 is perhaps a little high, and a range of Ab_{75-60} might be more suitable. Unit 7 would then be adjusted accordingly.

Though the above agreement holds in general, there are numerous exceptions, and there are many places where the rocks are obviously not in metamorphic equilibrium.

EVIDENCE OF RETROGRESSION

The mafic igneous rocks of the northern half of the district show many anomalous assemblages. It is not uncommon for the gabbros, for example, to show brown hornblende or remnants of pyroxene, and feldspar as calcic as bytownite, in the same section with epidote, actinolite, biotite and calcite. It should be noted that the relations recited above from the literature are for increasing metamorphic grade. Such textures as fine actinolite needles in chlorite may then be found. In many places here, especially in the northern part of the district, the reverse relations seem to hold. Judging from the relations seen in thin sections, the biotite and hornblende did not develop from chlorite, calcite, etc., but rather the reverse. It is common to see brown hornblende surrounded by blue-green hornblende or biotite, biotite with chloritic alteration, hornblende with chlorite closely associated, and feldspar crystals peppered with grains of epidote.

The textures just described and the obvious lack of equilibrium are considered to be due to retrogressive metamorphism. That is, the rock was formerly at a much higher metamorphic grade, but was later subjected to conditions of lesser intensity and began to develop minerals appropriate to the new conditions. In many cases the new equilibrium was not reached before the temperature fell so low that the reactions, in effect, stopped. In plotting these and similar cases on the map, the value shown by the "contours" is the lower grade. The fact of the alteration is shown by recording the change on the map; the assemblage just given would appear, for example, as 8→3. The lower figure indicates the highest grade that is consistent with the alteration minerals reported. This, in effect, gives a minimum for the degree of retrogressive alteration.

ANOMALOUS FELDSPAR

Cases also occur in which the calcium content of the feldspar in the rock is much lower than is indicated by the chart above. In a section from Laurie Lake, for example, there is about 87 per cent quartz with 3 per cent each of albite and hornblende, the latter altered to biotite. Garnet is closely associated with this rock. Obviously the grade is above the garnet isograd (>5), but the feldspar composition is Ab_{92}. This has been interpreted to mean that the original rock was so low in lime that no more calcic plagioclase was possible.

In other places the grade assigned to the rock has been a matter of weighing conflicting evidence. It was stated above that much weight has been given to the composition of the feldspar, but there are a number of cases where other evidence appears to outweigh it. A thin section containing brown biotite, microcline, orthoclase, and brownish-green hornblende altered to biotite has 30 per cent feldspar (Ab_{80}). The feldspar fits in group 5, but the other minerals would ordinarily go in group 7. In this case the feldspar is considered to be anomalous and is disregarded.

The presence of feldspar which is anomalous, whether because of high or low albite content, is marked by an "F" alongside the position plotted on the map.

In the rocks high in potassium, the presence of microline or orthoclase, albite-oligoclase, muscovite and yellowish brown to black biotite is considered to mark approximately the biotite zone, Unit 3, and the potassium feldspar is considered to be a surviving detrital material. The addition of garnet marks the garnet zone. Epidote may be present. In the sillimanite-bearing phases of the Sickle series, south of Naylor Lake, there is microcline, muscovite, biotite and plagioclase (Ab_{62}) in addition to the sillimanite. The biotite is light yellowish brown to dark brown and there are "knots" of muscovite and/or sillimanite. The presence of microcline, with or without sillimanite, is considered indicative of group 7, if accompanied by andesine.

GRANITIC ROCKS

Granitic rocks, especially the post-Sickle group, present a problem everywhere, because only rarely are the mineral associations diagnostic. It is obvious that the micas persist through a great range in the rocks of granitic composition, and they can also occur in the magmatic granite itself.

In general, the grey tonalite, quartz diorite, and diorite—the rocks commonly called "granite" by the prospector and others working in the district—contain little or no potassium feldspar. In many cases, in fact, they contain little or no potassium, and that little is present in the biotite. In the majority of examples, there is enough lime present to produce epidote, zoisite, or other calcium-bearing minerals as may be appropriate. The mineralogy shown in the table for the mafic igneous rocks is applicable to a large number of these cases.

The post-Sickle granite and tonalite in the southern part of the area have been the most difficult. Only rarely is there present a diagnostic mineral assemblage. As can be seen on Map No. 14, it has proven impractical to do anything constructive with the granite in that part of the district. The tonalite south of Lasthope Lake is shown below the garnet isograd because of the numerous occurrences of small amounts of epidote, which are visible in hand specimens and on the outcrop.

SILLIMANITE KNOTS

The quartz-muscovite-sillimanite knots, which are common in some parts of the number 7 zone, are a problem. According to Turner[1], orthoclase and sillimanite will react, in the presence of water, to produce muscovite and quartz, or *vice versa:*

$$KAlSi_3O_8 + Al_2SiO_5 + H_2O \rightleftharpoons KAl_3Si_3O_{10}(OH)_2 + SiO_2$$

Such a reaction might explain the small amount of sillimanite apparently present in the analyzed sample (p. 98). Orthoclase porphyroblasts of comparable size and distribution are not known in the gneisses, so it is unlikely that the direct reaction just quoted is applicable.

It seems more likely, in view of the presence of small amounts of iron and other elements, that the sillimanite results from the reverse reaction, i.e. the equation above was driven to the left with increasing metamorphic grade and sillimanite was formed by the combination of muscovite and quartz. This is supported, to some extent, by the discovery of similar small "knots" of muscovite in schistose Sickle sediments (Map-unit 20) southwest of Tod Lake. No sillimanite is known there and the rocks are apparently at comparatively low grade. The reaction of the muscovite aggregates with the quartz would produce sillimanite-bearing knots such as are common south of Naylor Lake. The surprising thing is that so little sillimanite appears to be present in the analyzed sample.

The spatial association between pegmatites, aplites, and sillimanite knots is especially striking along the railway south of Naylor Lake, and the possibility that the knots formed by the breakdown (not formation) of sillimanite should be investigated. The reaction is approximately:

$$\underset{\text{sillimanite}}{6Al_2SiO_5} + K_2O + H_2O \rightleftharpoons \underset{\text{muscovite}}{2KAl_3Si_3O_{10}(OH)_2} + 3Al_2O_3$$

according to Turner. This implies that the dykes are of igneous origin and that the alumina released by the reaction may have left the system. A number of analyses would be necessary to settle the matter and they are not available. The evidence, at present, suggests that the dykes are not of igneous origin, but should it be found that there has been potash metasomatism this idea would have to be reviewed.

REGIONAL PATTERN OF METAMORPHISM IN THE DISTRICT

In interpreting the metamorphic map it is important to recognize that a very local change may have very far-reaching effects on the appearance of the map. Two reports of low grade in an area of higher grade will give the appearance of a very large area of reduced grade, when, in fact, the reduction may be merely two isolated local cases (Fig. 38). This weakness is especially marked in the present case where the number of control points is very limited for such a large area. It is therefore necessary to examine the low-grade areas to be sure that a significant number of points are present within each. In most cases the areas of low grade are the result of retrogressive metamorphism.

Consider first the highest grade reached for each station. It then appears that the regional grade of metamorphism is the amphibolite facies. The areas of greatest intensity are south of Laurie Lake and Eager Lake, the whole area south of the line Wilmot Lake to Finch Lake, the vicinity of Barrington Lake, and possibly along the northern border of the district. There is also a suggestion of an area of

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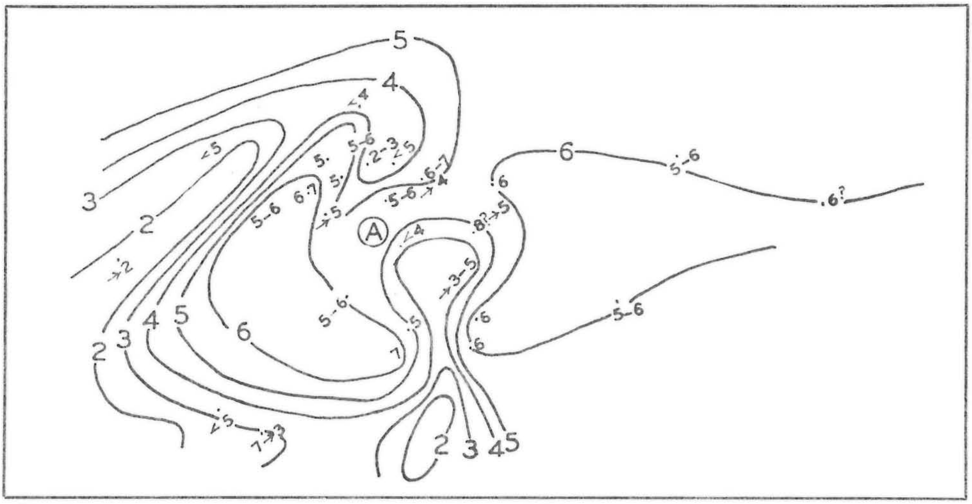
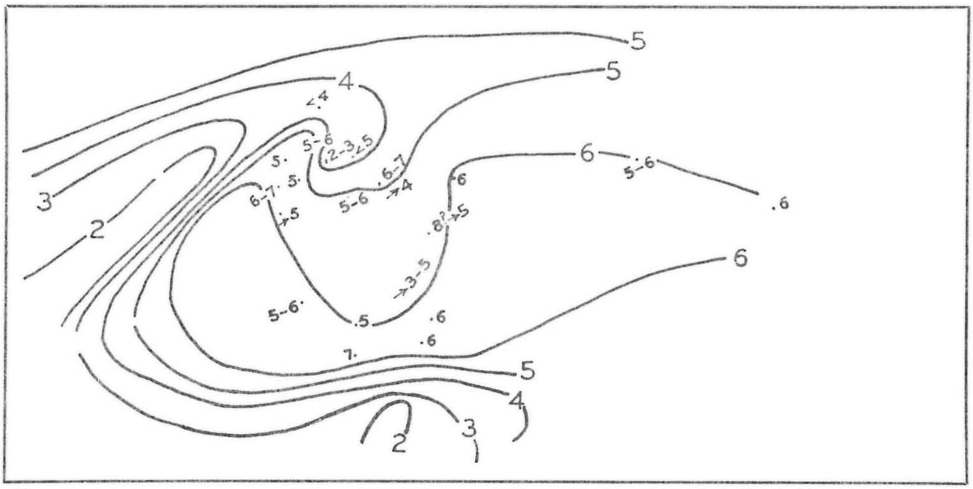
[1]Turner, F. J.: Evolution of the Metamorphic Rocks. *Geol. Soc. Am. Memoir 30, p. 118, 1948.*

high-grade rocks east of Sickle Lake. On the general line of Dunphy Lakes, Cockeram Lake, Hughes Lake and Barrington Lake, there are a small number of places where the highest grade reached was apparently the equivalent of the sillimanite zone. It seems, therefore, that essentially the whole district had reached the sillimanite zone (amphibolite facies).

The northern part of the district, especially that just mentioned on the line of Dunphy Lakes-Barrington Lake, is now at much lower grade. There are a number of irregularities, due to the local occurrences of low grade, but the whole broad zone is fairly consistently of lower grade. In the majority of cases one gains the impression that the rocks of this belt approach closely to equilibrium. That is, the minerals characteristic of high grade are in small amount and strongly altered, and the bulk of a section is composed of minerals representative of the new conditions.



A



B

Figure 38 — A. Effect of very local changes on the appearance of the map showing grade of metamorphism. If a single observation, as at A, is removed, Map B, below, is a likely interpretation.

B. While not basically different from the above, this suggests a completely different sequence of events.

It will be noticed also that the general grade reached in the southern part of the district (Laurie Lake to Finch Lake) represents approximately the staurolite zone. The southern part, and possibly also the Barrington Lake area, thus show that the last major metamorphism was more intense there than in the area of Wasekwan rocks to the north. This seems to indicate that the area of greatest intensity was near the southern boundary of the district, and beyond it to the south. From the south the grade decreases northward (and westward?).

The post-Sickle granitic rocks are associated with the areas of highest grade. Are the "granites" the cause or the effect of the last high-grade metamorphism? It is known that granitic rocks and gneisses of the Kisseynew type extend southward for over a hundred miles. It was suggested above that the metamorphism might be the result of the introduction of a late granitic batholith. It has also been suggested by Harrison that the gneisses represent the margin of a basin, of geosynclinal proportions, which was depressed to great depth. The granitic area to the south would represent the core of that great basin. The grade would decrease northward away from the zone of granites in either case. The resulting lower grade could be attained only by a reduction of the regional high grade (sillimanite zone) previously attained.

The traces of high intensity metamorphism, found in the northern part of the district, suggest that it is possible they represent the metamorphism which must have accompanied the orogeny at the end of Wasekwan time. It seems improbable, however, that rocks of such high grade should have persisted, even in the present altered condition, through the subsidence which formed, and the orogeny which deformed, the Sickle series.

The correlation between mineralization and metamorphic grade is one of the outstanding features, but unfortunately not one that is readily apparent from the metamorphic map. With very few exceptions, all those prospects which have been considered worthy of serious exploration by drilling are found in areas of rocks of moderate grade. With still fewer exceptions, the prospects which have shown significant value when drilled are below the garnet isograd (No. 5). This is the case also for the two producing mines, and for all those prospects which have shown sizeable bodies of minerals of ore grade. In a surprising number of the sulphide occurrences reported on Map No. 10, the location is also below the garnet isograd.

This empirical relation may be of some use as a guide in prospecting, but should not be taken too seriously as yet. The reason, if any, for the relation is not known. One must also consider that the map is of a very general nature and that the boundaries are based on a very small number of control points. The relation does suggest, however, that detailed study would be justified to fix more closely the boundaries of the metamorphic zones, and to confirm or disprove the correlation with mineralization. At present it is probably not justified to say that ground is not favourable for prospecting if in a high grade zone. It does suggest, however, that the mafic rocks which are altering, or have altered, to low metamorphic grades are more likely to contain appreciable concentrations of sulphides. The significant gold occurrences known to date also occur at low metamorphic grade.

CHAPTER X

ECONOMIC GEOLOGY

GENERAL

EXPLORATION

Exploration within the district has been extensive, but not intensive, in most cases. In the excitement of the staking rush which developed following the discovery of the "A" mine, practically all the Wasekwan rocks in the district were staked. Some large areas of Sickle rocks were also covered. The staking was done in mid-winter, and geophysical methods were the only method possible for immediate exploration.

During the winter of 1945-46, magnetometer surveys were made of a very large number of properties. Where the magnetic field departed from uniformity, the "anomalies" were tested by drilling. Nothing spectacular was found and exploration gradually died down. Activity practically ceased, except around Lynn Lake, between 1949 and 1954. Exceptions were the Nickel Lake property of God's Lake Gold Mines Limited, and the property at Tow Lake now held by Anglo-Barrington Mines, Limited.

A large number of properties large and small, in aggregate forming a large area, were staked only for speculative reasons. The claims were allowed to lapse after the first year, and in some cases were not even recorded. The properties which were recorded are dealt with in the appropriate place below to keep the record complete.

Intensive exploration was limited to very few properties. The "A" orebody at Lynn Lake, and the area surrounding it, were explored by magnetometer methods. The "El" mine was found at this time, and the other orebodies at Lynn Lake were gradually located and explored by drilling over a period of several years. Over a period of years also, a large amount of drilling was done on the property of God's Lake Gold Mines at Wheatcroft Lake, and on the property of Anglo-Barrington Mines at Tow Lake. Financing arrangements for the latter property involved several nominal changes of ownership over the years.

The general routine of exploration was the same for all the properties. A magnetometer survey was followed by one or two drill holes into any "anomalies" so found (i.e. usually any departure from a uniform magnetic field). This drilling might precede an electromagnetic survey, but such a survey was usually followed by a greater drilling effort on such conductors as coincided with magnetic "highs". In a few cases, a survey first performed with a dip needle or Thalen-Tiberg instrument was repeated, using an Askania or other instrument of comparable sensitivity. Where the preliminary drilling encountered sulphides, a more extensive program naturally followed. Rarely were more than one or two holes drilled into each anomaly, though occasionally a number were drilled along a fault.

The amount and kind of exploration varied from place to place. Apart from the properties mentioned above, the most extensive work has been done on the gabbro at Tulune Lake, and a number of prospects within a few miles of Lynn Lake. The Nickel Lake and Tulune Lake properties, and one or two more, are rather unusual in that exploration included geological mapping at an early stage.

The geophysical work was not always done with care. In many places, of course, it was well done, but in others the work probably did not justify the expense, and it is questionable if such properties can be considered to have been examined at all. Although the conditions were undoubtedly difficult, it is obvious in some cases that the trouble was carelessness, or lack of interest, on the part of the observers; in others it was probably haste in the interpretation of the maps. The geophysical techniques are most valuable, but surely the owner is entitled to expect care in the performance of the work: An area interpreted as volcanic inclusions in granite, because the magnetometer operator could not be bothered to note the magnetite-bearing conglomerate over which he walked, can hardly be called careful work. Nor can the drawing of a line on the "x" gamma contour and calling it a rock boundary be called careful interpretation.

The exploration of the gold prospects, of course, followed the customary procedure of trenching, and test-pitting, on the vein, followed by diamond drilling. The most extensive work was on the property of Lasthope Lake Gold Mines, and near Cartwright Lake. Exploration for gold practically ceased after 1941.

OCCURRENCES OF SULPHIDES

On Map No. 10 are shown the occurrences of sulphides noted by those who worked on the surface mapping of the district. It is important to note that the map reports nothing more than the mere *presence* of sulphide. Very often this is nothing more than a few grains of pyrite noted in a hand specimen. Several people engaged in exploration have suggested that such a map would be of interest to them, and it has been included here. To allow some discrimination as to the significance of the various reports, a summary of each is included in Appendix C.

The sulphides are most commonly found in the amphibolites (greenstones) and other rocks of similar mafic composition. This is the usual experience also in the properties where sulphides have been found during exploration, though they are found in other rock types as well. In general also, it appears that the greatest concentration of sulphide is adjacent to faults and other fractures.

Sulphides are found in altered banded iron-formation, but this is probably a case of the combination of sulphur with the iron of the sedimentary rock. The gossans, or "burns", which form on these sulphides have received much attention from prospectors in the past, but they do not appear to have any significant quantity of valuable metals. The iron-formation near Beaucage and Black Trout lakes was explored extensively in the late 'thirties.

In addition to the pyrrhotite-pentlandite-chalcopyrite assemblage at Lynn Lake, copper and zinc have been found in a number of bodies outside the gabbro plugs there, but within one or two miles of them. At least one other body has been found which contains galena in addition. It is about three miles distant. There is here a suggestion that there may be some form of systematic distribution of the different metals, but there are, as yet, insufficient data to test the idea.

A small lead vein has also been found at Snake Lake, but lead seems to be rather uncommon in the district.

Occurrences of sulphide minerals also appear to be more common in those parts of the district which are below the garnet zone of metamorphism. This has been discussed at some length above (p. 166) and will not be repeated here.

Gold-bearing quartz veins have been found at Lasthope Lake, McVeigh Lake, Cartwright Lake and near Beaucage Lake. In the latter case the gold is associated with pyrite in quartz veins cutting Black Trout Diorite and sedimentary rocks of the Sickle series. At Cartwright Lake the gold is in a severely fractured quartz porphyry dyke, whereas at Lasthope and McVeigh lakes the veins are in hornblende-biotite schists, granodiorite and quartz-rich sedimentary rocks. In some cases there is carbonate alteration of the wall-rocks, adjacent to the vein.

The gold found in the veins cutting the Black Trout Diorite and the Sickle series is obviously younger than the Sickle, and is probably younger than the post-Sickle orogeny. The diorite, on the evidence at the south end of Beaucage Lake, is younger than the folding of the Sickle. For the same reasons, the gold found in a few quartz veins cutting the pre-Sickle quartz diorite near Pool Lake is probably also later than the folding of the Sickle rocks which occur only a few feet away.

In other cases the host rocks are older than the Sickle series, and the veins might be of any age. At Cartwright Lake there is a bare possibility that the porphyry dyke fills a fault which at Hughes Lake cuts the Sickle series. Such would settle the age there also.

The ore at Lynn Lake is obviously the most important example of sulphide deposition. Hunter, in the course of a petrographic study made for the owners in 1948, adduced much evidence which suggested that the sulphides were formed as an interstitial filling between the silicates of the host-rock, and that they were therefore formed in the gabbro during the magmatic stage. Since that time, underground exploration has become possible, and much new information has been obtained. The critical question, as in many other such bodies, is apparently one of time relations.

The evidence is detailed below (Elb group). Briefly, rocks of several types and ages are found within the Lynn Lake gabbro plug, which has been faulted and the faults filled by quartz. All rock types are mineralized, if they are within the ore zone, and sulphide minerals occur in the quartz which fills the faults. It is also relevant to this question to note that nickel of ore grade—but not in quantity large enough to be an orebody—has been found in Wasekwan amphibolite northeast of Lynn Lake. For none of these cases could deposition of the sulphide at the magmatic stage of the gabbro be an adequate explanation. At the "El" mine, dykes which resemble the Berge Lake granite cut the gabbro, and the mineralization is probably younger than that granite. Ruttan has suggested that the mineralization is related to the Berge Lake granite.

If the ore deposits at Lynn Lake were, in fact, formed at a late stage of the pre-Sickle intrusive activity, we have in the district mineralization of two distinct ages, and of different character. The odds against two such mineralizing periods, in the same area, and so widely separated in time, must be very high. Therefore, although not discounting the possibility completely, it seems better to await more compelling evidence on the pre-Sickle age of the Lynn Lake sulphides.

DESCRIPTION OF PROPERTIES

Elb Group **(1)**[1] *SE 14*[2]

Property Boundaries

The Elb group, which includes the two producing mines of the district, was originally staked as a group of 353 claims. The staking was begun in 1945 in the Ralph Lake area. In September of that year a substantial length of sulphides was discovered in a drill hole in what is now the "A" orebody, and the area of the claims was immediately enlarged. The freeze-up was very lengthy that year. By the time flying was resumed in late December, and competing prospectors arrived, the Elb group covered all the orebodies since discovered. An interesting outline of the events of those few weeks—written by one of the participants—has

[1]Boldface numbers refer to claim groups as outlined on Map No. 16.

[2]Numbers in italics at right side of page refer to map numbers, all from National Topographic Series sheet 64C.

been given by Brown.[1] The original Elb group has been reduced in size by a total of 18 claims. In 1947, two claims, near Barbara Lake, were re-staked as part of the Alp group. In 1950, sixteen more claims were allowed to lapse and nine of them became a part of the LM group, which was itself a re-staking of a part of an earlier LM group. In 1953, the LM group lapsed and became, in turn, the Ralph group. In 1958, the Elb group comprised 335 leased claims.

The group covers several square miles centred at Lynn Lake. From Ralph Lake, on the west, the group extends north to Barbara Lake, east to Keewatin River, south along Lynn River and Wheatcroft Lake, and west through Fraser Lake to Frances, Sheila, and Ralph lakes. The western boundary is quite irregular, because of the shape of the adjoining Incon group of claims.

Discovery

The outcrop of the "A" orebody was discovered in 1941. Because it is often claimed that many others knew of this occurrence prior to that time, it is of interest, perhaps, to record the conditions at the time of the discovery. The circumstances, as Austin McVeigh told me the story, were about as follows:

The first indication of sulphides was the discovery of a boulder of pyrrhotite as float. This was in the Lynn River below the outlet of Lynn Lake. So far as I can place Mr. McVeigh's description, it was probably just east of where the railway line crosses the river. Subsequently he searched for other pieces of sulphide float, but found none west of the west side of Lynn Lake.

In 1941, while prospecting a small ridge north of Lynn Lake, he noticed a brown oxide stain, or burn, about a quarter of an inch wide alongside a joint in the gabbro of a small outcrop. Curious as to the cause, he followed the joint crack for a few feet, till it disappeared in a shallow hollow filled by dirt and two or three small trees. He was able, by pulling up the trees, to remove the dirt. Tangled in the tree roots was a fragment of massive pyrrhotite which fitted into the bedrock beneath.

Returning the next day with the necessary tools, McVeigh was able to strip the whole outcrop of the sulphides. He described this as being about 2 or 3 feet wide and about 6 feet long. It had been completely covered by dirt and bushes.

The original exposure was near the present position of the crusher house at the "A" mine.

"A" Mine

Surface Plant and Production

The "A" mine is the centre of mining operations, and is the main producer at present (1959). In addition to the main producing shaft, the mill and administrative offices are also located there. Nearby are the terminal of the railway line which connects the mine with the railway system to the south, the airport, and the townsite, which serve both the "A" and "El" mines, and also the extensive commercial fishing industry which has recently been developed. The airport has sand and gravel runways 1,500 yards long; it is used regularly by DC 3 aircraft.

The "A" shaft currently handles the production of the main mine. It has five compartments and is 13′ 4″ by 18′ 0″ outside the timbers. The shaft is 1,627.5 feet deep and accommodates two 3½ ton (85 cu. ft.) skips, a 6′ 4″ by 12′ 0″ cage compartment, a counterweight, pipeway and manway compartments. A 385 horsepower hoist provides a hoisting capacity of 135 tons per hour, and is now operated automatically. Ventilation air passes down the shaft, and is heated in winter to 40°F. Fan capacity is 60,000 c.f.m.

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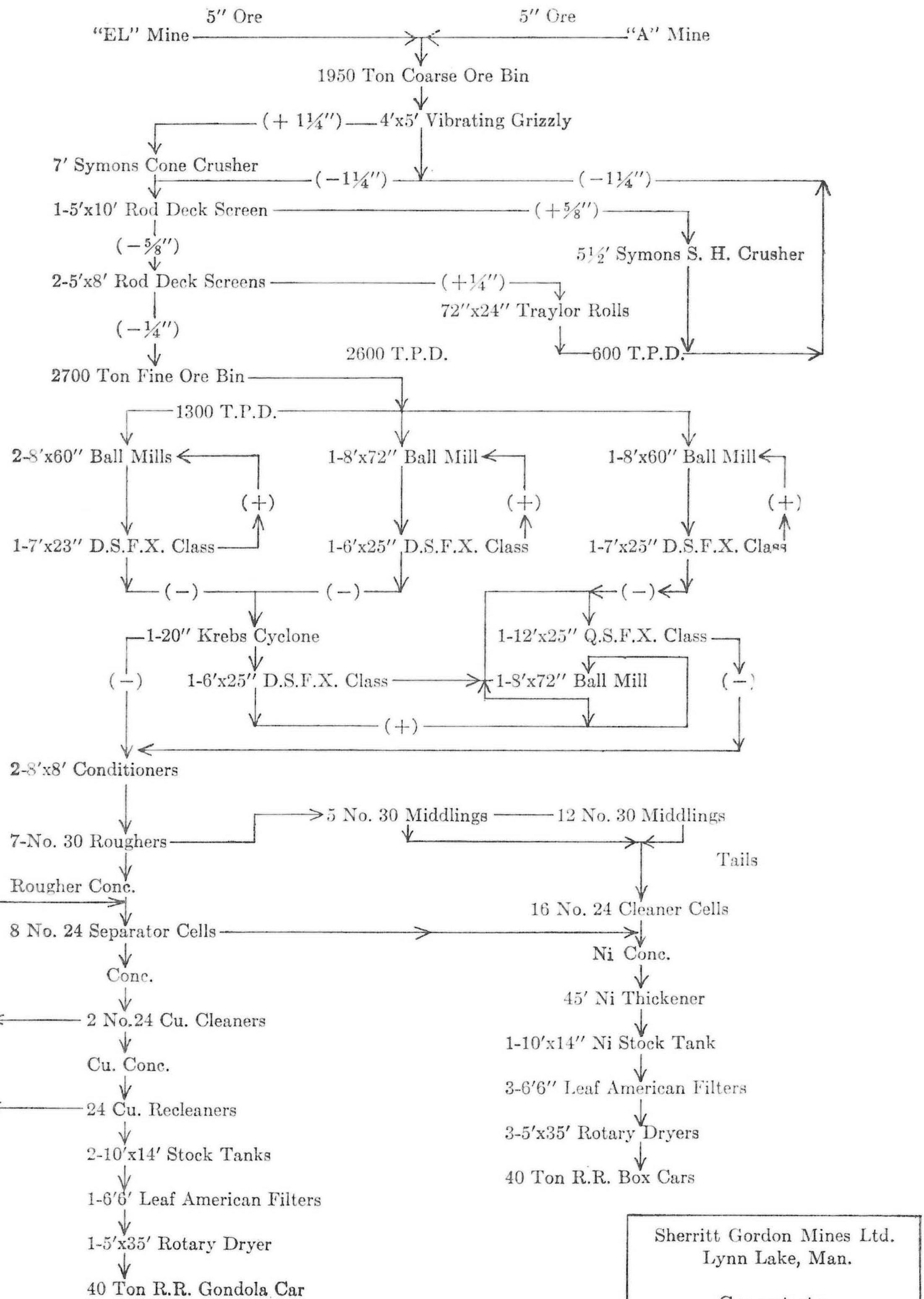
[1]Brown, E. L.: Sherritt Gordon Project; Notes on Discovery and Financing; *Trans. C. I. M. M., Vol. LVIII, pp. 187-200, 1955.*



Sherritt Gordon Mines Ltd.
Lynn Lake, Man.

Concentrator
Flow Sheet

May, 1957

The Farley shaft has been sunk to provide for production from the orebodies under Lynn Lake, and for further exploratory work. It is 24′ by 16′ 8″ outside the timbers, and is one of the largest in Canada. It will have two skip compartments, a 10′ by 15′ cage compartment, and a ventilation compartment, in addition to manway, pipe and cable and counterweight compartments. Sinking has now been completed at 2,360 feet.

A very simple and inexpensive mining method is possible, because of the favourable shape of the "A" orebody. An open stope sub-level method is used, with sub-levels approximately 75 feet apart. The ore is broken into a slot from long blast holes, drilled in rings about six feet apart. The maximum stope dimension is 200 by 230 feet. The ore is withdrawn through four scram drifts on the 14th level, and drops to a 42″ by 36″ crusher which reduces it to 6-inch size, whence a belt conveys the crushed ore to the loading pocket. The average production (1957) is 25.26 tons per man-shift (underground).

Underground diesel haulage is planned for use in mining the other orebodies in the "A" gabbro plug. For this purpose a large haulage level is now being driven on the 14th level, and the use of rubber tired dump trucks is intended.

The mill has a capacity of 2,700 tons per day, at present. Construction is now in progress to increase this to 4,000 tons per day. Ore from underground is further reduced, by two cone crushers and a roll crusher, to ¼ inch. It is then ground, to 75 per cent minus 100 mesh, in 8′ by 60″ and 8′ by 72″ ball mills, in closed circuit with classifiers.

The feed to flotation circuit assays roughly 1.90 per cent nickel, 0.75 per cent copper and 0.06 per cent cobalt.

Two concentrates are made. The nickel concentrate contains 14 per cent nickel, 1.5 per cent copper and 0.35 per cent cobalt. The copper concentrate has 30 per cent copper, and 0.60 per cent nickel. In this circuit 85 per cent of the nickel, 93 per cent of the copper and 80 per cent of the cobalt are recovered. The concentrate is thickened, filtered, and dried to three per cent moisture for shipment. Daily production consists of about 280 tons of nickel concentrate and 40 tons of copper concentrate. The nickel goes to the company's refinery at Fort Saskatchewan, Alberta, where metal is produced by the ammonia-leach process. Copper concentrate is sold to Noranda Mines Ltd.

When production started, in 1953, the reserves, in all ore bodies, were estimated at 14,055,000 tons averaging 1.22 per cent nickel and 0.62 per cent copper. In 1958, reserves were estimated to be 14,600,000 tons averaging 0.90 per cent nickel and 0.48 per cent copper. It is interesting to note that the exploration of the orebodies, prior to mining, involved 205,555 feet (39 miles) of diamond drilling from the surface, and a further 107,547 feet (20 miles) of drilling from underground.

"A" Orebody

The "A" orebody is irregular in outline, but has approximately equal length and breadth. In vertical section, the salient feature is a series of blocks of ore between thrust faults which dip steeply westward. The highest grade of ore is near the faults, and the ore grades outward to an arbitrary limit in rock which contains disseminated sulphides. The actual, though arbitrary, ore boundary can usually be recognized by inspection, and does not present a serious problem in development work. Within the ore zone all rock types are mineralized to some extent.

Lithology

The host rock for the orebody is the "Lynn Lake gabbro" (see Map No. 1), which is in the form of a plug, intruded at the contact between volcanic and sedimentary rocks. The contacts are apparently very steep. On the western side the boundary of the gabbro dips eastward, at about 75 degrees, between the surface and 12 level (970 feet deep). Underground exploration has not extended to the eastern side of the plug. The Wasekwan volcanic rocks, in the vicinity of the plug, include massive and schistose flows, with some interbedded tuffs; minor amounts of siliceous sediments are also present. The latter become more extensive to the northeast, where garnets are present in both the quartz-feldspar-biotite-bearing sedimentary rocks, and in the hornblende-rich volcanic material.

The Wasekwan rocks which surround the southern half of the plug are very siliceous, with small amounts of biotite, and with some feldspar in most cases. Biotite may be present in thin bands, or in clusters or aggregates. East of Lynn Lake, recent mapping has shown that these impure sediments grade into rocks of granitic appearance.

The Lynn Lake plug, shown on Map No. 1 as "gabbro, norite, and hornblendite", is a composite of a number of rock types. Those recognized and mapped by the mine staff are: peridotite, gabbro, norite, diorite, "quartz hornblende diorite", and "amphibolite", along with acid and basic dykes.

The *peridotite* occurs as considerable masses in the "A" mine, but is not visible on the surface, where it underlies low ground. Irregular masses as large as 600 feet across are known from underground drilling, and drill intersections as long as 200 to 250 feet are not uncommon. South of the "B" orebody (that is, under the middle of Lynn Lake) a mass 900 feet wide and in excess of 1,300 feet long has been indicated by drilling. The orebodies occur in the vicinity of peridotite, and the "H" orebody is within the large mass just mentioned.

The peridotite is dark grey to black, faintly greenish on the fresh surface, and is coarse grained, with the characteristic "knobby" or porphyritic appearance already described in some of the gabbro of the district. (See Appendix B.) It consists of stubby black pyroxene prisms, about 0.1 inch long, in a greenish, fine-grained groundmass. Olivine is present in the freshest phases, but the rock is usually altered to a talc or serpentine rock which carries little or no carbonate. The altered peridotite does carry a little finely divided magnetite, which is presumably the repository for excess iron resulting from the alteration. The peridotite is the only appreciably magnetic rock in the plug, and is probably the cause of the very slight magnetic anomaly which does occur over it. (See Map No. 13.)

"*Norite*" occurs as fragments and remnants within the ore, and in a few places on the surface. It was described above (p. 54). Hypersthene has been reported, but is apparently not abundant; the usual ferromagnesian mineral is enstatite.

Gabbro has been described at some length above (pp. 54-57) and the description need not be repeated here.

Diorite is another of the main rock types within the mine. The term has been used in the mine mapping to distinguish any medium- to coarse-grained, dark, feldspathic rock, regardless of the feldspar composition. It has come to signify a rock containing feldspar in excess of about 30 per cent. In hand specimen it is very similar to other pre-Sickle diorites of the district. (See Appendix B.) Small amounts of black biotite may be present, forming pseudomorphs after hornblende. The hornblende is light chlorite-green, and some chlorite may be present.

"*Quartz Hornblende Diorite*" (locally called "Q. H. D.") also occurs in masses of large size in the mine. It is usually very closely associated with the ore, and has apparently had some influence on the location of faults.

The characteristic feature of this rock is its dark glassy appearance and fine grain. In many respects it resembles the fine-grained greenstone of the district.

"*Amphibolite*" is another term of local use. In the mine it is probably the most voluminous rock type, and is certainly that most commonly associated with the ore. The term is applied to basic rocks of altered appearance, which are apparently derived, for the most part, from gabbro or diorite. The characteristic feature of the "amphibolite" is the presence of actinolite, instead of the black hornblende. (The latter is usually brownish, green or bluish green in thin section.) The other main constituent is plagioclase. In most places carbonate is present in this rock in very minor amount, if at all, and epidote also is not common.

Black dykes occur in a number of places in the mine. In some cases they are fine-grained black lamprophyres; in others the rock is coarse grained and resembles diorite. The dykes may be either fresh or altered to "amphibolite", or chloritized. The alteration is usually especially marked where the dykes are in peridotite which is, itself, high in talc. These occurrences of both fresh and altered dykes immediately suggest the possibility that dykes of two ages may be present.

Another feature of the black dykes is the presence of a micaceous selvedge in some cases. The margin may consist of ½ inch to 2 inches of chlorite or biotite schist, whereas the core of the dyke is coarse grained and of unaltered appearance. An example seen cutting peridotite in the "A" mine shows a similar alteration zone within the peridotite adjacent to the dyke. This may be due to movement between the two rock types, or to reaction between them. In some respects, the appearance is suggestive of the unusual dyke noted at Tulune Lake (see page 113) but the mineral segregation is by no means as clear cut, and the interior of the dykes in the mine is mafic. Where there is a chloritic selvedge, there is usually a slip plane along the margin. Vellett[1] considers that the core is an intrusion along an older fracture, and therefore later than the alteration, which accompanied the fracturing. If true, this would tend to corroborate the evidence of the other fresh dykes and point towards a series of late dykes. Most of the dykes carry small amounts of sulphide and, where they are in a mineralized area, they may be ore in their own right.

Under the heading *acid dykes* the mine maps show small amounts of rock, which ranges in composition from quartz veins at one extreme, towards diorite at the other. They are mostly narrow, though such cases as the quartz veins, for example, are very persistent. They may, in other cases, be discontinuous.

Included within the category of acid dykes, are the quartz fillings of some of the wider faults, and they are mineralized if within an ore zone. Dykes of granite and feldspar porphyry are also included under this heading.

Correlation of Mine Lithology with that of the District

Several of the units recognized in the mine have also been used in mapping in other parts of the district, though the very detailed mine work has, of course, resulted in greater subdivision. Peridotite has not been used as a unit on the accompanying maps, and it has, in fact, been reported on the surface only in the case of one doubtful outcrop. This probably reflects the soft and easily-weathered nature of the altered rock which, if present, is likely to be underneath low ground, just as at the "A" mine. The gabbro and norite of the mine area have been described above and many other rocks of the district have been recognized as similar. It is worth noting, however, that one characteristic feature of the gabbro at Lynn Lake is the low magnetite content. This feature has been mentioned before (p. 50) in connection with the lack of magnetometer response over certain gabbro bodies. (See Maps Nos. 13, 13A.)

The diorite of the mine, on the basis of appearance above, would be correlated with the pre-Sickle diorite of other parts of the district. On the basis of the direct evidence in the mine area, it is closely related to the gabbro into which it passes gradationally. No direct cutting relations of gabbro and diorite have been noted, but all such data are complicated by the widespread alteration to amphibolite.

"Quartz hornblende diorite" probably has no complete correlation with the other units of the district. In the past, some of the dark dykes in the mine have

[1]Personal Communication.

been mapped with this unit. Other rocks, showing the characteristic fine to medium grain and the presence of a little quartz, have also been included. In many cases, therefore, rocks very similar in appearance to surface "greenstones" have been mapped with this unit. The mine geologists now entertain the possibility that some of the large masses of "Q.H.D." shown on their maps may be, in fact, large inclusions of Wasekwan "greenstones". Such inclusions do occur in the plug, and have been recognized in the vicinity of the "E" and "G" orebodies. On the other hand, inclusions of the Wasekwan sediments should be equally likely in the southern part of the plug, but the more limited exploration there has not indicated them. There is, however, the possibility, at least, that within the "Q.H.D." unit there are included some rocks which are of different ages. This does not imply that it is all either greenstone or late dykes.

Some "Q.H.D." appears to be definitely intrusive. On the basis of appearance some of it would be correlated with some of the quartz diorites of Map Unit 10. This does not appear to conflict with any of the mine data, which indicate the "Q.H.D." to be the latest unit of the basic group of intrusions, but it must be pointed out that the quartz diorites are usually of coarser grain than is typical of the "Q.H.D."

Age Relations

The rock types of the mine appear in the same sequence as has been recognized elsewhere in the district. Exceptions must be noted for the peridotite, which is not known from surface mapping, for the "amphibolite", which is obviously an alteration product, and for the acid and basic dykes.

The intrusive group has been assigned to a pre-Sickle age, in the present work. The question of age was discussed at length above (pp. 71 to 73), but the argument may be re-stated briefly here:

1. At many places in the district the mafic rocks of this type have been found to be cut by quartz-diorite and more siliceous types, but no large masses of mafic rock have been found to be younger than granitic types. Exceptions are the Black Trout Diorite, which is demonstrably post-Sickle, and gabbro dykes at Cartwright and Tulune lakes. The dykes are also believed to be of post-Sickle age.

2. Granitic rocks of the types which post-date the gabbro are found beneath the Sickle unconformity.

3. Where a gabbro body is not cut by a pre-Sickle type of granite, there is the possibility of post-Sickle age. There is, conversely, a fair presumption of post-Sickle age when a gabbro does cut such a granite.

In the specific case of the Lynn Lake plug, it has been assigned to the pre-Sickle group. The reasons are essentially those just outlined: (1) The sequence of the basic rocks is that found elsewhere for that group; (2) the gabbro is cut by granitic dykes; (3) except for the late basic dykes, there is nothing to suggest an age younger than the granitic rocks, and those dykes may well be of post-Sickle age. It is realized, of course, that the foregoing does not constitute proof of a pre-Sickle age and that it is, at least, possible for the rocks of the plug to be much younger than the age here assigned to them.

Further, there is only minor deformation in rocks known to be of post-Sickle age. It seems probable, however, that the faulting in the "A" plug is due to the orogeny which is now represented by the folded Sickle sediments, which would be the first major disturbance to affect a post-Wasekwan intrusive.

Structure

In the vicinity of the Lynn Lake plugs, the Wasekwan rocks have obviously been severely deformed. So far as our present knowledge goes, the gabbro is on the north flank of a large syncline, the axis of which lies along the general line of Muter Creek. It appears probable that the Berge Lake granite occupies the centre of the adjacent anticline.

The only internal evidence of deformation of the gabbro is the faults which cut it. Though extensive areas of the plug now show "amphibolite" alteration, there is actually little or no foliation in this rock. Unless one is to postulate that the whole plug is later than the post-Sickle orogeny, however, it is obvious that it has been through at least one period of deformation. One would anticipate some foliation as a result. Because it is probable that the gabbro is of pre-Sickle age and, therefore, probably deformed, one is forced to postulate either that the gabbro adjusted itself to the folding without developing any marked planar features or that such were obliterated by the alteration which produced the "amphibolite". In consequence, one must either give the absence of internal foliation little or no weight as evidence, or give serious consideration to a possible post-Sickle age for the intrusion.

There is no available evidence suggesting that the deformation of the Wasekwan rocks was, in any way, affected by the presence of the gabbro, or by its intrusion. This, too, suggests that the gabbro was introduced by stoping, and that it is either post-Sickle, or that the gabbro was not seriously deformed by the post-Sickle orogeny. The latter possibility implies that, during deformation the Sickle rocks slid upon a thrust plane at their base. Such a possibility was suggested by Bateman, and wide shear zones are present at the base of the series in many places. Until it is possible to decipher the structure of the Wasekwan, and decide on the influence of the post-Sickle orogeny, this view is adopted here. The Wasekwan is considered to have been deformed only on the broadest scale by the post-Sickle activity, and such faulting as occurs in the vicinity of the plugs is ascribed to that activity.

The major displacements recognized in the mine are the "Upper A", "Lower A", and the "1984" faults. These can be followed from level to level. The "1984" fault strikes N 45° E and is practically vertical. It can be followed from near the surface, where it is truncated by the "Upper A" fault, to the present lowest level of the mine. The "Upper A" fault dips about 45° west and outcrops near the "A" shaft. It therefore passes outside the area of active mine operations above the 5th level. The "Lower A" fault strikes about N 10° E, dips 70° west, and outcrops at the northeast corner of Lynn Lake. It passes into the area of the "A" orebody at the 12th level; the upper part of the orebody "bottoms" against this fault near the 14th level.

The net slip is not known on any of these faults. The displacement of the ore zone indicates that they are thrust from the west, and with a right hand offset, i.e. west side north. Such broad areas as the ore zones, which do not match across the faults, are insufficient to permit accurate estimation of the net movement.

Three periods of activity are indicated on the main faults. The fracturing of the basic intrusion was followed by the introduction of small siliceous dykes and quartz veins into the faults and adjacent fractures. The fault filling is itself fractured, however, and the fractures commonly are filled by slickensided sulphides, which suggest a third movement.

It is notable that, in many places, faults coincide with the contacts between rock types. It is thus evident that variations in properties have been an influence in fixing the position of the faults. The several cases where "Q.H.D." is apparently truncated by a fault illustrate this point. A large mass of this rock may end against a fault, but the apparently displaced portion is not found. This seems to mean either: the fault has such displacement that the missing portion has been moved clear outside the area of exploration, or the fault is located approximately along the pre-existing edge of the rock mass.

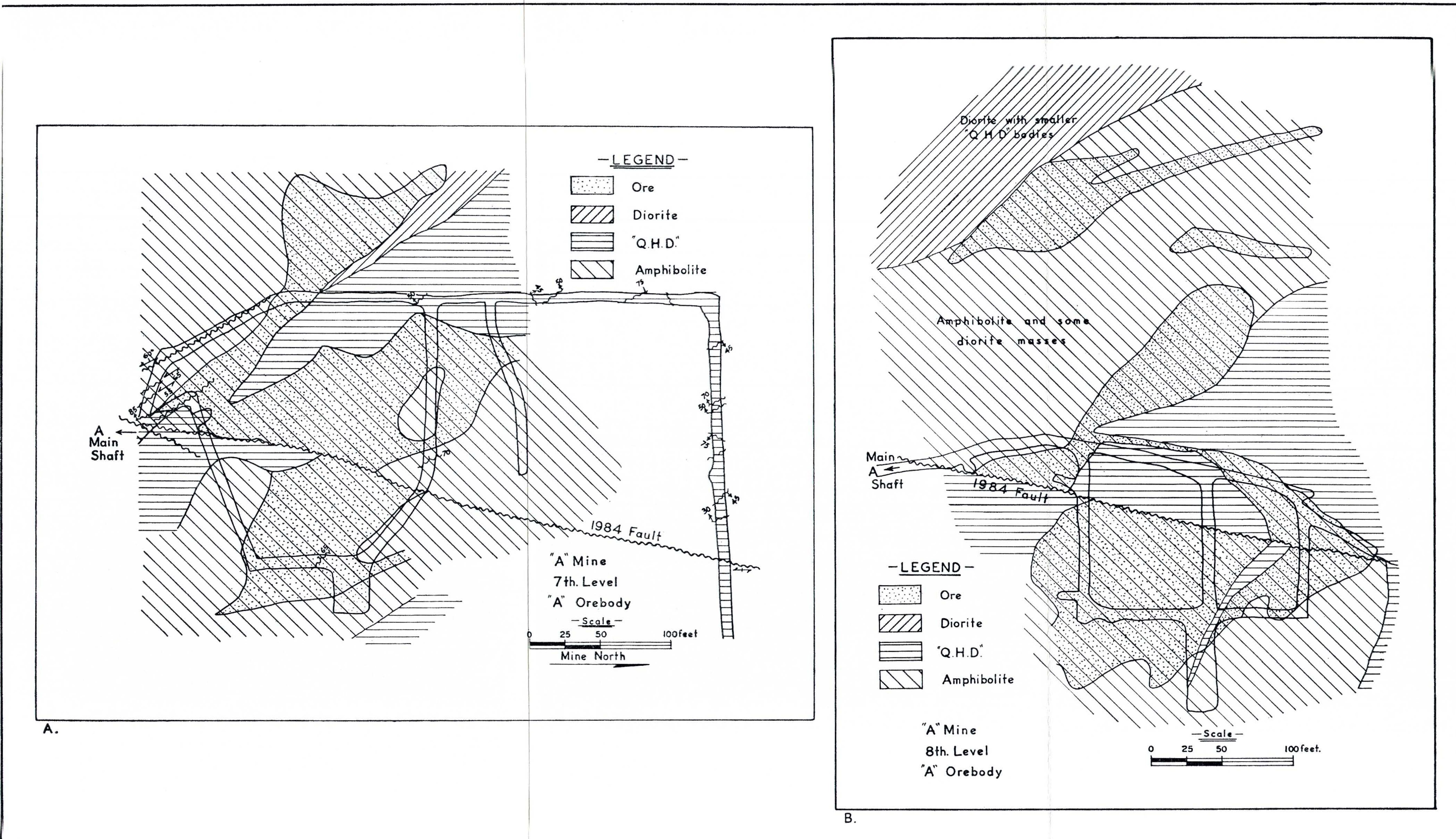


Figure 39 — A. Plan of the 7th level' "A" orebody, Lynn Lake.
B. Plan of 8th level, "A" orebody, Lynn Lake.

In the apparent localization of faulting by variation in rock properties, is a suggestion of a feature also noted elsewhere in the district, i.e. the concentration of faults and shear zones in areas where there are several different rock types.

Other faults are found in the mine, of course. Some of these have very minor displacements, and offset the latest dykes. Others are apparently also of minor displacement, are contemporary with the larger movements, but are filled by the acid dykes and quartz veins.

To try to fit the observed faults into definite systems is probably still premature. Casual examination of level plans suggests, however, that the faults shown thereon can be grouped under four major directions, if the obviously late faults are ignored for the moment. They are: (1) Those which parallel approximately the "1984" fault, and strike NE with a very steep (80° to 90°) northwest dip; (2) Those which approximate the attitude of the "Lower A" fault (N 10° E, dip 70° W); (3) Those which trend about N 30° W and dip at 65° to 75° SW. The most prominent member of this group cuts the "C" orebody, and may curve towards the Lower "A" fault; (4) A group of fractures filled by narrow acid and basic dykes. Those trend about N 60° W and dip at 60° to 70° northeastward. Eastward-dipping fractures do occur, but are rare.

The orebodies are closely related to the faults, which apparently acted as a controlling factor in localizing the ore. This results in the paradox of an orebody localized by the faults which appear to displace it (such as the "Upper A", "1984", and "Lower A" faults). Sulphide minerals are present in the faults, however, and within the ore zone the dykes which fill the faults are themselves mineralized. It can only be concluded that such mineralization post-dates the faults. It was not the ore, then, which was displaced by the fault, but the ore *locus*, the area which subsequently was mineralized. It is possible that the ore zone itself was a shatter or breccia zone resulting from the movement on the westerly dipping thrust planes. This is suggested by the presence of angular rock fragments in the massive ores, but there is really little direct evidence. Douglas[1] has recently made the suggestion that the locus of such orebodies as this may be determined by physical differences in the gabbro resulting from gas phase movements late in the magmatic stage. While this is a most ingenious idea, it is difficult to see what criteria would be indicative of such a control.

Rock Alteration

Alteration is extensive in the mine area. The peridotite is mostly altered to talc and serpentine, with a small amount of very finely divided magnetite. The gabbro, norite and, to some extent, the diorite are altered to "amphibolite", with its characteristic actinolitic hornblende. The question immediately arises: "Is this alteration associated with the mineralizing process, and therefore a guide to orebodies, or is it the result of regional metamorphism?"

The larger part of the ore occurs in amphibolite. This is a matter of empirical observation in the mine. Though all rock types in the ore zone are mineralized, the ore shows decided preference for the amphibolite. Probably the least suitable host rock is the "Q.H.D." This is clearly shown on Figure 39. It appears, therefore, that the presence of the actinolitic alteration is one of the more favourable indications of a potential host-rock for ore.

Amphibolite alteration is not a pre-requisite for ore formation, however. Within a mineralized zone any rock type, including the late black dykes, may be of ore grade. On a broader scale, peridotite is also the host rock for the "H" orebody, though this is a rather exceptional case.

Certain evidence points toward an association between the "amphibolite" alteration and the mineralizing process, or is compatible with it. The close

[1]Douglas, G. V.: Pipe-Like Ore Bodies in Plutonic Rocks, *Econ. Geol., Vol. 52, pp. 578-581, 1957.*

association between the amphibolite and ore is of this type. There is very little ore without amphibolite, though, of course, much amphibolite without ore. Alteration of these amphibolite and diorite bands is found in many drill holes. They suggest the irregular margin of a zone of alteration, rather than the all-pervasive rearrangement which might be expected from regional metamorphism. Pyroxene-bearing rock occurs as residuals in the ore in some places. If the actinolitic alteration was a regional phenomenon preceding mineralization, one should not expect pyroxene to have survived to the zones where actinolite is stable.

Certain other points suggest, however, that the alteration was not directly associated with the mineralization but was the result of a regional process. The most obvious one is the wide extent of the alteration. It is both adjacent to, and distant from, known ore. If this is a hydrothermal alteration associated with the ore, it is very extensive and all pervasive. This would probably imply that the channelways for the altering solutions were numerous and widespread.

Differences between diorite, "Q. H. D." and amphibolite, are chiefly in the character of the amphibole. It is, at least, possible that these might reflect original compositional differences, rather than an alteration by metasomatic processes. For example, the essential difference between the (quartz)-feldspar-hornblende-biotite assemblage of the "Q. H. D." and the feldspar-actinolite assemblage of the "amphibolite" is a decrease in the content of alumina. But, while both are assemblages characteristic of the amphibolite facies of regional metamorphism, the nearby talc alteration of the peridotite is not. The talc should appear only in the greenschist facies.

The juxtaposition of these two rock types, indicative of different grades of metamorphism, is not compatible with an origin by simple regional recrystallization with addition or removal of material. (However, the talc could be produced by simple addition of SiO_2 to serpentinized peridotite, if MgO were removed.)

The time relations between amphibolite and other rocks should be helpful. Should it happen, for example, that the late dykes, which are mineralized, were later than the amphibolite, there must be an hiatus between alteration and mineralization. One could not then be caused by the other.

The evidence, at present, does not permit a clear-cut decision. The differentiation of the late dark dykes is a relatively recent feature of the mine mapping, and their relations are still somewhat obscure. At present, it can be said that there are dykes which are not altered to amphibolite. These could possibly be later than the alteration process. At the same time there are rocks, containing a large proportion of actinolite, which also appear to be dykes. Until the relations of these dykes can be settled, the evidence is ambiguous.

Distribution of Sulphides

The distribution of the sulphides in the mine appears to be controlled by three factors: (a) persistent thrust faults of relatively large displacement; (b) fault breccia or shatter zones, probably related to (a), and serving as ore loci, and (c) rock type.

The rock type appears to exert a chemical influence. It is found that in a mineralized zone or area all rock types are mineralized. It is a notable feature visible on the level plans, however, that the "Q.H.D." as a whole contains very little ore. Rocks of a composition which would alter to amphibolite, however, are the principal hosts for ore. (See Fig. 39.) Singularly enough, the volcanic inclusions (?) in the plug also, apparently, are not ore carriers, though elsewhere in the district they are the rocks in which sulphides are most commonly found. (See Appendix B and Map No. 10.)

A mechanical control by the rock type is suggested also. It has been noted above that faults are possibly localized where there is a variety of rock types, presumably by the variety of physical properties present.

It should be noted in passing that the orebodies are all near the bottom contact of the gabbro, if a nearly vertical intrusion can be said to have a foot-wall.

Origin of Ore

The age of the mineralization has an important bearing on the possible origin of the ore. To be present in the quartz filling of such as the "1984" fault, the sulphides were certainly mobile after the consolidation of the gabbro mass. Other rock types which cut the gabbro are also mineralized. Included in these are the minor granitic bodies and the later black dykes. This suggests that the mineralizing process occurred after the formation of the latest unit recognized within the plug. Direct magmatic segregation, therefore, appears unlikely.

It may be argued that the late dykes derived their sulphide content from the re-mobilization of already existing sulphides into which they were injected. This might be applicable to sparse marginal stringers of sulphide, but seems quantitatively inadequate to explain dykes which are ore in their own right (with up to 6 per cent nickel content).

The period of mineralization must long post-date the gabbro. If, as is here considered to be the case, the diorite and "Q. H. D." of the mine are correlative with similar rocks elsewhere in the northern half of the district, they are later members of an intrusive group. The mineralization must then be later than the fracturing of the latest members of that group. Should the late dykes be post-Sickle in age, as is at least possible, then gabbro and sulphides are separated by a complete orogeny.[1]

The other deposits of the "A" plug conform, in general, to the foregoing remarks, which apply primarily to the "A" orebody. There are some differences in detail. In the "C" orebody, for example, the controlling fractures were apparently more widely spaced and the brecciation less thorough. The mineralization has accordingly been less thorough and the ore tends to follow the fractures. This resulted in an orebody which, while crudely oval or lenticular in over-all plan, is composed of a number of steeply dipping tabular higher-grade zones sandwiched between a similar number of lower-grade zones.

The "H" orebody is exceptional in that the host rock is altered peridotite.

"El" Mine

The "El" orebody is distinctive in that it is enclosed within a very small plug. (See Map No. 1.) This intrusion was discovered by geophysical means during the early explorations which followed discovery of the "A" mine. It did not outcrop.

The orebody occurs within the core of a plug about 350 feet in diameter. As in the "A" mine, the host-rock is mostly amphibolite, with some diorite, peridotite and "Q.H.D.". The outer zone is a dark medium-grained diorite.

The grade of the massive sulphide of the "El" is the highest in any of the orebodies. When production began, grade of the massive ore was estimated at 5.5 per cent nickel, 1.5 per cent copper, and 0.20 per cent cobalt. The disseminated ore of this mine was estimated at 0.75 per cent nickel, and 0.40 per cent copper, a little less than the average of all the reserves.

Characteristic of the ore of the "El" mine are the residuals of unmineralized rock which form inclusions in the massive sulphides. They are usually well-rounded, unmineralized, and from half an inch to several feet across. Exceptionally high cobalt content is reported from the halo of pyrite and chalcopyrite which, in some places, surrounds the inclusions. Where the "remnants" are especially numerous, the sulphides are, in effect, veinlets between the remnants filling the fractures of the brecciated rock.

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[1]While one can entertain this possibility, it would appear at least as likely that the gabbro and its mineralization are all post-Sickle.

The prime control of the ore, as at the "A" mine, is apparently a shear zone which strikes northwest and dips north at 50°. This can be followed through the mine to the bottom of the present workings, but seems to have negligible displacement. The massive ore is adjacent to this fault, where it cuts the core of the plug, and occurs in both the hanging- and foot-walls. The lower-grade disseminated ore is also associated with the same fault, but is a distinct body. There is a possibility that the foot-wall ore is associated at lower levels with a similar shear of different attitude.

Fraser Lake Gabbro

The Fraser Lake gabbro occupies the southwest corner of the Elb group. The surface geology has recently been re-mapped, at 500 feet to the inch, by the company geologists. They report that some details of position of the boundary and shape of the plug, as shown on Map No. 1, should be modified. Moreover, very careful investigation of all visible contacts has not produced conclusive evidence of the relative ages of granitic and gabbroic rocks. (See below under Incon group.) On the basis of magnetometer and electromagnetic surveys, a number of holes have been drilled at two locations in the gabbro. These have both intersected considerable quantities of pyrite and pyrrhotite, but are barren of copper and nickel.

Other Mineral Deposits

Within the Elb claim group there are two other deposits of interest. They are characterized by chalcopyrite, sphalerite and gold in the Wasekwan rocks. One is just south of Lynn River on the Elb 119 and 120 claims. The other is at the contact between sedimentary and volcanic rocks, on the Elb 138 claim.

A similar occurrence has also been found just north of the junction of Lynn River and Wheatcroft Lake, on ground held by God's Lake Mines Limited. Still another occurs on the contact between granite and volcanic rocks west of Berge Lake (see below under Al group) and a somewhat similar deposit was found east of Keewatin River on the JR group, by Agassiz Mines Limited.

Over the years, much geophysical work has been done on the Elb claims. Numerous weak indications have, of course, been found. A total of no less than 236 "conductors" has been recorded on the group. Most of these are obviously of no importance. Several, however, have been strong enough to merit some further exploration. A total of 22 holes were drilled on 2 of the Elb claims (L475-474); 6 were drilled on L642 and 12 on L643. Encouragement was obtained, in some cases, but no ore has yet been found.

It was noted, incidentally, that those conductors parallel to the regional trend were usually barren, while those with a northerly direction often contained some valuable sulphides.

NE 7

Golden Star Group	*Joan Group*	
Pee Dee Group	*Fox Group*	
Lynx Group	*Gold Group Claims*	(2)
Link Group	*Loon Group*	

At the time of the other early staking in the district in 1934, the Golden Star (P1732-37), Pee Dee (P1726-31), Lynx (P1720-25), and Link claims (P1793-95) were staked near Beaucage Lake, by Messrs. Biggotty, Collins, Young, Couchie, Head, and Akers. Only on the Link 2 claim was there any work done and the claims were cancelled the following year.

The ground was re-staked as the Joan group. The earliest available maps show only four claims of this group (P3206, 3208, 3210, 3400). Three of them were on the east shore of Beaucage Lake, south of where Beatty Creek enters the lake. They were staked in 1936 by Arthur Beaucage, and were evidently part of a much larger group of 19 claims.

Trenching was reported on each of the three claims in 1938. In 1936 and 1937, other trenches had been reported on the Joan 1 and 12 claims. This work was on either side of Beatty Creek about a quarter of a mile north of its discharge into Beaucage Lake. No details of what was found in the trenches are now available.

The Joan group lapsed in 1939.

Approximately the same ground was re-staked as the five Gold Group claims (P11699-11704) in 1946. Seven more were added to the group in 1947 (P12271-75, 13158). The whole shoreline south of the rapids on Beatty Creek was thus covered as far south as the narrow lake east of Beaucage Lake. In 1946, a rock trench, 30 feet long, was opened on the boundary between the Gold Group 5 and 6 claims (i.e. near the creek running south into the narrow lake). No further work was done, however, and the claims were cancelled in 1948.

The northern end of the ground formerly covered by the Joan group was re-staked as the Fox Group (P12578-51) in 1947. Some seven trenches were reported on this group that year. Five of them are near the west shore of the first small lake upstream on Beatty Creek, one is on the eastern shore and one is at the outlet of this lake. There are no available details on what was found in the trenches. The claims were cancelled in 1949.

The whole area of the original Joan claims was again staked in 1953 as the Loon group (P30335-48). Diamond drilling and trenching were reported.

NE 7

Baker Lake Group
L. G. Group (3)
Hubba Group

The L. G. group of 45 claims (P15708-16; 15717-253; 15348-64) was staked in 1947. It covered the entire eastern shore of Beaucage Lake and the large bay and narrow lake east of it.

No work was done, and the claims were cancelled in 1948.

The same applies also to the Baker Lake claims (P14096-14131), which adjoined to the eastward of the L. G. group. This group was underlain almost completely by granite.

The Hubba group (P16736-64) was also staked in 1947. It lay to the north of the Baker Lake claims and to the east of the Gold group. These claims, too, were allowed to lapse in 1948.

NE 7

Anna Lou Group
Star Group (4)
Rex Group

The Anna Lou group comprised 15 claims (P17349-63) which were staked in 1946. They lay southwest of the Ruth group, between it and Deane Lake.

In 1947, five trenches were excavated on the Anna Lou 3 claim and considerable stripping of overburden was also done. On the Anna Lou 16 there was some additional stripping and a small trench. This latter is near the north end of Deane Lake, on the eastern side.

The Anna Lou claims were cancelled in 1949 and a part of the area re-staked as the Star group (P22209-17).

Further trenching was reported on the Star 1 claim (former Anna Lou 3) in 1950 and again in 1951 and 1952, amounting to over 3,000 cubic feet. The adjoining sketch map shows the trenches visible on the ground in 1950 (Fig. 40).

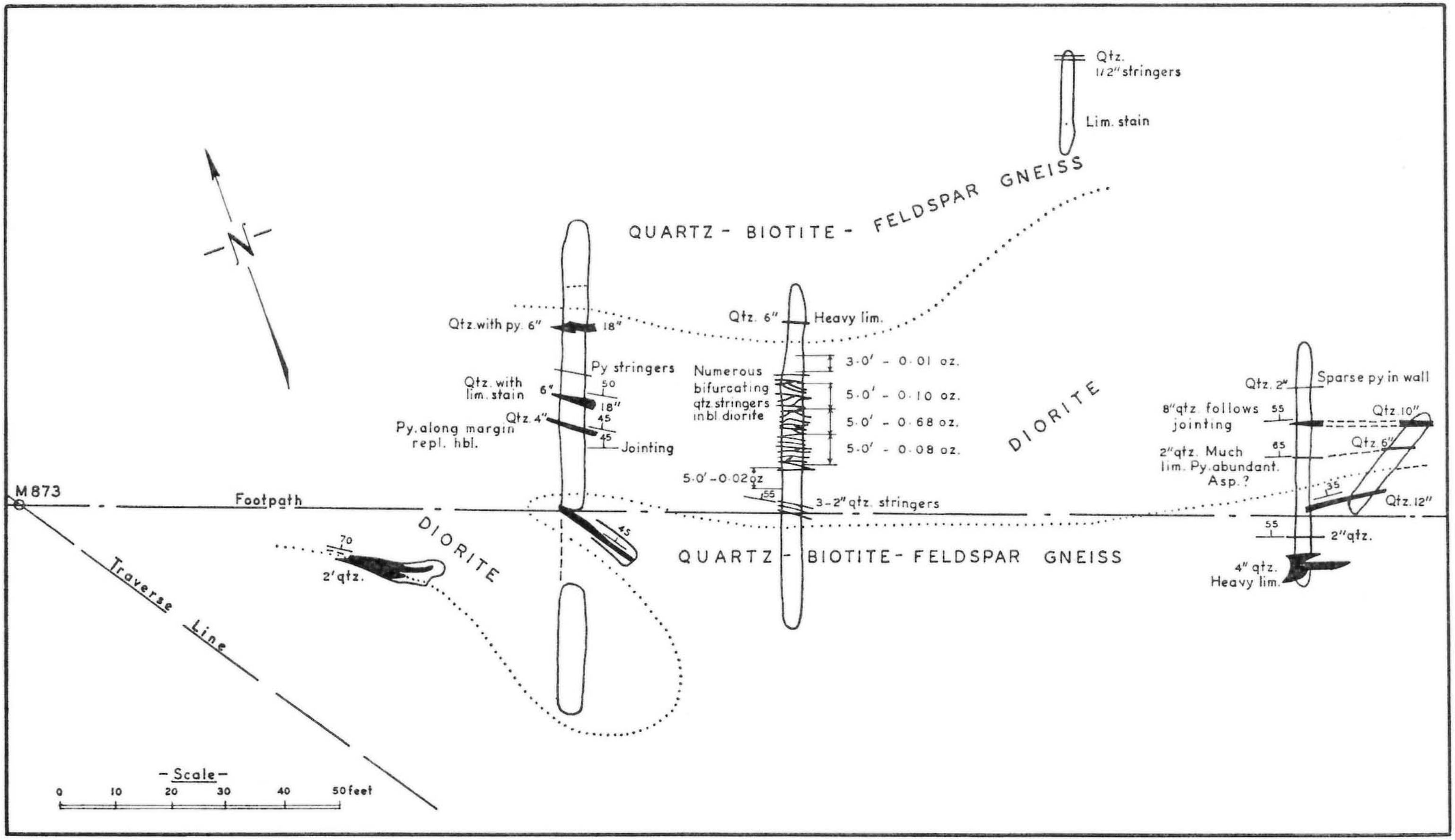


Figure 40 — Plan of trenches on the Star 1 claim.

The Rex group (P25911-15) was staked in 1952 on the extension of the Star claims.

No further work was done until 1958. In the meantime, the claims had been sold by the estate of the previous owner, and then optioned to Selco Exploration Co. Ltd.

This company re-sampled and extended the previously existing trenches and opened five new ones. Detailed sampling confirmed the values shown on the 1950 map, but also showed that it was due to high gold content in a thickness of only 3 inches.

Staking of additional claims by this company has covered the immediately surrounding area. Three additional groups have been added: Sky (P68069-109), Ivan (P61312-5) and Snowball (P61316-7). The area of the Eureka, Ruth and Lily claims (**6**) was also covered.

Further exploratory work has consisted of trenching, surface mapping and a little drilling with a "Packsack" drill. Interesting amounts of gold have been found, but it is erratically distributed.

North of the old Star showings, a long narrow and extremely shallow lake leads towards Black Trout Lake. West of this shallow lake, quartz veins have been found cutting Sickle sediments. Four trenches have been opened on these veins. Spectacular quantities of gold were found in one of these, and encouraging values in the others. But here, also, the valuable sections are narrow and no systematic distribution has yet been recognized. This ground has been staked recently as the Ham group.

The quartz veins appear to lie in two directions. Those of the old Star showing and its vicinity trend southeastward. The northern group, in the Sickle series, trends northeastward and appears to follow tension fractures in the Sickle rocks. Such tension fractures would, of course, be expected to be present on the outside of the Willis Lake fold (see page 122). The quartz-filled fractures in the diorite of the Star showing cannot be directly correlated with such folding, however, if the diorite intrusion came after the orogeny, as appears to be the case.

Practically all veins in, and west of, the diorite are reported to contain sufficient gold to show colours when samples of the outcrop are panned.

Exploration has not included Deane Lake. It is known, however, that there is outcrop on the north end of the peculiar crescent-shaped peninsula in the lake. It is to be noted also that the Sickle rocks strike east, at the eastern end of the next small lake to the north. Should the unusual shape of Deane Lake be due to bed rock, and not to a moraine, it would suggest the possibility of a crumple, like a large drag-fold, in the rocks of the Sickle series, north of Deane Lake. Strike faults, parallel to Beaucage Lake, would then not be unlikely.

NE 7

T. W. Group (**5**)

The T. W. group of 24 claims (P15783-800; 15602-05) were staked in 1947 at the south end of Beaucage Lake.

The claims were mapped for Noranda Mines Limited in 1947, under the direction of V. D. Colcleugh. Nothing was found which is essentially different from that shown on Map No. 7. No sulphides were found. Though the ground was, in a general way, regarded as favourable, no further prospecting was done.

The claims were cancelled in 1951.

NE 7

Eureka Group *Ruth Group* (**6**)
Monsees Group *Lily Claim*

The area of greenstone, iron-formation, and diorite southeast of Black Trout Lake has long been a favourite spot for prospectors. The Eureka group was staked there by Oluf Johnson in 1939, but the claims were allowed to lapse in 1940. The area to the north and east had been staked previously as the Monsees group (P1797-1805) in 1934, by B. O. Monsees. Some trenching was reported but the claims had lapsed by 1937.

Essentially the same ground was re-staked as the Lily claim (P10870) and the Ruth group (P10707-10) in 1946. A trench was put down near the north boundary of the Lily claim in 1947, but no further work was done and the claim lapsed in 1948. The Ruth group was enlarged in 1947 by the addition of 18 claims (P16226-43). At this time the group extended from the long shallow lake south of Black Trout Lake as far east at Beatty Creek, where it adjoined the Fox claims.

Trenching was reported on each of these claims in 1947. The Ruth 15-22 claims were allowed to lapse in 1949, but further trenching was reported on the others till 1950. During this period a total of no less than 36 trenches was *reported* on this group.

Only a few of the trenches were seen during the present work, and unfortunately the records of assessment work do not contain details of the rock found in them. Where they were seen, east of the shallow lake mentioned above, the country rock is mainly iron-formation, with bands of hornblende schist about 12 inches thick. A shear zone 18 inches to 36 inches wide dips 55 degrees east and strikes approximately north. The schist is strongly chloritized and recrystallized and contains amphiboles in grains up to 2 centimeters long. In some places the shearing is intense, with the rock reduced to 1 inch to 2 inches of gouge. The whole is strongly stained by oxidation of pyrite and pyrrhotite, which are disseminated throughout the schist.

Although sulphides do occur within the quartz, both the pyrite and pyrrhotite show a marked preference for the chloritized hornblende. The quartz was probably introduced after the shearing had occurred. A grab sample of the most heavily pyritized rock showed 0.22 ounces of gold per ton.

Visible gold was found by the writer on the Ruth 4 claim. A channel sample of the wall of a quartz vein contained 0.46 ounces of gold per ton for 4 inches from the contact. The continuation of the channel in the quartz showed 24.37 ounces per ton for 11 inches. The occurrence is obviously an erratic deposit.

The last of the Ruth claims were cancelled in 1951.

SE 10

Sickle Group (7)

The Sickle group of nine claims (P15352-60) was staked in 1947, between the north end of Black Trout Lake and Sickle Lake. It covered a part of a large mass of gabbro east of the two lakes, but no work was done on the group. The claims were cancelled in 1948.

SE 10

Lakeshore Group
Hope Group (8)

The four claims of the Lakeshore Group (P4810-11); 5124-5) were staked by Oluf Johnson in 1939. The group covered the west side of Black Trout Lake, south of the large bay and islands on that side. In 1940, nine trenches were opened: 7 along the west shore, and 2 west of the portage at the south end of the lake. During 1940 and 1941, a 7- by 8-foot shaft was sunk near the cabin on the west shore. According to the reports submitted for assessment work, this is 30 feet deep. Mr. Walter Hanson, who worked on it, reports that the total depth is actually about 65 feet. It was sunk with the intention of running a short drift under the lake where a fault was thought to be. Substantial but erratic values in gold were obtained from some quartz veins in the vicinity but only very little was found in the shaft, according to Hanson.

The ground on the west side of the lake was re-staked as the Hope group, which was gradually extended till, at its greatest, it included 22 claims. Four were staked in 1946 (P10703-06); nine in 1947 (P16439-47); and nine in 1950 (P22218-26). They covered most of the long diorite dyke on the west side of Black Trout Lake and, in addition, those staked in 1950 covered the east shore of the lake. This ground on the east side had previously been staked as the F. H. J. and Golite groups in 1947 and 1943 respectively.

In September, 1947, Noranda Mines Limited drilled 3 holes out under the lake alongside and south of the shaft. They intersected diorite, with a little sediment at the bottom of the holes. Similar results were obtained in 2 holes on the Hope 11 claim, near the creek draining to Sickle Lake. A few quartz stringers were found, but the best gold value was only 0.02 ounces per ton, for a 1-foot section. The last of the claims of this group were cancelled in 1956, after being held for 3 years under protection of an estate.

SE 10

R. Double J Group *Palladium Claim* (9)
Bee Group *Golite Group*

The earliest staking recorded in the Lynn Lake district was on the east side of Black Trout Lake. The R. Double J group (P877-82) was staked in September, 1933, by Pete Johnson; apparently R. J. Jowsey also held some interest in the claims. They covered the ground on both sides of the gabbro contact between Black Trout and Jac lakes. In 1934 and 1935 some trenching was done, and three additional claims were staked (P1453-55) in 1935. The latter were cancelled the next year, and the whole group was allowed to lapse in 1937.

A part of this ground was again staked, by Oluf Johnson, as the ***Bee Group*** (P4179-81) in 1938. During 1939 and 1940, trenching was reported as assessment work on the east side of the Bee 1 claim, i.e. near the creek which follows the south contact of the gabbro. Again, there is no information on what was found. The claims were cancelled in 1942.

The single ***Palladium*** claim was staked in 1944, on part of the same ground. It lapsed in 1945.

The ***Golite*** group of 5 claims (P6356-9; P6434) were staked in 1943, south of those just described. The group ran parallel to Black Trout Lake, just west of the small lake southwest of Jac Lake.

Trenching was reported for assessment work in 1943 and 1944, from the Golite 4 claim (P6359). So far as can be inferred from the claim maps of the day, this was probably in the vicinity of the fault which runs southeast from the south end of Black Trout Lake. The claims were cancelled in 1946.

The whole area of the above claim groups was included in the F. H. J. group.

SE 10

F. H. J. Group (10)

The F. H. J. group comprised 58 claims and fractions (P15273-85; 15287-331) and was staked in 1947 in three blocks. Two of these surrounded the Ruth group (6) and extended southeastward from the south end of Black Trout Lake. Except for that involved in the Ruth group and four Lil claims (11) and fractions, the F. H. J. group covered all the area of tonalite, sedimentary and volcanic rocks, diorite, and Sickle conglomerate south of Black Trout Lake. The third block, of 11 claims, lay south of the creek between Jac Lake and Black Trout Lake. Most of this area is granitic, though gabbro occurs to the north.

No work was done, and the claims were cancelled in 1948.

SE 10

Lil Group (11)

Four claims and fractions (P10871-3; 10936) of the Lil group covered the fault zone southeast from the south end of Black Trout Lake. They were staked in 1946 and cancelled in 1948. Some trenching was reported on each of the claims in 1947.

NE 10

Bowes Group (12)

The Bowes group consisted of 18 claims (P15138-55) staked in 1947 northwest of Belleau Lake. Part of the group is underlain by greenstone, but has very few outcrops. No work was done and the claims were cancelled in 1948.

NW 10

Heath Group *Nencie Group* (13)
Smoke Group *D. N. Group*
Oro Group

Lasthope Lake Gold Mines Limited, a subsidiary of Sherritt Gordon Mines Limited, was formed in 1940 to explore a group of claims north of Lasthope Lake. The group consisted of the Smoke, Heath, Nencie, Oro, and D. N. claims—a total of 67, all of which were surveyed. The original discovery of gold on this group was made by Dick Madole, in 1937, on the Smoke 2 claim. This was one of the earliest recorded discoveries of gold in the district, with the exception of the occurrence at the south end of Cartwright Lake (see Mac and Giant claims), which was discovered in 1934, and the R Double J, which was staked in 1933. To the Heath, Nencie, and Smoke claims, staked by Madole, were added the Oro claims, staked by Fred Johnson in 1938.

Some shallow test pits were opened in the early development work and, in 1939, Sherritt Gordon drilled 59 holes with a total length of 10,260 feet. To a depth of 150 feet, this drilling indicated about 140,000 tons containing 0.23 ounces of gold per ton. In 1954, the core racks had collapsed and the core was in a hopelessly jumbled heap.

The Madole vein is described by Bateman, from whose plan the adjacent sketch is drawn (Fig. 41). The outcrop is on the south side of a low sandy ridge, and can be reached readily by a good trail (which goes over the outcrop) from the north side of Lasthope Lake.

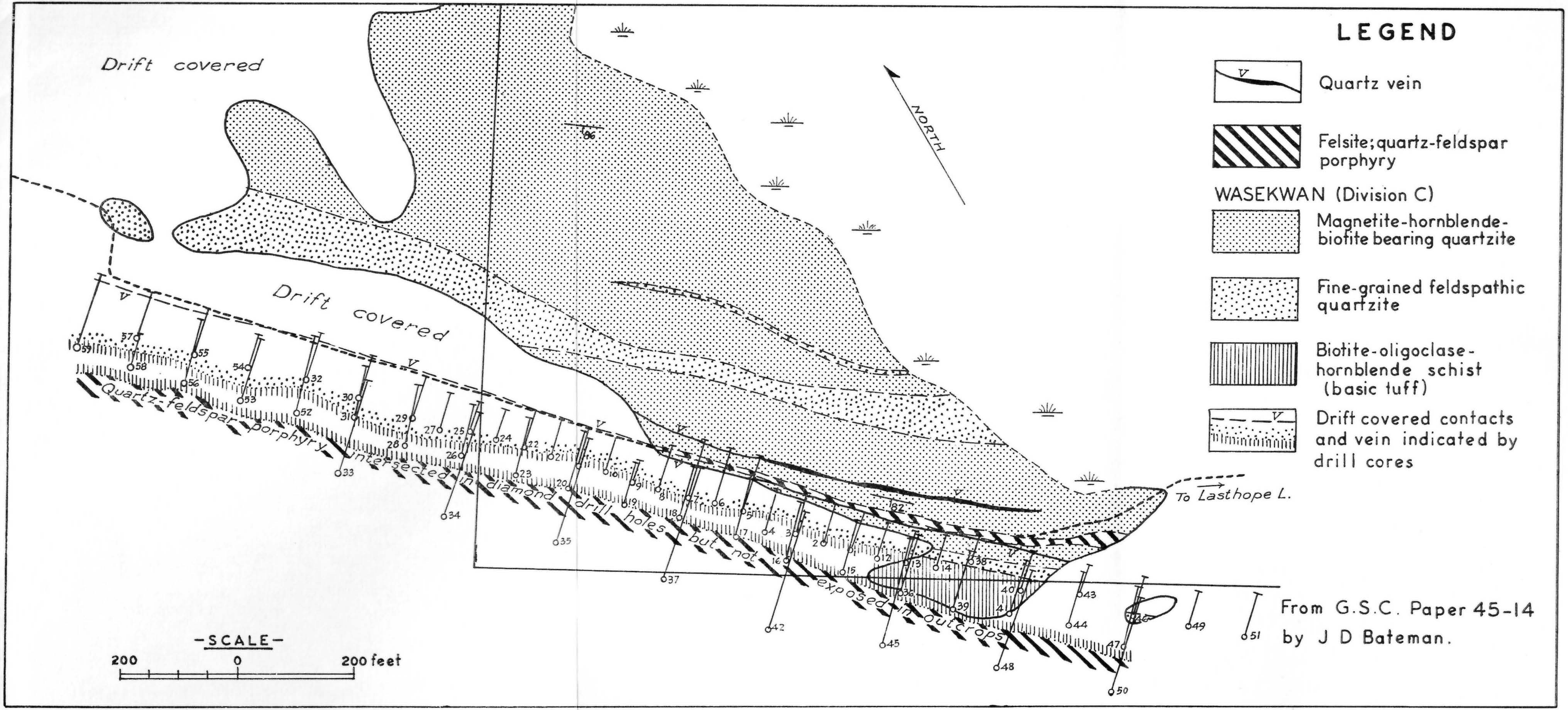
The vein outcrops for 735 feet, and was followed by drilling for an additional 1,000 feet. It strikes northwest, dips 80 degrees southwest, and fills a fracture in thinly bedded impure quartzite. The north boundary of the vein, as visible in the test pits, is a felsite dyke and in most places is schistose at the contact. The south boundary is described by Bateman as hornblende schist and "chert-like feldspathic quartzite". Where visible in the pits, the latter appears to be minor in amount. The wall-rocks are altered for only an inch or so, and there is little silicification, but the quartz of the vein cuts quartz stringers in the wall rocks. The quartz is sugary, with a suggestion of ribbon structure in a few places. No carbonate or chlorite were seen in the pits, but Bateman reports that some chlorite is present. There is sparse pyrite, chalcopyrite, and galena and, in one pit, sphalerite was seen lining cavities in the quartz. No visible gold has been reported.

There is a wider, but barren, quartz vein about forty feet north.

NW 10

Hope Group *Flett Group* (14)
Elk Group

The Hope group comprised 17 claims (P4581-3; 5103-14; 5126; 5135) and was staked in 1939 by B. O. Monsees. In 1939 and 1940, some trenching was done on


Drift covered
Drift covered
NORTH
Quartz-feldspar porphyry intersected in diamond drill holes but not exposed in outcrops
To Lasthope L.
LEGEND
Quartz vein
Felsite; quartz-feldspar porphyry
WASEKWAN (Division C)
Magnetite-hornblende-biotite bearing quartzite
Fine-grained feldspathic quartzite
Biotite-oligoclase-hornblende schist (basic tuff)
Drift covered contacts and vein indicated by drill cores
From G.S.C. Paper 45-14 by J D Bateman.
-SCALE-
200 0 200 feet

the Hope 1 claim, which adjoined on the east side of the Nencie 3 (**13**). No details are available.

The two Flett claims (P5734-5) were staked in 1941, for Sherritt Gordon Mines Limited but were allowed to lapse at the end of one year. They were on Lasthope Lake at the outlet of the stream from Cloverleaf Lake.

The ground of the Hope group was included within the Elk claims (L78-105 Group 521) which were staked in 1945. This group extends southeastward from the Nencie claims as far as the northwest side of Sickle Lake. The claims were surveyed in 1946, and, in 1948, 30 holes, totalling 2,961 feet, were drilled on the Elk 2 claim.

NE 11

D Group (**15**)

Nine claims of the D group (P14605-13) covered the south shore of Pool Lake and the area immediately west of the railway. They were staked in 1947. Three more claims (P17760-62) were added later in 1947.

R. G. Crosby did a magnetometer survey of a part of the group for Trans-northern Nickel and Copper Mines Limited in 1952. He found a band of strong anomalies running westerly between Pool and Monique lakes. This would coincide with the band of greenstone there. Crosby recommended surface work on this part of the group.

Two holes were drilled in the northwestern part of the D 2 claim, in March, 1953. These holes, located approximately 400 feet and 200 feet west of the railway, cut medium-to fine-grained andesite with some quartz and aplite stringers and a few inches strongly mineralized with pyrrhotite. Sparse pyrrhotite, 5 to 10 per cent, is more widespread. One hole cut 9 feet of banded iron-formation and the other, 5 feet. Specks of chalcopyrite and sphalerite are present, but are rare.

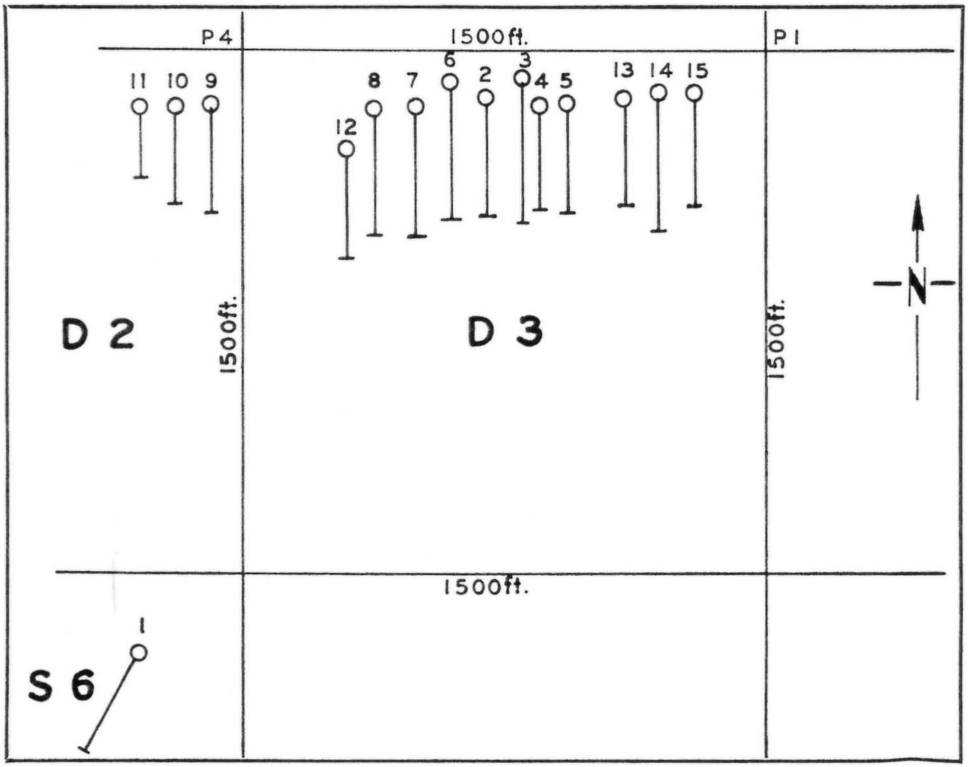


Figure 42 — Sketch showing location of drill holes, D group.

A considerable quantity of X-ray core is lying about the portage trail between Monique and Pool lakes, and has evidently been there for some years. No logs are available, but the recorder's files show that the holes were located as shown on the adjacent sketch (Fig. 42). Crosby reports that according to Oliver Dickson, one of the stakers: "some of the core assayed close to 1 per cent copper, 1 per cent zinc, 0.28 per cent nickel, with up to $2.40 in gold". The drilling appears to have been done in the anomaly found by Crosby.

Near the conglomerate contact north of the small lake which lies northwest of Pool Lake, a small quartz vein cuts the quartz diorite. This would be on the D 11 claim. The quartz contains a little pyrite, chalcopyrite, and malachite. A grab sample taken by the writer contained 2.76 ounces of gold per ton.

Three of the claims were cancelled prior to 1949; the remainder, in 1954.

NE 11

S Group (16)

The S group consisted of 27 claims (P14585-604) staked in 1947, at the same time as the D group immediately north. They covered the band of greenstone running southeastward from Monique Lake, as well as the granitic area to the east. As part of the drilling program on the D claims, a 100-foot hole was drilled on the S 6 claim. The claims were cancelled in 1949.

NE 11

P. E. H. Group (17)

The P. E. H. group of 45 claims (P15035-79) was staked in 1947. It covered a block of ground from the southeast corner of Pool Lake halfway to Mail Lake, and then southeast to cover the western shore of Counsell Lake. The western boundary passed through the first lake west of Counsell Lake. The group therefore included parts of the greenstone on both flanks of the syncline through Counsell Lake, and the small body of gabbro at Pool Lake.

On the southeast shore of Pool Lake, and for about 650 feet southeast, there are a number of trenches. The rock on the shore is a fine-grained andesite, cut by thin dykes of feldspar porphyry. To the south this is succeeded by siliceous sediments, with about 200 feet of mixed greenstone and thinly-banded sediments between them and the andesite.

A quartz vein 4 feet wide is bounded by 2 feet of mineralized wall-rock and has been trenched at intervals for 40 feet. Pyrite and chalcopyrite are scattered sparingly in the quartz and wall-rock. Surface samples contained no appreciable value in gold or silver. It is understood that Sherritt Gordon Mines drilled two holes under the vein, but found nothing.

The claims were cancelled in 1948, and the ground is now a part of the Mail group.

NE 11

Mail Group (18)

The Mail group comprises 155 surveyed claims which, with the Bel group, form a large southerly extension of the main property of Sherritt Gordon Mines Limited. The south end of the group includes Pool Lake and the two smaller lakes to the east towards Counsell Lake, and Mail Lake. Many of the claims of the former Ace and Faust groups are included, near Franklin Lake, and the area south of Fraser Lake is also included. Part of the former V. X. group (22) is therefore covered also. The claims were surveyed in 1954.

Recent exploration of these claims has consisted of geological mapping by A. F. Gregory, of the Sherritt Gordon staff, on some 61 claims in the southern part of the group. This covered the general area of two hornblende gabbro plugs shown on the preliminary maps of T. A. Oliver. Gregory's conclusions differed considerably from Oliver's, and they have been followed in preparing Map No. 5. The major change has been a reduction in the area of the gabbro bodies. Both Gregory and Oliver suggest that the gabbro is derived from recrystallization of earlier basic lavas, and are in effect remnants in the quartz diorite in which they are found, and into which they grade. Certainly direct evidence of the intrusive nature of the gabbro appears to be absent, and others who have examined these bodies, though with less care, have also come to the same conclusions.

An electromagnetic survey of the group was made in 1955, using a large vertical transmitting loop. This produced rather disappointing results. A conductor about 300 feet long was found near the small lake in the band of mixed sedimentary and pyroclastic rocks that runs southeast from Pool Lake. It is caused by a sulphide zone, which had been found by drilling during earlier exploration. It may extend south of the lake also. The sulphides occur as light disseminations in siliceous fine-grained material of rhyolitic appearance, but which may actually be sedimentary, and in quartz veinlets in interbedded tuff, quartzite and andesite. Only traces of gold were found.

Several holes were drilled on the Mail 18 claim. The rock is dioritic and contained nickel and copper in amounts less than 0.1 per cent. Some actinolite alteration was reported from one hole.

An interesting item was noted in Hole 455 on this claim, where the core contained an 18-foot length reported as "nearly massive magnetite" separated by a 37-foot length of diorite from a further 6 feet of similar magnetite. The hole was drilled at −45 degrees.

NE 11

Key Group (19)

The Key group consisted of 30 claims (P15005-34), staked at the same time as the P. E. H. group (17), in 1947. The claims adjoined the P. E. H. group on its southwestern side, and extended westward from the south shore of Counsell Lake. Much of the area of this group is underlain by granite, though the eastern part has some volcanic rock. No work was recorded and the claims were cancelled in 1948.

NE 11

Skid Group (20)

During the construction of the railway to Lynn Lake in 1953, Sherritt Gordon prospectors discovered chalcopyrite near the railway at Boiley Lake. The Skid group of 36 claims (P30151-74; 30260-3) was staked. The main surface showing was only a few feet off the 23rd Base Line, near the south shore of Boiley Lake. It consisted of stringers and disseminations of pyrite and chalcopyrite in a contorted biotite schist. Two other small outcrops, just north of the base line, also had heavy gossan stains.

An electromagnetic survey of the claims was made in 1953 and some drilling was done early in 1954. Four holes, about 100 feet apart, were drilled under the chief surface showing and two others were drilled beneath each of the other gossan occurrences. The latter are approximately on the strike of the schist from the main surface showing. A ninth hole was drilled a further 1,400 feet west to test the possible continuity of the shear zone. The holes beneath the surface showing encountered sheared basic volcanic rocks and tuffs, with quartz stringers in a few places. Up to 10 per cent sulphides were found, but the copper content is low. Some carbonate is associated with the sulphides. A little interbedded greywacke was also reported. In the holes beneath the other gossan occurrences, garnet and staurolite-bearing sediments were predominant and volcanic rocks relatively minor. Sulphides were negligible.

In 1956, further drilling was done near the surface showing, and two holes were drilled near the east side of Boiley Lake. The latter found a zone of schist which probably is the Boiley Lake Fault, and is therefore of some structural importance, but they found nothing of commercial value.

NE 11

N. E. J. H. Group (21)

The N. E. J. H. group, of 27 claims (P15465-91), covered the southeastern part of Counsell Lake and extended southeast far enough to include all of the band of altered greenstone there. No work was done, and the claims were cancelled in 1948.

NE 11

Elb Group
V. X. Group (22)

The Elb group comprised 36 claims (P5778-814, less 5797) and covered an area north of Pool Lake and west of the railway line. This group should not be confused with the Elb group (1) described on page 169.

The Elb group (22) was staked by Austin McVeigh in 1941, on behalf of Sherritt Gordon Mines Limited. No assessment work was reported on the group and the claims were cancelled in 1942. Some half-dozen pits were actually dug, however, and the caved trenches are still visible on the ground. The company is not now able to provide any record of what was found in the trenches. Apparently nothing of value was found, and it is known that some pits did not get through the sand to bed rock.

The V. X. group consisted of 94 claims and was staked in 1947 in the general area bounded by Nail Lake, south of Motriuk Lake—west of Gemmel Lake—north of Pool Lake—north of Nail Lake.[1]

During 1947, a magnetometer survey and geological map were made for Noranda Mines Limited. The geological mapping was done by G. G. Suffel, while the magnetometer work was performed by Geo-Technical Development Company Limited. Electrical methods were applied to 5 of the magnetic anomalies so found: by resistivity on 4, and by self-potential on the other one. Four of these anomalies are associated with the western end of the diorite at Nail Lake.

The geology, as mapped by Suffel, has been included on Maps Nos. 1 and 5. Several changes should be noted, however, and there have been certain omissions due to the limitations of scale. In the former category, in the area between Nail Lake and Gemmel Lake, the maps have followed the designations of Oliver and Allan, who mapped the rocks there as predominantly volcanic flows (Unit 5). In his work, Suffel emphasized the sedimentary character of the formations, and mapped the whole as sediments "with minor volcanics". He included in this category also the outcrops shown on the present maps as Unit 3. In the matter of smaller details, Suffel reports several occurrences of "conglomerate" and "squeezed conglomerate" interbedded with the other rocks. One outcrop is south of the lake erroneously shown on Map No. 1 as "Nail Lake" and it is reported again in three places, on the large outcrop (Unit 3) on the south edge of Map No. 1 at 101° 10′ W. Another difference is probably a matter of interpretation, for Suffel describes outcrops on the tonalite-greenstone contact north of Pool Lake as "diorite and gabbro, in part granitized" and shows them as inclusions in "granite and hybrid granite".

Garnet and staurolite schists are both reported from northeast of Gemmel Lake. Quartz stringers and a rusty zone are reported from the V. X. 40 claim, southeast of Nail Lake and near the railway.

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[1]Included were the following claims: P13486-518; P13719-21; P14262-87; P14888-895; P15088-90; P15803-13; P16596-603; P17397-98.

The magnetometer survey revealed an irregular area of stronger magnetic field north of Nail Lake. Four different peaks in this area reached as much as 1,500 gammas, and three were over 2,000 gammas. Three of the areas were examined by Geo-Technical Surveys Limited, using resistivity methods, and on a fourth the self-potential method. The latter (anomaly E) showed a linear area of high potential (up to 30 m.v.) parallelling a negative area (up to −40 m.v.), just north of the east end of Nail Lake. About 1,200 feet north of anomaly E, a magnetic high (anomaly B) coincided very roughly with an irregular zone of low resistance.

No drilling was reported on these claims.

It should be noted that Nail Lake, as shown on Map No. 1, is in error. The name is correctly applied to a small lake, shaped like a crumpled track spike, about 1¼ miles southwest of that shown on the map.

As used in the above description, Nail Lake applies to the one correctly so called, and not to that shown on Map No. 1.

SE 11

J. L. Group (23)

The J. L. group consisted of nine claims (P14996-15004) staked in 1947. They were in the area of Kisseynew type gneisses west of the railway and about four miles north of Drybrough station. The area is very swampy, and exposures are very sparse. No work was done and the claims lapsed in 1948.

NW 11

D. Group

D. D. Group (24)

Two contiguous groups, the eighteen D. claims (P15494-511) and the five D. D. claims (P16379-383) were staked in 1947. They covered part of the band of greenstones and sedimentary rocks west of Gemmel Lake. The two groups included the lake on the assumed extension of the fault through Boiley Lake, and extended eastward about halfway to Gemmel Lake. No work was done and both groups of claims were cancelled in 1948.

NW 11

Watt Group (25)

Northeast of Wilmot Lake an esker runs northward to a pair of elongate lakes, which formed the southeastern corner of the Watt Group. The group consisted of 45 claims (P14027-71), and was staked in 1947. The eastern boundary followed the northward extension of the esker, and the group extended westward far enough to reach the isolated area of greenstone northeast of Irene Lake. The sedimentary and volcanic rocks are exposed in some places in the eastern part of the group, but the western part is apparently devoid of outcrop. No work was done and the claims were cancelled in 1948.

NW 11

G. T. Group (26)

The G. T. group consisted of 28 claims numbered G. T. 37 to 64 (P14662-14689), and was staked in 1947. Its northeast corner adjoined the Watt group, the northwest was on the north end of Irene Lake, and the claims extended southwestward about halfway to Binks Lake. The claims were cancelled in 1948 for lack of work.

NW 11

P. T. Group (27)

The P. T. group of 44 claims (P15367-410) was staked in 1947. It included the south half of Irene Lake, the north half of Sarah Lake, and extended eastward far enough to include the two outcrops of greywacke northeast of Binks Lake. This group had a very few outcrops of volcanic and sedimentary rocks, but exposures are very poor, as in all parts of this area.

The claims were cancelled in 1948, without any work done on them.

NW 11

G. A. Group (28)

The G. A. group of 40 claims (P15190-15229) was staked in 1947. It included all of Binks Lake, the south shore of Sarah Lake, and the area west of Dunphy Lakes. Four claims were on the south shore of the eastern bay of Dunphy Lakes. Over most of this area, the rock is obscured by drift, but a little gabbro occurs on the south shore of Dunphy Lakes.

So far as known, no work was done on these claims and they were cancelled in 1948.

NW 11

E. P. Group (29)

The E. P. group was staked in 1947 and comprised 28 claims (P14175-202). The group was L-shaped and extended northeast from the east shore of Binks Lake for 5 claims, and thence southeast almost to Wilmot Lake. This area is probably mostly greenstone; very little of the sedimentary rock north of Wilmot Lake would be within the group.

The claims were cancelled in 1948.

NW 11

Limpo Group *Fin Group* (30)
Betsy Group *Don Group*

Northeast and southwest of the small lake south of Binks Lake, the Limpo and Betsy groups, each of nine claims (P14009-017; 14018-026), were staked in 1947. They formed the southern border of the G. A. (28) and E. P. (29) groups. The three Fin claims (P1518-60) separated the Betsy claims from the southeastern part of the E. P. group. The two Don claims (P15156-7) were on the south side of the Limpo group.

No work was reported on any of these claims and all were cancelled in 1948.

NW 12

N. I. Group (31)

The 18 claims of the N. I. group (P15161-178) adjoined on the southwest side of the Limpo group. They included a little of the gabbro south of the east bay of Dunphy Lakes.

So far as known, no work was done. The claims were cancelled in 1948.

NE 12

T. K. Group (32)

The T. K. group of 11 claims (P15591-15601) covered the area between the outlet of Dunphy Lakes and the north end of Snake Lake. The claims were staked in 1947.

A geological map of the claims was made in the summer of 1947, by T. S. Smith under the direction of V. D. Colcleugh, for Noranda Mines Limited. The outcrops found by that survey are included on Map No. 4.

No mineral occurrences were found on the group.

The claims were cancelled in 1949.

NE 12

M. J. Group (**33**)

The M. J. group was staked in 1947. It consisted of 18 claims (P14978-95) on the south shore of the central bay of Dunphy Lakes. From the central part of the bay the group extended southward to include most of Wolf Lake.

Though covering a considerable area of greenstone and gabbro, no work was recorded on these claims.

About halfway between Dunphy Lakes and the narrow lake to the south, there is a small prospect pit. The pit is about 3 feet square and 2 feet deep, and is now badly caved. It was opened on a small "burn" in the dark schistose rock. Samples from the wall of the pit show no fresh sulphides and the source of the gossan is not known.

The claims lapsed in 1948.

This group should not be confused with the M. J. group (**131**) north of Cockeram Lake.

NE 12

A. T. H. Group (**34**)

The nine claims of the A. T. H. group (P14817-25) covered the remainder of the shore of the central bay of Dunphy Lakes, east of the M. J. group (**33**), but only one of the claims reached as far south as the east end of Wolf Lake. No work is known to have been done on these claims and they were cancelled in 1948. Stanton reported a rusty lens about 25 feet by 4 feet, and 1,000 feet south of Dunphy Lakes, on this group. It lies within dark grey to brown impure quartzites and is cut by aplite and white sugary quartz. No sulphides were seen and the rust appears to be caused by weathering of amphibole.

NE 12

Inspiration Group (**35**)

The Inspiration group covered the area of volcanic and sedimentary rocks between Wolf Lake and the southern extremity of the east bay of Dunphy Lakes. Six of the claims extended northward over the granite ridge between the central and eastern bays of the lake. There were 18 claims in the group (P14513-30).

No assessment work was recorded on this group, and the claims were cancelled in 1948.

NE 12

L. D. Group (**36**)
Dun Group

The L. D. group consisted of 18 claims (P14808-16; 15119-127). It covered the complex of rock types on the south shore of the east bay of Dunphy Lakes, and included the gabbro around the two small lakes southeast of that bay.

No work is recorded on these claims and they were cancelled in 1948.

On the south shore of Dunphy Lakes there is a group of old test pits and trenches on a gossan zone which runs approximately parallel to the shore for at least 930 feet. This gossan zone consists of four main bands and numerous smaller bands, and has a maximum combined width of 200 feet. The general strike of the rocks of this zone is about N 50° E, but this changes toward the eastern end to N 75° E. There are several additional flexures, with marked changes in strike within 50 feet or less. About 100 feet from the eastern end of the exposures, there is a narrow, drift-filled hollow. Across it there is a change in strike of 30 degrees, and a similar discordance was noted at one other place farther west on the continuation of the hollow. Possibly this change is due to a fault. If so, the main part of the gossan zone is north of the fault.

The host-rock is a fine-grained siliceous sediment with some interbanded fine-grained flows. It includes quartzite, quartz-feldspar schist, and quartz-biotite-chlorite schist (sometimes with sparse hornblende). A broad zone at the western end contains abundant reddish garnet, in irregular grains up to ¼-inch in diameter.

At the eastern end, massive feldspar porphyry dykes are intimately interfingered with the sediments, and, in some places, resemble discontinuous feldspathic beds.

Apparently, differential movement between beds formed schistose layers, with which pyrite is associated. There may also be an association between sulphide and the porphyry dykes. The gossan is due mainly to pyrite, usually fine-grained and less than about 2 per cent of the rock. A little pyrrhotite was seen, and strong magnetic anomalies suggest that more may be present. A few quartz veins were noted.

An electromagnetic survey was conducted over this area as part of the Dun claims (P69612-67) by Sherritt Gordon Mines in January, 1958, but nothing of interest was found.

NE 12

Ace Group (37)
Lucky Strike Group

These two groups totalled 21 claims (P13561-81), of which 3 were in the Lucky Strike group. They covered a strip, 3 claims wide, from the east end of Wolf Lake northeastward, and so included most of the southern part of the gabbro southeast of Dunphy Lakes.

On the Ace 1 claim, south of the extreme southern tip of Dunphy Lakes, there is a shallow trench about 10 feet long. I saw no sulphides, though Stanton reported disseminated grains and narrow stringers of pyrite and chalcopyrite in dark grey quartzite.

No assessment work was recorded on these claims, and they were cancelled in 1948.

NE 12

Fox Group (38)

The Fox group comprised 37 claims (P14203-239) covering the north end of Snake Lake, along with Fox Lake and the three lakes immediately southwest of it. The area is underlain by some tonalite, but mainly by greenstone with some interbedded tuffs and sediments. No assessment work was recorded, and the claims were cancelled in 1948.

SE 12

I. F. Group and Associated Claims (39)

The I. F. group comprised 12 claims, and had associated with it a group of 20 claims individually named. They were all recorded in a block (P16072-16103) and are here so considered. Considerable trenching and stripping was reported on the claims, in 1948, but no details of the rocks found are now available. The claims were cancelled in 1949.

The group adjoined the Fox group, touched the northwestern extremity of Pyta Lake, the northern end of Eager Lake, and included the southern of the three lakes between McWhirter Lake and Hatchet Lake.

J. F. Group (40)

The J. F. group consisted of 18 claims staked in two groups: (P16198-206 and P17846-54.) The second group was north of McWhirter Lake; the first was east of the northern arm of that lake and extended about halfway to Pyta Lake.

No work was recorded on these claims and they were cancelled in 1948.

SE 12

H. F. Group
D. C. Group (41)

Twenty-four claims (P14072-14095) formed the D. C. group, which was in turn completely surrounded by the 37 claims of the H. F. group. The latter group was staked in two lots (P14950-14977; P16683-16691). Both groups were staked in 1947 and were centered about a point between Pyta Lake and Snake Lake. They included the Sickle conglomerate on the south end of the lake and most of the gabbro plug to the north.

A magnetometer survey, using an Askania and a Davidson magnetometer, was made by W. L. W. Taylor and R. L. Montgomery, during 1947, on behalf of Falconbridge Nickel Mines Limited. The interpretation was made by C. S. Davidson and O. A. Seeber, but there were few observations which were not explainable from surface geology. One anomaly is due to magnetite in a greenstone inclusion; others are due to coarse grains of magnetite in sedimentary rocks.

A geological map was made during September 1947, by G. P. Mitchell of the Falconbridge staff. The geology is essentially the same as shown on Map No. 4 except for his classification of the gabbro as diorite. According to Mitchell, finely disseminated pyrite and pyrrhotite occur in the gabbro, but not to any significant extent.

There is no record of any drilling or trenching having been done on this property. A number of the claims lapsed in 1949. The remainder were cancelled in 1950.

SE 12

Hub Group (42)

The Hub group, of 12 claims (P16207-18), covered the northeast arm of Pyta Lake, and adjoined the H. F. Group (41). The area is almost entirely underlain by the Sickle series and its contact with the earlier rocks.

The claims lapsed in 1948, without any work having been done.

SE 12

K. Z. Group
Gal Group (43)

The K. Z. group consisted of 15 claims (P14873-87) staked in 1947. The group was located at the south end of Snake Lake, and was underlain by greywacke and other sediments, and a part of the gabbro body to the south.

A geological map was prepared for Noranda Mines Limited by T. S. Smith, under the direction of V. D. Colcleugh, in 1947.

The geology, as reported, is shown on Map No. 4, though Smith mapped the gabbro as diorite. South of the rapids at the outlet of Snake Lake, he reported a rust zone trending northeast, and about 20 feet wide. Another such zone occurs on the south bank of the creek below the rapids, and a third, south of the southwest corner of Snake Lake.

The K. Z. group lapsed in 1949.

Essentially the same area was restaked, in 1955, as the Gal group of eight claims (P35936-43). Galena had been discovered on the south bank of the creek which drains Snake Lake.

An electromagnetic survey was made for Cyprus Exploration Corporation Limited in September, 1955, by Moreau, Woodard and Company. A base line was cut just south of the creek and parallel to it. The 1,800 W offset line, normal to the base line, passes through the rapids. The survey found one conductor near the surface showing on the creek, but it is weak and did not appear to be closely related to the showing. No anomalous readings were obtained over the actual exposures on the creek bank. A conductor was found between lines 18W and 16W, and 400 to 200 feet south of the base line. Holes 5 and 5A were drilled to test this anomaly. The cores consist mainly of coarse-grained quartz-biotite-feldspar gneiss similar to that visible in outcrop. Sulphides are very sparse in most of the core, except for a 3-foot band in hole 5A which shows 25 to 30 per cent pyrite with smaller amounts of pyrrhotite and chalcopyrite.

We have no record of magnetometer work on the claims, but the report of Moreau, Woodard and Company notes that no conductor was found "over the magnetic anomaly at Jeanne Lake", which is the triangular lake near the centre of the gabbro area.

Some trenching had previously been done on the river bank. Three pits are visible between the 300 and 500 west lines. They show quartz-biotite-feldspar gneiss (as in drill holes 5 and 5A) in contact with coarse-grained gabbro, possibly a narrow dyke. At the contact are pyrrhotite, pyrite and massive galena; chalcopyrite is disseminated in the schistose gabbro. The width of the mineralized zone varies from 1 inch to 12 inches. Some vein quartz is present, and also carries galena. A sample made up of fragments from the pits contained 3.06 per cent lead, 0.73 per cent copper, and 0.12 ounces Au and 10.0 ounces Ag per ton. A grab sample of the vein quartz contained 0.61 ounces Au and 31.1 ounces Ag per ton.

Several trenches have been dug on gossan stains along the possible westward extension of the mineralized zone. The one most distant from visible sulphides is near the rapids. In most of these the fresh rock is not visible where the gossan is heaviest.

On the 1800 west line, a trench has been blasted on a 10-foot quartz vein. No sulphide was noted in the quartz, which is glassy. Spodumene was found in fragments alongside the trench but was not seen in place.

A drill hole under the creek from the north side, on the possible eastward extension of the mineralized zone, cut fine-grained quartz-biotite-muscovite rock with a strong foliation. Chlorite is present in small amounts in the core, and garnet is abundant towards the bottom of the hole. There is sparse pyrite throughout. A 2-inch quartz stringer carries some galena, and there are fine specks of galena in the walls of the vein for about eight inches.

SE 12

Wolf Group (44)

The Wolf group, consisting of 15 claims (P17420-34), was staked in 1947 and covered most of the area of gabbro south of Wolf Lake. Seven trenches in the northeast corner of the Wolf 1 claim, within about 100 feet of the claim post (i.e. near the central of the three lakes east of Snake Lake) were reported for assessment work in 1948, but were not seen by Stanton and were not looked for by the writer.

The claims were cancelled in 1949.

SE 12

Falcon Group (45)

This group comprised four claims (P16692-95) east of the Wolf group, and west of the south end of Hassett Lake. The area is drift covered, and no work was done. The claims were cancelled in 1948.

SE 12

Tee Pee Group (46)

The six claims of the Tee Pee group (P16411-16) were staked in 1947. They centered about the occurrences of pegmatite on Laurie River between Laurie Lake and Tod Lake. Some stripping of overburden was reported in 1948, but the claims were cancelled in 1948.

SW 12

Dixie Group (47)

The Dixie group comprised ten claims (P16417-26) staked in 1947. The group was located between Laurie Lake and Tod Lake, and covered a portion of the greenstone and the Sickle conglomerate north of the Tod Lake Fault. Five rock trenches were reported as assessment work on these claims in 1948 but, in the course of detailed mapping of this area, only a small prospect pit was found. It is at the west end of the southern and the two small lakes west of Laurie River. It shows lineated and strongly schistose greenstone and heavy gossan stain just north of the conglomerate contact. The stain is due to sparse pyrite parallel to the schistosity. The freshest material shows some silification, and there is some vein quartz in the adjacent dump.

SW 12

Caimito Group (48)

The Caimito group consists of eight surveyed claims (L 1-8) covering the largest island on the south shore of Laurie Lake. At one time there were four additional unsurveyed claims (P4905-6; 4561-62). The claims were first staked in 1939.

Work on the claims consisted of trenching and X-ray drilling and was concentrated near the narrow channel which separates the island from the mainland. Dark quartz was visible on both sides of the channel. The wall-rock is silicified amphibolite probably derived from basic lavas cut by a shear zone along which the quartz was introduced. A strong lineation, plunging 50 degrees north, was visible at the north end of the channel. The greyish, glassy quartz has some ribbon structure, and contains inclusions of chloritized wall-rock adjacent to which the value appears to be greatest. Some ankerite and calcite were reported from drill holes. Farley, who mapped it for the owners in 1940, recognized a late generation of white glassy quartz. There is sparse disseminated pyrite, pyrrhotite and minor chalcopyrite; Farley reported rare galena. A chip sample from a pit on the eastern bank, taken by Stanton, showed 0.03 ounces of gold per ton over 4 feet 7 inches, but values as high as 0.56 ounces have been reported.

In 1953, most of the area of the group was flooded when the Eager Lake dam was erected. Prior to the flooding, Sherritt Gordon drilled several holes on behalf of Caimito Gold Mines Limited. They were drilled under the quartz showings noted above, and also northwestward to test the possible extension under the lake. One of the latter holes contained a 3.3-foot section which averaged 1.5 per cent copper.

In the course of routine testing of the cores, spectroscopic analysis indicated 0.02 per cent gallium. Because of the high price of this metal, this would give a very high nominal value per ton to this rock, should subsequent analyses confirm the above result, and further drilling confirm the intersection first found. Efforts on the part of Caimito Gold Mines have shown that a market for the metal is probably available. However, because the entire current production is a by-product from aluminum refining, the company has not been able to get any indication of the possible cost of extraction under circumstances such as those on the Caimito claims.

N. T. Group *W. J. Group* *Berg Group* (49)
Dan Group *Lew Group*

The N. T. group of 14 claims (P13832-13845) was staked in 1947. It included the north end of Berge Lake and the area between Stick Lake and Goldsand Lake.

Immediately southwest, and underlain by Berge Lake and the large peninsula in it, was the W. J. group of 16 claims (P13822-31; 13854-55; 13861-64). To the west of these were the Dan claims (P12913-21; 13007-009), with Stick Lake in the centre, and the Lew group (P12922-30), south of that towards Barbara Lake. The Berg claims, (P12294-12308) covered the intervening ground and the northern third of Barbara Lake.

During the summer of 1947, a magnetometer survey was conducted on this composite group by A. J. Macbeth, under the direction of E. F. Creelman. It appears that the Berg claims were held by International Mining Corporation (Canada) Limited; the remainder were held by Hoodoo Lake Mines, Limited. The work was done with an Askania magnetometer. Places which showed deflections greater than ten degrees were detailed, and were checked by self-potential or resistivity methods.

Twenty anomalies were found. Two are caused by iron-formation which forms a straight band between Barbara Lake and the south part of Stick Lake. There is no large-scale folding or faulting of the iron-formation, which is just a little too narrow to be shown on Map No. 1. A second shorter zone of iron-formation is inferred at the north end of Stick Lake.

The "A" anomaly, of 15,000 gammas, occurred in granite with sediment and greenstone inclusions. No magnetite was observed, but pyrrhotite and chalcopyrite were found in highly altered basic rock not more than 100 feet from the edge of the anomaly. No contacts were found. Because of this adjacent sulphide, drilling of the "A" anomaly was recommended. Three other anomalies were found in granite; only one had a corresponding resistivity low.

Five magnetic anomalies were found in areas of sediments, which are cut by granitic rocks in a number of places. Checking by self-potential methods eliminated one of these, but confirmed the rest, and found another on the shore of Stick Lake. This new one was trenched, but no mineralization was found.

Six more magnetic anomalies were found in tuffs and flow breccia. They were probably caused by pyrrhotite, but some chalcopyrite and sphalerite is also present.

One magnetic anomaly is in a swamp; it might be of importance.

Geological mapping was carried out at the same time by E. O. Lilge. Insofar as scale permits his data are included on Map No. 1. The sediments are interbedded with basic tuffs and flows, and are often considerably sheared and metamorphosed. They are altered to hornblende and mica schists, with the hornblende predominant.

Tuffs and fragmental volcanic rocks, in about equal amounts, form a band on the Berg claims, but both lens out to the north. Individual bands can be traced for hundreds of feet.

East of Stick Lake there are bands of hornblende schist in the sedimentary rocks. They are up to several hundred feet wide, show cross-cutting of the sediments, and must therefore be intrusive. However, in the southern part of the property, according to Lilge, the hornblende schist appears to be derived from the sediments. The mineralized inclusions from the "A" anomaly, near the shore of Berge Lake, look like coarse-grained gabbro according to Lilge, and appear to be banded. A sample of this rock contained quartz, hornblende, magnetite and feldspar (including orthoclase). It is perhaps worth noting that chlorite and calcite are also present.

There is no record of any drilling on these claims. The N. T. and W. J. groups were allowed to lapse in 1948 and 1949. The Dan, Lew, and Berg groups were cancelled in 1950 and 1951. Essentially the complete area of the Berg claims was re-staked in 1952, as the Berge group (P26796-26817), and the ground of the Dan claims was covered by the Bark group (P27041-69) which was also staked in 1952. This last group was cancelled the following year because no assessment work had been done. Some trenching has been reported on the Berge claims, but mostly in overburden, and no details are available. Some drilling was done by Sherritt Gordon Mines on the anomalies found by Creelman, but the results were disappointing.

NE 14

W Group (50)

Between Stick Lake and the south shore of Goldsand Lake, the 14 claims of the W group (P13856-60; 13865-73) formed the western boundary of the Dan group. Much of the area is swampy and rock exposures are scarce. In part the claims are underlain by hybrid rocks derived from sediments and tonalite; in part the underlying rock is probably sedimentary.

There is no record of any work done on this group, and the claims which were staked in 1947 were cancelled in 1948.

This group should not be confused with another W group, of three claims, on the west shore of Berge Lake.

NE 14

Z Group (51)

The 20 claims of the Z group (P13319-13338) were staked in 1947, southwest of the W group. The Lew group adjoined on the eastern side.

There is very little rock exposed, but the claims must have been underlain almost entirely by tonalite.

No work was done on the claims, which were cancelled in 1948.

NE 14

C Group (52)

The C group of 15 claims (P13010-13018; 12982; 13046-13050), was in two lots, adjoining the Alp group on the north and west. This group was mostly on the northern side of the tonalite-sediment contact east of Glad Lake.

The claims were staked in 1947, but no work was done and they were cancelled in 1948.

NE 14

Jock Group (53)

The 14 claims of the Jock group (P12965-70; 12974-81) were staked in 1947 between the north end of Merle Lake and the north end of Ralph Lake, and adjoined the Alp group. This area is mostly muskeg, but it is probably underlain by Wasekwan greywackes.

No work was done and the claims were cancelled in 1948.

NE 14

W. Group *Bert Group* (54)

A group of three claims (P11828-11830) was staked in 1946, between the Berg and Al claims, on the west shore of Berge Lake. These claims lapsed in 1947 and were re-staked (P17985-7) in 1948. In October, 1948, geological mapping was done by Sherritt Gordon Mines Limited. Tuffs are the most widespread type on the three claims, but flow breccia is also prominent; the latter is much like that at Ralph Lake. The tuffs are fairly uniform in composition but vary in texture and appearance. They are thinly laminated, somewhat fissile, and hornblende needles are abundant. There are accessory amounts of pyrite and pyrrhotite in the tuffs, but nothing of value. Magnetometer and electromagnetic surveys were recommended.

The claims were allowed to lapse in 1950.

Approximately the same ground was restaked in 1953 as the Bert claims (P27258-60) but no work was done and the claims were cancelled in 1954. They were again staked in 1954, under the same name (P30986-9), surveyed, and leased by Sherritt Gordon Mines Limited. No further work was done on the claims; that necessary for leasing was done on adjacent Elb claims under grouping arrangements.

NE 14

S Group (55)

The S group of nine claims (P15528-36) were on the east shore and southeastern bay of Berge Lake. The area is entirely underlain by the Berge Lake granite, and no work was recorded on the claims. They were cancelled in 1948.

NE 14

Al Group *Alp Group*
J Group *JM Group* (56)

The Alp group originally comprised 41 claims (P12812-47; 12901-4; 13053) covering both sides of the north end of Ralph Lake and the southern end of Barbara Lake, and for approximately a mile to the northwest. The claims were staked in 1947. In 1948 all those west of Ralph Lake were allowed to lapse, leaving a group of 18 claims between Barbara and Ralph lakes.

The Al group, of 12 claims (L2022-2033), along with 4 JM fractions, adjoins the Alp group on its eastern side, and covers the area east of Barbara Lake, including the south half of Berge Lake.

The twelve J claims (Lots 2010-2021) lie southwest of the Al group, and extend from the southwest tip of Berge Lake almost to West Eric Lake. They, in turn, are followed southward by the JM group, which consists of 8 claims (Lots 2002-2009) and 6 fractions (Lots 2067-2072). These tie onto the Elb group at West Eric Lake.

The above assemblage of claims thus covers most of the ground between the north half of Ralph Lake, and the south half of Berge Lake, and south as far as the intersections of the runway allowance on the Lynn Lake airport. All were staked in 1947, and with the exception of a portion of the Alp claims, as noted above, none has lapsed since. Some of the very large claims were broken up, and fractions formed, at the time the claims were surveyed in 1954. These various groups are now held by Sherritt Gordon Mines Limited.

Under the name of the "Goodenough" claims, this whole group was mapped by magnetometer in 1947, under the direction of Hans Lundberg. At the same time, geological mapping was also done by M. W. Hotchkin for Toburn Mines Limited.

The geological map has been incorporated into Map No. 1, but a few points which cannot be shown merit some comment. There is some variation in the volcanic flows, with some siliceous types present. Metamorphism is most noticeable in the tuffs, where narrow parallel zones are accentuated by the development of secondary hornblende and amber-coloured mica. The granite near West Eric Lake is finer grained than at Berge Lake, and is gneissic in some places.

The magnetometer work showed a number of areas of strong variation in the magnetic field. Such areas were mapped in greater detail by magnetometer and over these an electrical (ratiograph) survey was also performed. As found by others who worked to the north and south, the area of *Barbara Lake and immediately south towards Ralph Lake* is a zone of extremely high magnetic intensity. This was attributed to magnetite, possibly associated with a gabbro or norite mass beneath Barbara Lake. Perhaps the wish was father to this thought, for no mention is made of the obvious possibility of iron-formation. At that time, of course, it probably was not known that such had been found both to the north and to the south.

West of Barbara Lake, the magnetic data were interpreted to mean quartzite, greywacke and derived schists. Within this area are a number of magnetic highs and lows with a relief of about 2,000 gammas; a high always has an associated low. This effect was attributed to lenses of magnetite or pyrrhotite in the sedimentary rocks. A vertical hole was suggested to check this, but apparently was never drilled.

Just west of West Eric Lake, detailed work showed three fairly strong local magnetic highs, associated with magnetic lows, near the contact of the granite with the Wasekwan lavas. The electrical survey showed the areas of strong magnetic field to be conductive. One of the three zones was tested by drilling to a depth of 301 feet in a vertical hole. The hole penetrated coarse- to fine-grained grey hornblende "granite", which contained pink garnets in the upper 150 feet; one 25-foot section contained 50 per cent garnet. Pyrite and pyrrhotite were disseminated in the core, and some streaks of abundant magnetite were also present. Presumably the electrical conductivity is due to the disseminated suphides. Copper and nickel values were negligible.

East of the northern part of Barbara Lake, and close to the granite contact, the survey found three well-defined magnetic anomalies. One of these, circular in shape and 5,000 gammas above normal, had a very strong electrical indication associated. It was tested by a vertical hole (No. 7) to a depth of 306 feet. Another anomaly, 4,000 gammas above normal, had a weak associated electrical indication. This was tested by a vertical hole, No. 8, to a depth of 300 feet. The third, an anomaly of 3,000 gammas with an associated weak conductor, was tested by hole No. 9 to a depth of 305 feet.

Both No. 8 and No. 9 holes penetrated tuffs and breccia, with short sections logged as hornblendite and hornblende schist. Sulphides consist of disseminated pyrite, pyrrhotite, and chalcopyrite, and occur in the siliceous tuffs rather than the more basic tuffs and breccias or the "hornblendite". A few scattered crystals of sphalerite were also noted. Copper content is low.

More interesting values were found in No. 7 hole. After passing through 45 feet of pink granite, the hole penetrated six feet of tuffs and then 69 feet of "altered hornblendite" before passing again into grey granite, which contained short sections of diorite and hornblendite—possibly inclusions. All the main mass of altered hornblendite is mineralized. Assays over a true width of 35 feet averaged 1.34 per cent copper, including a 5-foot section containing 2.5 per cent. Traces of nickel were present, and gold content averaged 0.03 ounces per ton. Details of alteration are not given. This is on the boundary between the Al 1 and Al 2 claims, on the west side of Berge Lake.

Holes 13 and 14 were drilled from the same site as No. 7, one at −65° east southeast and the other at −65° west northwest. No. 13, drilled towards Berge Lake, cut 155 feet of pink and grey granite with narrow quartz stringers, and a few inches of "hornblendite" which presumably is the edge of that found in hole 7. Hole 14, drilled towards the greenstone, cut alternating hornblendite and dark granite, the latter described as "partially altered to hornblendite". It would appear that this hole ran practically along an irregular contact between the "hornblendite" and the contaminated granite.

Subsequently further drilling was done in the vicinity of this hole. No. 15 hole, 100 feet north of No. 7, cut "hornblendite" mostly, but with numerous bands of grey granite, up to 15 feet long, in the core. The "hornblendite" again contained pyrite and chalcopyrite, with some magnetite and pyrrhotite. Molybdenite was reported from one place, and sulphides up to 8 per cent were reported near the top of the section.

Hole 17, 325 feet east of 7, 13, and 14 and on approximately the same line of section, found only grey granite, except for about 12 feet of hornblendite at 480 feet. Contrary to the experience in the previous holes, however, 19 feet of this core was fine-grained granite with heavy pyrrhotite, chalcopyrite, scattered sphalerite, and a little pyrite. Sulphides totalled over 50 per cent. The granite carried a little scattered sulphide as alteration for a few feet on either side of this zone. One hundred feet north, however, hole 18 cut through the granite-tuff contact at 411 feet. The tuffs are silicified adjacent to the contact for about 48 feet; there are also moderate amounts of pyrite, pyrrhotite and a few crystals of sphalerite. The only hornblendite found was about 5 feet at 500 feet. It contained abundant sulphides and there was minor sulphide in the granite beneath it.

So far as known, no holes were drilled against the apparent dip of the hornblendite, i.e. southeast, except No. 13, which apparently passed over it. Nor do the logs offer any suggestion as to a controlling agent for the heavy sulphides found in the granite in hole 17, or the smaller amounts at the bottom of hole 18.

Holes 13 to 18 were drilled by Asarco Exploration Company of Canada Limited, in October 1952. Further drilling was subsequently done by Sherritt Gordon Mines, but there is insufficient tonnage to make a commercial orebody, though some material of ore grade was found.

The third area of detailed magnetic and electrical survey is *east of the south end of Barbara Lake*. Over a length of 1,800 feet, there is a zone of magnetic anomalies, which have a northerly trend, and the zone coincides with a very good conductor. Holes 1, 2, 3, and 4 were drilled in this area.

Holes 1 and 2 both penetrated tuffs and flow breccia. In No. 1, disseminated pyrite, pyrrhotite and some chalcopyrite and sphalerite, along with narrow stringers of massive sulphides, occur in two zones. Copper and nickel content was low. The sulphides occur in "medium basic volcanic tuffs and breccias". In the second hole, 500 feet north of No. 1, similar material was found in "acid tuffs" and "slaty sediments", and was considered to be the same as the lower mineralized zone found in No. 1. The upper mineralized zone from hole 1 was thought to be present in holes 3 and 4, still farther to the north. In all cases, however, the copper values were low.

NE 14

G. J. Group (57)

The G. J. group of twelve claims (P12971-3; 13054-62) was staked in 1947 and extended east from the east shore of Merle Lake. The area is covered by extensive muskeg and is probably underlain by Wasekwan sediments. No work was done and the claims were cancelled in 1948.

NE 14

G. C. Group (58)

This group also consisted of 12 claims (P13028-33; 13040-45) situated between the south end of Merle Lake and the north end of Betty Lake. The area is almost entirely swamp. The claims were staked in 1947 and cancelled in 1948, for lack of assessment work.

SE 14

L. P. Group (59)

The L. P. group of 12 claims (P12983-91; 13037-39) covered the south part of Betty Lake, and the area immediately west. These can all be described as "water claims". No work was done and the claims were cancelled in 1948.

SE 14

WU Group (60)

This group also contained 12 claims (P13019-13027; 13034-36), staked in 1947. They were due south of Betty Lake and covered part of the area of Sickle conglomerate there. In 1948 they were cancelled for lack of assessment work.

SE 14

J. T. Group (61)

Twelve claims of the J. T. group (P14775-14783; 14750-52) were staked in 1947, south of the WU group and west of the creek draining Betty Lake. They were cancelled in 1948.

SE 14

Mar Group (62)

The fourteen claims of the Mar group (P12649-57; 12674-78) were staked in 1947. They surrounded the small lake in the middle of the Sickle conglomerate area at Betty Lake. The F. N. M. claims adjoined on the eastern side. The claims were cancelled in 1948 for lack of work.

SE 14

C. B. Group (63)

Eight claims of the C. B. group (P14753-60) were staked in 1947. They were in an area of swamp south of Veronica Lake and east of Wye Lake. No work was done and the claims were cancelled in 1948.

SE 14

J. V. A. Group (64)

South of the C. B. group were the seventeen claims of the J. V. A. group (P14733-41; 14767-74). Most of the area of these claims also is obscured by sand and swamp, but it is probably underlain by Sickle conglomerate. The claims were cancelled in 1948.

SE 14

H. F. V. Group (65)

The nine claims of this group (P14761-66; 14784-86) were staked in 1947, south of the J. V. A. group. They were west of the lake in the area of Sickle conglomerate, and the rock is obscured by swamp and sand. No work was recorded and the claims were cancelled in 1948.

SE 14

E. G. Group (66)

The E. G. group consisted of eight claims (P14742-49) which were staked in 1947. They covered an area of slightly elevated ground about a mile south of Wye Lake. The geology of this area is not shown on Map No. 1. The claims were cancelled in 1948 for lack of work.

SE 14

C. G. Group (67)

The twelve claims of the C. G. group (P14787-89; 14799-807) lay to the south of both the E. G. (66) and the H. F. V. (65) groups. They extended eastward into the area of Sickle conglomerate southwest of Betty Lake, but outcrops are very sparse. They were cancelled in 1948 for lack of assessment work.

SE 14

J. B. Groups (68)

Two adjacent groups of claims both have the name J. B. The western one comprised nine claims (P12276-84) and lay on both sides of the swamp and creek draining southward into the north end of Motriuk Lake. The second group contained sixteen claims (P12618-19; 12626-35; 12645-48), and lay immediately east of the first. It extended as far east as the swampy valley draining into the widening of the river just below Motriuk Lake, and as far south as the northern end of that lake.

Both groups were underlain by sedimentary and volcanic rocks, and possibly also by granite.

They were staked in 1947, and both lapsed in 1948.

SE 14

N. H. K. Group (69)

The fifteen claims (P12992-13006) of the N. H. K. group were staked in 1947. They lay south and west of the J. B. group, and the southwestern corner reached the small lake northwest of Motriuk Lake. The exposures in this area are very poor, but the group was probably underlain mainly by sediments, possibly including some Sickle conglomerate.

The claims were cancelled in 1948.

SE 14

J. K. Group (70)

The J. K. group comprised 18 claims (P14694-711) covering the north end of Motriuk Lake. The area is mostly swampy and the nature of the underlying rock is not known. The claims were staked in 1947 and cancelled in 1948.

SE 14

Ed Group (71)

The Ed group consisted of 18 claims (P13693-710) and was staked in 1947 by Towagmac Exploration Company Limited. It extended north and west from the small lake northwest of Motriuk Lake. During March, 1947, magnetometer profiles were run on the claim lines, and a few intervening picket lines, by K. G. Honeyman, of St. Francis Mining Company Limited. A sketch map of the geology was also prepared.

Honeyman's work showed a ridge of greywacke running southwest from the small lake in the southeast corner of the group. A parallel depression north of the ridge contained most of the magnetic variations found on the claims. To the north again are ridges due to bedrock and gravel. Granite was found in one outcrop, outside the limits of Map No. 1, and it probably underlies the area to the north.

No further work was done and the claims were cancelled in 1948.

B. N. Group (72)

North of the Ed group were the nine claims of the B. N. group (P14790-98). The area is swamp- and drift-covered and the geology is not shown on Map No. 1. No work was done and the claims were cancelled in 1948.

SE 14

J. M. Group (73)

The fifteen claims of the J. M. group (P12636-44; 12620-25) stretched from north of the outlet of Motriuk Lake to the south end of Frances Lake, where they adjoined the Elb group. Except at Frances Lake, the rock under these claims is entirely granitic. No work was done and the claims were cancelled in 1948.

SE 14

Par Group (74)

The Par group comprised nine claims (P14724-32) west of the outlet of Motriuk Lake, and including part of the large island in the north end of the lake. The area is probably entirely granitic. No work was done and the claims were cancelled in 1948.

SE 14

Camp Group (75)

The nine claims and fractions of the Camp group (P14939-47) covered the outlet of Motriuk Lake and a small area immediately to the east. The claims were underlain by granite. No work was done and the claims were cancelled in 1948.

SE 14

Bell Group *Lap Group* (76)

The thirty-one claims of the Bell group (P12848-78) were staked in 1947. They covered the area between the east side of Motriuk Lake, Eileen Lake, and the south tip of Frances Lake. This area included the diorite mass north of Eileen Lake, and part of the granite further north, as well as a large part of the tonalite southwest of Eileen Lake.

No work was done and the claims were cancelled in 1948.

The area of the diorite body was restaked in 1948 as the Lap group of sixteen claims (P19694-19709). No work was done on these either, and they were cancelled in 1949.

SE 14

Fraser Group (77)

The Fraser group of 21 claims (P12285-12293; 12309-12320) was staked in 1947. The group was bounded on the west by the Bell group, from the south tip of Frances Lake to Eileen Lake. Eastward, it extended to the line of Fraser and Nail lakes. Most of the area is underlain by quartzites and tonalite but it includes a little of the gabbro at Fraser Lake. The western half is covered by glacial deposits, mostly sand but including drumlins and an esker.

In 1947, geological mapping and a magnetometer survey were carried out by Kenneth C. Rose, under the direction of W. L. C. Greer. The work was done for International Mining Corporation.

Their geological map has been incorporated in Map No. 1. The quartzites are fine grained, often cherty, white to black in colour, and form the main portion of the sediments. Impure quartzites, greywacke and tuffs also occur. The sediments are all thinly laminated. The mass at Fraser Lake was described by Greer as "gabbro-diorite" composed of plagioclase and pyroxene or hornblende. He pointed out also that the sparse disseminated pyrrhotite caused very little magnetic effect. The dark hornblende tonalite has a contact aureole in the sediments, and there is an adjacent zone of contamination formed by numerous inclusions in the intrusion. Numerous aplite dykes, up to one foot thick, occur in the contact zone. As shown on Map No. 1, the tonalite boundary passes much closer to Nail Lake than it was shown by Greer.

The geophysical work was done with a Thalen-Tiberg magnetometer. Several anomalies (i.e. deflection greater than 5 scale divisions) were found. All but one are small, and the larger is a multiple of several small ones aligned parallel to the probable direction of the underlying quartzites. All but one of the anomalies occur where the underlying rock is suspected to be either quartzite or granitic. They were therefore ascribed to magnetite, though the possibility was recognized that a gabbro body might be present. The areas in question are drift covered. A weak anomaly was found in the gabbro area, but the greater part of it is in the Sherritt Gordon ground to the north. Greer recommended that this part should be re-examined with a more sensitive instrument, but considered that the other magnetic indications probably did not have any economic significance and that no further work should be done on them.

The claims were allowed to lapse in 1950.

Some drilling was done by Sherritt Gordon Mines on the extension of this anomaly, under a joint arrangement with the International Mining Corporation. Massive sulphides, in some quality, were found, but the nickel and copper content was disappointingly low.

SE 14

F. N. M. Group (78)

The F. N. M. group of 21 claims (P13066-13086) was staked in 1947. It covered a strip, two claims wide, running north from the widening[1] in the river below Motriuk Lake toward Betty Lake. It included the small lake west of the gabbro. At the southern end, four claims reached eastward toward Frances Lake. Exposures are very sparse, especially in the southern part of the group.

During the spring and summer of 1947, magnetometer and geological surveys were performed by staff geologists of Falconbridge Nickel Mines Limited. The details of surface geology have been incorporated in Map No. 1. The major structural feature is the fault which runs southwest across the group from Ralph Lake. The location of the fault on the F. N. M. claims is based on the magnetic data, but was confirmed by drilling northeast of the group. Rocks bordering the shear are very schistose. Sparse pyrite and pyrrhotite are disseminated through both sedimentary and volcanic rocks.

The magnetometer measurements were made with an Askania and a Davidson magnetometer. (Swampy areas were done during the winter; hence, the two instruments.) The paucity of outcrop on the claims made difficult the correlation of the magnetic data with surface geology. Therefore, Seeber and Davidson, who did the interpretation, based it largely on their experience in the adjoining L. M. claims. There it was found, on the basis of electromagnetic work and drilling, that most of the magnetic anomalies were caused by magnetite in the sedimentary rocks, and a pyrite-pyrrhotite body on a through-going fault zone. It was assumed that similar conditions hold on the F. N. M. claims. They further noted that,

[1]Locally called "Eve Lake".

though magnetic highs associated with a shear zone were undoubtedly due to magnetite, they considered them to indicate favourable ground for electrical prospecting. They considered this magnetite to have been introduced as a wall-rock alteration around sulphide bodies.

Overburden in the northern part of the group is up to 100 feet deep.

Six of the claims, extending eastward over the granite, were allowed to lapse in 1950. The remainder were cancelled in 1952.

SE 14

L. M. Group *Mal Group* (79)

The L. M. claims were staked in three distinct blocks, two of which were contiguous. The whole assemblage totalled 42 claims (P11005-11046) and was staked in 1946.

Block 1

A block of 12 claims (P11005-16) was east of the centre of Ralph Lake, and between West Eric and Sheila lakes. During the summer of 1947, a geological and magnetometer survey were done by E. O. Lilge and by E. F. Creelman, respectively.

The geological details have been incorporated in Map No. 1, with a few changes near Ralph Lake. The andesitic flows are usually schistose, though recrystallization produced a coarse-grained rock resembling diorite in some places. The fragmental rocks are andesitic and include the flow breccias of Ralph Lake described above (p. 43). There are some rather siliceous lavas, which are dark in colour. There are also several small plugs and intrusive masses of quartz porphyry, which are too small to show on Map No. 1. The quartz porphyry is light cream coloured, with blue quartz phenocrysts. A few irregular "hornblendite" dykes were also noted.

No concentrations of sulphides were noted. Magnetite crystals occur in the lavas, in the quartz porphyry and in dark siliceous felsite, which occurs in small amount. Chalcopyrite and pyrite occur in sheared felsite, near the contacts of quartz porphyry, and in the schistose lavas, but only in minor amounts.

The magnetometer survey showed only very weak anomalies. They were ascribed to magnetite or, in the case of the L.M. 4 claim [now Mal 8 (P35951), on the airport] to disseminated pyrrhotite such as was seen on a porphyry outcrop in the vicinity. Drilling showed that such was the case on the nearby J. M. claims, where disseminated sulphides were encountered.

This block of claims lapsed in 1950 and was restaked in 1951, with the addition of 12 claims covering Ralph Lake, and formerly part of the Elb group. The group then bore numbers P23086-103 and P23105-110. These claims lapsed in 1952, were staked again as the *Lam* claims which expired, without work, in 1954 and were again staked in 1955 in two groups: the ***Mal*** group (P35944-55) covers the same ground as the original twelve L. M. claims, the ***Ral*** group (P37131-42) of twelve claims covers Ralph Lake and an area originally staked as part of the Elb claims.

Some trenching was reported on the Ral 1 claim in 1956, but details of the exposure are not available.

A magnetometer survey was again performed on the Mal group in 1957, following a second geological mapping program in 1955. An electromagnetic survey was also reported in 1958. This latter did not reveal any conductors. The magnetic survey again picked up the high on the Mal 8 (former L. M. 4) claim, as well as a less intense linear "anomaly" about a half-mile west.

Block 2

A second block of 20 claims (P11027-46) ran south from the south end of Ralph Lake as far as the river draining Motriuk Lake. The block was two claims wide, and covered most of the larger of the gabbro plugs south of Ralph Lake as well as some of the volcanic rocks to the west of it. Granite probably underlies the southern part of the block. Two isolated claims (L. M. 41 and 42) were on the east shore of Frances Lake.

During March and April, 1947, Falconbridge Nickel Mines Limited carried out a magnetometer survey of this block of claims (less L. M. 41 and 42). Geological mapping was also done.

The details of the geological map have been transferred to Map No. 1, where most of the details shown south of Ralph Lake have been derived from that work. The rock, here shown as gabbro, was mapped as diorite by Falconbridge.

The magnetometer work was done with an Askania instrument. It showed an anomaly running southward, from the bay in the southwest corner of Ralph Lake, along the line of a topographic depression. The anomaly was ascribed to magnetic minerals along a fault zone. This was subsequently confirmed by drilling which revealed a fault dipping 70° E, with associated pyrite and pyrrhotite. The magnetic variations found around the gabbro were considered to be due to the effect of contact metamorphism.

The L. M. 41 and 42 claims, which were not included in this work, were cancelled in 1947. The ground was restaked in 1953, as *Fran 1 and 2* (P27238-39).

The remainder of this second block (L. M. 23 to 38) was allowed to lapse in 1951. The claims were re-staked in 1951 as the *Lucky* group (P24485-96), and as four claims (P37112-13; 37118-9) of the *Zero* group in 1955. As the Lucky group, a further magnetometer survey was performed in 1953 by B. R. Richards. He found five anomalies. Erratic highs and lows were ascribed to magnetite in the sediments south of the gabbro, as had been done by Falconbridge. Two moderately high and well-defined anomalies on the Lucky 7 to 11 claims were related to the basic plug just to the east. It was suggested that a lens of sulphides might lie under the southwest corner of the Lucky 8 claim (former L. M. 35), where a strong dipolar effect had been explained by the Falconbridge geologists as due to magnetite introduced into the Wasekwan rocks. One anomaly on the Lucky 12 claim (formerly L. M. 27) was ascribed to magnetite in the volcanic rocks. This is on the zone which Seeber and Davidson had shown was due to magnetic minerals in a shear zone. Richards considered an anomaly on the Lucky 1, 2, 3, claims (formerly L. M. 28, 39, 32) as the most promising zone and possibly due to the concentration of pyrrhotite, though the Falconbridge staff had considered it to be caused by metamorphism peripheral to the gabbro body there. Richards recommended careful surface prospecting of the Lucky 1 and 2 claims, and an electromagnetic survey of the same ground.

The electromagnetic survey was carried out in August, 1957, by E. W. Bazinet using the Ronka horizontal loop. This survey found a conductor 2,000 feet long, bearing N53°E, through the Lucky 11 and 12 claims (formerly L. M. 27). This is the shear zone found by Falconbridge and the anomaly coincides with sulphides found by two previous widely spaced drill holes. In these there was some pyrrhotite and pyrite, but only minor amounts of copper, zinc, and silver.

Another weaker anomaly was found at the southern end of the group. Two drill holes were recommended, but there is no record that they have yet been drilled.

Block 3

The third block of ten L. M. claims (P11017-26) was between Betty Lake and Ralph Lake, where it abutted the Elb group. It extended northward from the south end of Betty Lake. The area is underlain by Sickle conglomerate and possibly some Wasekwan sediments also. The claims were staked in 1946 and were cancelled in 1947.

The area is now a part of the Zero group (P37112-30) which was staked in 1955 and extends northward between Ralph and Merle lakes.

SE 14

Ayr Group (80)

The Ayr group consists of 17 surveyed claims (L1250-66) which are mainly southwest of Margaret Lake, though part of the group touches Frances Lake south of the Incon group (83). The claims were staked in 1946.

A magnetometer survey of the group was done by O. A. Seeber, of Falconbridge Nickel Mines Limited in October and November of 1946. An Askania instrument was used. The survey showed that the southern portion of the group is probably underlain by granite. An area of irregular "highs" and "lows" on Ayr 8, 9, 11, and 12 claims was ascribed to magnetite in the sediments there. The narrow band of greenstone southwest of Margaret Lake was also represented by a narrow anomaly. A small anomaly on the Ayr 7 claim failed to react when tested electrically, and is possibly due to the same greenstone. A huge anomaly trending westward from Margaret Lake to the south edge of the gabbro body was diamond drilled. It was found to be due to magnetite in sediments which have been intruded by sills of gabbro.

Geological mapping was begun simultaneously with the magnetometer survey, but was not completed until June 1947. The results are incorporated in Map No. 1. The sedimentary rocks southwest of Margaret Lake are garnetiferous and gritty, with thin flows interbedded. The gabbro shown to the west of the lake, on Map No. 1, is medium grained, on the Ayr claims, and was termed quartz-diorite by the Falconbridge geologists. They also suspected the presence of fine-grained greenstone inclusions. Altered and sheared quartz porphyry was found by drilling, and it was suggested that this might be older even than the gabbro. The chief evidence apparently was its altered appearance. Alteration of the sediments around the gabbro, is shown by the development of hornblende (in small concentrations and veinlets) and much disseminated fine-grained magnetite. Sparse disseminated pyrite and pyrrhotite are widespread in both the sedimentary and volcanic rock.

The claims were surveyed in 1948.

SE 14

H Group (81)

The H group, which was staked in 1946, consisted of nine claims (P10001-5; P10397-400) lying between the Ayr (80) and F. N. M. (78) claims on the west side of Frances Lake, with one claim on the east side. The group is probably underlain by volcanic and sedimentary rock, but, in fact, there are practically no outcrops.

As part of a more extensive program on the "Goodenough" group, Hans Lundberg carried out a magnetometer survey of these claims in 1947. According to this survey, the granite contact northwest of Frances Lake should be a little farther south than shown and the sediments strike northerly. (It has been shown on Map No. 1 to conform with the Falconbridge data to the north and west.) The survey also found an anomaly, near Frances Lake, which extends northward into the Ayr 16 claim. The magnetic intensity was found to be 3,000 gammas above normal, at maximum. A ratiograph survey indicated that the magnetic rock was also a conductor. Two drill holes were recommended to test this conductor and two closely associated ones. So far as known, the holes were not drilled.

The claims were allowed to lapse in 1947 and have since been re-staked as part of the Fran group.

SE 14

Lucky Nickel (82)

A single fractional claim (P12226) between the L. M. and Elb groups, on the east side of Frances Lake, was staked in 1947 and cancelled in 1948 for lack of assessment work.

SE 14

Incon Group (83)

The Incon group consists of 60 surveyed claims and fractions (L716-31; 733-69; 1064; 1068-9; 1079-82). The group was originally (1946) practically surrounded by the Elb group (1) on the north, east, and south; the Ayr group (80) formed the southwest boundary. With cancellations and re-staking the names of the surrounding groups have changed.

The group is in two blocks of roughly equal size. One lies north of Margaret Lake, and is separated from both Ralph and Sheila lakes, by a single claim width in each case. The north boundary is the Mal group (formerly L. M.) (79) while the eastern boundary just touches the western extremity of the airport allotment. Parts of eight of these claims extend southwest of the creek draining Ralph Lake. The second part adjoins at Margaret Lake, (which is practically completely within the group), and extends across Frances Lake and south of Lake of Bays to within a quarter-mile of the railway near Flag Lake. Approximately half of Frances Lake is included.

The group covers the large area of volcanic rocks north of Margaret Lake, most of one and part of the other of the gabbro plugs south of Ralph Lake, mixed volcanic and sedimentary rocks west of Frances Lake and quartzite east of it. Part of the north end of the Fraser Lake gabbro is also included.

The claims were surveyed in 1947.

Magnetic and geological surveys of the group were made in the summer of 1946, by R. W. Baker, for International Mining Corporation (Canada) Limited.

Though the outcrops found by the geological survey have been shown on Map No. 1, so far as scale permits, considerable changes have been made from Baker's interpretation of them. The chief changes affect the gabbro at the south end of Ralph Lake, and the area between Margaret and Frances lakes. On Map No. 1, two isolated exposures of gabbro east of Ralph Lake are shown as satellites to the main plug at the south end of the lake. These were shown by Baker as part of the same mass, which therefore was dyke-shaped with a large inclusion of greenstone. Some doubt as to the intrusive nature of this gabbro has been resolved by the discovery of tongues of massive gabbro cutting schistose flow breccia on the L. M. group just southwest of Ralph Lake.

Between Frances and Margaret lakes, Baker described the rock as "tuffs with interbedded rhyolite". Where seen, the rocks are about half greenstone, with tuffs and other sediments forming the remainder, and the whole has been mapped as greenstone with some interbedded sediments to conform with exposures north and south.

Similarly, the basic rock west of Flag Lake has been included with the Fraser Lake gabbro, which is extensively exposed to the south. This coarse-grained rock on the southern part of the claim group was described by Baker as "diorite", but has been here interpreted as an alteration phase produced by the action of the "granite" on the fine-grained flows. The relative ages of the tonalite and the Fraser Lake gabbro were apparently definitely established by Baker's discovery of dykes cutting this "diorite", though recent detailed work, according to the Sherritt Gordon staff, has shown no definitive age relations anywhere on the gabbro-tonalite contact.

Sulphides of any significant value were not recognized in the surface mapping. A 4-foot silicified zone on the Incon 16 Fr. west of Flag Lake, contains a little disseminated pyrrhotite, but no values in gold, nickel, or copper. A large inclusion in the granite on the Incon 41 claim, east of Frances Lake, has similar pyrrhotite, and no values. Some old trenches were found near a shear zone on the contact between tuffs and andesite, on the south boundary of the Incon 28 claim south of Margaret Lake. There are a few threads of quartz and carbonate in the shear. The trenches are on this and on some quartz "blows" to the northeast.

The magnetic survey was conducted with a Thalen-Tiberg instrument, and readings over 5 scale divisions from normal were considered anomalous. The area between Margaret Lake and Frances Lake was not covered by the magnetometer survey.

In the eastern block, the magnetometer showed no significant anomalies. Anomalous readings were found for 400 feet southwest of the silicified zone, mentioned above, on the Incon 16 Fr. Another anomaly is associated with the large inclusion in the granite on the Incon 41, also mentioned above. Several linear "highs" were found in the gabbro on the Incon 55 claim, near "an area of relatively unaltered andesite", possibly a fine-grained phase of the gabbro.

On the western block 4 extensive anomalous areas were found, 3 of them in areas of swamp or low ground. One is on the Incon 27 claim, near the west end of the airport allotment. This is the same general area where disseminated pyrrhotite was found on the J. M. claims, and suspected in a magnetic anomaly on the L. M. 4 (now Mal 8) claim because it was seen in nearby outcrops. Another anomaly on the Incon 50 claim, occurs over the greenstone near the north contact of the gabbro, east of the south end of Ralph Lake. A few threads of pyrite occur in the greenstone. A third anomaly occurs on the Incon 17 claim west of the extreme south end of Ralph Lake. The underlying rock is gabbro. A linear anomaly occurs near the shore of Margaret Lake south of the creek from Ralph Lake. An outcrop at the south end of the anomaly shows quartz, magnetite, hornblende, chlorite and garnets in tuffs. An electrical survey of the three anomalies in the vicinity of Ralph and Margaret lakes was recommended.

Two diamond drill holes, with a total length of 717 feet, are reported to have been drilled on the Incon 70 Fr. and Incon 72 Fr. in 1947.

SE 14

Rex Group (84)

The Rex group comprised nine claims (P13444-52) staked in 1947 between Eric and West Eric lakes, and northward toward Berge Lake.

A magnetometer survey of the claims was made for Van Dyke Snow Lake Gold Mines Limited by Geosurveys Limited under supervision of R. A. Litkenhaus, in April 1947. A Wolfson magnetometer was used. Five anomalies were found. Three of these are associated with the granite-greenstone contact at Eric Lake; the other two are in the granitic area between the lakes.

Surface exploration was recommended and carried out. It revealed only granite outcrops within the limits of the group.

The claims were cancelled in 1949.

SE 14

Viking Group (85)

The Viking group consisted of seven claims (P14168-14174) at the south side of Eileen Lake. The area is covered by drift, including an esker. No work was done on the claims and they were cancelled in 1948.

Auni Group (86)

The Auni group of 30 claims (P11348-11377) was staked in September, 1946. The group covered an area north of Auni Lakes, and west of Key Lake; it extended north almost to Eagle Lake. There were four claims west of Eagle River.

A magnetometer survey was done on this group in 1947, using a Thalen-Tiberg instrument, and a geological map was made at the same time. The work was done by Kenneth C. Rose, under direction of W. L. C. Greer, for International Mining Corporation (Canada) Limited. In large part, the geology as shown on Map No. 2 is based on the above work.

Certain details may be added to what is shown on Map No. 2. The volcanic rocks (unit 5) are for the most part the usual fine-grained dark hornblende-feldspar aggregate, but here they also contain chlorite. At the eastern end of the tongue of "greenstone" which reaches east of the south end of Eagle Lake, there are also tuffs with interbedded iron-formation. The tuffs are very fine grained, with well-developed laminae; in some places, the laminae wrap around crystals of garnet about ⅛-inch in diameter. Small lenses of iron-formation are also reported to occur in the volcanic rocks. Two small porphyry dykes occur west of Eagle River. These dykes are fine grained, black, and have phenocrysts of plagioclase.

A massive siliceous limestone is also reported. It is composed of abundant ⅛-inch quartz grains in a groundmass of carbonate, which effervesces readily in dilute acid. It is found just east of the bend in Eagle River, near the principal point of photograph A10947-381. It is presumably a remnant of sedimentary rock surrounded by the tonalite. At the same time, it is certainly unusual to find the carbonate preserved under such circumstances, where lime silicates would be expected to occur. The only other known occurrence of a carbonate rock is on the south shore of Pole Lake, 10 miles to the south, and there it is much coarser grained.

Sheared rocks are fairly common, especially in the sediments. The schistosity parallels the tonalite contact, and might be a peripheral feature.

Fine disseminated pyrite is common, but values are negligible even when the sulphide is abundant. An outcrop of sheared "greenstone", near the north tip of east Auni Lake, contains 20 per cent pyrite, but only a trace of gold. Slightly sheared diorite on the south boundary of claim 11377 (i.e. near the north end of the twin lakes northwest of Key Lake) also showed a trace of gold, no nickel, and negligible copper. Material grading 0.18 per cent copper was found in some "greenstone" about 400 feet northeast.

The magnetometer survey showed only small departures from uniformity. Three main anomalies were recognized, apart from other smaller local departures. All were attributed to magnetite, in most cases adjacent to the greenstone-tonalite contact, or in roof pendants in the intrusion. A long curving anomaly, crossing the river and the north end of the western lake, was interpreted as due to drag-folding of a belt of iron-formation. There is a strong dipole in the swamp on the south boundary of claim 11361 (2,800 feet west of Eagle River).

The claims were cancelled in 1950.

NE 15

M. B. Group (87)

The M. B. group of 18 claims (P13301-13318) was staked in 1947 southwest of Auni Lakes. The southern part of the W. J. F. group (91), and the R.D.S.B. group (90), adjoined it on the west; the Fox group (88) adjoined on the east. Ten of these claims are now included in the Lin group (99).

There is no record of work having been done on this group, and the claims were cancelled in 1948.

This group is not to be confused with another group with similar name, but situated to the east, between Jim and Dorothy lakes.

NE 15

Fox Group (88)

The Fox group, of 27 claims (P13238-13264) covered most of Auni Lakes, and the band of volcanic and pyroclastic rocks east of Eagle River, almost as far as Low Lake. The Key (19) and Auni (86) groups adjoined on the north and east; the M. B. group (87) on the west.

The claims were staked in 1947. There is no record of any work done, and they were cancelled in 1948.

NE 15

Tip Group (89)

Four claims of the Tip group (P14509-14512) adjoined the southern boundary of the Fox group, northwest of Low Lake. They were staked in 1947 and cancelled in 1948.

NE 15

R. D. S. B. Group (90)

This group of 24 claims (P11546-11569) was staked in 1946. It was located south of Pill Lake, extending eastward from Muskeg Lake and north of the bend in the Hughes River there. There is no record of any work done on these claims and they were cancelled in 1948.

They are all included within the area of the present Lin group (99).

NE 15

W. J. F. Group (91)

The rather extensive W. J. F. group consisted of two blocks of claims (P11605-11658; P11664-11689) touching each other along one claim. One block of claims covered the area of volcanic rocks between Tulune Lake and the south end of Eagle Lake. The other covered a similar area of volcanic and pyroclastic rocks at Pill Lake and the north end of Muskeg Lake. The first block adjoined the MW group (92) of claims, at Tulune Lake, on the eastern side; the second block was on the south side of the MW group (92). The claims were staked in 1946, for Sherritt Gordon Mines Limited, and surveyed in 1947. Lot numbers 1181 and 984-1063, inclusive, were assigned to the group.

Geological mapping was carried out on the group in 1948 by H. F. Aston, under the direction of W. F. Morrison. The geology as shown on Map No. 2 differs only slightly from that mapped by Aston. He distinguished a "transition zone" between the tonalite and the volcanic rocks between Eagle Lake and Auni Lake; this transition zone is not shown on Map No. 2. Also, a band of "andesite, coarse facies", not otherwise described by Aston, has been shown on Map No. 2 as included with pyroclastic rocks west of Muskeg Lake. This is not entirely consistent, for a rock similarly described, between Tulune Lake and Eagle Lake is apparently a gabbro, and is so shown on Map No. 2. Iron-formation lenses occur with the porphyritic andesite, west of Eagle Lake and may be present between Pill Lake and Muskeg Lake. Most of the lava is porphyritic, with feldspar phenocrysts which show up as tiny white spots in slight relief on the weathered surface. Small amounts of tuff and greywacke are present.

On the basis of top determinations in pillowed lavas, the formations face north in the vicinity of the north end of Muskeg Lake.

Aston suggested that faults may underlie the southeasterly-trending muskeg filled "ravines", at the south end of the large lake about half a mile east of Tulune Lake. The evidence visible on the ground is not especially compelling.

No commercial material was found. Whispy quartz stringers and blebs are particularly common around the Eagle Lake granite, but are also present in many parts of the district. Quartz veins occur in lots 1039 and 1040, at the north end of Muskeg Lake, but do not contain gold. Several shear zones containing sugary pink or flinty grey quartz also carry sulphides, particularly very fine-grained pyrite, but have no gold. A 25-foot shear zone west of Eagle Lake (Lot 993) carries massive pyrrhotite; sulphide-bearing quartz was also found there as float. The pyrrhotite has no nickel or copper content and the quartz contains no gold or silver.

All but four of the W. J. F. claims are included in the "Lin" group (99) at present (1958).

NE 15

MW Group (92)

The MW group, of 71 claims (P11268-11338) was staked in 1946, on behalf of the International Nickel Company of Canada Limited. The group was adjoined (later) to the east and south by the W. J. F. group (91), of Sherritt Gordon Mines, Limited. The MW group included the gabbro mass at Tulune Lake, extended northward almost to Raven Lake and westward about a mile and a half from Tulune Lake. Two additional claims (Camp 1 and 2) at Raven Lake are included with this group.

During the summer of 1947 geological mapping, a magnetometer survey using a Hotchkiss Super-Dip, and a drilling program were conducted on the property. Sixty-two claims of the group were covered by this program, which was carried out by company geologists under the direction of C. E. Michener.

The volcanic rocks include trachyte, rhyolite, tuff, and agglomerate, but greenish black andesite is the most common type. Thin sedimentary bands, which contain much disseminated magnetite, are interbedded with the lavas.

Characteristic of the gabbro is the large number of fractures, which are filled with aplite and lamprophyre dykes, quartz stringers, and epidote. This varied, and complex, assortment is more noticeable in the western part of the gabbro, and renders it distinctly different in appearance from other gabbro bodies in the eastern part of the district. It is supposed that these features are related to the diorite and tonalite intrusions to the north and west, which are younger than the gabbro. The gabbro is altered, with much uralitization, especially in the western part. Patches of magnetite and ilmenite are especially common in the largest outcrop of gabbro north of the west end of Tulune Lake. These minerals are each surrounded by a narrow light zone containing much feldspar, and are usually associated with coarser-grained phases of the gabbro. There is no apparent system to the distribution of these minerals, though in one place they form a broad irregularly banded zone. This is cut off by a 3-foot band of anorthosite.

A fault, cutting the gabbro into two parts, is shown on Map No. 2. The company geologists also assumed a fault striking north through the volcanic rocks at the east end of the lake. This is based on apparent offset of magnetometer anomalies.

Diamond drilling, to test the magnetic anomalies found, totalled 3,148 feet. The logs of these holes are not available. Some concentrations of massive pyrrhotite were found, in two parallel bands, in interbedded volcanic and sedimentary rocks south of the gabbro. The pyrrhotite was ascribed to sulphur in combination with the magnetite of original iron-formation. Some minor chalcopyrite and pyrite were found. The other anomalies tested were found to be due to magnetite.

Eight of these claims were re-staked, in 1958, as the ***Mel*** group, and two holes were drilled near the creek at the west end of Tulune lake. The results are not available.

B. O. Group (93)

The B. O. group of 54 claims (P13631-13684), occupied the area west of the north end of Muskeg Lake, north and east of the Hughes River. It was underlain by the large area of volcanic and pyroclastic rocks surrounding Bob Lake. The eastern boundary was formed by the MW claim group (92) and the W. J. F. group (91). The group was staked in March, 1947. A geological map was made and magnetometer survey carried out during the next three months, for the Towagmac Exploration Company, by K. G. Honeyman of St. Francis Mining Company, Limited.

Two zones of high magnetic intensity were found by this work. Zone A, about 2,000 feet north of Bob Lake, is approximately on the contact between the "greenstone" and the tonalite to the north, and showed intensity up to 10,000 gammas. This was interpreted as due to magnetite in a shear zone. This zone continues into the MW claims (92), where a sample of sheared volcanic rock containing 10 per cent arsenopyrite assayed 0.13 ounces of gold per ton. According to Honeyman, this sample was taken 2 claim lengths east of the boundary between the B. O. and MW groups. Zone B also trends east, about 1,000 feet south of Bob Lake. Trenching on this zone showed sheared rhyolite with very fine pyrrhotite. This contained only a trace of gold.

The tonalite in the northern part of the group is gneissic.

Part of the group was cancelled in 1948, and the remainder in 1950.

NE 15

J. G. Group (94)

The J. G. group consisted of 22 claims (P11796-11800 and P16307-16323). Part of the group was staked in 1946; the remainder was staked in 1947. The group was in two parts: a small block of six claims surrounded the small lake near the eastern extremity of Arbour Lake; the remainder covered the northwest side of Arbour Lake.

There is no record of any work having been done on this group, but some trenching, at least, was done on a quartz vein near the No. 1 post of J. G. 3 claim, which is on the top of the prominent hill inland from the island in Arbour Lake. There is considerable gossan associated with quartz veins which cut the grey hornblende tonalite and some volcanic rocks. The quartz is fractured and mineralized with pyrite, chalcopyrite and sphalerite(?). Some sulphides also occur in the tonalite and the greenstone. The veins are 8 feet, 5 feet, and 2 feet wide and have been exposed in four pits which are actually on the J. G. 1 and the J. G. 4 claims. The 8-foot vein has some ribbon quartz. The gold assays are not known.

North, across a valley, there are three trenches, 100 feet apart. One of them, 30 feet long, cuts a black oxidized zone for 20 feet. Some specimens are solid fine-grained pyrrhotite; others show disseminated pyrrhotite in chlorite schist. About 100 feet south is an outcrop of well-banded bluish-grey quartzite and some greenish finely-laminated beds, probably tuff, which dip 70° NW.

The claims were cancelled during 1948 and 1949.

NE 15

D. L. Group (95)

The D. L. group comprised a maximum of 72 claims, but the number valid at any one time varied considerably. Thirty-six claims (P13786-13821) were staked in 1947, surrounding the MW group (92) on the west, north and east. This group was later extended east to Eagle Lake, and northeast beyond Raven Lake, by a further 36 claims (P16129-16164) also staked in 1947. The original 36 claims were cancelled and the eastern portion of both groups re-staked as D. L. 1 to 39 (P19476-19490; 19534-19554; 19566-19568). Of this group D. L. 1-4, 8-13, 22-23, and 34-36 were cancelled in 1949. All the claims were finally cancelled in 1951.

The only work recorded on this group is 705 feet of X-ray drilling done in 1949 on the D. L. 20 claim (P19541).

Seven holes were drilled. Nos. 1, 2, 3, and 6 were lost in overburden. No. 4, a vertical hole, was drilled in pink biotite granite and a dark fine-grained feldspar porphyry to 90 feet; thence quartz-hornblende diorite to 144 feet. Nos. 5 and 7 holes encountered similar sections, with the diorite from 103 to 198 feet and 83 to 109 feet respectively. The core was logged by W. J. Farley and S. Pearson.

One of these claims, at the east end of Raven Lake, was restaked as the Toni 7 in 1955.

NE 15

Star Group (96)

The Star group of 33 claims (P14902-14931; 14936-38) was staked in 1947, to cover the area of volcanic rocks and gabbro west of Hughes River and north of Arbour Lake.

There is no record of work done on these claims, and they were cancelled in 1948.

This group should not be confused with the Star claims north of Beaucage Lake.

NE 15

Eldon Group (97)

This group comprised nine claims (P16535-16543) and was staked in 1947. It was located just north of the large bend in the Hughes River, north of Hughes Lake. The Lindy group, of Sherritt Gordon Mines, adjoined it on the east.

There is no record of any work on these claims, and they were cancelled in 1948.

NE 15

Toni Group (98)

The Toni group of seven claims (P33098-33104) was staked in January 1955, by H. L. Thompson. Six of the claims are at the south end of Eagle Lake, and are a re-staking of a small part of the former W. J. F. and D. L. claims. One claim (Toni 7) is at the east end of Raven Lake.

The claims are underlain by basic volcanic rocks and tonalite. Rock trenches were reported for assessment work in 1956 and 1957. Four trenches were reported near the shore of Eagle Lake on the Toni 2 and 3 claims, but could not be found during the present work.

NE 15

Lin Group (99)

The Lin group of 115 claims (P58991-59099; 69883-88) was staked in 1957 for R. G. Crosby. It includes the former W. J. F. (91), M. B. (87), and R. D. S. B. (90) groups, and a part of the Auni group (86). It therefore, covers much of the ground between Muskeg Lake and Auni Lakes, and between Tulune and Eagle lakes. This area is underlain mostly by volcanic rocks, with a band of pyroclastic rock running across it through Pill Lake. (See, however, above under W. J. F. group (91).) South of Pill Lake to Hughes River, there is no outcrop and nothing is known of the geology from surface work.

During the winter of 1957-58 an electromagnetic survey was conducted, using the "dip angle" method. Conductors so found were examined in more detail using the Boliden loop method. Two conductors were considered to be due to sulphide alteration of iron-formation. A third, of most unusual curved shape, was found under Pill Lake. Five others were examined in detail, using a "Doolimeter", and one was thus eliminated as a possible orebody. Further exploration was in progress in 1958, but details of results are not available.

NE 15

Ox Group (100)

The Ox group consisted of 24 claims (P18714-18737) lying between Hughes River and Arbour Lake. The major part of the group was underlain by diorite and the tonalite to the south of it. The claims were staked in 1948. No work was done, and they were cancelled in 1949.

NE 15

Duluth Group (101)

The Duluth group comprises eight claims (P37431-37438), on the same ground as the former Ox group, adjacent to Hughes River. These claims were staked in 1956, and some trenching has been reported.

NE 15

Leo Group (102)

The Leo group consisted of 36 claims (P23015-23050). It was, in large part, a re-staking of the former Key group (19) surrounding Key Lake and extending eastward. No new work was done and the claims were cancelled in 1952.

SE 15

Bruno Group (P13758-66) *Woni Group (P13767-75)*
Lauder Group (P13776-84) (103)

These three groups, each consisting of nine claims, were staked in 1947, at the north end of Hughes Lake. They covered the area between the south side of the Lindy group (Sherritt Gordon) and the outlet of Hughes Lake.

Under the name "Wodula Group", the 27 claims were mapped by W. H. Gross in July, 1948. A magnetometer survey had already been done during March and April, 1948. Conglomerate and granitic types form the northern part of the group. The "greenstone" around the outlet of the lake is mainly andesite, porphyritic in many places, and there is some amygdaloid. On claim 13761 (i.e. near the tonalite contact on the east side of the large bay at the north end of Hughes Lake) the lavas are well silicified, and quartz stringers are abundant. Finely disseminated pyrite was also noted in massive andesite, on claim 13774, (i.e. the vicinity of the third rapids downstream from Hughes Lake).

Gross recommended three drill holes to further test the volcanic rocks, but there is no record that they were drilled.

The claims lapsed in 1950.

SE 15

Super Group (104)

The twenty-seven claims of this group (P11718-11744) were staked in 1946 between Chepil Lake and the north end of Hughes Lake. The Lind group (170) adjoined on the east side.

The group was mapped by P. A. Chubb, in the summer of 1947, for Central Manitoba Mines Limited.

A dip needle survey was also made. The volcanic rocks are dominantly andesite, but rhyolite and trachyte are also reported. There is some flow breccia. Outcrops are not abundant.

It should be noted that, though Chubb's map was used in preparing Map No. 2, and his outcrops are shown, he is not responsible for the structural interpretation thereon.

Some dip needle readings up to 12° were obtained, but generally there is little magnetic variation over the area of the claims. The high readings occur in the wide bay where the eastern of the two outlets of Chepil Lake joins Hughes River. They were attributed to abundant magnetite in the flows.

Nothing of value was noted on the property.

The claims were cancelled in 1949.

SE 15

Kenle Group *Wal Group* (105)

These two groups were staked in 1947 and formed a unit of 54 claims (P15541-45; 15564-69; 15573-90) on the east side of Chepil Lake and south almost to Ron Lake, extending eastward to within about half a mile of Hughes Lake. The rocks underlying these claims are almost entirely granitic. No work was done, and the claims were cancelled in 1949.

SE 15

Sam Group (106)

The nine claims of this group (P14346-54) covered an area of Sickle conglomerate and granite on the northwest side of Hughes Lake, and part of the lake itself. They were staked in 1947 and cancelled for lack of assessment work in 1948.

SE 15

Holly Group (107)

This group was staked at the same time as the Sam group, above, and covered a strip, one claim wide, from east to west across Hughes Lake. The claims were numbered P14355-63, and four of them were water claims. They lapsed in 1948.

SE 15

Hodg Group (108)

This group of nine claims (P13339-13347) extended eastward from the east shore of Hughes Lake. From north to south the group was two claims wide, and extended across the narrow band of acid and basic lavas there. The claims were staked in 1947 and cancelled the next year. No work is recorded for this group.

SE 15

Reg Group (109)

The Reg group (P13435-13443) was staked in 1947, to cover the narrow band of lavas and pyroclastic rock between the Lauder (103) and Hodg (108) groups on the east side of Hughes Lake. The claims were cancelled in 1948, with no work done on them.

SE 15

S. K. Group (110)

This also was a group of nine claims (P13348-13356) on the east side of Hughes Lake, and extending south to the northern end of Stan Lake. The Tor group (173), of Barrington Lake Copper Mines Limited, adjoined on the east. No work was done and the claims lapsed in 1948.

SE 15

Bob Group (111)

Twenty-seven claims of the Bob group (P15635-15661) were staked in 1947 at the southern end of Hughes Lake. They covered the area of Sickle sediments north of Bog Lake and extended across to the western side of Hughes Lake. No work was done and the claims were cancelled in 1948.

SE 15

Max Group (112)

The Max group (P15662-15668; 15670-15689) adjoined the Bob group (**111**) on the west. It reached the western extremity of Hughes Lake, and the group of three small lakes to the north of it.

No work was done, and these claims also were cancelled in 1948.

SE 15

H. L. Group (113)

The H. L. group of 28 claims (P11522-31; 11588-11604; 16225) was staked for Sherritt Gordon Mines, in 1946 and 1947. The claims were underlain by the band of lavas and pyroclastic rocks south of Hughes Lake, and extended from Stan Lake almost to Gap Lake.

Angular boulders, on the north side of Gold Lake, were found to contain gold. Drilling was undertaken in an effort to locate the sources of the boulders. Though some mineralization was found just east of the lake, the source of the boulders was not established. Those boulders now visible are light green to grey schist, probably from a "greenstone". There is sparse pyrite in the fractured quartz which cuts them. Some of the quartz has open cavities lined by terminated quartz crystals.

The large outcrop to the north of Gold Lake is very schistose, very dark, and fine grained. Northward this gradually becomes more massive and coarse grained, with irregular streaks of biotite in a matrix of grey feldspar. After about 400 feet, the rock changes abruptly to a fine-grained rock cut by numerous felsite stringers. The coarser phase was mapped by Allan as diorite. On Map No. 2 it is included with the volcanic rocks, mainly for lack of any intrusive relations. The strong schistosity is ascribed to a fault in Gold Lake.

Thirteen holes were drilled but the logs are no longer available. Nos. 1, 7, 8, 9, 10 are along the south shore of Gold Lake; 2, 3, 4, 5, 6, near the creek at the west end of the lake; 11, 12, 13, on the large outcrop about 2,000 feet southwest of the lake. The claims were allowed to lapse in 1951.

SE 15

Gap Group (114)

The 43 Gap claims (P12183-12225) extended west from the H. L. group (**113**), included Gap Lake, and reached as far as the eastern side of Cartwright Lake. They were staked in 1946.

There is a considerable variety of rock types in this area. At the east end are diorite, pyroclastic, and Sickle sedimentary rocks, while diorite, and mafic and siliceous volcanic rocks are present at the west end. To the west is the old gold showing at the south end of Cartwright Lake—the first discovery in the district.

In the spring of 1947 a survey of the group was done for Eastlynn Mines Limited, by E. F. Creelman, using a Berg magnetometer. The map was submitted for assessment work, but there is no accompanying report. No mineralization has been reported from this group. There is no record of any drilling. On the basis of the magnetometer map it is, at least, possible that tonalite underlies Gap Lake and that Sickle sediments lie to the north of the three small lakes due west of Gap Lake.

The claims lapsed in 1950.

Several of the claims at the western end of the group have recently been re-staked as part of the Cart group.

SE 15

Ron Group (115)

The Ron group comprised 39 claims (P14297-14335) and was staked in 1947. The Gap claims (114) were immediately south, and the Ron group covered the area northward between Pole and Ron lakes. The Max group formed the eastern boundary.

The area is underlain by a complex of acid and basic lavas and pyroclastic rocks. There is a suggestion, in the repetition of the acidic flows, that there may be a syncline through Pole Lake. Associated with the fault zone along the south shore of Pole Lake is an unusual carbonate rock which weathers to an irregular surface resembling that of a conglomerate. (See above, page 153.) The only other highly calcareous rock known in the district is near the Eagle River, on the Auni group of claims (86).

No record is available of work done on these claims and they lapsed in 1948. A portion of the group was restaked as the *Alice* claims (P22987-99; 23001-14) in 1951; all the Alice claims were formerly in the Ron group. This was again re-staked in part as the Cart group (1957).

SE 15

Polaris Group *Pole Group* (116)

The Polaris group consisted of 18 claims (P13283-13300) and was staked in 1947. The group extended from Pole Lake west to Cartwright Lake and south to the Gap claims (114). The claims were cancelled in 1948, and a part re-staked as the *Pole* group of nine claims (P22978-86) in 1951. No work is recorded for these claims either, and they were cancelled in 1952. The Pole group now forms a part of the Cart group.

SE 15

OT Group (117)

The twelve claims (P19022-19033) of this group were staked in 1948, northwest of Norrie Lake. The area is granitic. No work was done and the claims were allowed to lapse in 1949.

SE 15

L. C. Group (118)

This group of 45 claims (P16976-17019; 17321) was staked in 1947. It was mapped in 1948 by geologists of International Nickel Company, under the direction of C. E. Michener.

The claims covered the plug of gabbro and norite northwest of In Lake. The gabbro is not well exposed at the margins, but has better outcrops in the central part. The rock is somewhat brecciated, especially near contacts, and contains many inclusions of the surrounding volcanic rocks. Narrow granite dykes have intruded the gabbro along fractures. According to Michener, there are also inclusions of granite in the gabbro, but these were not noted by the Mines Branch geologists.

Geophysical work was recommended on the property. Though it is understood such was done, no record of the results is available.

The claims lapsed in 1950.

SE 15

Bank Group (119)

The twelve claims of the Bank group (P15771-15782) were staked in 1947. They covered the area immediately east and north of Norrie Lake, which is underlain mainly by granitic rocks. The group extended far enough east to include some of the diorite southwest of Hugo Lake, where it adjoined the Ron claims.

No work is recorded on this group and the claims were cancelled in 1948. This area is now included within the Cart group.

SE 15

Norrie Group (120)

The Norrie group consisted of 20 claims (P15332-15351) staked in 1947. It covered the south half of Norrie Lake, and the area of volcanic and pyroclastic rocks east of In Lake, almost to Cartwright Lake. The small body of gabbro at Norrie Lake was included. No work was done and these claims were cancelled in 1948. This area, too, is now included within the Cart group.

SE 15

Mink Group (121)

The Mink group consisted of 18 claims (P13265-13282) covering an area of volcanic rocks on the north shore of Cartwright Lake, south of In Lake. No work was done on these claims, which were staked in 1947, and they were cancelled in 1948.

SE 15

G. C. Group (122)

The G. C. group (P17659-17685), staked in 1947, consisted of 27 claims covering the water area of Cartwright Lake. No work was done, and the claims were cancelled in 1949. The Cart group now covers this area.

SE 15

B. C. Group (123)

Thirty-six claims (P17713-17748) extended west from Norrie Lake to tie on to the L. C. group (118) north of In Lake, and around the southwest of that group. It included much of the greenstone area northeast of Moses Lake but did not reach the gabbro plug there.

The claims were staked in 1948 and lapsed in 1949 for lack of assessment work.

SE 15

Hanson Group	*Oke Group*
Kakut Group	*Elk Group*
Cameron-Clarke Group	*Cartwright Gold Group*
Leach Group	*Mac Group*
Durie Group	*Bona Group* (124)
Johnson-Tamlyn Group	*HMC Group*
Dal Group	*Au Group*
Lucky Group	*Bacon Group*
Donnie Group	*Gigi Group*

M. D. S. Group

An area along the southern shore of Cartwright Lake has had a long history of staking and re-staking under different claim names. A gold prospect in the southeast bay of Cartwright Lake was discovered in 1934. The characteristic feature of the prospect is a sheared "porphyry" dyke which runs from east to west. Suggestions of similar shearing can be found far to the west, and there is the obvious possibility that a major "break" lies just south of the lake. This potentially valuable ground has been constantly re-staked ever since the first discovery.

The first claims were staked in 1934. Those covering the immediate area of the showing were the *Hanson* group (P1101-1106) and were staked by Stan Akers for Peter Durie. Apparently a number of prospectors were working as a group, or in the immediate area, for we find that, to the eastward, the *Kakut* claims (P1295-1305) were staked at approximately the same time by J. Moar and J. R. Cryderman, the *Cameron-Clarke* group (P1632-5; 1695-7) was staked by A. J. Clarke and Forbes Cameron, and the *Leach* claims (P1593-99; P1705-07) were staked by E. A. Leach and John Owens. The result of all this was a belt of claims, about a mile wide, from near the outlet of Cartwright Lake to the west end of the tonalite near Gap Lake.

Westward extension began in 1935, when W. Hanson and S. Akers staked the 14 *Durie* claims (P2296-2309) while R. D. Tamlyn and J. L. Johnson staked the *Johnson-Tamlyn* claims (P2334-2347). This extended the belt to the west end of Cartwright Lake and the east side of Anson Lake. There was then a period when staking stopped and some exploration was done.

Most claims were kept in good standing, though the Cameron-Clarke group was cancelled after one year, and the Durie claims were also cancelled in 1936. On the Hanson claims, some trenching had been done in August, 1934, about a quarter mile south of the main showing, on both the west side and on the east side of the bay. Some additional work was done on the Hanson 2 claim; so far as can now be determined it was about a quarter mile northeast of the present surface showings. Further work was recorded on the Hanson claims in 1935 and 1936, but they were cancelled in 1937. Similarly, trenching was reported on the Leach group and on the Kakut claims in 1935, but, in 1936, nine of the latter group were allowed to lapse and finally, in 1937, all the remainder were cancelled. The Johnson-Tamlyn claims were kept in good standing till 1941. By that time the other claims had been staked again and all were consolidated into a single unit by J. P. Gordon.

The Hanson claims, which had been cancelled in 1937, were restaked by Tom Lamb in 1938 as the *Dal* claims (P4182-87). Further trenching was recorded in 1938 and 1939 on the Dal 4, 2, and 1 claims (former Hanson 4, 1, and 2, respectively).

At about the same time (1939), R. D. Tamlyn, staked the *Lucky* (P5383-4) and *Donnie* (P5385; 5389-91) claims on the ground formerly occupied by the Durie group at the outlet of Cartwright Lake. They were kept in good standing by rock trenching till 1941, when they were transferred to J. P. Gordon along with the Dal and Johnson-Tamlyn groups. A part also of this consolidation were the *Oke* claims (P5413-26) and the *Elk* group (P5395-412) staked late in 1939 by J. P. Gordon and Albin Anderson, and by S. Akers, respectively.

It is unfortunate that there are no records of what was found in the numerous trenches reported to have been dug on these various claims. A considerable program was also undertaken under the auspices of J. P. Gordon. Of all this work, only the trenches on the shore of Cartwright Lake are now clean enough to be useful, and are described below. South of the west arm of Cartwright Lake there are a number of caved pits, one of which is 135 feet long. Some schist shows in the dump from the latter but no other information is available, though there must have been some reason for such an extensive excavation.

After the first staking, little attention was paid to the possible eastward extension of the "break" at Cartwright Lake. The only activity was the three *Cartwright Gold* claims (P5386-88) staked by Tamlyn to the east of the Dal group in 1939, and transferred to J. P. Gordon in 1941.

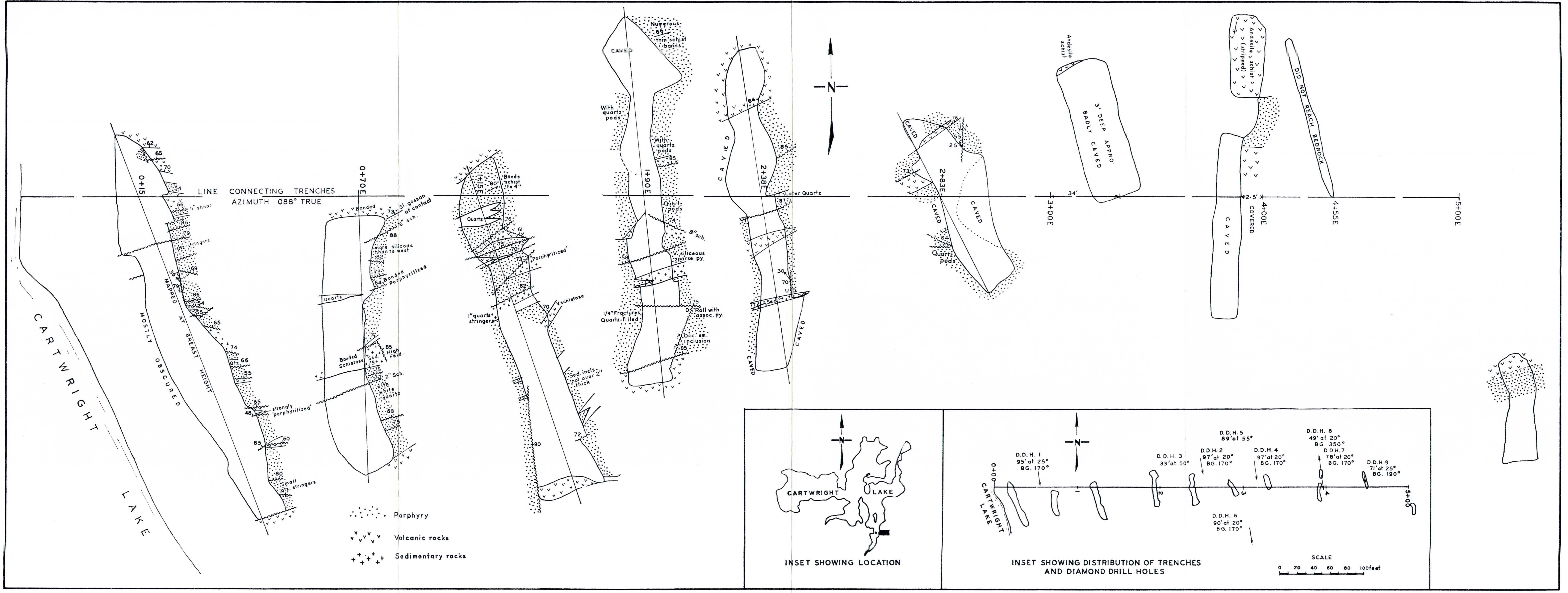

Figure 43—Map of Trenches on Giant Claims, Cartwright Lake.

The whole property was thus held by Gordon in 1941 and was finally allowed to lapse in 1942.

According to Bateman[1] the property had been examined by representatives of R. J. Jowsey, Alderson and MacKay, Ventures Limited, and Hudson Bay Mining and Smelting Company. The latter negotiated for an option but no agreement was reached.

During the staking activity which followed the discovery of the Lynn Lake mine, the area of the prospect and its possible westward extension were staked repeatedly. The *Mac* group (P11537-45), covering the surface showings, was held by Torwin Prospecting Syndicate in 1947. It was examined by M. C. Minton at this time, and a small area mapped. The Mac group was followed westward by the *Bona* group (P10035-52) and was bordered northward by the *HMC* group (P10623-8). The two groups were allowed to lapse in 1947 and 1948 and were re-staked as the *Au* group (P18408-28). These latter claims were cancelled in 1949, at which time the Mac claims, covering the prospect, were still valid. The Mac group, however, lapsed in 1950 and the south shore of the lake was re-staked as the *Bona* claims (P22277-79) and the *Giant* group (P22264-69; 22274-6), which claims are still valid (1958). The *Bacon* group (P23992-6) was immediately north of the Giant, and a portion of Cartwright Lake was held briefly as the *Gigi* group of water claims (P26314-18). Westward of the outlet of the lake were the *M. D. S.* claims (P22345-51).

So far as now known, of all these later groups other than the Giant, the only work was done on the M. D. S. claims. In 1953, seven holes were drilled on the M. D. S. 1 claim. All but one encountered "greenstone"; a small amount of quartzite, tuff, and porphyritic aplite was reported in some. A hole near the No. 3 post found quartz-feldspar porphyry.[2] According to A. Talbot, who did the drilling, the highest assay obtained was 0.5 ounces Au per ton, but most were quite low. Quartz stringers and carbonate stringers are both present in the volcanic rocks; the carbonate is associated with hornblende schist. Slight chalcopyrite and heavy pyrite are reported from the southwest corner of the M. D. S. 1 claim, in both the greenstone and the "quartz-feldspar porphyry". Several zones of schist are present here, but there is no readily recognizable correlation with the zone on the Giant claims.

The area of the surface showings on the Giant claims is shown on the accompanying map (Fig. 43). There are eight trenches across the "porphyry" dyke at intervals of approximately 50 feet. The geology shown is what was visible in the pits in 1958. In 1952, nine holes were drilled by Mid-North Engineering services for Brewis and White, of Toronto, who held an option on the ground. These holes are also shown on the map.

The "porphyry" of the dyke is not notably porphyritic in most places, and resembles very closely the siliceous red granite, which outcrops on the shore about 100 yards north, and which has been correlated with the Berge Lake granite.

At least two ages of movement are present. It is apparent in the prospect pits that the Wasekwan volcanic (and possibly some interbedded sedimentary) rocks were strongly schistose prior to the introduction of the "porphyry". There are some remnants of schist within massive "porphyry", as well as numerous schist fragments which also have associated shears in the "porphyry" to show there has been further post-intrusive movement. Distinct fractures within the intrusive rock are filled with milky quartz; in many other places, the quartz is irregularly distributed as pods of indefinite shape. The latter are more abundant, and, for any shape relation, might be segregations in the intrusion itself. The "porphyry" is notably low in ferromagnesian minerals.

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[1]Bateman, J. D.: *Geol. Surv., Canada, Paper 45-14, p. 33.*

[2]This will mean that the contact between Units 5 and 11 as shown on Map No. 2, should be moved southward approximately 600 yards, near 100° 45′ W. The data from these holes were not known at the time the map was being prepared.

According to G.S.C. Paper 45-14, the prospect was sampled by Professor A. M. Bateman in 1935. He obtained gold assays of $10.60 across 20 feet. (Gold at $20.67 per ounce?) Sampling by the owners, at about that time, is reported to have shown $11.90 across a width of 30 feet.

On the western side of the bay, there is a broad zone of contorted schists and intrusive breccia, which can be followed for at least 1,200 feet from the shore on the continuation of the strike of the zone on the east side. So far as visible on the outcrop, the intrusion is similar to that on the east side of the bay, and has numerous smaller dykes and tongues, which both follow and transect the schistosity of the Wasekwan rocks. On the shore, it forms an intrusive breccia with what was apparently a pillowed flow. Small pillows are still visible; they are severely epidotized, and the interstices appear to be filled by epidote. As on the east side, the intrusion is a zone of dykes rather than a clear cut mass.

Near the prospect pits the wall-rocks show some hornblende, but most of it has been altered to biotite and chlorite. There is some pyrite and sparse chalcopyrite. No carbonate was noted.

On the western outcrops there is a wide band of severely drag-folded, banded rock, probably a tuff. The banding strikes east and dips 70° N. The drag-folds (and incipient faults) plunge 65° towards N 50° E. The west side moved up.

Allan suggested the possibility that a fault underlies the bay alongside the prospect. Its intersection with the fractured "porphyry" would be an interesting thing to see. Inasmuch as the zone of intrusions on the west side of the bay appears to be precisely on the strike of the similar zone on the east side, there must have been very little movement on such a fault, if it exists.

On the M. D. S. claims, at the western end of Cartwright Lake, is a wide zone of shearing near the contact between greenstones and an alaskite or rhyolite. Should the shear zone which localized the "porphyry" extend that far, the length of potentially mineralized ground is increased to about 2 miles.

It is tempting, also, to speculate on whether or not there is any connection between the shear on the Giant claims, and the fault which has been inferred to explain the displacement of the Sickle sediments southwest of Hughes Lake. Should they be the same, of course, the movement must be post-Sickle, as must the age of the intrusion.

SE 15

BB Group (125)

The BB group consisted of 30 claims covering an extensive area of diorite south of the southeast arm of Cartwright Lake. The group was staked in 1947, but no work is recorded and it was cancelled in 1949.

SE 15

Vox Group (126)

The 36 claims of the Vox group (P13722-13757) were staked in 1947, south of Cartwright Lake and west of the stream draining that lake. The area of the claims is very poorly exposed, but is probably underlain by granitic rocks exclusively. No work was done and the claims were cancelled in 1948.

SE 15

Vic Group (127)

The Vic group of ten claims (P10693-10702) was staked in 1946, between the west end of Cartwright Lake and the east side of Moses Lake. The group covered the assumed contact between the Wasekwan rocks and the granite to the south. In 1947, three trenches and some stripping were reported southeast of Moses Lake, but the claims were allowed to lapse in 1948.

NW 15

Ay Group *Rock Group* (**128**)

The Rock group of 24 claims was staked in two parts: P12024-43 in 1946, and P14932-35 in 1947. The claims were north of Arbour Lake, covering, with the J. G. (**94**) and the Star (**96**) claims, the area of basic lavas and minor pyroclastic rocks north of that lake. With the six Ay claims and fractions (P16953-58), added in 1947, the whole belt was covered as far as the large unnamed lake northwest of Arbour Lake. Thence the large block of Gar claims (**129**) extended southwestward.

No work was recorded on these claims and they were cancelled in 1948. Some surface work on the J. G. claims shows quartz veins and sulphides, however, and trenching was also done on the Rock claims, though not recorded.

NW 15

Gar Group (**129**)

The 55 claims (P12388-12442) of the Gar group adjoined the Rock claims, just described, on their western side. The Gar claims extended southward from the western bay of Arbour Lake, and included the northern end of the lake east of Minton Lake. Part of the gabbro body between this lake and Arbour Lake was probably included within the group, which extended northwest for about 1¼ miles.

Much of the area has very few rock exposures. Diamond drilling and trenching were recorded for assessment work on the Gar 18, 23, 27, and 28 claims, but the logs are not now available.

The claims were cancelled in 1950.

This group should not be confused with the Car group (**130**) about 2 miles south.

NW 15

Car Group *Jenny Group* (**130**)

The 14 Jenny claims, as originally staked in 1947, extended southwest from the southwest corner of Arbour Lake, to the northeast corner of the G. T. group (**132**). Five Jenny fractions, along the north boundary of the G. T. claims, occupied the gaps between that and the Car claims, almost to Minton Lake. The Jenny group was extended southeast to Huet Lake, in 1948, when the Jenny 15 to 28 claims (P17141-17154) were staked. With the addition of the 30 Car claims (P17155-17184), the group was extended along the creek between Huet and Carr lakes and thence south to the north boundary of township 90. The group thus included the sedimentary band south of Carr Lake, but not the gabbro body to the west of the lake.

The two groups were mapped by E. F. Creelman, and a magnetometer (=dip needle?) survey made for Omnitrans Exploration Limited. Areas of interest were detailed with an Askania magnetometer. In his report, dated November 1948, Creelman stated that considerable pyrrhotite and pyrite had been found but no nickel. Only one magnetic anomaly had been revealed. Because similar anomalies in adjacent areas, drilled by International Nickel Company, had revealed only magnetite and pyrrhotite, he did not recommend any further work. All except the Jenny 4, 5, 6, 7 claims were cancelled in 1951 and they were cancelled in 1952. There is no record of any trenching, or other surface work.

NW 15

George Group *M. J. Group* (**131**)

The M. J. group consisted of 27 claims (P11206-11232) staked in 1946. It included part of the west shore of the north end of Cockeram Lake and, at the south end of the group, there were parts of six claims south of Keewatin River and its junction with the Lynn River. On the west were the F. J. (**136**) and W. H. M.

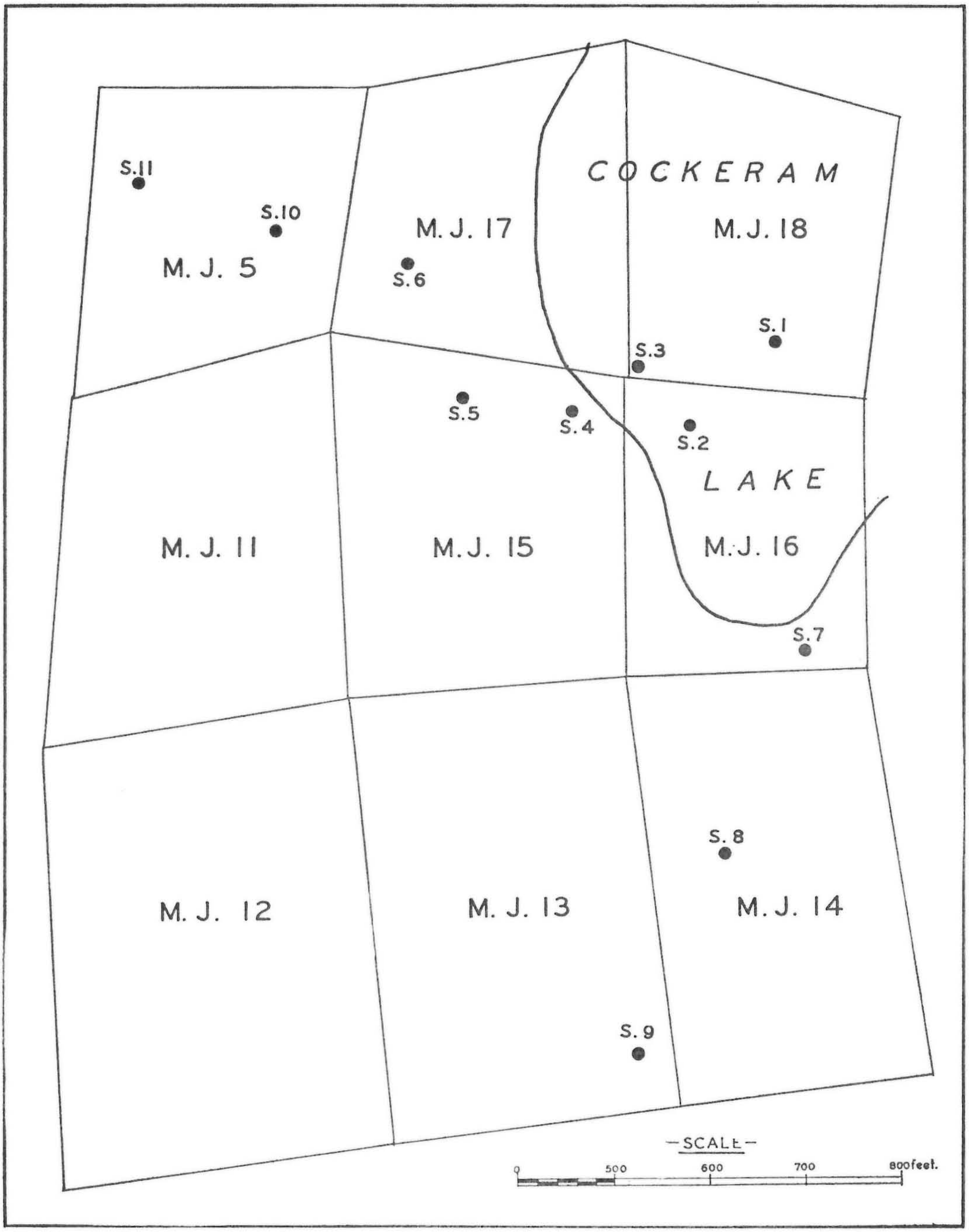

Figure 44 — Map showing location of drill holes on M. J. and G. T. claims, 1947.

(134) claims. The group extended north for about 7,000 feet from the north tip of Cockeram Lake, i.e. almost to Minton Lake.

Except at the southern and northern extremities, the group is essentially devoid of outcrop.

During the winter of 1946-47, Geo-Technical Development Company Limited, performed a magnetometer survey of the property for Denison Nickel Mines, Limited. In this work were also included 12 claims of the G. T. group (132), then newly staked and under option. (G. T. 22-24; G. T. 28-36; P12530-32; P12379-84; P12724-26).

In his report to the owners, dated March 1947, J. T. Randell, of Geo-Technical Development, pointed out eight anomalies in the southern part and ten in the northern part of the property. The eight southern anomalies are mostly near the shore of the northwest bay of Cockeram Lake, or between it and the Keewatin River to the south, (i.e. near the southern boundary of the uncoloured area on Map No. 2.) He stressed that none of the anomalies was likely to represent massive sulphides, and pointed out the probability that most were due to magnetite. However, because the magnetic highs could be caused by disseminated sulphides, and such were known in the area, he recommended that each anomaly should be tested by a vertical drill hole at the place where the magnetic field was strongest. Because the magnetic maxima, in several cases, trend crosswise to the known northeast formational trend, Randell pointed out the possibility that the maxima may represent magnetite concentrations near the contact of a granitic intrusion. This seems to be the most likely explanation for the magnetic feature associated with the diorite on the shore of Cockeram Lake, and possibly also for a more or less linear zone of highs on the G. T. 24, 28, 32, 34 claims.

During April and May, 1947, Denison Nickel Mines Limited drilled eleven holes, which had a total length of 5,425 feet. Abbreviated logs of the holes are given below:

Hole No.	Length ft.	Angle	Summary
S1	150	90°	.....Grey, medium-grained quartz diorite, and pink to red fine-grained syenite.
S2	260	90°	.....Mostly dark grey, medium-grained quartz diorite and diorite, with pink aplite and syenite. Small amounts of very fine pyrite reported throughout. Silicified at 153 to 164; 182 to 184; 249 to 260 feet.
S3	583	90°	.....Quartz diorite to 133 feet; diorite to 219; with bands of syenite. Andesite with flow structure reported at 219 to 220 feet. Thence, quartz diorite and granite to 536 feet, after which mostly granite. All showed pyrite alteration. Some carbonate crystals in the andesite. Eight sections sampled: all showed neither silver nor gold.
S4	626	90°	.....Mostly diorite, quartz diorite and granite, apparently intimately intermixed. Andesite reported from 131 to 184 and 193 to 210 feet. Quartz from 132 to 135.0 feet carried 0.08 oz. Au per ton "associated with cubic [!] quartz". Numerous narrow quartz and granite stringers. Twelve other samples contained no gold.
S5	583	90°	.....Diorite, quartz diorite and granite as above. Mostly andesite between 374 and 549 feet. No value.

(Table continued on following page)

Hole No.	Length ft.	Angle	Summary
S6	622	90°	.....Quartz diorite, minor diorite and some granite. Widespread minor pyrite and pyrrhotite. Some sheared sections. No value.
S7	326	90°	.....Similar to 6.
S8	356	90°	.....Similar. Some silicification at 45 feet, with 0.02 oz. Au per ton.
S9	396	90°	.....Similar to 6.
S10	604	S50°E. −55°	.....Similar, but with a little more granite.
S11	919	S50°E. −50°	.....Similar.

It is perhaps fair to summarize all these as: diorite and quartz diorite, with inclusions of greenstone, cut by granite, [=tonalite?].

A magnetic anomaly running diagonally across the G. T. 30 claim was interpreted by Randell as due to gneissic volcanic or intrusive rock. It was tested by two drill holes. Hole 1, at 45°, found andesitic agglomerate, tuff and altered andesite, with bands of predominantly buff or grey quartz porphyry from 157 to 265 feet and 344 to 463 feet. Total depth was 617 feet. From 136.0 to 138.2, the tuff contained 10 per cent pyrrhotite and pyrite; otherwise mineralization appears to have been very light, though quartz stringers with a little pyrite were found. No assays are available. In Hole 2 essentially the same rocks were encountered, with the porphyry in three bands. Six sections showed over 20 per cent pyrite and pyrrhotite; the longest was 8 feet containing 65 per cent pyrrhotite. Assay values were low; the best (not on same sample) was 0.16 per cent copper and 0.13 per cent zinc. Nickel is not reported, or was not looked for.

The G. T. 34, 35, 36 claims were cancelled in 1949 and the M. J. group was cancelled in 1950.

The area covered by the M. J. claims, and the portion of the G. T. group here considered, was re-staked, in 1956, respectively as the George and part of the Edo claims of Evelynn Nickel Mines, Limited and Red Bark Mines, Limited. What is known as the "South Group" of Evelynn Nickel Mines, corresponds almost exactly with the former M. J. claims.

In February, 1957, as part of a project covering a larger area, Geo. W. Sander performed magnetometer and electromagnetic surveys on the George claims. The electromagnetic work was done with a Sharpe instrument, using a frequency of 1,200 c.p.s. Of the various anomalies found, Zone "M", on the George 16 claim (P35675), was considered important because an electromagnetic anomaly coincided with magnetic data suggestive of a basic plug. This was drilled in April, 1957, with three holes approximately 120 feet apart for a total core length of 878 feet. These holes found tuffs and grey bedded and sheared material (possibly greywacke); the shearing is reported for core lengths up to 50 feet. In the southern hole, scattered small pebbles and fragments are reported from 65 to 100 feet. (See above: "Wasekwan Conglomerate".) In the northern hole are found bands of basic material, up to 10 feet thick. Two 10-foot mineralized sections were sampled, but the values were low. Hole No. 4, in the western part of George 16, also found sediments (quartzite and greywacke).

For Zone "N" on the south boundary of the George 16 claim, 2 holes were recommended but were not drilled.

A weak electromagnetic anomaly in the northwest bay of Cockeram Lake does not match magnetic data, nor does another in the diorite on the west shore of the lake. No work was considered necessary on them.

Hole 5, on the George claim, passed through very siliceous material into altered greenstone with numerous quartz stringers, quartz-carbonate bands, and two narrow basic dykes.

Holes 15 and 16, on George 11, found strongly schistose greywacke and quartzite, in places resembling altered conglomerate.

NW 15

G. T. Group (132)

The G. T. group consisted of 36 claims staked early in 1947 (P12509-32; 12379-87; 12724-26). The group was adjacent to the W. H. M. group (134), to the west, and the M. J. group (131), of Denison Nickel Mines Limited to the south. Twelve of the G. T. claims were, in fact, optioned to Denison in early 1947.

The area covered by this group extended from Minton Lake eastward to about the western edge of the gabbro mass west of Carr Lake. Thence the boundary ran south for about a mile, where the group was bounded by the M. J. claims. It also covered the northern half of Minton Lake.

Geo-Technical Development Company, Limited, during the winter of 1946-47, did magnetometer surveys over a large portion of the area north of Cockeram Lake, for various companies. As part of this overall project, the G. T. group (less twelve claims optioned to Denison) was examined for Base Metals Mining Corporation. The field work was done in March and early April, 1947, apparently at a time of very deep snow. Essentially nothing was seen of the surface geology. The observations were made with an Askania magnetometer.

The W. H. M. group (134), of Granville Lake Nickel Mines, was immediately adjacent on the west and was examined at the same time. It was found that there were three magnetic zones recognizable on the W. H. M. property, and that they continued eastward onto the G. T. claims. A zone of high magnetism was interpreted as due to basic lavas and hornblendite "intrusives"; a central weaker zone, as sediments, tuffs, and acid volcanic rocks; a third zone of dipoles, as a gneissic phase of the volcanic rocks. On the G. T. property the strike of the first zone changed to easterly and that of the third to northerly. Twenty anomalies were listed in the area of the resulting "pinch-out". Randell recommended that all should be drilled, after further geophysical tests using electromagnetic methods.

The G. T. group formed part of the much larger area re-staked in 1956 as the Edo group (140). This was surveyed by both magnetic and electromagnetic methods early in 1957 and some drilling was done. For details see description of the Edo group.

Another group of claims called G. T. 65 to 84 (P14826-44) was staked in 1947 north of the P.O.T. group (137), and covering a part of the small gabbro remnant east of Berge Lake. No work was done and the claims lapsed the following year.

NW 15

O. M. Group
Ram Group (133)

The O. M. Group of 40 claims (P17020-32; 17034-60) was staked in 1947, at about the same time that the Car claims (130) were staked to the east and the Jenny group was enlarged on the north. The group covered the gabbro mass west of Carr Lake. Because it included the west side of Carr Lake, and the lakes and creeks leading south from the vicinity of the gabbro, it covered practically all the good prospecting ground to the north boundary of township 90.

There is no record of preliminary mapping or geophysical work, but drilling was done by International Nickel Company, in 1947, to test the gabbro west of Carr Lake. The holes were located as shown on the plan (Fig. 45), and summaries of the logs are given on page 228 and 229.

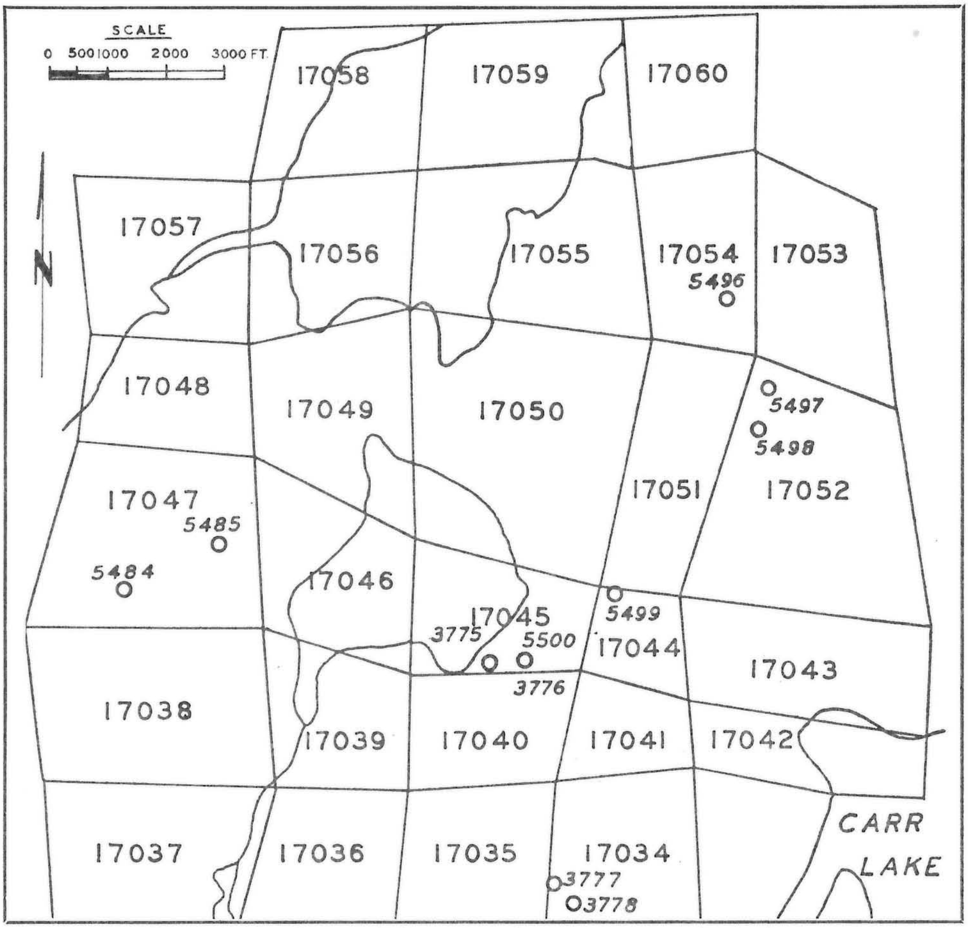

Figure 45 — Map of O.M. claims showing location of drill holes.

Hole No.	Length ft.	Angle	Summary
3775	693	Vert.	0 to 400 feet, mostly acid norite, micaceous to chloritic in a few places. From 400 feet—mostly basic norite in lower section. Altered in a few places: plagioclase to albite at 560 feet; hornblende to chlorite at 660 feet.
3776	495	E @ −45°...	Basic norite or gabbro, cut by aplite dykes, quartz stringers and grey syenite dyke. Local chloritization of hornblende.
3777	594	Vert.	Mostly diorite, with some hornblende gabbro. Locally chloritized.
3778	27	.....	Gabbro.
5484	347	Vert.	Fine- to medium-grained barren gabbro, weakly to moderately magnetic. Probably some greenstone inclusions (non-magnetic). Occasional carbonate stringers. Ca. 2 feet gabbro with chalcopyrite, pyrrhotite and pyrite at 210 feet. Some weak pyrite mineralization at 250 feet.

Hole No.	Length ft.	Angle	Summary
5485	303	E 34° S −45°.	Coarse-grained norite, moderately magnetic, to 152 feet. Gabbro grading to norite beneath. Granite stringers at 153 and 154 feet. Trap dykes at 54 and 187 feet.
5496	299	Vert.	Basic norite, moderately magnetic; chloritic at 209.5 feet; siliceous with minute chalcopyrite fracture filling at 245.2 feet. Diorite porphyry at 252 and 295 feet.
5497	297	E @ −45°. .	Gabbro to 30 feet, diorite porphyry to 82 feet, thence gabbro to 102 feet and mostly diorite and quartz diorite to the end of the hole. Siliceous, with pyrite, at 70 feet. Strongly magnetic silicified zone and pyrite at 83.5 feet. Pyrite as very sparse fracture filling at 45 feet. Gabbro moderately magnetic.
5498	203	Vert.	Gabbro, with narrow diorite dykes.
5499	202	Vert.	Gabbro, with some norite bands. Sheared to chlorite schist, with magnetite at 18.7, 52, 80, 97 feet. Quartz-calcite-magnetite stringers at 18.5 feet. Granite stringers 52-62 feet. Three feet of feldspar porphyry (orthoclase phenocrysts) at 100 feet. Several diorite porphyry dykes in lower section.
5500	338	W @ −45°. .	Basic norite and hornblende gabbro.

No assay results are available for any of these holes.

The O. M. claims were allowed to lapse in 1950.

The ground was re-staked in 1956, by Sherritt Gordon Mines Limited, as part of the *Ram* group of 36 claims (P44963-97), which cover essentially the same area as the earlier O. M. group. During January to March, 1957, an electromagnetic survey was carried out, by the "dip-angle" method, using a 25-foot vertical transmitting loop at a frequency of 1,200 c.p.s. The survey found no definite indications of conductors and no drilling was recommended. Two areas were suggested as meriting surface work in an attempt to evaluate weak anomalies. One is about on the greenstone-tonalite contact northwest of the gabbro, as shown on Map No. 2. The other is at the gabbro-diorite contact west of Carr Lake.

No further work has been done on these claims.

NW 15

W. H. M. Group (134)

The W. H. M. group contained 27 claims (P10053-79) staked in 1946. The claims formed an almost square block southwest from Minton Lake nearly to the Keewatin River. The western boundary was approximately along the line of the creek and two small lakes west of Minton Lake. The eastern boundary was the G. T. (132) and M. J. (131) groups. There are very few exposures on the W. H. M. claims, which are underlain mostly by sand and boulder ridges.

A magnetometer survey of the group was performed in January and February, 1947 by Geo-Technical Development Company, for Granville Lake Nickel Mines, Limited.

The magnetic data were interpreted by J. T. Randell as indicating three zones on the property. In the western part there is a zone of high magnetism, probably caused by basic lavas and hornblendite "intrusives". A central zone of weak magnetic field was considered to be due to sediments, tuffs and acid lavas. A third, or eastern, zone of dipoles was interpreted as a gneissic phase of the volcanic rocks. These features continue eastward into the G. T. group, at that time held by Base Metals Mining Corporation Limited. At the same time, similar surveys were being conducted for other companies in the area and a common grid system was used for all of them. An outcrop described as "hornblendite", at 9000 W on L56 (NW corner W.H.M. 7) on this grid system yielded an assay of 0.25 per cent nickel. The accompanying magnetic high is 2,000 feet long and 200 to 600 feet wide and the intensity is up to 15,000 gammas. Such extreme values are obviously due to magnetite. Three drill holes were recommended, the first under the outcrop just mentioned.

For the numerous other departures from magnetic uniformity, an electromagnetic survey was recommended.

During the summer of 1947, S. V. Burr, of Geo-Technical Development, mapped the geology of the property and supervised the drilling then in progress. Drilling began in April, 1947, under the "hornblendite" noted above. This hole encountered forty feet of "amphibolitized andesite", with scattered sulphides between 45 and 50 feet. The 5-foot section contained 0.11 per cent nickel and 0.06 per cent copper. Thereafter the hole was in "acid volcanics" which contain abundant fine magnetite, disseminated and in fractures. A 5-foot section at 150 to 155 feet contained 0.39 per cent copper, but no nickel.

A further 4,090 feet of drilling in nine holes on W. H. M. 7 and W. H. M. 18 claims found much acid tuff and agglomerate, some basic flows, felsite and, in hole N5, numerous amphibolite dykes. The dykes cut across the bedding of the tuffs at angles up to 20 degrees. The holes are shown in the adjacent sketch.

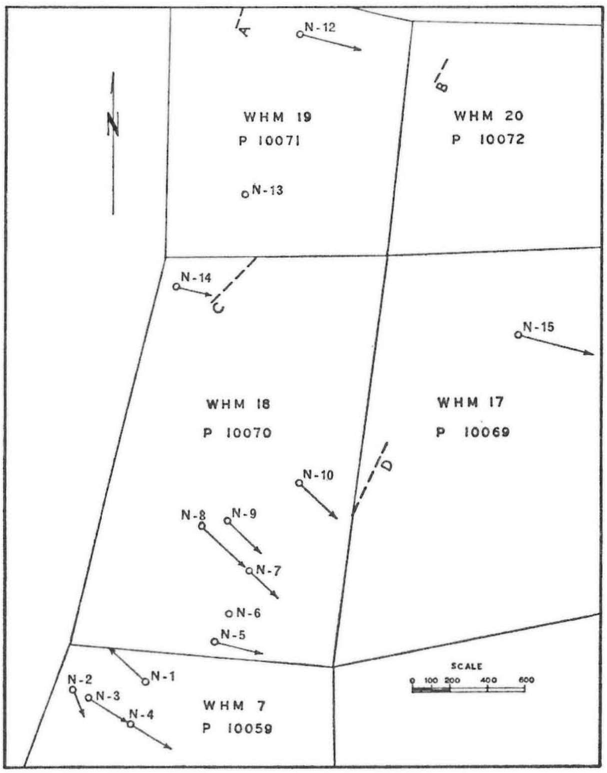

Figure 46 — Diamond drilling on W.H.M. claims, 1947. Letters mark electromagnetic conductors.

There was a further drilling on the W. H. M. 19 claim. Hole N12, at 7800 W on line 68, encountered andesite followed by andesitic tuffs. Within the tuffs are four narrow zones of sulphides and quartz. Immediately below (i.e. east of) these zones is an 18-foot amphibolite dyke. The samples of the quartz-sulphide sections are interesting:

From	To	Length	Cu	Ni	Au	
377.6	379.0	1.4	0.38%	0.68%	Tr	Sulphide-quartz in andesitic tuff
383.7	385.8	2.1	0.30%	1.30%	.01 ozs.	
392.0	393.3	1.3	0.19%	0.13%	—	
406.0	410.6	4.0	0.35%	0.12%	Tr	Silicification and sparse sulphide in amphibolite

It is worth noting that here we have two small occurrences of nickel mineralization, one at least of ore grade, in quartz in basic tuffs. This is an unusual association in which to find nickel, though such have recently been found elsewhere.

In the same anomaly, a silicified zone in andesite, in hole N13, contained 0.54 per cent copper. Hole N15 found andesite and amphibolite dykes beneath 106 feet of overburden. Disseminated sulphides, and sulphides in fractures, were generally present in the first 300 feet, but nickel and copper values were negligible. In N17, which cut andesitic tuffs and agglomerate, there were two short sections of heavy sulphide, but it was mostly pyrite and was of no value. Hole N18 also intersected andesitic tuffs and flows; chlorite alteration was notable in the upper 150 feet.

In June, 1957, an electromagnetic survey of the W. H. M. 1, 7, 8, and 17 to 21 claims was performed by Sharpe Geophysical Surveys, Limited, using the "dip-angle" method and 1,000 c.p.s. equipment. Anomalies so found were checked by the horizontal (Loop-frame) instrument. Four conductors were found, three of which were considered as possibly caused by sulphides. Surface trenching was recommended prior to any drilling. Inasmuch as previous drilling had required from 10 to 150 feet of casing through overburden, this latter recommendation was perhaps more hopeful than helpful.

Most of the active exploration work on this group has been concentrated on the four claims west of Minton Lake.

NW 15

D. D. M. Group *Bang Group* (135)

The 17 D. D. M. claims (P13220-13236) along with the six Bang claims (P10917-22), form a block along the north shore of Minton Lake and extending north and west for about a mile and three quarters to an un-named "double" lake. Much of the area shown on Map No. 2 as conglomerate of the Wasekwan series lies within this group. The claims were bounded on the east by the G. T. (132) and Gar (129) groups, and on the north and west by the P.O.T. (137) group. The Bang group was staked in 1946, the D. D. M. claims in 1947. Both groups were cancelled in 1949. Part of the area of the Bang claims is now included within the Edo group (140).

During April and May, 1947, Geo-Technical Development Company, Limited, conducted a magnetometer survey of the group for Doramal Mines Limited. By the time the report on this work was submitted, in August, a geological map had been prepared by F. J. Sugden.

The surface geology in the northern part of the group is indicated on Map No. 2; outcrops are scarce in the southern part. It should be pointed out that, though details on the map have been derived, in part, from Sugden's work, he did not map unit 1 as conglomerate. Rather, both he and Allan considered it as "volcanic fragmental". This question is discussed at some length following page 36 (under "Wasekwan Conglomerate"). Whatever the origin of this fragmental rock, be it sedimentary or volcanic, a plunging fold is suggested by its distribution, though there is actually little or no direct evidence of such. The northwesterly strike of the tuffs near the northern contact, and a similar direction near the felsite dyke at the southern end, are suggestive of a local departure from the general northeasterly trend of the Wasekwan rocks. No criteria of bedding tops have been recognized. There is a distinct change in direction of schistosty between the eastern and western parts of the conglomerate area.

The dykes shown on Map No. 2 as "pegmatite, aplite" are in this case very fine grained, siliceous, and resemble some rhyolite. They postdate the regional schistosity in the enclosing rocks. Small dykes of similar type occur in areas of volcanic breccia, but not within the massive flows. They trend northeast and northwest and are up to 8 feet thick. Altered basic dykes up to 4 feet thick also occur; they trend northeast and slightly west of north.

The only faulting observed directly is on D. D. M. 13 in the conglomerate, near the contact with the lavas. The fault strikes N 65° E, is filled with 2 inches of quartz, and offsets a diorite dyke by 3 feet. (The north side moved west.)

In his report on the magnetometer work, Randell indicated a strong fault in the northwest part of the group, through D. D. M. 17, D. D. M. 16 and the adjacent J. J. group (**137**). This marks the boundary between an area of magnetic uniformity and one of considerable complexity. Because this complex area coincides fairly closely with the area of exposed Wasekwan conglomerate, perhaps one might suggest that the conglomerate is the cause of the magnetic disturbances; the western boundary of the conglomerate corresponds fairly well with the position of the assumed fault.

The portion of the property near Minton Lake has a zone of high magnetic intensity parallel to the lake shore and about 1,000 feet from the lake. In its southwestern extension, on the W. H. M. claims (**134**), this zone has been found, by drilling, to consist of andesite and basic tuffs with some amphibolite dykes and siliceous tuffs. On Doramal ground eleven anomalies were recognized in this magnetic zone. Randell pointed out that hole N12 of Granville Lake Mines, on the extension of the zone into the W. H. M. claims, had cut 30 feet of massive sulphides which contained 0.38 per cent copper and 0.15 per cent nickel.[1] He therefore recommended the peak reading of the zone (9400 gammas) as the major interest, because it "must be pyrrhotite". One other was considered as probably, and three others as possibly, due to sulphides. A resistivity survey was recommended to further test the magnetic anomalies. The anomalies along the shore were drilled in 1957-58, when the ground was a part of the Edo group. (See page 238.)

NW 15

F. J. Group (**136**)

The thirty-six F. J. claims (P10308-10343) formed a roughly square block on both sides of the Keewatin River north of Lynn River. This claim group formed the eastern boundary of the Elb group (which includes the Lynn Lake mines) and was itself bounded to the north by the W. H. M. group (**134**). The F. J. group extended about one claim length east of the junction of the two rivers. The claims were staked in 1946 at about the same time as the Elb group, and were surveyed in 1947.

The surface geology of the group was mapped in 1946, by R. W. Baker for Conwest Exploration Company, Limited. This work was done at the same time as a magnetometer survey. The area is mostly muskeg, with some sand plains and

[1]But see log of N12 summarized on p. 233.

low sand ridges in the southern part, and only six outcrops were found on the whole group. They are andesite.

The magnetometer measurements were made with a Thalen-Tiberg instrument, and deflections greater than 5 scale divisions were considered to be anomalous. The measurements showed a fairly uniform magnetic field with an erratic and widespread series of dipoles, elongated parallel to the regional strike of the formations. These were attributed to local concentrations of magnetite in the flows, caused by the metamorphic effect of the granite nearby at Cockeram Lake.

No recommendations were made for any further work.

Diamond drilling to a total of 2,584 feet was done on the F. J. 25, 26, 29, 34, and 35 claims, but no information on the cores is now available.

The claims were leased, in 1951, to Lynwatin Nickel Copper Mines, Limited.

NW 15

J. J. Group *Dot Group*
J. R. Group *P. O. T. Group* (137)

The claims of the above groups are here considered as a unit because the history of the four groups has been so intermixed that it appears to be the clearest method of presentation.

The earliest staking was that of the J. J. group (P10416-33) in 1946. The eighteen claims of this group were the northeastward extension of Sherritt Gordon's Elb group, and were east of, and approximately parallel to, the Keewatin River. The Dot group (P14634-5; 14254-61; 14642-43) of 12 claims formed a zone, one claim wide, on the west of the J. J. and Elb (1) groups. This was succeeded to the west by the previously recorded D. R. and Z. N. groups. The P. O. T. group of 35 claims (P14288-96; 14614-14633; 14636-14641) was a very irregular area which can best be described as filling in all the odd corners and re-entrants left west and north of the J. J., D. D. M., and Gar (129) groups. The northern boundary included part of the small gabbro remnant east of Berge Lake and the southern end of the large lake to the east of it. These groups, therefore, formed altogether an irregular band, about a mile and a half wide, southwest from that lake along the edge of the Wasekwan rocks as far as the east shore of Dot Lake. Both the P. O. T. and Dot groups were staked on behalf of Noranda Mines, Limited, and the J. J. group was optioned to that company.

In the summer of 1947, geological mapping was done by G. G. Suffel. In describing the property he noted that the J. J. group is mostly underlain by basic volcanic rocks, though there is much fragmental rock on the group as a whole. Fragments up to 10 inches across are rhyolitic and show lineation. They suggest bombs and lapilli. Good examples are reported on the Dot 9 claim, at Dot Lake. Some banded tuffs are present, notably west of the D. D. M. claims, but they are not common. Suffel also pointed out that a dioritic body on the boundary between J. J. 18 and J. J. 12 might be an intrusion, though no definite intrusive relations were found. A broad band of dioritic rocks, near the south boundary of the P. O. T. claims, he did not consider to be intrusive.

Faults were not identified, though the possibility was recognized that the Keewatin River might follow the Eldon Lake fault, (then not known). Shearing is reported to be intense in some places, with the development of chlorite, hornblende, and some carbonate. Top determinations, to aid in solution of structural problems, were not possible. Quartz veins and lenses are common, but no deposits of commercial interest were seen.

A magnetometer survey, using a "Berg" instrument, was run simultaneously with Suffel's field work. In reporting on this, V. D. Colcleugh, of Noranda Mines Limited, noted a zone of magnetic highs running southwest across the J. J. 5 and J. J. 4 claims, and another southwest across the J. J. 7 claim. These are the continuation of similar zones found on the W. H. M. claims (134) to the east. Some testing on the W. H. M. claims had shown disseminated pyrrhotite and magnetite, with some low value in nickel. Colcleugh, therefore, felt that no further work was justified on the part of Noranda. The claims were allowed to lapse: the P. O. T. and Dot groups in 1949 and the J. J. group in 1950.

When the J. J. group came open, in 1950, a portion was re-staked as the J. R. group, by R. and J. W. Rundle, of The Pas. Some trenching and test pitting was done between then and 1955, when the claims were surveyed, (12 claims and 2 fractions, L1711-1724). The J. R. group was purchased, in 1955, by Agassiz Mines, Limited.

Drilling, in June and July of 1955, totalled 2,127 feet, and showed that the magnetic anomalies found by Noranda were due mostly to magnetite in the flows. Two holes, 100 feet apart, showed a low content of gold, silver, and zinc, and nickel up to 0.12 per cent.

An electromagnetic survey by the "loop-frame" method was performed in August, 1955, by Moreau, Woodard and Company.

In November, 1955, the ground was optioned to Newkirk Mining Corporation, Limited, who assigned it to Aumaque Gold Mines, Limited.

A resistivity survey was run over parts of the area in May, 1956 by Geo-Technical Development Company Limited.

Drilling from January to June, 1956, totalled 11,067 feet, in 25 holes.

In the drilling program of 1955, designed to test the magnetic anomalies, Hole 3, on the boundary between J. R. 3 and J. R. 8 showed up to 4.5 per cent zinc, gold up to 0.08 ounces per ton, and silver to 0.36 ounces per ton in the upper part of the hole. In the lower part, a basic intrusive rock has a low nickel and copper content, with some gold, and silver up to 1.4 ounces per ton.

The drilling program of 1956 was designed to test several weak electromagnetic conductors. Holes 8 and 10 cut true widths between 2 and 3 feet that carried over 0.2 ounces of gold per ton. Two per cent zinc was found in one hole. Hole 9 cut 3 feet of massive sulphides with only very low value, and hole 12 found large barren quartz veins. Holes 22 and 26, drilled prior to the resistivity survey, also found encouraging values in gold over widths between 2.4 feet and 8.5 feet. Six further holes, numbered 27 to 32, were drilled to test resistivity anomalies. They found sulphides, with only scattered gold values in one hole; in the others, the sulphides were barren.

Hole 11 had found some encouragement, and a further nine holes (13 to 21), totalling 5,261 feet, were drilled to test the surrounding area. These indicated a plug-like mass of "amphibolite", about 200 feet by 250 feet, which may be intrusive. It appears to plunge southwest at 70 to 80 degrees, and to widen with depth, Fractures are filled by vein matter and sulphides. According to A. S. Dawson, three types of material are of importance:

(a) Quartz-carbonate veins. The quartz is off-white; the carbonate is calcite(?), is the more abundant mineral, and is very finely brecciated. The fractures are filled with sulphides. Pyrite and pyrrhotite are always present; sphalerite and galena are not prominent; in some places there is arsenopyrite and chalcopyrite. A few specks of visible gold and of wire silver have been seen.

(b) Massive arsenopyrite. This is fine-grained, is associated with lesser amounts of other sulphides and commonly contains small amounts of brecciated carbonate. [Grades into (a) (?).] In most places this has high gold value.

(c) Very fine-grained pyrite, commonly banded. This has associated minor amounts of fine-grained pyrrhotite and arsenopyrite and traces of chalcopyrite. Sphalerite and galena are usually absent.

Small tonnages of material of ore-grade have been indicated by the drilling to date.

Dot Group *D. R. Group*

Z. N. Group (138)

Twelve claims of the D. R. group (P14722-23; 13846-53; 14948-49), were staked in 1947 west of the Dot group (which apparently was staked after the D. R. group). It formed a block northeast of Dot Lake and the widening in the Keewatin River there, and was underlain almost entirely by the Berge Lake granite.

No work was recorded on these claims and they were cancelled in 1948.

The Z. N. group, of 28 claims (P15091-118) formed the northwestern edge of the completely staked ground stretching east to Arbour Lake. The Z. N. group was a belt, 2 claims wide, adjoining the Dot and Elb claims, from the north end of Dot Lake almost to Eric Lake. At the north end it was underlain by the Berge Lake granite, but southwards it included the Wasekwan lavas and interbedded sediments.

No work was done on these claims, and they too were cancelled in 1948.

Most of the ground formerly included within the Z. N., D. R., Dot and part of the J. J. groups was restaked in 1952, by Sherritt Gordon Mines, again under the name of the Dot group. The claims were surveyed in 1950, and given numbers L1951 to 1999. The group now includes the southern tip of Berge Lake and the northern tip of Eric Lake.

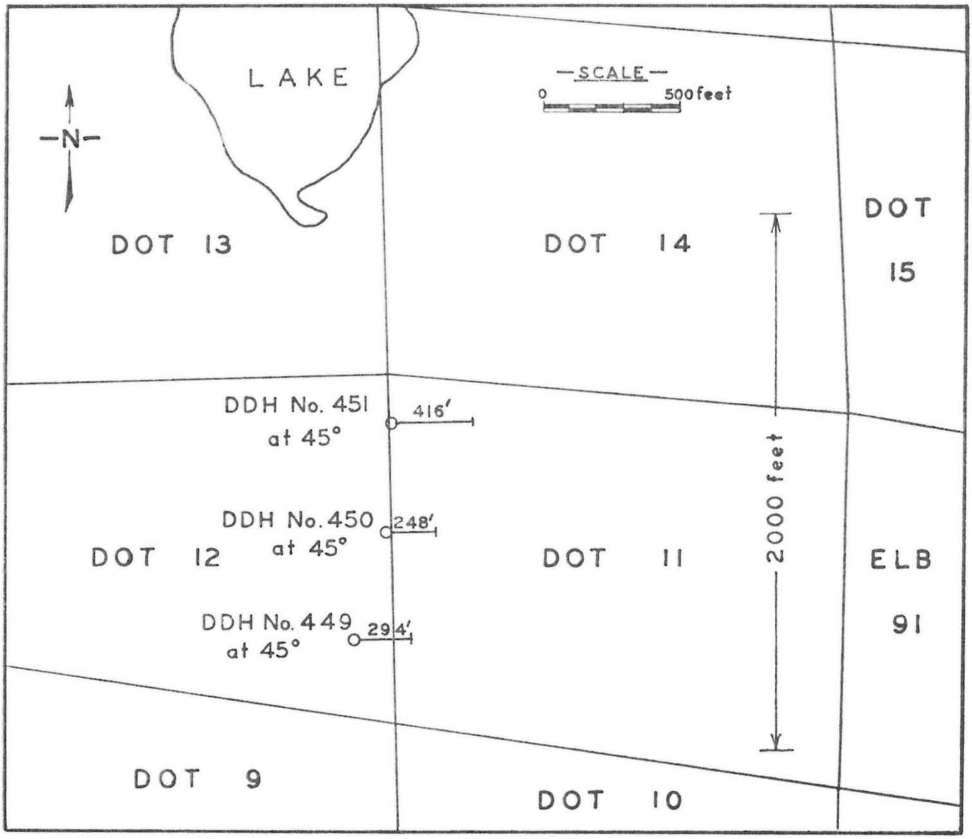

Figure 47 — Location of drilling on Dot claims, 1956.

In January, 1956, Sherritt Gordon drilled three holes totalling 958 feet under the boundary between Dot 11, Dot 2, and Dot 12 claims. Hole 450 encountered 135 feet of the Berge Lake granite followed by 113 feet of andesite and tuff with a 12-foot granite dyke. The tuff is somewhat granitized in places and contains scattered pyrite and pyrrhotite, (up to 15 per cent pyrite). Nickel and copper values are low. Hole 451 cut fractured, and somewhat banded, andesitic volcanic rocks, with numerous quartz stringers. In two places there are narrow but quite strong shear zones, and the quartz stringers appear to be associated with these for about 40 feet (*core length*) on either side. Carbonate is present in one. There is about 10 feet of core which is quite chloritic. There are low copper, nickel, and zinc values. In hole 449 the upper part is mostly tuff above 145 feet, rhyolite and sediment to 180 feet and then andesite. Chlorite, carbonate, quartz stringers, and sulphides are widespread, the latter up to 10 per cent. Values, however, were found to be low.

NW 15

Jo Group (139)

Three claims of the Jo group (P16105-107) were staked in 1947, in the vicinity of the outlet of Berge Lake. They were mainly water claims; no work was done and the claims were cancelled in 1948.

NW 15

Edo Group (140)

The Edo group of 72 claims (P40971-41042) was staked in 1956. It comprises ground formerly within the Gar, G. T., and Jenny groups, with small portions of the D. D. M. and Bang groups (135). Reference should be made to those groups for details of the results of earlier work on this ground.

The part of the original G. T. group which was optioned to Denison Nickel Mines, Limited, (and described above with the M. J. group) is now a part of the Edo group, but held by Red Bark Mines, Limited, (Edo 7-16, approximately equivalent to former G. T. 27-33). Both magnetometer and electromagnetic surveys were made over this ground by Geo. W. Sander, in February 1957, as part of a larger project.

Four zones were found, two of which are prolongations of trends in the north portion of the F. J. and George claims (former F. J. (136) and M. J. (131) claims). In three of the zones, moderately strong magnetic and electromagnetic anomalies coincide, and drilling was recommended on the two which continue onto the George claims. The third zone is normal to the general trend and was considered as probably due to an intrusion. The fourth zone comes into the property from the west and dies out.

So far as known, none of the recommended holes has been drilled.

The part of the Edo claims known as the North group extends northeastward across Minton Lake and beyond, over ground formerly part of the Bang, Jenny, and Gar groups.

Twenty-six claims of this northern part of the Edo group were covered by Sander, as part of the combined magnetometer and electromagnetic mapping project above mentioned. The area involved covered most of Minton Lake and the two unnamed lakes to the north and east of it.

The magnetic highs, which follow the trend of the formations, were ascribed to magnetite in the volcanic rocks, or to magnetite in iron-formation. The anomalies are concentrated in a zone, about 2,000 feet wide, running northeast along the north side of Minton Lake. To the northeast they appear to swing north and pinch out. Sander suggested this might be due to north-trending faults lying between Minton

Lake and the next lake to the east. (*Compare the somewhat similar phenomenon* noted by Randell in the magnetic maps of the *W. H. M.* (**134**) and *G. T.* (**132**) groups.)

Six conductors were found by the electromagnetic survey. A very lengthy one, along the north shore of Minton Lake coincides with a magnetic high. Drilling was recommended. Two of the anomalies were actually one a prolongation of the other on the Edo 70 claim. One hole was recommended.

Seven holes were drilled in testing these anomalies. They were located on the Edo 26, 40, 54, 59, 60, 61, and 70 claims. Two holes which tested the long conductor on the north shore of Minton Lake found low nickel values. There is some suggestion in the logs that the conductor is a shear or shatter zone, with short sections of massive sulphides. The other holes encountered sheared zones with considerable quartz and carbonate and small amounts of sulphides. A few inches of iron-formation was found in one hole.

NW 15

Aero Group (141)

The Aero group consisted originally of two large blocks of claims, one north of Moses Lake and the other on the west side of Cockeram Lake. The eastern group of thirty claims (P12727-47; 13453-61) was staked in 1947. It extended east from the outlet of Cockeram Lake, and included the area of volcanic rocks between Moses and Cartwright lakes. The western group of 66 claims (P12443-12508) covered the western shore of Cockeram Lake and extended westwards toward Wheatcroft Lake. It included much of the area of granite, tonalite, and diorite south and west of the two islands in the centre of the lake.

In March 1948, a magnetometer survey of nine claims only of the group was performed by W. H. Gross. This was followed by geological mapping in July of that year, on the same claims. The report on the geological survey described the rocks as hybrid—mixed granite and diorite. The departures from magnetic uniformity were attributed to isolated masses of dioritic rock included in the "granite" and so were indicative of nothing of economic importance. No further work was recommended. The nine claims were P12468-70; 12476-8; 12489-91, and were immediately west of the creek running into the first bay of Cockeram Lake south of the outlet of Keewatin River. No work was done on any of the other claims, thirty of which were underlain by greenstone.

The other claims were cancelled in 1948. The surveys were used as assessment work on the claims they covered, and it was sufficient to hold them until 1950, when they were allowed to lapse.

NW 15

X. L. Group (142)

On the northern edge of the eastern group of Aero claims (**141**), nine X. L. claims (P16334-42) were staked in 1947. They included the shore of Keewatin River east of the island in the outlet of Cockeram Lake, and extended eastward as a single row of five claims. This ground is underlain by basic volcanic rocks.

There is no record of any work done on these claims and they were cancelled in 1948.

NW 15

K. P. Group (143)

The 18 claims of the K. P. group (P14644-61) were staked in 1947. They covered the small area of greenstone on the shore line at the southeast end of

Cockeram Lake and as far north as the mouth of the creek draining the swamp south of Carr Lake.

Nothing was done and the claims lapsed in 1948.

NW 15

G. M. S. Group (144)

The recording maps of that day are contradictory but, so far as can be learned, it appears that most of the eastern shoreline of Cockeram Lake (except the K. P. group (143)) was staked in 1947 as the G. M. S. group. Much of the lake itself was also included. The group comprised 44 claims (P16017-060).

The scarce exposures on the claims suggest that the group was underlain mainly by granitic rocks of various types. Locally there is a considerable complexity.

No work was done and the claims were cancelled in 1948.

SW 15

Bay Group *J. D. J. Group*
E. C. Group *B. C. Group* (145)
TM Group *E. P. Group*

In 1947 the L. C. group (118) was staked to cover the body of gabbro northwest of Cartwright Lake. Between this group (which extended well into the northwest corner of Twp. 90, Rge. 21W) and the claims already staked along the east shore of Cockeram Lake, there were a number of different claim groups. One of them, the B. C., continued around the south end of the L. C. group and northward again on the eastern side.

The Bay group, at the north end, adjoined the O. M. (133) and Car (130) groups, just south of Twp. 91. Its eight claims (P17033; 17314-20) stretched from the north end of the L. C. group to the deepest embayment on the east side of Cockeram Lake.

South of it, the E. C. group of 26 claims (P17686-17710; 17712) covered most of the ground east of the lake, and as far south as the creek draining the swamp south of Carr Lake. It is underlain by tonalite, diorite, and some volcanic rocks at the eastern end. Set into the centre of this group, covering the granite and diorite adjacent to the creek, were the six claims of the TM group (P17308-313).

The nine claims of the J. D. J. group (P17518-17526) were west of the small lake on the western edge of the gabbro, and would be entirely underlain by greenstone.

The E. P. group (P17220-21; 17267-8) covered essentially the area between the two lakes north of Moses Lake. This area is predominantly greenstone, but with sparse exposures. The group did not quite include the small body of Berge Lake granite.

Between the E. P. and the L. C. groups, is a large area of volcanic rocks which was covered by the B. C. group.

No assessment work was recorded on any of these claims except the Bay group and all were cancelled in 1948. The Bay group was cancelled in 1949.

SW 15

G. B. J. Group (146)

Between the G. M. S. claims (144) and the D. H. group (148), on the west side of Cockeram Lake, was an irregular group of nine G. B. J. claims (P16696-16704), staked in 1947. They covered the complex of tonalite and diorite north of the mouth of the Keewatin River. No work was recorded, and the claims were cancelled in 1948.

A small part of the north end of this group is now covered by the southern extremity of the George group.

NI Claim Cu Group (147)

The Cu group of five claims (P16604-08) and the single NI claim (P16609) covered the shoreline of Cockeram Lake immediately south of the Keewatin River, as far as the Aero group (141). In early 1948, the International Nickel Company performed a magnetometer survey [of the entire group?]. Only the Cu 1 claim, at the river mouth, is reported. A small positive anomaly on the west edge of the claim was ascribed to magnetite. All claims except the Cu 1 were cancelled in 1948, and it lapsed in 1949.

D. H. Group F. L. Group (148)

The D. H. group of ninety claims and fractions (L1091-1180) was staked in 1946 on behalf of God's Lake Gold Mines Limited. They extend on both sides of Keewatin River for about one mile above its junction with Cockeram Lake, and also southward near the west shore of the lake, to the vicinity of the first large creek entering the lake. The group extends westward to the northern end of Wheatcroft Lake. The claims were surveyed in 1947.

Adjoining on the west is the F. L. group (L550-603) also held by God's Lake Gold Mines Limited. This fills in the area between the D. H. group as described above and the Elb claims, which are held by Sherritt Gordon Mines Limited. Included is much of the west side of Wheatcroft Lake, and the Lynn River. These claims also were surveyed in 1947.

A magnetometer survey of the D. H. group was carried out in 1947, and geological mapping was also done in the same year. The area of the two claim groups is mostly swampy and has very few exposures, so that surface exploration is not very rewarding and geophysical methods are necessary. The interpretation supplied by the consultant who prepared a magnetic map consisted essentially of labelling the 200 gamma contour a granite contact!

The magnetometer map was re-examined, and interpreted, by Dr. A. A. Brant, in December, 1947. He recognized 15 anomalies or groups of anomalies on the F. L. claims, and 9 similar areas on the D. H. group.

On the F. L. group the majority of the anomalous areas are on the west side of Wheatcroft Lake, between Lynn River and the southern end of the claim group. A group of anomalies was also found on the east side of the outlet of Wheatcroft Lake, on the F. L. 9 claim. Three others were found near the Lynn River in the northern part of the claim group. (See figure 48.)

On the D. H. group most of the anomalies are near the eastern shore of Wheatcroft Lake. They are probably all near the boundary of the diorite (Map-unit 10) which lies between Wheatcroft Lake and the mouth of Keewatin River at Cockeram Lake. Anomaly "G" is in the sediment (Map-unit 2) at the south end of a small lake. Anomaly "C" is about halfway between that and Wheatcroft Lake. The locations suggest they may be due to metamorphic effects from the diorite intrusion. Two other groups of anomalies were found near Cockeram Lake. "J" is most probably due to a large mass of "greenstone" and mafic rock known to be present there.

Considerable drilling was done prior to 1952. Most of the work was concentrated in the western, non-granitic, part of the property, on the F. L. claims. The results of the drilling, other than on the F. L. 15 and F. L. 9 claims, are summarized in the table on page 242.

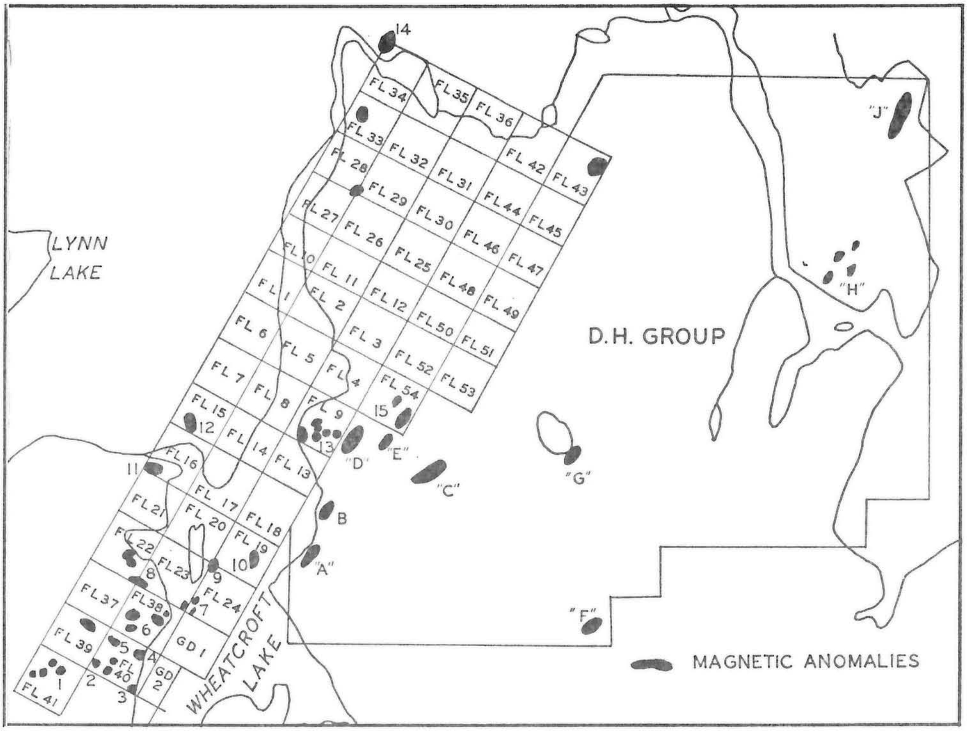

Figure 48 — Magnetic anomalies on F.L. and D.H. claims.

Claim	Anomaly	Remarks
F.L. 39, 40, 41	1 to 5	Ascribed to magnetite. Not drilled.
38 and 24	6 and 7	Seven holes. Found sedimentary rocks, with narrow, well-mineralized sections. No Cu or Ni. Some quartz-diorite in SW corner of F.L. 24, with 0.06 per cent Cu associated.
22 and 23	8	Fourteen holes prior to 1953. Found "greenstone" and sediment with minor amounts of diorite, quartz diorite, and granite. Longest and best section was top 27 feet of Hole 1, but only 0.8 feet had valuable metal (0.26 per cent Ni.)
19	9	Four holes. Found sedimentary rocks with some mineralization. Grade less than 0.1 per cent Ni or Cu.
19	10	Single hole. An 11-foot and a 14-foot section mineralized, but only 0.1 per cent Cu.
16	11	Not drilled.
F.L. 28	Near No. 2 post	Ascribed to magnetite. One hole. Reported as sedimentary rock, with some vein quartz. A 25-foot section of core averaged 1.12 per cent zinc, including 5 feet of core containing 2.82 per cent zinc. Another short section contained 2.17 per cent zinc. A second hole, from 150 feet away, did not cut this mineralization.
F.L. 33, 34	14	One hole each. No mineralization.

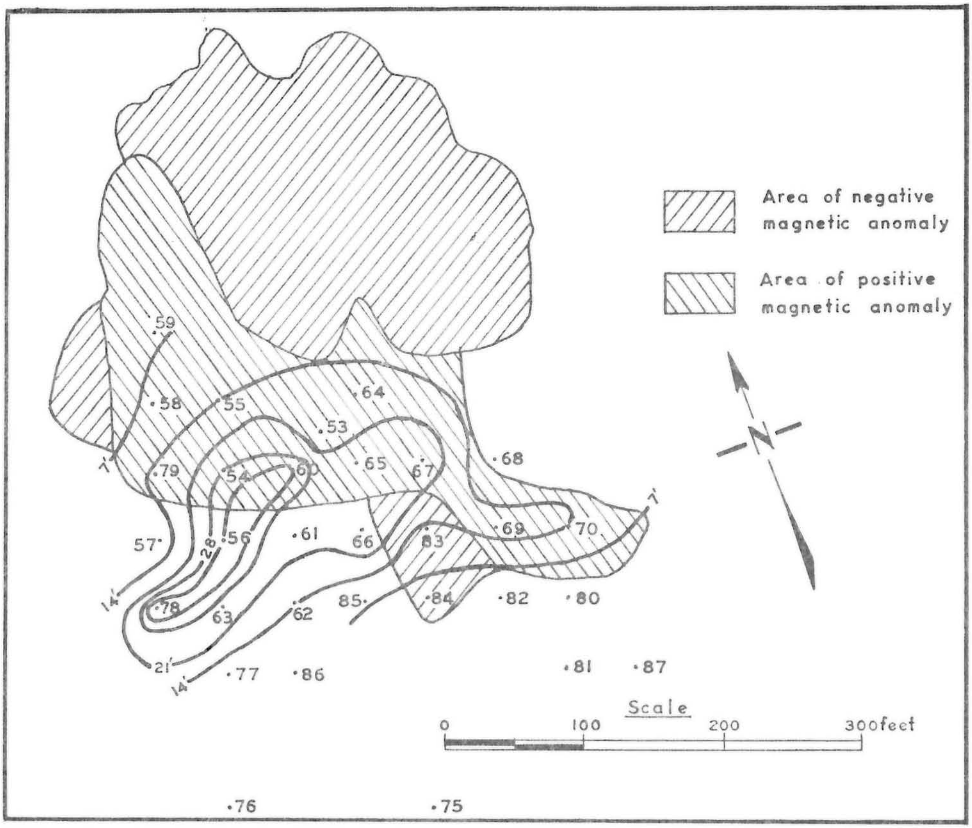

Figure 49 — Location of drill holes on the F.L. 15 claim.

The major drilling effort has been made on the F.L. 15 claim, just north of Lynn River. The locations of the drill holes are shown on the sketch map of Figure 49. The thirty-one vertical holes drilled prior to 1952 totalled 8,129 feet. They were located on the magnetic anomaly recognized by Dr. Brant. This anomaly had also been tested by EM work done by Sherritt Gordon, in conjunction with their testing of an anomaly on their own ground immediately west of the F.L. 15 claim.

The drilling of this particular program found sulphides of ore grade in all but two holes. The location of the mineralized section is indicated in figure 50. North of the general line of holes 62, 66, 83, 69, 70 only one band of sulphides was reported. South of that line there are sulphides at two levels, and in holes 80, 81, and 84 three or more separate intersections were found in each hole. The holes were from 117 to 507 feet deep, and in only 6 was the depth less than 200 feet. Copper and zinc are present, along with minor amounts of gold.

Detailed drill logs are not available, but the summaries show the sulphides to be present in a variety of rock types. As reported, these include "basic intrusive", "basic flows and sediments", "fragmentals", and "sediments". Drill hole intersections of the sulphides are as long as 35 feet.

Correlation of data without detailed logs is obviously risky. It appears not unreasonable, however, to assume that the highest intersections are the top of any ore mass which may be present. Plotting the depth of the highest intersection (Fig. 50), shows that the upper surface of the mineralized zone slopes steeply southwest. It is at a depth of 25 feet in holes 67, 69, and 70, and in excess of 240

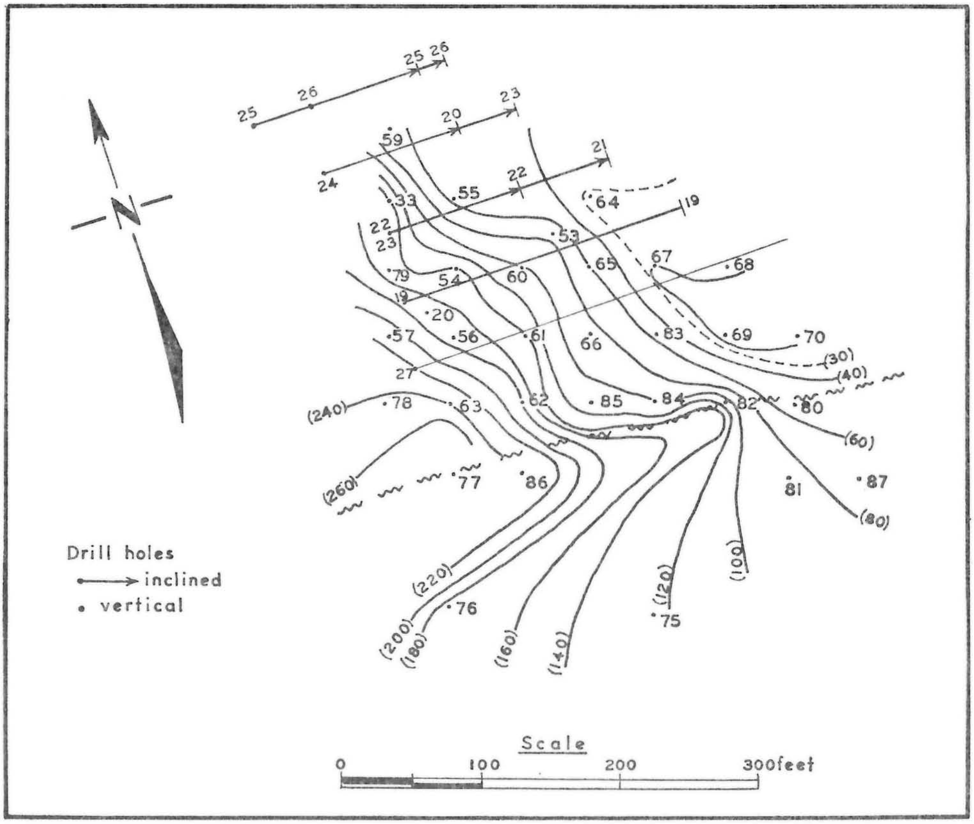

Figure 50 — Contours on the upper surface of the mineralized zone of F.L. 15 claim.

feet deep in holes 63 and 78. The surface appears to be fairly regular. However, along the line of holes 82, 84 and 85, there is an abrupt change in the upper surface of the mineralized zones, which suggests that the portion to the south is about 40 feet higher than that to the north. This change coincides, approximately, with the northern limit of where two or more mineralized zones were found. The lower zone is thin (2 feet to 8 feet) in most intersections, but core lengths up to 21.5 feet, and of good grade, were also obtained. This lower zone is about 20 to 30 feet below the upper.

Thickness of the upper mineralized zone possibly increases southwestward also, but this is less definite. The maximum thickness was found in hole 56, and is 35 feet. The thickness decreases outward from this to seven feet on the northern and southern sides (fig. 49).

In summary, then, the drilling program had shown, prior to 1953, a mass of mineralized material amounting to at least 500,000 tons, with an average grade of 0.9 per cent copper and 2.2 per cent zinc. The upper surface of this mass slopes southwest at about 52 degrees, and the thickness may also increase southwestward. All the holes were drilled on the "positive" portion of the anomaly. If the sulphides are the cause of the magnetic disturbance, the southwestward plunge should result in a magnetic low to the southwest. There is then no adequate explanation, from the drilling, for the "negative" anomaly to the north. The decrease in thickness on the southern side coincides with the abrupt change in elevation of the upper surface. This suggests the possibility of a fault along the general line of holes 77 and 82, with the south side displaced upward.

An electromagnetic survey was made by McPhar Geophysics, Ltd., in 1953 and 1954, using the dip angle method, and 1 Kc. equipment. Many of the weaker anomalies thus found were based on dip angles which were within the limits of error of the measurements. Some of the stronger anomalies were examined in greater detail, using a 6 Kc. frequency. Some encouragement was obtained because the observed angles were larger, and other areas were examined in detail, at the same frequency. Further testing showed, however, that this dual frequency method was not satisfactory.

Nineteen conductive zones were found on the F. L. claims. Mostly these are broad zones containing a number of weak conductors. A total of sixteen holes was recommended to test the anomalies.

Those holes of immediate interest on the F. L. 15 claim were numbered 19 to 27, and are shown as inclined holes on the western part of figure 50. The holes cut rocks described as "basic sediments", "basic fragmentals", and "acidic sediments", as well as minor amounts of "diorite" and "basic dykes". It is probable that the "greenstone" band east of the "EL" shaft extends some distance north of its outcrop. There were core lengths of up to 7 feet of massive pyrrhotite, with some chalcopyrite and sphalerite. The maximum length which might have been considered of value was 34 feet, in hole 22; it averaged 1.61 per cent copper and 1.57 per cent zinc. The highest grade was in hole 20, where 14.5 feet averaged 3.31 per cent copper and 0.76 per cent zinc.

The data from these holes are inconsistent with the results of the earlier drilling. Transverse sections containing the drill holes are plotted as figure 51, from information supplied by the owners. It is obvious that the possible ore-grade sections in the inclined holes do not agree with the outline of the sulphides as inferred from the vertical drilling of 1952. The cause of this is not known, unless there is some error in locating the inclined holes on the plan. (A westward lateral displacement of 75 feet on the inclined holes would give fair agreement.)

A long magnetic anomaly, or zone of anomalies, stretches across the F. L. 9 claim from near the outlet of Wheatcroft Lake. Brant considered this to be possibly in association with a shear zone, and that any sulphide is likely to be at the western end of the zone. The larger part of the drilling has been concentrated near the west end, in consequence. The 23 drill holes are shown on figure 52, together with the areas of magnetic anomaly.

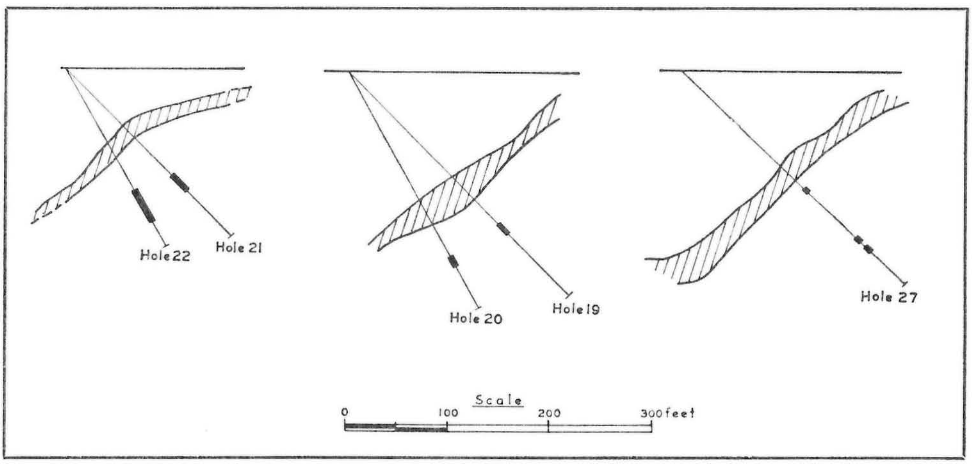

Figure 51 — Vertical cross-sections through mineralized zone of F.L. 15 claims. Inclined holes are shown. The mineralized zone is plotted from the data of earlier vertical drill holes.

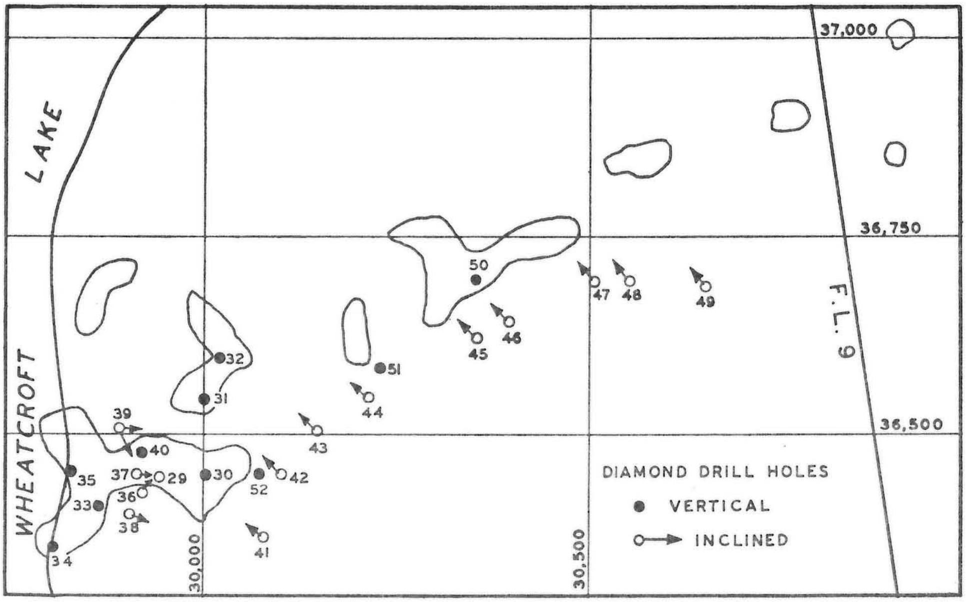

Figure 52 — Plan of drilling on F.L. 9 claim.

Sparse sulphides were found in many of the holes, but they are of low value in most places. As on the F. L. 15 claim, sediments, hornblendite, flows, "fragmentals", and quartz stringers are all reported to carry sulphide.

The best intersection was in hole number 29, where 66 feet of chlorite schist average 0.73 per cent copper and 2.2 per cent zinc. Hole 37 must have passed about 30 feet above that section, but did encounter a little more than 4 feet of 0.57 per cent copper and 2 per cent zinc at the same general level. All of the other holes immediately surrounding 29 cut sparsely mineralized sections with low metal content. Hole 51 showed two zones of low grade. Similarly hole 52 contained a 42-foot length which averages 0.1 per cent copper and 0.6 per cent zinc.

A very interesting hole was drilled under the outlet of Wheatcroft Lake in February, 1954, (Hole 2, F. L. 9 claim). It cut micaceous quartzite to 267 feet and reddish gneiss thereafter. From 268 to 270 feet the core was lost; from 270 to 271.5 feet it consisted of badly broken reddish gneiss with a 6-inch mud seam. This suggests that the drill cut the Eldon Lake Fault beneath the river.

SW 15

E. E. Group *G. B. Group* (149)
Ble Group *V. M. C. Group*
Nels Group

This aggregate of claims was staked during 1947 for Baker Lake Explorations, and mapped under the name of the Eldon Group. The claims included are the following:

Ble (P12753-12757; 12785-12811); G. B. (P16005-16008); E. E. (P13140-157; 13519-30); V. M. C. (P12749-52; 12758-84).

There was a total of 100 claims in the combined groups.

The area covered by these claims is most irregular. It is perhaps best described as everything between Cockeram Lake and the Elb claims (1), and south of the D. H. and F. L. groups (148), excepting the Aero group (141). There was a further extension of eleven Ble claims east of Ray Lake.

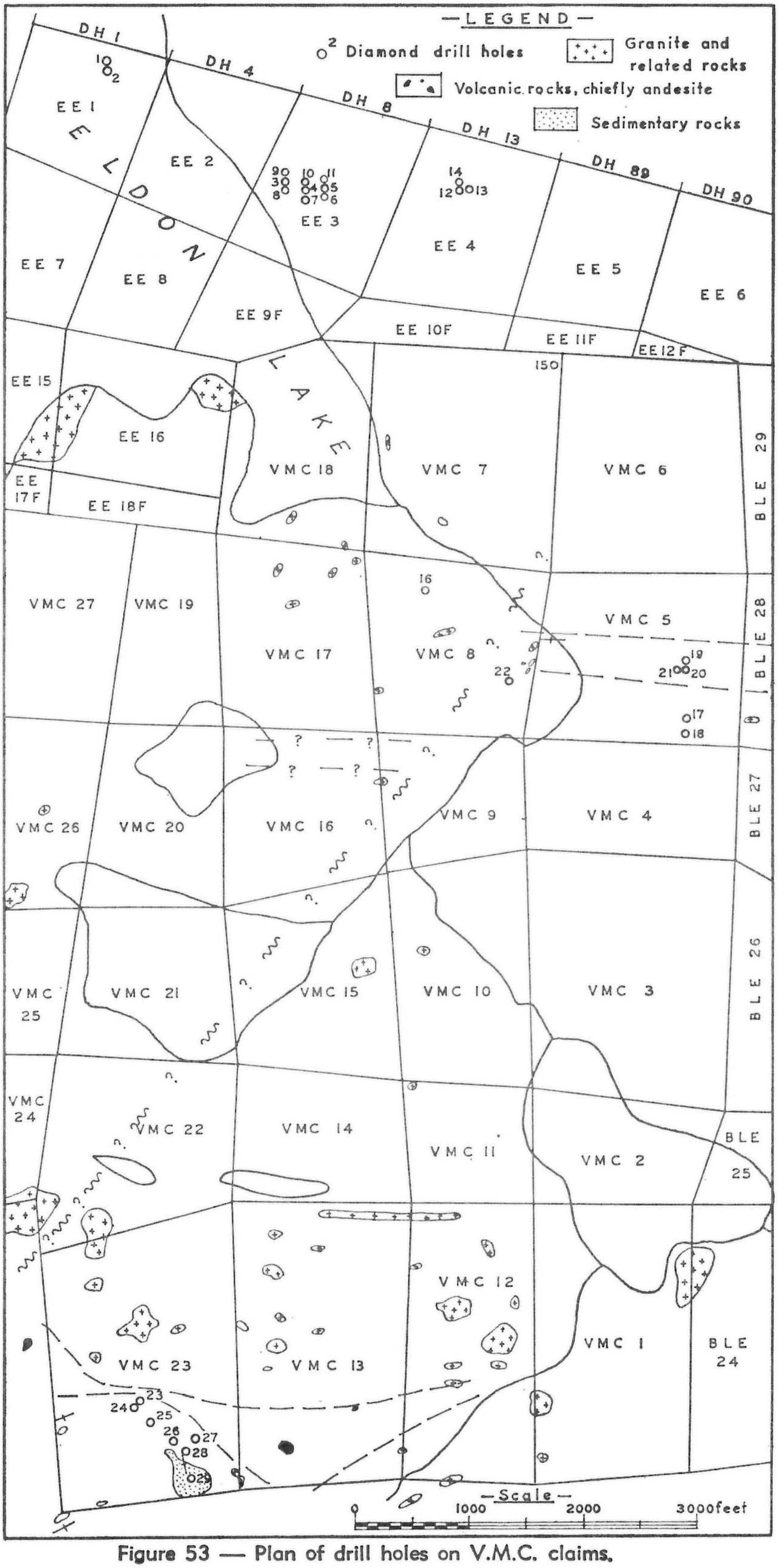

Figure 53 — Plan of drill holes on V.M.C. claims.

During April to June 1948, a magnetometer survey was carried out by Variometer Surveys, Ltd. under the direction of J. W. Ambrose. Geological mapping was done by R. G. Crosby. This work covered a total of 75 claims out of the group.

The main area of the claims is underlain by granitic rock types, except for six of the southern group of Ble claims, which are on the volcanic rocks of the type Wasekwan area. In the south half of the V. M. C. 23 claim a very high anomaly (5,700 gammas) was ascribed to magnetite in sedimentary rocks adjacent to the contact with the "granite". But, a 1,400-gamma anomaly, 1,000 feet long, on the north boundary of the V. M. C. 23 claim was recommended for drilling, as well as on one between the V. M. C. 14 and 13 claims. Small anomalies in the "granite" area were ascribed to bedrock surface irregularities. Ambrose also suggested, on the basis of the magnetic data, that a fault ran northeast across the V. M. C. 16 claim. The creek which drains into Wheatcroft Lake from the small lake on the boundary of Map No. 2 at 56°48′N, would run along this fault. A left-hand offset of the order of 1,500 feet was suggested.

In his geological report, Crosby noted that sediments are cut by basic sills up to 12 inches thick, and he suggested that there are two ages of granite in the area—one older and one younger than the basic intrusions, but he did not detail his reasons. The basic sills contain a small amount of disseminated pyrrhotite and up to 0.1 per cent nickel.

A zone of magnetic highs, south and east of Wheatcroft Lake, is associated with rather regular bands of highly altered greenstone, and with numerous inclusions in the granite. Crosby suggested that this marks the former synclinal axis along the line of Fraser Lake and Muter Creek.

A sulphide body occurs in the southern part of the V. M. C. 23 claim. The foot-wall rocks are light grey, very fine grained, and have white patches up to ½-inch in diameter. They are probably quartzites, though there is very little evidence of bedding. In a small northeasterly-trending fold, "a breccia zone, formed by crushing of weaker beds against the strong . . . footwall quartzite [is] replaced by sulphides." The sulphide is mostly pyrrhotite, with small amounts of chalcopyrite, sphalerite, pyrite, and galena. Some sections are up to 90 per cent sulphides, but the assays are low and bear little relation to the amount of sulphides present.

Diamond drilling apparently went on concurrently with the magnetic and geological mapping. By June 1947, about 3,700 feet of drilling had been completed; the total was in excess of 6,000 feet. The locations of the holes are as shown in the adjoining sketch map (Fig. 53).

South of the D. H. 4 and D. H. 1 claims (**148**), the four Nels claims (P28979-82) were staked in 1953. They were transferred to God's Lake Gold Mines Limited. No work was done on this ground, though the claims were held until 1958 under a grouping certificate.

SW 15

Faust Group *C. L. Group* (**150**)
Dave Group *Ace Group*
Bel Group

During the early exploration activities in the district, a group of quartz veins was found near McVeigh Lake, at about the same time that others were found north of Lasthope Lake. The Faust, Ace and Dave groups were staked during 1939 and early 1940, on behalf of Sherritt Gordon Mines Limited and Central Manitoba Mines Limited. The whole block of claims extending from Ace and Franklin lakes eastward as far as Cockeram and Moses lakes was eventually consolidated under Lasthope Lake Gold Mines Limited, a subsidiary of Sherritt Gordon Mines. The separate group of claims at Lasthope Lake was also included.

The Faust group originally consisted of 150 claims surrounding McVeigh Lake. On the west side of the Faust claims, between Ace Lake and Fraser Lake, were the 58 Ace claims, and on the eastern extension of the Faust group were the 84 Dave claims, the 17 C. L. claims and 27 S. B. claims. The last were all fractional claims. This whole assemblage covered all the ground as far as Moses Lake. The claims were surveyed in 1941, and with the group at Lasthope Lake, made the largest single block of surveyed claims then held by a company anywhere in Canada—a total of 417 claims.

Surface mapping of both groups was carried out by J. D. Bateman in 1941, for the Geological Survey of Canada. The work was published in 1945, as paper 45-14, accompanied by a map on a scale of 1,000 feet to the inch. In this work Bateman subdivided the volcanic and sedimentary rocks into a large number of units and sub-units, and proposed for the assemblage the name "Wasekwan series". The geology, as mapped by Bateman, is shown on Maps Nos. 1, 2, and 5, with his numerous units combined to fit the subdivisions of the Wasekwan used here.

Surface exploration and diamond drilling were in progress at the time when Bateman was mapping.

Gold was found on the southwest side of McVeigh Lake in 1938, by Austin McVeigh and J. Sayies. Gold-bearing float was also found in the creek between Foster and Reservoir lakes. The next summer the source of the float in the "Johnson Shear Zone" was found by Fred Johnson on the south side of Reservoir Lake, and in 1940, the western extension of the zone was found. In 1940, also, gold was found by McVeigh on the shore of Franklin Lake; he had previously found the Austin vein on the west side of McVeigh Lake.

The *Johnson Shear* consists of one or more narrow shear zones in hornblende schist and hornblende-biotite-schist, and it dips steeply north. Trenching has exposed the shear at intervals along practically all the north side of Foster Lake. Gold was found at a number of places over a length of 4,500 feet. South of Reservoir Lake, stripping showed that the zone is over 20 feet wide. It is reported to show four quartz veins between 4 and 8 inches wide, which contain sparse galena, pyrite, and chalcopyrite. Considerable brecciation is visible in the country rock and a similar silicified breccia was seen at the boundary between the Faust 3 and 4 claims. The fresh sulphides are later than the brecciated quartz. Bateman reports carbonate alteration of the rock in the shear zone, and also of a material probably originally fault gouge.

The western extension of the zone, on the Faust 11 claim, is 2 to 3 feet wide and contains a quartz vein, less than 10 inches thick, in a thinly-laminated biotite quartzite. Still farther west the zone is 8 feet wide and contains several quartz stringers with sparse sulphides.

Bateman suggests that, because of its stratigraphic position, the showing of gold found on the northeast shore of Franklin Lake may be a further extension of the Johnson Shear. At that point the shear is 40 feet wide, and contains quartz stringers with sparse sulphides, and associated chlorite and carbonate. Half-inch quartz-carbonate veinlets, which cross the main shear, carry coarse gold and a very little galena and pyrite in a few places. The gold envelops euhedral quartz crystals.

Forty-five holes were drilled in 1940 in testing the shear zone, and more were drilled in 1941. Six holes were drilled under a length of only 140 feet of the zone on the south shore of Reservoir Lake, and eleven more over a length of 230 feet where the shear zone crosses the creek feeding Reservoir Lake.

The *C. L. claims* were staked on behalf of Central Manitoba Mines Limited in 1939, and were optioned to Sherritt Gordon Mines in 1940. The gold discovery is on the C. L. 7 claim, east of Wasekwan Lake. Five trenches were opened by the original stakers. In addition, ten holes were drilled by Sherritt Gordon in 1940. The prospect was not examined during the present work, and the following is derived from Bateman:

The gold occurs in an albitite dyke cutting sediments. The dyke averages 20 feet wide, and a network of quartz stringers fills fractures in it. There is a replacement by a ferruginous carbonate. The hanging-wall rock is also carbonatized, and considerable secondary biotite and chlorite is present in some places. The quartz carries galena and a little pyrite and sphalerite.

There was deep weathering—apparently pre-glacial—of schist inclusions in the dyke. The deep weathering produced a concentration of the gold. Surface sampling indicated gold of commercial grade for a length of 430 feet, with an average width of 20 feet. Diamond drill samples of the fresh rock beneath the deep weathered zone were very low in gold, however.

The *Austin Vein* was located by trenching in the northwest corner of the Faust 5 claim, on the west side of McVeigh Lake. A few trenches, at intervals over a length of 400 feet, are reported to have indicated commercial amounts of gold, and some diamond drilling was done. The vein runs across the narrow neck of granitic rock on the west side of the lake, dips steeply northwest and fills a fissure 1 foot to 4 feet wide. The quartz is shattered and contains pyrite, galena, and a little sphalerite. Feldspars in inclusions of the country rock are completely albitized.

The *Ace Vein*, on the boundary between the Ace 14 claim and the Ace 36 Fraction, is reported to contain galena, sphalerite, and small amounts of pyrite and chalcopyrite, as well as some coarse gold. It occurs in interbedded quartzite and hornblende schist.

Claims in these groups were gradually allowed to lapse. By 1946, all those east of Potato Lake, Expansion Lake, and the north end of Wasekwan Lake had expired, and some between Foster and Wasekwan lakes had been restaked under their original names. The claims west of Maynard, Elb, Ace, and Franklin lakes had also lapsed. In general, only the prospects at McVeigh Lake were covered.

During the staking activity which followed the discovery of the Lynn Lake mines, the ground originally covered by the Ace, Faust, and Dave claims was restaked as a number of groups. For the sake of completeness the names and serial numbers are recorded here but, so far as known, no work was done on most of these claims and such were cancelled after one year. The groups east of McVeigh Lake were:

A. G. group of 9 claims (P15726-15734)
M. C. group of 35 claims (P15735-15770)
WL group of 36 claims (P13371-13400; 13402-13407)
Land group of 18 claims (P13122-13139)
U. P. group of 36 claims (P12582-12617)
Rick group of 3 claims (P16002-16004)
Loon group of 9 claims (P16325-16333)

They were all staked in 1947.

West of McVeigh Lake the area of the former claims was restaked as:

Ice group (P12561-65; 13365-68)
M. M. group (P12566-7; 12569; 13369-70)
R. F. group } (P12931-64)
R. L. group }
S. D. group (P12538-44; 12553-60; 13357; 13360-64).

These claims were staked in 1947 and cancelled in 1950.

These groups made a slight addition to the ground originally covered by the Faust and Ace claims; the area southwest of Fraser Lake was included as far as Nail Lake. The Elb group, which adjoined on the north, extends to Lynn Lake and beyond.

During the summer of 1947, E. O. Lilge made a geological map of the new western staking for Auburn Mines Limited, (R. F. and R. L. groups) and Omnilynn Mines Limited. A magnetometer survey was also carried out by E. F. Creelman.

In his geological report, Lilge noted that the lavas contain considerable magnetite and that pyrite is disseminated in small amounts in most of the rocks. Chalcopyrite was found in small amounts in the volcanic rocks, but no high concentration of any sulphide was seen.

The magnetometer survey found several anomalies around the granitic tongue south of Fraser Lake. These were ascribed to small amounts of magnetite and pyrrhotite, as several nearby anomalies were known to be caused by the same minerals. Two anomalies near Nail Lake were ascribed to pyrrhotite. Heavy gossan is associated with these occurrences, and some trenching was attempted, but the pits filled with water before fresh bedrock was reached. A large and extensive anomaly, west of Franklin Lake was considered to be due possibly to sulphide. This is on the extension of the fold axis which runs through Franklin Lake. Anomalies noted in the areas of sedimentary rocks were ascribed to iron-formation, but no explanation was offered for another in the gneissic tonalite.

In extending its holdings to the south of the Lynn Lake area, Sherritt Gordon restaked, in 1954, all the ground previously covered by the Ice, M. M., S. D., R. F., and R. L. groups. A small part of the area underlies the 38 Bel claims, but the bulk of it is included within the Mail group (**18**). Because the latter is a very large group and covers a great area, which is not of immediate concern, it is discussed elsewhere (p. 188).

The Bel group is, in large part, a restaking of claims originally part of the Ace group, but several fractions fill in irregularities between it and the Elb group which adjoins on the north. The claims were staked in 1952 and surveyed in 1954 (L1751-1788).

During July and August, 1953, eight holes were drilled near the boundary between the Bel 10 and 11 claims. These holes are approximately 3,000 feet north-northwest of the end of Ace Lake, in an area shown as primarily quartzite on Map No. 1. The logs describe the rock encountered as almost completely tuffs of slightly varying appearance, siliceous in places, and with some replacement quartz. The tuffs are cut by narrow, sheared, hornblendite dykes. Sulphides are scarce. These rocks are unusually blocky and caved badly, forcing abandonment of some holes.

Good amounts of pyrrhotite and pyrite were found; short sections (4 feet) contain 20 to 35 per cent pyrrhotite in one hole. In general, it is the more abundant iron sulphide, and the logs imply that these sulphides are usually banded. Minor amounts of chalcopyrite and sphalerite are reported; in some cases they are found in late fractures. The sulphides are associated with silicified tuffs and, in at least one case, with chlorite bands or dark slaty tuff. Quartz may be as high as 35 per cent. It appears that crumpling, chloritization, and silicification of the tuffs are all associated with the sulphide deposition.

SW 15

Travelair Group (151)

The Travelair group, of 21 claims (P13088-13121), was staked in 1947. The claims included the large island in the southwest part of Cockeram Lake and extended westward to the creek which drains Ray Lake.

No work was done on these claims. They were not cancelled until 1951, however, because of the provision in the Mines Act for protection of an estate for a period of three years.

Tor Group (152)

This group, which totalled 131 claims, was actually staked in two distinct parts. One group, consisting of 65 claims, was situated between Hughes River and Hughes Lake. The remaining 66 claims (P14531-575; 11497-512; 10937-39; 16448; 11378) were on the southeast part of Barrington Lake, and included what is now called Webb Lake, as well as much of the belt of volcanic rocks through the islands on the east side of Barrington Lake and to the east of it. They were held by Barrington Lake Copper Mines, Limited.

The claims were staked in 1946 and were allowed to lapse in 1949.

The *Barrington Lake portion* of the two groups was mapped by M. C. Minton, on a scale of 200 feet to 1 inch, and portions of his map have been incorporated in Map No. 3, which accompanies this report. A magnetometer survey, on lines spaced at 300 foot intervals, was done by Geo-technical Development Company Limited during May and June, 1947. Numerous dipoles found by the magnetometer, were attributed to magnetite concentrations. There is a reference in Minton's report to a self-potential survey in 1946, but details are not available.

The northern part of the property at Barrington Lake was not seen during the present work. It is described by Minton as composed of rocks similar to those found northwest of Webb Lake, cut by the adjacent granite and with both these rocks cut by basic dykes. Chalcopyrite and molybdenite have been found in quartz stringers in a few places, but nothing of importance has been reported.

The southern part of the Barrington Lake property, in the vicinity of Webb Lake, is composed mainly of fine-grained volcanic rocks. These include both massive and porphyritic flows, and flow breccias. The latter are composed of porphyritic fragments in a fine-grained and darker matrix. The phenocrysts are feldspar in most cases. More acidic phases occur in a few places; some are dykes, but others appear to be part of the volcanic sequence. Basic dykes were reported by Minton but were not seen—possibly because of similarity to the volcanic rocks.

An alteration zone is found in the granite near its contact with the volcanic rocks.

Small amounts of work have been done at five different places:

1. A group of three narrow shear zones, striking approximately S 80° E and dipping 70° south, about 30 feet apart. They occur on the south shore of the large bay north of Webb Lake. Four pits were blasted on one of these several years ago. The wall rock is silicified flow breccia. Within the shear zones is enough mica locally that the rock is a mica schist. In places the shear is filled by quartz. There is sparsely disseminated pyrite and pyrrhotite; a few specks of chalcopyrite were seen. Sphalerite has also been reported.

2. An irregular mass of quartz and felsite, cutting silicified fine-grained volcanic rocks, is visible in a pit not far from the granite contact. It contains fine-grained disseminated pyrite, molybdenite and chalcopyrite, and is cut by stringers of glassy quartz. A short drill hole was put down beneath this. The core still visible near the site shows very sparse pyrite and pyrrhotite, but accurate logs are not available, and identification marks on the core are now obliterated.

3. On magnetometer line 275, and 300 feet east of the base line (about 100 feet south of 2), is a similar fine-grained felsite which has been stripped for 22 feet. It is up to 12 feet wide and contains considerable molybdenite and sparse chalcopyrite. From this pit a 12- to 18-inch quartz vein trends N 15° and can be followed for 220 feet, but is not continuous on surface. It cuts across massive and porphyritic flows, which here trend N 10° E. In this vein is the best molybdenite seen here; a sample of this assayed 2.5 per cent molybdenum.

4. An acid dyke, more feldspathic than above and with varying amounts of hornblende and biotite, carries disseminated pyrite, chalcopyrite and sparse molybdenite. Maximum width is 6 feet, and it is visible for 20 feet. Minton reports an assay over 2.5 per cent Cu, but nothing was seen which would suggest this grade.

5. A "pyrrhotite dyke" which appears to be three (possibly four) narrow, parallel shear zones, cutting porphyritic and massive flows, and mineralized with pyrrhotite and a little pyrite. There is a rusty zone about 40 feet wide, in which the oxidation is very heavy, considering the amount of sulphide in the freshest rock visible.

None of these occurrences is of commercial value.

They suggest, however, that mineralization here is restricted to the quartz veins and "acid" or felsite dykes cutting the volcanic rocks.

Quartz veins are much more numerous than is usual in other parts of the district, and pyrite, chalcopyrite, and molybdenite are found in the quartz. No information on gold value is available.

NE 16

Bell Group
Ed Group (153a) *Pat Group*
Mike Group (153b)

The *Bell group*, of 27 claims (P13408-13434), was staked northeast of the northern part of the Tor group (152) described above. It covered most of the area of pyroclastic rocks there. The claims were staked in 1947, but there is no record of any work done on them and they were allowed to lapse in 1948.

The *Ed group*, of 45 claims (P18429-18473), in a block six claims wide, covered the area south from the south shore of Wellmet Lake. There is much muskeg and swamp in this part of the area, but the claims were probably underlain mostly by granitic rocks, with small amounts of greenstone and diorite. They were staked in 1948 and lapsed in 1949. There is no record that any work was done.

The *Pat* and *Mike* claims (P14493-14508), nine and seven claims respectively, covered the area of volcanic, pyroclastic, and dioritic rocks west of Star Lake. These claims were staked in 1947, and allowed to lapse during 1948. There is no record of any work on these claims.

NE 16

N. L. Group (154)

This group of eight water claims (P19387-19395) was on the south part of Barrington Lake. It adjoined the G. L. M. C. group (174), west of the outlet of the lake. The claims were staked in 1948; no work was recorded and they were cancelled in 1949.

SE 16

Tow Lake Nickel Group
Abe Group (155)
Ken Group
Vic Group (156)
Hope Group
Rio Group

Genrico Nickel Lines, Limited, a subsidiary of Anglo-Barrington Mines, Limited, has a group of 91 unsurveyed claims between Tow Lake and Barrington River. The group consists of the following claims:

Tow Lake Nickel 1-54 (P22795-22848); Tow Lake Nickel Ext. 7-8 (P29483-4); Tow Lake Nickel Ext. 10 (P29722); Tow Lake Nickel Ext. 13-27 (P29725-39); Dr. Chace Tow Lake 0-6 (P30231-30236); Abe 15-26 (P37546-37557); Abe 33 (P37564).

Review of Ownership and Work Done

Most of the ground now included in this claim group was staked as the *Ken, Vic, Hope,* and *Rio* groups in 1946. (P10008-10034; P11251-11267; P11806-11819; P12062-12070). The original claims were owned by Lynbar Mines, Limited, a subsidiary of Towagmac Exploration Company, Limited. They were mapped by R. J. Merrill, in August, 1947, on a scale of 400 feet to the inch, with some sections at 100 feet. A magnetometer survey had already been done. At the same time, K. G. Honeyman also made a survey of five parts of the group, mainly along the southern rim of the gabbro, by the self-potential method. For these surveys, a series of lines was cut across the area; this grid is still clearly visible and in constant use. The claim groups were considered as separate entities and separate reports and maps were submitted for each.

During 1947, in the course of the 1-mile mapping program of this department, G. P. Crombie briefly examined the gabbro which underlies the claims. For this immediate area he used most of the details of Merrill's map but, whereas Merrill had mapped the intrusion as gabbro, Crombie's petrographic work showed some norite present.

In 1952, Palomar Industries, Limited which had succeeded Lynbar Mines as the owner of the claims, employed Koulomzine, Geoffroy and Company to re-examine and interpret the magnetic, geological and self-potential data previously collected. The area of claims 22795 to 22848 was covered. Some 20,000 feet of drilling were recommended, in 30 holes, of which 18 holes (12,850 feet) were considered an absolute minimum for adequate testing. Also recommended was a self-potential survey of some 660 acres, near the northern edge of the intrusion, and the survey of a further 800 acres by electromagnetic methods.

Additional geophysical work was done by McPhar Geophysics, under the direction of S. H. Ward, in December 1953, at which time the ground was under option to Gold Fields American Development Company Limited, Inc. The work was done by the "dip angle" method using 1,000 c.p.s. equipment. Several anomalous zones were found, but Ward's report stressed that the indications were weak and that many were only "increnulations in the profile of the readings" and were, in many cases, within the limits of error of the method. No drilling was recommended, but Ward did suggest testing with 6 kilocycle equipment. This recommendation was based on then current experience near Lynn Lake, where 6Kc conductors were being found under such weak 1Kc anomalies. [It was subsequently found that the two-frequency method was not rewarding. See D. H. and F. L. claim groups (**148**)].

While McPhar had been conducting this survey, Gold Fields American Development drilled two holes east of the outlet of Tow Lake, under the direction of F. M. Chace. In June, 1954, a further two holes were drilled with a "Packsack" drill, southwest of Tow Lake; two trenches were blasted at the same time. This work was done on an outcrop on which a self-potential anomaly had been found by Honeyman.

In February, 1955, W. R. Williams recommended that Anglo-Barrington Mines, Limited should carry out the drilling program outlined by Koulomzine in 1952. Accordingly, 13 holes, totalling 7,479 feet, were drilled between July and November, 1955. This tested an extensive anomaly south of the main part of Tow Lake.

This work was paralleled, in September, 1955, by an airborne magnetometer and electromagnetic survey, conducted by Lundberg Explorations Limited. The excitation for the electrical measurements was provided by an alternating current applied to a well-grounded cable on the surface. Two of the zones outlined by the airborne electrical survey were checked, by ground methods, in January and February, 1956.

Between February and April, 1956, eleven holes totalling 3,039 feet were drilled. Four of them tested a conductor indicated under the southeast arm of Tow Lake; four others were drilled to test a conducting zone indicated south of the outlet of the lake. The drilling did not satisfactorily explain the conductor under Tow Lake. Central Geophysics Limited was therefore engaged, in April, 1956, to check certain other of the Lundberg anomalies, near More Lake[1], using a "dip-angle" method of measuring the field resulting from a vertical transmitter coil.

On the basis of the combined recommendation of Lundberg and Central Geophysics, three holes, totalling 1,631 feet, were drilled near More Lake, where most of the previous drilling had been done, and two were drilled to test a conductor near the small lake[2] at the southeast corner of the gabbro mass.

After a review of the work and results to this time, W. R. Williams recommended a gravity survey, which was performed in August, 1956, by Radar Explorations Limited. It covered an area approximately 3,000 feet wide and extending over a mile west from the south end of Tow Lake. On the basis of the gravity data, Radar Explorations recommended five holes, two of which were drilled. They totalled 801 feet, and were in the same area south of Tow Lake where most of the previous work had been done.

Harold O. Siegel and Associates, of Toronto, were then provided with all the available information and engaged to review it and make recommendations. This report was submitted in November, 1956, and was essentially the same as the opinions of J. M. Bruckshaw, of London, England, who also examined the data and reported independently in January, 1957. Bruckshaw recommended drilling on one of the anomalies found by Koulomzine and Honeyman. Siegel suggested several others.

In the meantime, during the summer seasons of 1952 and 1953, H. E. Hunter[3] had mapped the gabbro and the immediately adjacent area on a scale of one inch to 1,000 feet. Hunter discussed the petrology of the gabbro at considerable length. He recognized three zones in the gabbro, concluded that they resulted from slight differentiation while the gabbro was horizontal, and that the mass had later been rotated to its present vertical attitude. He further concluded that it had lacked an appreciable sulphur content at any stage and that this, together with its low magnesium content, made it an unlikely host rock for a nickel sulphide orebody.

In 1957 further geological work was done by P. M. Mathews, of Genrico Nickel Mines Limited, which company had been organized to deal with the property. Mathews recognized a number of shear and fracture zones. His work suggested that the known occurrences of sulphides were located at the intersection of such zones. He also succeeded in finding small amounts of hitherto unknown sulphides at similar intersections. This encouraged the company to re-examine the surface geology to locate such fracture zones as a possible ore guide. The mapping is currently (summer, 1958) in progress.

Details of Work Done

On his 1947 map, Merrill divided the intrusive body into a gabbro core, and a mantle of hornblende diorite surrounding it. The gabbro was considered as grading "by alteration of the pyroxene to hornblende and of the feldspar to a lighter variety" into the diorite. Adjacent to the common boundary, near the 3,150 South cross-line, are anorthosite bands and inclusions of volcanic rocks. Shear zones, in this area of differing rock types, contain magnetite and disseminated sulphides.

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[1]This is the small lake on the south boundary of the gabbro at approximately 100° 12′ W., also locally called "Flag Lake".

[2]Locally known as "Pogo" or "Sausage" lake.

[3]Hunter, H. E.: A study of the Tow Lake Gabbro. *Manitoba Mines Branch publication 53-5, 1958.*

Similar conditions obtain east of Tow Lake from about 6600 E, 600S to 10800 E, 1700 N, near the pothole lake locally called "X" Lake. Merrill recognized a shear zone, dipping steeply north, which he considered ran across the whole property from More Lake to "X" Lake. However, about a mile of this length, to the east of Tow Lake, is covered by swamp and muskeg. He also recognized that there is associated with this shear a series of cross-fractures, which strike northeasterly and make an angle of about 45 degrees with the shear zone, and on which the movement is right-handed. This general pattern seems to be confirmed by the geological mapping now in progress. Varying degrees of schistosity are found; in some cases there are dark chloritic schists and amphibolites, which contain abundant disseminated magnetite, some nickeliferous pyrrhotite, chalcopyrite, and pyrite. In addition, bornite and sphalerite were found in two narrow veins of sulphides which outcrop at about 3225 S and 2850 W. It is in this latter area that most of the drilling has been done. Merrill ascribed the magnetic highs found by Honeyman to concentrations of disseminated magnetite in shear zones and to lenses of "the massive micaceous variety" of magnetite adjacent to inclusions in the gabbro. Koulomzine, in his 1952 study of the data of Honeyman and Merrill, recognized a large number of linear zones of magnetic maxima. To explain their discontinuous nature, he postulated some fourteen faults. East of Tow Lake, the assumed faults have a northwesterly trend; the eight faults west of the lake have a northerly trend, and near More Lake the direction is about N 20° E.

In the drilling program recommended by Koulomzine, sixteen holes were sited to test self-potential highs, most of which are in the vicinity of the 3150 South cross-line, west of Tow Lake. In many cases a zone of magnetic maxima coincided with the self-potential high. Koulomzine appears to have paid no particular attention to the faults he had deduced from the magnetic data. Six of the holes, east of Tow Lake, also were sited on the same basis. In a zone running northeast from about 6000 E, 1200 S to 8100 E, 900 N one of the deduced faults coincided with a self-potential high. Six more holes were sited to test this zone and its termination against a fault with northwest trend similarly deduced from the magnetic data. The zone is associated with a complex of gabbro, anorthosite, and inclusions of pre-gabbro rocks. Finally, two holes were sited to test the possibility of a fault along the length of the southeast bay of Tow Lake. No drilling was done.

The first drilling to test any of the anomalies was done with a "Packsack" drill, in June, 1954, for Gold Fields American Development Company. Two holes were drilled at 600 W, 2150 S. They were only 12 feet deep. One encountered 4 feet of massive granular magnetite, with disseminated pyrrhotite, chalcopyrite and pyrite. It contained 2.15 per cent Cu and 0.25 per cent Ni. The second found 5 feet of similar material. There is a 3-inch band of alteration adjoining in the wall-rock.

Two other holes were drilled by the same company in December, 1953. The first (552 feet long, and south at −45° from 1800 E, 1670 S) tested the magnetic anomaly for which Koulomzine's No. 17 hole was proposed. It found mainly medium- to coarse-grained gabbro, with some quartz stringers, olivine, and serpentine alteration. A few pyrite stringers, and considerable lengths containing disseminated pyrite were also found. The log shows no indication of the extension of the fault in the southeast bay of Tow Lake. The second hole (550 feet long, S 30° E and −45° from 1120 E, 1300 S) also found medium-grained hornblende gabbro, but more severly altered than in the first; considerable lengths are reported to be chloritic. Disseminated pyrite and magnetite are present in long sections but there is no very evident correlation between these minerals and the alteration.

The weak indications obtained by McPhar Geophysics, from their electromagnetic survey, coincide generally with self-potential anomalies already known. In the one place where this was not the case, Koulomzine's holes 9 and 10 would have tested it.

Serious drilling began in 1955 with Anglo-Barrington's program for drilling as proposed by Koulomzine three years before. Thirteen holes, with a total length of 7,479 feet, were drilled between July and November, 1955; ten of them were holes proposed by Koulomzine. They were generally close to the 3150 S cross-line between 1800 W and 4200 W, and tested a combined magnetic high and group of self-potential anomalies. These are all in the "A" gabbro, according to Hunter's three sub-divisions.

All the holes intersected gabbro of varying coarseness and degrees of alteration. Some diorite, quartz veins, chloritic gabbro, and pink granite were also found. Most core showed sizeable lengths of sparsely disseminated pyrite and pyrrhotite, but only in hole No. 1 was there a 12-inch length of massive sulphides. Assays showed 3.38 per cent Cu for seven feet at 275 feet; 0.27 per cent Cu and 0.25 per cent Ni for 16 inches at 343 feet. The bands rich in magnetite, which are found in most cores, are probably adequate to explain the magnetic anomalies found; the disseminated sulphides are presumably also the cause of the self-potential anomaly. Most of the stringers of sulphides are in fractures in the foliated gabbro. Where more strongly schistose, sulphide is localized in the schistose portion, or is found in quartz veins which appear to be associated with such schistose zones. Commonly also there is an epidote alteration or clinozoisite in association with the sulphide.

Following the airborne surveys, and the subsequent detailed surface work, 8 holes were drilled to test conductors found. Though not recognized at the time, three of the holes found the fault in the southeast bay of Tow Lake, which had been postulated by Koulomzine in 1952 (his hole No. 18), and indicated as a conductor by Lundberg's electrical survey. Assays showed traces only of copper. Four other holes were drilled between 300 W and 600 W, and between 1700 S and 2150 S. They found a sparse dissemination of sulphides, an occasional quartz vein and tongue of granite, and some shearing. Apparently conditions at this point are very similar to those found by the earlier drilling just to the west.

In the southeast bay of Tow Lake, the Central Geophysics survey found a conductor which is due to the faulting there; another conductor at the southeast end of More Lake (subsequent drilling confirmed the fault found there by Hunter); a weak conductor between two of Honeyman's self-potential highs; and a long curving conductor near "Pogo Lake".

The two holes north of More Lake found quartz veins and granite stringers in the gabbro. A one-foot length of gabbro showed 0.24 per cent Cu but values in zinc, nickel, and cobalt are nil or very low.

Three more holes tested the weak conductor noted above, and found gabbro, sparse sulphides, traces of nickel, and copper values less than 0.1 per cent.

The "Pogo Lake" conductor was tested by two holes, which found granodiorite and quartz hornblende diorite, hornblende schists and quartz biotite schists, but very sparse sulphide minerals. Assay values are negligible.

Following the gravity survey by Radar Explorations, Limited, two holes were drilled in gabbro and quartz hornblende diorite, but they found no notable sulphides. There were a few streaks of epidote and a few calcite veinlets.

The drilling reached a grand total of 16,629 feet, in 30 holes; almost all was done in the area between 500 W and 4200 W.

Summary

The numerous geophysical surveys performed on this intrusion have shown a limited number of electrical conductors, and a large number of magnetic maxima. In the drilling done to date the electrical conductors have been shown to be due to dissimenated sulphides and/or faults. This, of course, gives no valid indication of the cause of other conductors not yet tested. It is, however, perhaps worth noting that the electrical anomalies found by Ward, and more recently by Koulomzine, are not very definite. (Does this mean that, to the depth of penetration of this equipment, no really good conductors are present?)

It has been pointed out several times, by consultants who have studied the property, that the magnetic disturbance caused by any nickeliferous sulphide body will be masked by the variation in the magnetite within the gabbro. Any use of the magnetic data must therefore be indirect only. This is implicit in Koulomzine's deduction of faults from these data, and their interpretation as possible ore loci. Also implicit in any such approach, however, is a knowledge, or assumption, that there is a systematic distribution of the magnetite and that the control is recognized. If, as preliminary results appear to indicate, magnetite is especially concentrated in narrow shear and fracture zones, deductions from the magnetic data may be valid. Should the magnetite be an irregular primary segregation in the gabbro, however, such deductions would no longer be possible. In short, despite the simplicity and reliability of the measurements, geological interpretation of these magnetic data must wait on recognition of the control of magnetite distribution, or be based on assumptions.

In this case, it would appear that primary reliance must be placed on surface mapping and such deductions as may be drawn from it.

SE 16

Copper Bay Group (157)

The Copper Bay group consisted of 27 claims (P14846-77), located south of Barrington Lake and west of Barrington River. The Hope group (156) adjoined it on the south side. The rocks underlying the group consist mainly of pyroclastic types, with smaller amounts of basic flows and quartz-feldspar porphyry. Gabbro is found in the southern part of the group, around the widening of the Barrington River which is now known as Larson Lake.

The Copper Bay claims were staked in 1947 and were cancelled in 1950.

During January to March, 1948, a magnetometer survey of the group was conducted, under the direction of A. A. Brant, on all but five of the claims. At that time the claims were held by Hemisphere Mining Company, Limited. Brant found anomalies large enough to be significant on claims P14869, 14847, and 14856. Similar anomalies on 14850, 14855, and 14860, he considered probably marked the extension of a shear zone from Nickel Lake, and pyrrhotite was observed in the adjacent outcrops of greenstone. Of the other anomalies, that on 14847 at the margin of the gabbro was expected to be similar to that found on the Nickel Lake property to the west: pyrite and pyrrhotite, with a little commercial sulphide, in lenses in shear zones. Drilling was recommended on three anomalous bands near the gabbro-volcanic contact, at the east end of Larson Lake, (claim 14869), which appeared to be adjacent to a northwest tension fault in the river.

Three holes were drilled, on claim 14869, during August and September, 1948. These found mainly gabbro containing some magnetite and occasional specks of pyrrhotite. Quartz veins in shear zones were also found, and contained small amounts of sulphide. Narrow dykes of granite occur, and in hole No. 2 a 40-foot band of granite was found. The combined length of these holes was 649 feet.

Two others were drilled on claim 14847 in September, 1948. Hole No. 4, found "sheared intermediate lava breccia", a few small carbonate stringers, and some fine-grained magnetite to 82 feet; thence gabbro, "non-magnetic", to 106 feet, with specks of chalcopyrite at 82 to 85 feet, and 162 to 198 feet. Fine-grained greenstone with magnetite sufficient to make the core magnetic occurred from 106 to 213 feet. Hole No. 5 intersected greenstone with carbonate stringers.

SE 16

Copper Hope Group (158)

The Copper Hope group, of 18 claims, was staked in 1947. It covered an area south of Webb Lake, on the east side of Barrington River, and adjoined the Copper Bay group (157) just described.

There is no record of any work having been done on the claims, and they were cancelled in 1949.

NW 16

J. B. M. Group (159)

This group comprised 10 claims (P11233-11242) over the eastern half of White Owl Lake, and adjoining the Lind group (170) of Sherritt Gordon Mines. The claims were staked in 1946 and were cancelled in 1948. They were mapped by M. C. Minton, for Torwin Prospecting Syndicate in August, 1947. His map shows porphyritic andesite and some basic rocks which appear to be tuffs, cut by a basic diorite. The andesite is fine grained, and dark grey to greenish black on the weathered surface. The phenocrysts form about 10 to 15 per cent of the rock and are feldspar with very minor quartz, in a matrix mostly of hornblende. The diorite has the common "pepper and salt" appearance, where visible east of the lake, and contains about 50 per cent hornblende in felted needles, which appear to be chloritized.

Minor amounts of pyrite and pyrrhotite were reported from the gabbro in the northeast corner of the property. Minton recommended a geophysical survey, but there is no record that this was ever done.

NW 16

Spider Group (160)

The Spider Group of 8 claims (P11514-11521), staked in 1946 and cancelled in 1948, was also mapped by Minton in 1947 for the Torwin Prospecting Syndicate. The claims covered the area of volcanic rocks east of Brooks Bay, Barrington Lake. According to Minton there is tuff and breccia present as a narrow band within the usual porphyritic andesite such as is found on the J. B. M. claims (159). Also present is a highly altered zone which is probably sheared andesite. Both the volcanic and granitic rocks are reported to be cut by basic dykes, though this is an unusual relation in this district.

Four trenches were put down, in 1946, on the shear zone, and, in 1947 X-ray drilling was recommended. There is no record of this having been done, nor of what was found in the trenches. Low gold content was reported from samples.

NW 16

M. S. Group (161)

This group of 16 claims (P12658-12673) covered the gabbro mass between the west shore of Barrington Lake and the north tip of White Owl Lake. The claims were staked in February, 1947 and were mapped by M. G. Smerchanski, for Winora Gold Mines Limited, in August and September of that year. They lapsed in 1949.

That portion of the claim group immediately south of Dorothy Lake is underlain by muskeg and sand. Outcrops are extensive only in the southern half.

The volcanic rocks are mainly fine- to medium-grained, and are porphyritic in the southwest corner adjoining the J. B. M. group (159), where the same porphyritic lavas also occur. Flow features are rare. Hornblende schist near the east part of the portage trail to Barrington Lake and near the extreme north tip of White Owl Lake is not extensive, and is probably due to shearing. There is a faint schistosity visible in the "greenstone"; this generally trends N 60° E.

The gabbro was mapped by Smerchanski as a basic diorite, and considered to be a coarse phase of the andesite, rather than an intrusion. This point has been settled by the discovery of foliated inclusions of greenstone in the massive gabbro. (See above, p. 52.)

A few dykes of pink to grey granite gneiss occur near the main mass of granite, to the northwest of the group.

Nothing of economic value was seen.

A geophysical survey was recommended but apparently was never performed.

NW 16

Mac Group (162)

This group of 18 claims (P12227-12244) was staked in 1947. It covered a roughly triangular area between Mac Lake, Marnie Lake, and the north end of Ellystan Lake. The Lind group (170) adjoined it on the north, and the B. J. M. C. (174) adjoined on the southeast corner.

The claims were examined by Dr. W. R. Newman in February, 1948, for Martin McNeely Mines Limited; further work was done under his direction during the summer. Claim lines were surveyed, a base line and cross-lines were cut, and a geological map was made. There is no record that any geophysical work was done, however.

The westerly ten claims are underlain by granite; the remainder by massive greenish andesite. In the southeastern part of the property the andesite is cut by a tongue of granite, with accompanying metamorphism. The granite is pink, contains hornblende and biotite, and is gneissic near the contact. There is a carbonatized, schistose rock of tuffaceous appearance in the "greenstone" near the creek which drains Mac Lake.

There are a few narrow shear zones in both the granite and the volcanic rocks, but these are reported to be without sulphides. A few quartz veins on claims 12231 and 12234 (i.e. on the west side, and south of, Mac Lake) carry only traces of gold. Northwest of the lake, a silicified zone, containing pyrite, carries 0.02 ounces Au per ton.

In pits, on the Leo claims (163), 300 feet east of the Mac Lake, the andesite contains disseminated pyrite, pyrrhotite, and chalcopyrite; this is not of economic grade.

The Mac claims were cancelled in 1949.

NW 16

Leo Group	(163)	*Kilroy Group*	(166)
N. L. Group	(164)	*Andy Group*	(167)
I. Q. Group	(165)	*Dorothy Group*	(168)

A group of 21 claims (P14448-14468) known as the *Kilroy* claims was staked in 1947, between White Owl Lake and Barrington Lake, and between the J. B. M. (159) and M. B. (171) claim groups. The group covered a part of the gabbro-diorite mass between the two lakes. The claims were cancelled in 1948 and the majority were re-staked as the *Andy* claims (P19718-19734).

Adjoining this group to the southeast was a similar group known as the *I. Q.* claims (P13202-13219), covering the ground east of Leo Lake. The I. Q. claims were between the Leo group to the west and the B. J. M. C. group (174) to the east. They were cancelled in 1948 and re-staked again in 1948 as the *N. L.* 21-38 claims (P19844-19861).

There is no record of any work having been done on any of these claims.

The *Leo* group of 26 claims (P12245-12270), staked in 1947, covered the ground south and west from the Leo Lake to Mac Lake and towards Ellystan Lake. The area is underlain by volcanic rocks, with some granite in the southern part. In a report on the Mac group, which was immediately west, there is mention of pits, 300 feet east of Mac Lake, which show fine disseminated pyrite, chalcopyrite and pyrrhotite. This is not of economic value. No other information is available on the work which was done on these claims. They lapsed in 1948.

The 24 *Dorothy* claims (P14469-92) covered the area of granite and volcanic rocks between Dorothy Lake and Brooks Bay, Barrington Lake. There is no record of any work done on these claims, and they were cancelled in 1948.

NW 16

B. J. S. Group (169)

This group comprised 29 claims (P16462-16490). The northern part of the group included Jim Lake; the claims extended east, west and south from there to the adjoining Lind group (170). There is some greenstone in the southern part, but otherwise the underlying rock is granodiorite. The claims were staked in 1947 and lapsed in 1948.

NW 16

Lind Group (170)

The Lind group consists of 10 surveyed claims at the west end of Farley Lake. and is held by Sherritt Gordon. These claims are the remnants of a group of 129 claims, staked at intervals during 1946. The original claims had the following numbers:

P9474-9503	P10923-10935
P10711-10718	P10995-10999
P10805-10831	P11001-11004
P10877-10913	P11081-11085

The group covered an extensive area centered around Farley and Gordon lakes. It extended as far east as White Owl Lake, to Marie Lake on the north, and Simpson Lake and Marnie Lake on the south.

Gold was first found in frost-heaved boulders at the west end of Farley Lake Diamond drilling subsequently confirmed the source of the boulders near the discovery, and several holes were drilled. The gold occurs in a dark grey to brown impure quartzite which is a part of the belt of iron-formation and magnetite-bearing slates at Farley Lake. Fine pyrite and pyrrhotite are disseminated through the rock at the showing, possibly associated with slip planes. Fine-grained quartzite, "slaty argillite", and diorite were found during the drilling.

The group was mapped in 1949, by C. D. A. Dahlstrom, under the direction of W. F. Morrison. The rocks were divided into massive and pillowed lavas, sedimentary and pyroclastic rocks, banded iron-formation, granite, felsite, diorite, and feldspar porphyry. Dahlstrom considered the structure to be a syncline (not an anticline, as shown on Map No. 3).

Drilling was also carried out on a gold prospect 150 yards northwest of Pump Lake. It consists of a white, sugary quartz vein, which is branching and lensy. It has an orange stain and some hematite. The vein strikes N 50° E and dips vertically. It has been traced on surface for about 150 feet. It pinches out to the southwest, but has been traced for a further 350 feet northeast by diamond drilling. At the northeast end it either pinches out or is faulted off. The vein lies in a shear in a dark greenish grey granodiorite high in quartz, which is bluish. Chlorite and a little pyrite occur on slip planes in the granodiorite, but there appears to have been very little alteration except silicification. There are numerous joints and shatter zones in the granite, but no definite system is recognizable. The maximum vein width on surface is 2½ feet.

Trenching was done at a number of other places within the group, but most of the pits are now caved and little is visible. No information is available from the former owners. The following notes are from Stanton's report of 1947[1]. At that time the work was new, and some trenching was still in progress:

"About 1,000 feet north of the east end of Gordon Lake a small pit has been sunk in a sheared siliceous and sericitic buff felsite, resembling sheared rhyolite, in contact with black graphitic argillite to the south. The felsite may be a flow or a fine-grained acid intrusion. The graphitic argillite has been mapped as a member of the sedimentary belt. The felsite is cut by a few quartz stringers. Some rust and a little pyritic mineralization is present. High magnetic deflection occurs in the region. Formational strike is due east and has a dip of 75 to 80 degrees to the north. No information as to length or width of the zone is available, as the working occurs on a small isolated outcrop.

"About 1,700 feet west of the southwest portion of Farley Lake, two pits have been sunk in a rusty mineralized zone in pillowed andesite. The rock of the mineralized zone is massive, fine-grained, green, and closely resembles the texture and colour of the pillowed andesites in which it occurs. The suggestion of walls however, implies it may be an andesite dyke. It is mineralized with the fine pyrite, a little chalcopyrite and pyrrhotite. The zone strikes about south 60 to 65 degrees east, and dips vertically to 85 degrees north. It is three to three and one-half feet wide and has been opened up by two pits over a strike length of 25 feet. No information on possible gold values was available. At time of inspection, surface trenching was still underway.

"About 2,000 feet north-northwest of Gordon Lake, trenching has been done on a rusty mineralized shear zone in volcanic rocks. The mineralized zone is 10 to 12 feet wide and has been explored by two trenches 100 feet apart. The rock comprising the zone is blocky, pale grey, massive to sheared, and leached, and is probably a fine-grained acid intrusive sill. The zone strikes about south 60 degrees east. Wall rock on the south is fine-grained andesite, and on the north is somewhat coarser porphyritic andesite. Agglomerate outcrops a short distance to the south. The zone is mineralized chiefly with finely disseminated pyrrhotite and pyrite. A grab sample was reported to carry 0.14 per cent copper but no gold or nickel."

A magnetometer survey, in 1947, showed a strong magnetic high in the centre of the group, from Farley Lake almost to Key Lake. (See also Map No. 13A). This zone is up to ½ mile wide and is apparently due to the banded iron-formation which outcrops at a few places. Where visible west of Gordon Lake, this formation is composed of cherty layers, usually less than ¼-inch thick, between layers of hematite and magnetite, which may be as much as 6 inches thick but are generally less than 2 inches. As is usually the case elsewhere, the rock is considerably drag-folded, and faulted on a small scale. Both these features show that the north side moved eastward, and the axes of the drag-folds plunge westward at 35 degrees.

A sample of the thickest and "best looking" material visible contains 37 per cent metallic iron. A sample taken by Stanton showed a somewhat lower iron content: 24.85 per cent on hematitic, 18.20 per cent on non-hematitic, material. Grab samples, one from the outcrop and another made up of fragments in the roots of an overturned tree, taken at the western end of the band, showed 11.80 per cent and 34.40 per cent metallic iron, respectively.

The 22 claims of the *Lindy* group (P11077-11080, P11167-11180, P11764-11767) adjoin the Lind claims, and are usually considered a part of the same group.

M. B. Group (171)

The M. B. group, of 24 claims (P13462-13485) was staked in 1947 and cancelled in 1949. Six of the claims were on the shore of Barrington Lake; the remaining

[1]Stanton, M. S.: Farley Lake Area, *Manitoba Mines Branch, Prelim. Rept. 47-5, 1948, pp. 19-20.*

18 covered the area of volcanic rocks and granodiorite north of Marie Lake, between Jim and Dorothy lakes.

There is no record of work done on these claims.

NW 16

Key Group (172)

The Key group of claims, 48 in number (P11901-48), was staked late in 1946, adjoining, on the west, the Lind group (170) of Sherritt Gordon Mines, Limited. The group extended west beyond Key Lake, with a part extending south almost to Low Lake. The property was held by Cheslynn Mines Limited, a subsidiary of Cheskirk Mines Limited.

The property was mapped by E. O. Lilge, in 1947. He found sedimentary and basic pyroclastic rocks, quartz diorite and gabbro, quartz porphyry and diabase. Apart from the small body of diorite east of Key Lake (Map No. 3), the accompanying maps incorporate most of the details shown by Lilge.

His map, however, shows a body of quartz porphyry instead of the diorite, and the porphyry is represented as underlying a much larger area than is shown on Map No. 3. Lilge shows a broad band of porphyry north of the two small lakes immediately southeast of Key Lake. Near the northeast corner of the smaller lake, and at the tip of the porphyry, he reported arsenopyrite and sphalerite in a quartz-filled shear, but no assay values were given.

Checking this on the ground has shown that for at least 800 feet north-northwest of the corner of the lake, the rock is bright greenish, strongly schistose "greenstone", high in feldspar. It is very schistose in some places and appears to have a high chlorite content. The "greenstone" is cut by dykes of diorite, which are up to five feet thick and are low in dark minerals (20 per cent). The diorite has less than 5 per cent quartz and is not porphyritic. It may well be even less extensive than is shown on Map No. 3. A few quartz veins are present.

A portion of this group was re-staked in 1950 as the *Leo* group, but no additional work was done and the claims were cancelled in 1952.

SW 16

Tor Group *Tor B Group* (173)

The southwestern part of the Tor claims, of Barrington Lake Copper Mines Limited, was located near the south end of Hughes Lake. The numbering of the claims of this group is involved, because they were numbered serially with those of the Tor group at Barrington Lake. Those at Hughes River were numbered as follows:

Tor 1 to 6	P10864-69
14 to 16, 18 to 21, 23 to 32	P11379-87, P11243-50
46 to 81	P12688-723
Tor B 1 to 6	P16449-54

As can be seen from the recording numbers, these claims were staked at intervals during 1946 and 1947.

The group covered the main area of acid and basic volcanic rocks and conglomerate between Westdal and One Island lakes and between Stan and Hughes lakes and Hughes River.

Reconnaissance magnetometer work was done in May and June of 1947, by running along the claim lines. Detailed work was done in the vicinity of a copper showing at Hughes River. The work was done by the staff of Geo-technical Development Company Limited under direction of M. C. Minton. In his report of August, 1947, Randell, of Geo-technical, was very critical of the above procedure. He interpreted the magnetic data to indicate a series of volcanic inclusions in granite, rather than the lavas and conglomerate visible on the ground. He reported, in consequence, that "the area does not appear favourable for the existence of either base metals or auriferous deposits".

Mapping during the following summer showed the area to be predominantly basic lavas, with some interbedded more siliceous types. The Sickle conglomerate, on the western side of the property, is cut by basic dykes (which must therefore be equivalent in age to the Black Trout Diorite). The volcanic rocks are intruded by granitic types, some of which may be post-Sickle. The geology, as shown on Map No. 3, is based on the work of M. S. Stanton, not on that of the company geologists, which is not available.

The sulphides mentioned above were found in an outcrop of andesite rock, which is practically on the granite contact on the shore at the extreme south end of a bend in Hughes River, east of Stan Lake. The exposures are on top of a steep hill rising up from the river.

Several drill holes are visible but their depths are not known. At the foot of the hill is a core rack which contained at least 750 feet of core, but the identifying numbers are now illegible, and some of it is scattered on the ground. It consists mostly of andesitic "greenstone", with some disseminated pyrrhotite, pyrite, and a little chalcopyrite.

Some stripping and trenching have been done in the vicinity of the drilling sites. A blast opened a considerable pit on the hillside, but it is now caved. Large fragments in the pit show some pyrite in disseminated coarse grains and small masses, in a siliceous gossan with a boxwork formed by cavities due to the solution of the pyrite crystals. This is on the extension of a fault visible in a pit on the hill top. The fault has associated disseminated pyrite and chalcopyrite in the wall-rock for several inches, and is filled by a ½-inch stringer of massive sulphides. There is some epidote, and rosettes of actinolite(?) were also noted. Minton reports that blue-green hornblende, fine-grained biotite, and chlorite were also found in thin section. Sulphide deposition does not appear to be in any way associated with the very regular and prominent joints which are spaced about 6 inches to 1 foot apart. The highest copper assay reported was 14.92 per cent over 1 foot, according to Stanton.

The plan of the drilling is difficult to deduce from the evidence visible. Evidently the holes were intended to test beneath the surface exposure. The inclined holes would pass beneath it at a maximum depth of 50 feet. Of the vertical holes, two were on the outcrop and the other 50 feet away. Pyrite occurs at several places in the vicinity.

A further hole is reported to have been drilled about 300 feet north of the surface exposures.

The above work was applied as assessment work on claims 1-32, which were allowed to lapse in 1950. The remainder of the claims of the group were cancelled in 1949.

SW 16

G. L. M. C. Group *B. J. M. C. Group* **(174)**

Nickel Lake Mines, Ltd., a subsidiary of God's Lake Mines Limited, holds a group of 68 surveyed claims, (L1282, L1291-3, L1300-04, L1309-13, L1320-22, L1651-1701), originally staked in 1947. The group extends from south of Leo Lake to within 2 miles of Barrington River. This is the remnant of a much larger group of 72 B. J. M. C. claims (P13937-14008) and 137 G. L. M. C. claims, (P12072-12143; P13874-13936) which originally covered most of the south shore of Barrington Lake. It adjoined the Leo (**163**) and I. Q. (**165**) claims at the northwest end, the Copper Bay claims (**157**) at the southeast end, and extended as far west as Ellystan Lake. The present claim group covers, primarily, the gabbro mass at Nickel Lake, the smaller satellite gabbro bodies, and the volcanic rocks in which they are found.

Some copper float was found on the southeast part of the property shortly after staking, but, the source has not been found; nor has the source of quartzose fragments from just east of Nickel Lake, which contained 0.60 ounces Au per ton.

The B. J. M. C. claims were mapped by H. R. Fowlie in 1948, by which time they had already been surveyed. Details of his map have been incorporated into Map No. 3. He reports that basic flows form the larger part of the Wasekwan rocks, though a little rhyolite and trachyte are present. Porphyrite and amygdaloidal andesites are fairly common. Amygdales, up to 1½ inches are filled by cherty quartz. The G. L. M. C. claims were mapped by G. M. Brownell in 1947, and a magnetometer survey was also done under the direction of A. A. Brant. For the area covered by this group of claims, Map No. 3 is based very largely on Brownell's work.

The magnetometer survey showed broad magnetic "highs" (500 to 1000 gammas) in the northern and southern parts of the G. L. M. C. group. These are in a granitic area and were ascribed to hornblende gneiss. Two magnetically uniform belts were recognized: one on the south margin of Nickel Lake, the other about 1,000 feet south. One had already been tested in claim G. L. M. C. 50E and in G. L. M. C. 52E. Because the most likely looking places had already been tested, no further drilling was recommended.

Further geophysical work was done by McPhar Geophysics Limited in 1954, under the direction of J. A. Syme. On the B. J. M. C. group several weak electromagnetic anomalies were found. Further exploration was suggested on three anomalies on claims 68, 59, and 37. No response was found over the magnetic anomaly on B. J. M. C. 48 or 49. On the G. L. M. C. claims a consistent response was found in several anomalies along the south shore of Nickel Lake and they were ascribed to shear zones. On the G. L. M. C. east group two very long conductors were found. They were considered to be due to a shear or contact, possibly mineralized. Previous drilling had already intersected one of these (on 51E and 52E). A small conductor on G. L. M. C. 73 coincided with a magnetic anomaly and drilling was recommended. The drilling which was done found mostly mafic rocks, some granite and porphyry, and only a narrow zone of very sparse sulphides. The highest assay showed 0.13 per cent Cu and 0.05 per cent Ni.

In March, 1949, Sherritt Gordon Mines Limited drilled eight holes, mainly in Nickel Lake, on the G. L. M. C. 28, 30, 31, 22, 23, and 24 claims. The holes found basic flows with interbedded pyroclastic rocks. The highest content of copper was 0.23 per cent and of zinc 0.5 per cent for 10 feet, though sparse sulphides are widely disseminated.

The fragmental volcanic rocks continue to the southwest for a short distance beyond the shore of the lake. Stripping, about 100 feet from the lake, has shown a branching shear zone cutting fragmental types in the northeast part of G. L. M. C. 21. This is very close to the gabbro contact. There is disseminated pyrrhotite in the shear zone.

Nickel Lake Mines drilled a hole under the lake in the northeast part of G. L. M. C. 25.

SW 16

Dot Group *PAQ Group* (175) *Gard Group*

Twenty claims (P15179-89; 15420-28) formed the *Gard* group, which adjoined the Tor group (173) and covered the eastern half of Westdal Lake. Almost the entire area is granitic. No work was done and the claims were cancelled in 1948. Adjoining this group on its eastern side was the *PAQ* group, (P13685-92), of eight claims staked sometime earlier. The PAQ group, with the thirty-three claims of the *Dot* group (P13161-13193) covered the narrow band of volcanic rocks through One Island Lake and the Hughes River south of Elizabeth Lake. No work was recorded on these claims and they were cancelled in 1948.

SW 16

S Group *DT Group* (176)

The DT group of 22 claims (P17924-34; 17938; 17970-79), together with the S group of eighteen claims (P17643-58; 17980-81) formed a unit on the south side of the G. L. M. C. group (174) at Nickel Lake. The groups covered most of the two small lakes on Ashley Creek south of Nickel Lake and extended southeast to include the western extremity of the gabbro at Larson Lake. Much of the area is underlain by granitic rocks. The claims were staked in 1947.

In February, 1948, Sherritt Gordon Mines drilled an X-ray hole to 220 feet on the S6 claim, and found andesitic flows cut by quartz diorite and granodiorite dykes. The rock was sheared from 188 to 220 feet, but contained no sulphides.

In April, 1949, four holes, totalling 450 feet of X-ray core, were drilled on the DT 5 claim. These holes are on the south shore of the second lake on Ashley Creek. They all found coarse-grained "quartz diorite and granodiorite" cut by pink pegmatites. Very slight pyrite was found in a few places. The holes were to depths from 75 to 150 feet. Three holes on the DT 3 claim also found granitic rocks.

In June, 1949, on DT 1 claim, four holes drilled from the same position at varying angles were also reported to have found quartz diorite cut by pegmatite and granite.

The claims were allowed to lapse in 1950.

SW 16

R. G. M. Group (177)

The R. G. M. group comprised 12 claims (P17935-37; 17939-47) along the northwest shore of the lake northeast of Marsh Lake. The area east of Omega Lake is almost entirely granite and diorite. The claims were staked in 1947, and cancelled in 1949 for lack of work.

SW 16

EXO Group (178)

This group of 50 claims (P17855-17904) was staked in 1947, covering an area of granite and diorite between the Hughes River and Omega Lake, north of Elizabeth Lake. No work was done, and the claims were cancelled in 1949.

SW 16

TAF Group (179)

Nineteen claims of the TAF group (P17905-23) were located east of Marsh Lake, and covered the western part of the Tow Lake gabbro body. There is, however, no record of any work having been done on this group, and the claims, which were staked in 1947, were cancelled in 1949.

The eastern portion of this area is now covered by the Abe claims of the Genrico Nickel Mines property at Tow Lake.

SW 16

Bell Group (180)

The Bell claims 6 to 15, (P16669-16680) were staked in 1947 on the band of volcanic rocks east of Hughes River and southeast of Elizabeth Lake. The claims were cancelled in 1948 for lack of assessment work.

APPENDIX A

PORTAGES ON THE CANOE ROUTES THROUGH THE DISTRICT

101°06′W 56°50′+N
MARGARET LAKE to SHEILA LAKE. Shallow. Navigable without difficulty at high water. G.C.M. 1956.

101°05′W 56°50′+N
1. SHEILA LAKE to FRANCES LAKE. Portage 250 yards. Trail wet. G.C.M. 1955.
2. SHEILA LAKE to LYNN RIVER below FRANCES LAKE. Portage 200 yards. Good trail. Good landings but the southern is difficult to reach when water is low.

101°05′W 56°50′+N
LYNN RIVER at discharge into W. LYNN LAKE. Good trail on S. bank, 200 yards long.

101°08′W 57°00′N
GOLDSAND LAKE to EX LAKE. Portage 130 yards. J.D.A. 1947.

101°10′W 56°49′N
On Creek between MOTRIUK LAKE and FRANCES LAKE. Portage 240 yards on east side. Western landing is treacherous when going downstream. Good trail. Shallow water at several places between this and Frances Lake. G.C.M. 1955.

100°59′W 56°52′N
LYNN RIVER between WHEATCROFT LAKE and KEEWATIN RIVER is very shallow. Navigable only at high water. At low water is almost dry near junction with KEEWATIN RIVER. Both portages, as shown, are good trails, but are not well marked on the ground. G.C.M. 1955.

KEEWATIN RIVER between GOLDSAND LAKE and COCKERAM LAKE is also shallow. No details on most of rapids. With roads now running close to LITTLE BRIGHTSAND and BERGE LAKES, it would be a waste of time to use the river.

100°48′W 56°55′N
ARROUR LAKE to HUET LAKE. Fair trail, 150 yards long. Poor landing at north end; shallow water.

100°51′W 56°52′N
Apparently much of the creek leading north from the east side of COCKERAM LAKE to the small pond west of CARR LAKE is navigable, but no details are recorded. J.D.A. 1946.

100°49′W 56°48′N
KEEWATIN RIVER at discharge into MOSES LAKES. The northern rapid is short and can be lined readily. There is a portage on the north bank, but it is badly obstructed by windfalls. The river is shallow for some distance upstream from the rapids. G.C.M. 1955.

100°48′W 56°46′N
MOSES LAKE to ANSON LAKE. Rapids can be lined on east side, with some difficulty. Portage shown was not used, and landings are not clearly marked. G.C.M. 1955.

100°45′W 56°45′N
KEEWATIN RIVER below ANSON LAKE is shallow in many places. Lining is possible at low water, but the rapids can be most quickly passed by the portage on the north side. East landing is good. West landing is over boulders in the river. Trail is through alders, but is good.

100°44′W 56°46′N
Outlet of CARTWRIGHT LAKE is easy travelling. Portage around a shallow stretch is 250 yards. It crosses a narrow swamp, but is otherwise very good. Landings are good. There is an excellent camp site at the entrance to the southeastern bay, but they are otherwise very scarce on CARTWRIGHT LAKE . G.C.M. 1955.

100°43′W 56°55′ to 57°00′N
HUGHES RIVER north of MUSKEG LAKE. No details available on the numerous rapids present. The writer has been told that two Indians once ran the full length of the river above HUGHES LAKE without portaging—but that pieces of their gear came downstream for several days after. G.C.M.

100°41′W to 100°34′W, 56° 47′N

Portage route Cartwright Lake to Hughes Lake, via Gap Lake. No details available. Understand this trail is very difficult as well as long, and is used mainly in winter. Fires have obliterated it in places. G.C.M.

100°35′W 56°53′N

Connection between Hughes River and Chepil Lake is navigable, but requires 50-yard portage through reeds at a shallow part. G.C.M. 1955.

100°34′W 56°52′N

Outlet at south end of Chepil Lake. Requires lining in one place, but channel has been cleared of rocks and is deep though narrow. G.C.M. 1955.

100°34′W 56°54′N

Eagle River below Auni Lakes. Southern portage is good dry trail, 770 yards long. South landing excellent. North landing swampy.

Northern portage has poor landing at south end, in willows and boulders, but is dry. Northern landing above a beaver dam. Trail, 660 yards long, through muskeg is fair, but has many branches, some firmer than others. G.C.M. 1955.

100°34′W 56°55′N

Between Auni Lakes. Two trails. Northern is longer and has a miserable landing at east end, in a wide swamp. The southern is a wide dry trail, with good landings at both ends. Going upstream, end of the southern trail is not visible from the lake. It is necessary to pole through reeds and shallow water well into the connecting creek. The landing is then readily visible on the left at the first right angle bend in the creek. G.C.M. 1957.

100°34′W 56°56′+N.

Eagle River. 45 yard portage on N side, where river is filled by boulders. Landings are dry but difficult to reach because of shallow water. Trail good in muskeg. G.C.M. 1955.

100°34′W 56°57′N

Rapids at outlet of Eagle Lake. Completely obstructed at all times. Good trail on north side, moist at west end. Excellent camp site on portage.

The river between Eagle Lake and Auni Lakes should be attempted with a loaded canoe only at times of high water. The wide part of the river south of Eagle Lake is very shallow. In August, 1955 it could be travelled with difficulty with a load. In July, 1957, it was barely passable with an empty canoe. G.C.M.

100°35′W 56°58′N

Portage trail shown, on preliminary maps, as connecting Tulune Lake and Eagle Lake has now been obliterated. There is good walking between the two lakes via surveyed claim lines, but no carrying trail.

100°32′W 56°52′30″N

First rapids upstream from Hughes Lake. Short portage over a ridge on south side. W landing is in grassy area well above the rapids. E end is not easily seen from river, and is some distance from the foot of the rapids. G.C.M. 1955

"Herman's" Cabin, at the north end of Hughes Lake was in use till autumn, 1956.

100°30′W 56°45′N

Hughes River below Hughes Lake. Formerly a much travelled route, but no details now available. Understand that many rapids require lining when going upstream, though water is deep.

100°24′W 56°54′N

Farley Lake to White Owl Lake. 530 yards through muskeg. Trail is fair. At east end landing is very wet; west end is a little better but is swampy. G.C.M. 1955.

100°22′W 56°55′N

White Owl Lake to Barrington Lake. Two portages and a small pond. Barrington Lake end is dry and a regular camping site, but near the lake the trail climbs very steeply up a high ridge. Thereafter a good trail to the pond. From the pond to White Owl Lake there is a former tractor road. The western landing is at the end of the tractor road but is not good. The portage trail parallels the tractor road and has excellent footing. The eastern end is a few yards south of the tractor road; the turn-off from the road at the western end is almost invisible. G.C.M. 1955.

100°17′W 56°53′N

Barrington Lake to Nickel Lake. Short portage over good trail from a shallow creek on Barrington Lake. Portage to Nickel Lake is over good trail but the north end is very wet, and the south end is difficult to find from Nickel Lake because screened by alders and willows. G.C.M. 1955.

100°15′W 56°51′N

ASHLEY CREEK is navigable from NICKEL LAKE to TOW LAKE, with deep water most of the way. There is a short portage at the outlet of NICKEL LAKE. Another, 310 yards long, is nearer TOW LAKE. Both are excellent trails. Landings are good. The creek channel is extremely crooked and branching. If possible, use aerial photographs to aid in choosing the best route.

The creek is not navigable at the outlet of TOW LAKE and for some distance downstream. G.C.M. 1957.

101°38′W 56°31′N

Creek connecting MURRAY LAKE to EAGER LAKE. Short portages, trails good. The northern of the three portages has been flooded by the raising of EAGER LAKE, as is also the north end of the centre portage. G.C.M. 1954.

101°35′W 56°36′N

SNAKE LAKE to PYTA LAKE. Trail runs for about 100 yards from a camp site on SNAKE LAKE to a shallow widening of creek. From the east end of this section of the creek a good trail 1 mile long to PYTA LAKE. S end now difficult due to flooding. From approximately the same point on Pyta Lake a good trail to CONGLOMERATE LAKE, also.

101°37′W 56°38′N

Two rapids on creek between DUNPHY LAKES and SNAKE LAKE are shallow but can be lined easily with an empty canoe. The 80-yard portage into SNAKE LAKE was cut out by the survey crew in 1948 but is now heavily obstructed. G.C.M. 1957.

101°30′W 56°41′N

Portage from SW tip of SARAH LAKE to DUNPHY LAKES. 400 yards long. No note of condition. T.A.O. 1950.

101°30′W 56°35′N

CONGLOMERATE LAKE to McGAVOCK LAKE. Good trail, 400 yards. The eastern end is in a swampy creek, but is not difficult to locate.

101°13′W 56°34′N

Creek running south from NAYLOR LAKE is navigable to about this latitude, but is very swampy. C.K.C. 1949.

100°59′W 56°40′N

Creek between MAY LAKE and HUNTER LAKE. First three portages below MAY LAKE have fair trails, though the central one is difficult to follow over boulders in central part. At the fourth portage, 570 yards, the creek is not navigable because of boulders. The fifth is 1,520 yards long and is probably used mainly as a winter trail.

There is no record of portages around the rapids farther downstream, though Allen reported the rapids. If portages are present they are not on the east side. Survey party apparently travelled downstream by canoe as far as the fourth portage.

Upstream from HUNTER LAKE the water is fast, but deep, to the first rapids. "Difficult to paddle up, but would be easy for kicker". A.P.F., C.M.A., 1949.

100°59′W 56°36′N

Creek joining EATON LAKE and HUNTER LAKE. Three portages, of lengths 265, 260 and 310 yards, are reported on this creek. None are shown on the 1-mile topographic map. C.M.A. 1949.

This creek is connected to FINCH LAKE by a 2,400 yard trail.

At 2,000 to 2,600 feet from FINCH LAKE "portage trail a stream in muskeg", and at 5,000 to 6,000 feet "swamp". A.P.F. 1949.

(Probably a winter trail?)

100°52′W 56°33′N

FINCH LAKE to AMY LAKE.

1st portage: 180 yards, north side of creek.
2nd portage: 260 yards. Would float a canoe for eastern 50 yards. Otherwise good trail.
3rd portage: 770 yards. "Good in part; in part through willows."
4th portage: 350 yards. "Begins and ends in willows." Otherwise good trail.
5th and 6th: No special comment.
A.P.F. 1949.

100°43′W 56°43′N

KEEWATIN RIVER above SICKLE LAKE. Portage 2,930 yards around a succession of rapids with a total drop of over 65 feet. Good trail. Possibly the first rapid, coming downstream, might be run. The lower ones are impossible. G.C.M. 1955.

100°40′W 56°33′N

Rapids on KEEWATIN RIVER between CHICKEN LAKE and SICKLE LAKE, going downstream:
1st rapid: Portage over rocks, 100 feet.
2nd rapid: Run without trouble.
3rd rapid: Run.
4th rapid: Run.
5th rapid: Good portage, 300 yards. Run with empty canoes.
6th rapid: Almost at mouth of river. 100 yard portage over rocks. Run with empty canoes.
7th rapid: at lake. Run.

South end of CHICKEN LAKE is shallow, with numerous boulder reefs. Dangerous for motors. A.P.F. July, 1948.

100°44′W 56°32′N

KEEWATIN RIVER between CHICKEN and GHOST LAKES. East end of portage is about 1,500 feet south of point shown on older maps (and is partly obscured by word "KEEWATIN" on Map No. 6). Poorly marked at both ends. Good trail, but begins and ends on steep ridges.

On the river there are two falls, of 5 feet and 6 feet. Fawley took his empty canoes down the river by lining over the falls and running the other rapids. He notes they would be difficult with a loaded canoe, but would probably be easier in spring.

KEEWATIN RIVER below GHOST LAKE is said to require caution.

100°31′W 56°40′N

BEATTY CREEK is navigable from BEAUCAGE LAKE to BELLEAU LAKE (56°44′N). At 56°38′N, there is a deep trail, 460 yards long, on the west side, in low wet ground. A little farther downstream another, on the east side, is 340 yards long. The lower rapids is apparently not serious, for Fawley reports he poled up through it because he could not find the trail at the lower end. A.P.F. 1948.

100°37′W 56°30′N

Portage 1,100 yards. North half of this trail is wet. The lake immediately north is extremely shallow. Deepest place is three feet. Average about 8 inches.

100°36′W 56°25′N

BEATTY CREEK is not navigable at discharge from BEAUCAGE LAKE. Two portages are shown at south end of the lake. The eastern, 590 yards long, follows low ground and is the only practical trail. The trail is much overgrown by alders at the north end but is excellent going. The south end is swampy and wet. The north end may be very difficult to find.

The western trail goes over a high ridge and is no place to carry heavy loads when the other is available. G.C.M. 1950.

APPENDIX B

DETAILED DESCRIPTION OF THE SPECIMENS OF THE ROCK TYPES OF THE PRE-SICKLE INTRUSIVE GROUP

Detailed descriptions of all available hand specimens are given below, for each of the units and varieties recognized. The numbers have no significance, but in a very general way the lower numbers have, by chance, been assigned to the earlier and more mafic members of the sequence. Colours are indicated by reference to the rock colour chart, National Research Council, Washington.

UNIT No. 1

Weathers dark grey to greyish black; in some cases, a distinctly pitted surface, with shallow pits up to ¼ inch in diameter. In detail, the surface weathers black and white, due to black hornblende grains about $\frac{1}{16}$ inch diameter in a matrix of feldspar. Fresh surface characterized by prismatic black hornblende crystals up to 0.5 inch and by aggregates of these crystals. Flashing cleavage faces give rock a porphyritic appearance. Hornblende surrounded by a matrix of light greyish white to translucent greenish or bluish grey feldspar and smaller grains of hornblende. Estimated 80 per cent hornblende. Some specimens show alteration of hornblende to brownish black biotite; the greenish colour of some feldspar may be due to epidote. Some samples show traces of pyrite. Included also is a variety characterized by more abundant biotite than usual, and by well-twinned feldspar laths up to 0.5 inches long, showing ophitic texture and a characteristic mauve colour. One sample shows clusters of biotite crystals, apparently the extreme case of alteration of the hornblende phenocrysts.

SPECIMENS: GS 0572-0573; A43-48; B91-48; S31-47; A69-47 (Stanton); S276-47; A52-47 (Stanton); S108-47; A33-48.

UNIT No. 2

Weathers to a mottled surface marked by black irregular streaks of hornblende in greenish white feldspar. Greenish colour barely noticeable under lens, but gives the weathered surface a definite greenish cast. Some samples show surface resembling very coarse sandpaper due to hornblende crystals standing out on weathered surface. Fresh surface brownish black, mottled with white feldspar. Some porphyritic hornblende as in No. 1, but maximum grain size about 0.2 inch. Feldspar estimated 30 to 40 per cent, white to bluish grey, some twinned, interstitial to hornblende. Minor development of biotite on hornblende. Fresh appearance. Trace of quartz.

SPECIMENS: GS 0404, 0402, 0411, 0434; A68-48; S432-47; A139-48; S125-47.

UNIT No. 3

Weathers medium dark grey (W4) to light grey (N6), with some specimens showing a speckled appearance due to black hornblende crystals in feldspar matrix. Hornblende weathers up in some cases. Fresh surface dark grey to brownish grey (N3 to 5 YR 3/1). Estimated 40 per cent hornblende, in black prismatic crystals 0.1 inch long, which are light greenish under lens. Matrix is greyish white feldspar, fine grained, with a greenish tinge in some places. Some specimens show rounded and corroded hornblende crystals. A little bluish opalescent quartz (1 per cent) in a few specimens. The porphyritic appearance characteristic of Nos. 1 and 2 is present but not marked, because of smaller crystals. One sample (A100-48) has ophitic texture with brownish, twinned plagioclose laths up to 0.5 inch long. A57-48 has 2 to 3 per cent randomly distributed small grains of opalescent quartz, 10 per cent brown biotite, ophitic plagioclase and trace of pyrite.

SPECIMENS: GS 0407, 0503, 0442; S290-47; A96-47, A57-58, A100-48.

UNIT No. 4

Weathers greenish grey (5 G 5/1) to mottled black and white; some has rough surface (like fine stucco). Fresh surface dark grey to medium grey (N4 to N5). Estimated 60 per cent hornblende, light greenish under lens, in laths up to 0.4 inch but acicular to thin prismatic, and more resistant to weathering than the feldspar. Feldspar has brownish cast under lens. Trace of pyrite.

SPECIMENS: A32-48, A36-1-48; S111-47; A79-48.

UNIT No. 5

Weathers smooth black or greenish black to speckled greenish black and white, with 0.2-inch hornblende crystals in white-weathering feldspar. Fresh surface black to greenish black. Estimated 70 to 80 per cent hornblende in stubby to irregular crystals up to 0.1 inch. Fresh. Trace of chalcopyrite and a little quartz in one sample.

SPECIMENS: A86-47 (Stanton); Crombie 533; GS 0424, 0428, 0425.

UNIT No. 6

Weathered surface speckled black and white, coarse grained; irregular clots of hornblende up to ½ inch. Fresh surface: black hornblende in stubby prisms up to ¼ inch long in a matrix of feldspar, and also surrounding feldspar laths. Some development of biotite (2 to 3 per cent) on hornblende, and a few scattered grains of chalcopyrite. Feldspar greyish to bluish white; in some cases laths up to 0.4 inch give ophitic texture, but average crystal much smaller and in irregular masses. Hornblende estimated 50 to 60 per cent.

SPECIMENS: GS 0594; A91-47; B218-3-48; A162-47; S150-47, S94-47, S148-47.

UNIT No. 7

Weathered surface greenish black to speckled black and white much like No. 6, but finer grained. Fresh surface grey mottled, estimated 60 per cent hornblende, black, maximum size *Ca.* 0.1 inch, occasionally as stubby prisms but mostly in irregular grains. Feldspar white to bluish grey; one sample shows trace of mauve shading in feldspars (*Cf.* No. 1). Trace chalcopyrite and pyrite.

SPECIMENS: B106-1-48, B11-47; A42-48; S107-47, S127-47; A50-47 (Stanton); Crombie 513.

UNIT No. 8

Weathered surface nondescript brownish grey to greenish grey and speckled white. One variety has a characteristic pock-marked surface due to weathering of aggregates of biotite and hornblende. Fresh surface medium grey with a bluish cast due to blue-grey feldspar. Ferromagnesians estimated 40 per cent, mainly hornblende and biotite (5 to 30 per cent) but with up to 5 per cent epidote in one case. Trace of quartz in some specimens. Feldspar in irregular grains and prisms up to 0.5 inch well-twinned.

SPECIMENS: A160-48, A157-2-48; B268-47, B260-48; A158-48; GS 0577.

UNIT No. 9

Weathered surface light brownish grey to dark grey with a speckled appearance often described as "pepper and salt". Occasional samples very dark grey weathered surface, almost black. Fresh surface shows brownish grey feldspar speckled with black hornblende crystals. The rock is uniform in grain size, with the maximum about 0.1 inch for the hornblende, which is evenly distributed in the matrix of feldspar. Hornblende is shiny black and the feldspar buff to greyish white. Total ferromagnesian content fairly constant at about 40 per cent, composed of hornblende and biotite. In a few samples hornblende is almost the only dark material, in others it is almost completely biotite. All biotite is formed on hornblende or appears to be pseudomorphic after it. Feldspar amounts to 50 to 60 per cent and is in irregular masses of crystals and as distinct laths up to 0.1 inch commonly shows good polysynthetic twins. Clear quartz forms 10 per cent or less and is frequently faintly bluish. A few samples show a very faint foliation.

SPECIMENS: Crombie 511; B61-6-48; S104-47, S189-47; A111-47 (Stanton); B44-1-48; A153-47.

UNIT No. 10

Differs from 9 mainly in being darker.

Weathers light brownish grey to speckled grey, often with a distinct dark brownish stain, probably due to liberated iron. Fresh surface dark grey, even grained, sometimes with a brownish cast. Dark minerals evenly distributed, maximum size less than 0.05 inches; average about 50 per cent, but greyish colour of feldspar gives impression of higher percentage.

As with No. 9, the percentages of hornblende and biotite vary considerably; the average is about equal parts of each. Most feldspar is bluish grey to grey, and fine grained; occasional crystals up to 0.1 inch, with thin twinning lamellae. Quartz is clear and less than 5 per cent. Included with this unit is a darker phase which has 50 to 60 per cent hornblende and biotite. This phase commonly shows ophitic texture, and quartz is negligible; one sample from Cockeram Lake is higher than normal in quartz and the brownish weathered surface is marked by ⅛ inch pits, probably due to weathering of dark mineral aggregates. This is characteristic and readily recognizable in outcrop. It differs from that of the gabbro in the finer grains and the distinctly brownish colour due to the weathered surface of the feldspar.

SPECIMENS: A45^{+}-48; M93-56, Crombie 545, Crombie 439; B69-48; A64-48?; M81-3-56; A66-48; S182-47; A101-47 (Stanton), A53-48; B50-48; A107-47; S187-47; A184-2-47, A48-48; A151-48; B68-48; A53^{+}-48; S122-47.

UNIT No. 11

Weathered surface smooth to slightly roughened by weathering, brownish grey to dark grey. Fresh surface is speckled grey with faintly brownish cast. Though rock appears dark, hornblende and biotite total only 30 to 40 per cent, of which $\frac{2}{3}$ is hornblende. Biotite in several specimens forms small clusters of grains; most is as an alteration on hornblende. Very faint foliation in some specimens; usually massive and even grained. Hornblende has occasional slender prisms up to 0.25 inch in matrix of feldspar but mostly is in smaller stubby crystals and groups. Feldspar white to light grey; some ophitic texture; twinning visible in some places. One to two per cent epidote in a few samples. Quartz clear, evenly distributed as interstitial grains, 5 per cent or less.

SPECIMENS: A58-48, A61-48; B94-48; A94-48; S109-47; A94-1-48, A104-47 (Stanton); B52-48.

UNIT No. 12

Some variation within this unit.

Weathered surface light grey to dark brown, covering the black spots on the surface due to hornblende and biotite.

Fresh surface of most specimens has a distinct brownish colour due to the feldspar, and a notable flashing of the flakes of black mica and hornblende, which mottle the surface. Another phase has a porphyritic appearance due to 15 per cent small prismatic crystals (or aggregates) of feldspar about 0.25 inch long. (A similar texture is found in boulders which are common all over the district, but in which the feldspar prisms are up to 2 inches x 1 inch.) Dark minerals, 35 per cent, biotite and hornblende, in some cases almost exclusively one or the other. Some hornblende in excellent prisms; some biotite in irregular clusters. Biotite is not as clearly derived from hornblende as in other units, and in some cases there is no real suggestion of pseudomorphism. Feldspar buff to brownish white, probably stained; some ophitic texture. Maximum grain size about 0.1 inch, except in porphyritic phase. Quartz clear, honey coloured, or faintly opalescent bluish, up to 10 per cent, usually less than 5 per cent. Gneissic phases are included.

SPECIMENS: A129-47; B163-47, B63-1-48, B61-3-48; Crombie 551, Crombie 609; GS 0399, 0579, 0363, 0396, 0376.

UNIT No. 13

Weathered surface varies, but generally gives impression of white spots raised above a black groundmass, and coarser grain than common with this group. Fresh surface shows 40 to 45 per cent black hornblende in a groundmass of distinctly brownish feldspar; average grain size 0.15 inch as black prisms and aggregates of black biotite formed from it; one sample has hornblende aggregates to 0.25 inch. Feldspar matrix has maximum grain size about 0.1 inch and shows numerous thin laths with minute twinning lamellae. Quartz is minor and is clear and glassy to very faintly bluish. Included here is a sample of altered appearance containing traces of chalcopyrite and pyrrhotite, and in which the fresh surface has a schistose appearance not notable on the weathered surface. The chief dark mineral is black to brownish biotite, about 40 per cent (though a casual glance suggests at least 60 per cent).

SPECIMENS: GS 0371; S438-47; Crombie: A62-47, A109-47, A36-47, A40-47.

UNIT No. 14

Weathered surface dark brown where exposed; greenish white to greenish grey where freshly stripped, and showing a trace of small greenish black biotite-hornblende aggregates of indefinite shape. Fresh surface dark grey, and fine to medium grained. Fifty per cent fresh shiny black hornblende, average 0.1 inch long, in a matrix of grey to bluish grey feldspar which envelops some of the hornblende grains, and which has appearance of being fine grained though some grains are at least $\frac{1}{4}$ inch long. Some hornblende is altered to biotite. Traces of pyrite. Quartz minor and transparent but bluish.

UNIT No. 15

Weathered surface stained brown, or greyish white speckled with black.

Fresh surface massive, fine to medium grained, with 50 to 60 per cent hornblende and biotite in a matrix of greyish white feldspar. Most of this is hornblende and fresh, but one sample shows about 20 per cent biotite formed on the hornblende. Maximum grain size *ca.* 0.1 inch. Feldspar in irregular grains, average 0.1 inch (maximum 0.15) some showing good twinning. Cleavage faces on hornblende and feldspar give flashing laths, in divers orientations. Quartz 1 per cent, water clear. Trace of pyrite.

SPECIMENS: S363-47; A177-48; Crombie: A107-4-47, A106-4-47.

UNIT No. 16

Weathered surface stained dark brown, or grey with "salt and pepper" effect. Fresh surface dark grey with a faint brownish cast. Hornblende and biotite about 50 per cent, evenly distributed, though fresh surface gives impression of higher proportion of dark minerals. Maximum hornblende size 0.15 inch, average 0.05 inch, evenly distributed. Massive, with only faintest suggestion of foliation. Feldspar is white to greyish white and tendency to develop rounded grains is more marked than usual—suggesting phenocrysts in some cases. Laths and prisms of feldspar showing good twin lamellae are also common. Biotite usually minor, about 5 to 8 per cent. In a few samples biotite alteration of hornblende is extensive; these samples also have abnormal quartz content. Quartz is water clear, interstitial, and averages about 3 per cent.

SPECIMENS: B204-48; S147-47, S434-47; A81-47 (Crombie); S362-47, S128-47, S196-47, S273-47.

UNIT No. 17

Weathered surface, dark brown to brownish black. One sample shows pitting of the surface, but this is not nearly as well developed as in the gabbro. Fresh surface dark grey, formed by 60 to 70 per cent black hornblende and derived biotite in a matrix of feldspar which is white to bluish grey. Hornblende in stout prisms to irregular rounded grains, maximum size *ca.* 0.15 inch; only 2 samples show preferred orientation (lineation) and rock is otherwise quite massive and fresh. Quartz up to 5 per cent. Some of feldspar is clear with high luster and, but for the cleavage, might be mistaken for a dark smoky quartz. This makes rock even darker. Biotite 5 to 10 per cent. Trace of pyrite in two samples.

SPECIMENS: GS 0364; S344-47, S345-47, S173-47; A56-47 (Crombie); S197-47; Crombie 547.

UNIT No. 18

Weathered surface dark greenish black spotted with irregular small patches. Fresh surface grey, due to evenly distributed hornblende, 50 per cent, and biotite, 10 per cent, in a matrix of bluish grey feldspar. Maximum grain size *ca.* 0.1 inch. Hornblende in slender to stubby prisms and irregular grains; occasional feldspar laths, but, in general, interstitial to hornblende. Trace pyrite. Quartz less than 3 per cent, and distinctly bluish.

SPECIMENS: S493-47, S180-47, S179-47, Crombie: 591, 567, 569.

UNIT No. 19

Weathered surface dark grey. Fresh surface dark grey to black, specks of white feldspar. Unoriented laths of greenish black hornblende, maximum 0.1 inch long, 60 per cent, in matrix of white to faintly greenish white feldspar. Fresh: no biotite; no sulphide; no quartz. Could be a felspathic greenstone.

SINGLE SPECIMEN: S277-47.

UNIT No. 20

Weathers to white clayey surface mottled by greenish weathering of hornblende. Overall effect is greenish white. Hornblende 45 per cent, as laths and prisms, frequently euhedral, in matrix of white to creamy white feldspar. Hornblende is dark greenish black, generally fresh, with a little black biotite (5 per cent) in a few places. Feldspar in irregular aggregates interstitial to the hornblende. Clear quartz in traces to 5 per cent.

SPECIMENS: S248-47; A186-47; B163-3-47.

UNIT No. 21

Weathered surface greenish white. Porphyritic in appearance. Fresh surface grey to black. Thirty-five per cent biotite and hornblende, very fine grained, in irregular areas interstitial to rounded areas (0.15 inch) of fine-grained greyish white feldspar. Dark minerals predominantly biotite.

SINGLE SPECIMEN: B292-47.

UNIT No. 22

Much as 21 but much coarser grained and with feldspar as individual twinned grains up to ¼ inch, frequently as euhedral prisms. Matrix fine-grained brownish black biotite. Foliation marked by lines of biotite.

SPECIMENS: GS 0592; B289-47.

UNIT No. 23

Weathered surface grey to dark brownish grey, or mottled greenish black and white. Some pitting due to weathering out of hornblende. Fresh surface dark grey, often with a brownish cast; some medium-grained, some coarse-grained. In many samples there is a definite porphyritic texture due to rounded grains of greenish black hornblende up to 0.2 inch, and averaging 0.1 inch; in this respect resembles gabbro, type 7. Hornblende totals 30 to 50 per cent, occasionally higher, in large grains or clusters of needles. In some cases hornblende is fresh; in others, masses of greenish brown to brownish black biotite are pseudomorphic after hornblende. Feldspar is bluish grey, sometimes in well-developed, twinned prisms, giving ophitic texture enveloped by hornblende. Some feldspar has a distinctly vitreous lustre, so that it looks like quartz. Quartz is usually minor, less that 10 per cent in most specimens, and is often opalescent blue. In one sample (A78-48) it is very high (20 per cent).

SPECIMENS: A78-48, A211-47, A142-47, A87-47; S175-47, S497-47, S336-47, S226-47, S191-47, S335-47; GS 0365, GS 0437, GS 0414; F11-48.

UNIT No. 24

Weathered surface light brown to brown with irregular black patches. Fresh surface distinctly light in colour, faintly brownish or buff feldspar spotted by black hornblende and biotite. Some samples have a distinctly greenish cast. Hornblende and biotite average 25 per cent—some specimens as high as 45 per cent, and these the greenish ones. About half is biotite in most samples. Feldspar bluish to brownish grey or white, in prisms up to 0.2 inch, with good twinning. Quartz clear to bluish opalescent up to 25 per cent; less than 10 per cent in a few samples. Traces of epidote. A strongly gneissic and granulated rock from Dunphy Lakes is high in quartz (40 per cent).

SPECIMENS: Crombie: 541, 658, 509; C45-48 (Stanton); GS 0397; S431-47, S429-47; A93-48; S64-47; A7-48; GS 0178.

UNIT No. 25

Weathered surface greenish white to brown, spotted with irregular, often interconnected, small masses of greenish black hornblende and biotite. Fresh surface bluish to brownish grey, usually massive, with irregular small patches of biotite and hornblende. In some cases these show a poor foliation. Dark minerals total 25 to 40 per cent mostly biotite, or hornblende with much closely associated biotite. Quartz up to 25 per cent, mostly in small irregular opalescent grains.

Feldspar buff to grey, with some showing the unique mauve colour reported in the gabbro feldspars. Traces of epidote associated with biotite. Feldspar laths up to ¼ inch in what has been an unofficial type specimen (A54) well twinned, but this not general. Others rounded and corroded—up to 0.2 inch.

SPECIMENS: A180-48, A52-48; B87-2-38, B62-3-48; A176-48, A136-48; S495-47; Stanton C-5-48; S494-47, S425-47; A57-47 (Crombie); S188-47, S501-47, S342-47; Crombie 445; GS 0413, GS 0436, GS 0435, GS 0343.

UNIT No. 26

Weathered surface light brownish grey; darker brown where exposed on lake shores. Usually massive. Fresh surface grey with brownish cast. This rock, as well as others of this group, is medium grained and granitic in appearance and was usually so described in the field. Composed of 15 to 30 per cent dark minerals in a matrix of stout buff to white feldspar prisms, up to 0.15 inch, mixed with quartz. Characteristic is the tendency for the prisms to develop, even in rocks apparently fine grained. Quartz varies considerably; averages about 20 but may be as high as 35 per cent, commonly bluish transparent to opalescent. Epidote is more common than in any type above. Some appears in the feldspar but is most commonly associated with dark minerals, especially near contact with feldspars. Consequently, rock often shows altered appearance. Hornblende in fresh rosettes of fine needles, and as irregular masses up to ¼ inch or more, with associated biotite and epidote. Some samples show biotite alone as the dark mineral.

SPECIMENS: J7-50, J35-50; S682-48; A54-48; B47-1-48; A106-2-48, A62-48, A144-48, A51-48, A80-48, A110-48; Crombie: 535, 527, 553, 543?, 624; S176-47, S192-47, S337-47, S411-47, S496-47; A64-47 (Crombie); S193-47; A160-47, A88-2-47; GS 0550; A66-2-48; B54-48; S87-47, S414-47.

UNIT No. 27

Weathered surface light brownish grey to light grey; dark minerals not prominent. Fresh surface light brownish to bluish grey, fine grained, with black flecks and streaks of biotite and hornblende. Dark minerals 20 per cent, mainly biotite; about 5 per cent hornblende is maximum; in some cases none. Some biotite is brownish black. Average grain size 0.05 inch; maximum hornblende needles 0.15 inch. Mostly massive, but fair foliation in some cases. In these, biotite is in thin streaks, and "clots" up to ½ inch long. Matrix is light brownish to greenish white feldspar, in rounded to euhedral prisms up to 0.15 inch long, with interstitial finer-grained feldspar and quartz. Quartz, 40 per cent, is greyish to bluish, translucent to opalescent, so the rock is notably siliceous. Finer-grained phases suggest sediments, but lack bedding. Some specimens have a distinctly greenish cast to the feldspars, which is not visible under the lens, nor is any epidote noticeable in hand specimens.

SPECIMENS: A88-48; B63(?)-48; A67-1-48, A214-48, A63-48; S84-48; GS 0372; K9-50.

UNIT No. 28

Weathered surface light grey to very light grey (N7-N8) or with a brownish stain. Fresh surface brownish grey with about 20 per cent dark minerals irregularly distributed in clusters of fine grains. These are "subdued" in their appearance and seem to blend into the quartz and feldspar rather than standing out sharp and black as in 27. Dark mineral almost exclusively biotite in very irregular aggregates and areas of very fine grains 0.1 inch diameter; rarely are large flakes of brownish black biotite noted. Ophitic texture is usually readily visible, with feldspar laths up to 0.15 inch common. Feldspar is buff-white to light bluish grey. Commonly very siliceous, with bluish, opalescent quartz up to 50 per cent; some quartz is clear.

SPECIMENS: GS 0607; S217-47, S63-47; A120-47, A117+-47; C41-48 (Stanton); A196-48; GS 0601, GS 0603; S267-47.

UNIT No. 29

Weathered surface rough, grey to light grey, with a distinctly greenish cast. Fresh surface also shows distinctly greenish grey shade, is coarse grained and has a spotted appearance due to large grains and aggregates of dark minerals; in one case individual grains of hornblende up to 0.4 inches diameter. Dark minerals 15 to 25 per cent, in rounded to elliptical spots of hornblende and/or biotite, both black or greenish black, sometimes enveloping euhedral feldspar laths. Much of feldspar is also coarse grained; maximum noted 0.75 inch, but 0.5 inch common. Many euhedral prisms of white to greenish white feldspar, some corroded and surrounded by fine-grained aggregate of feldspar. Twinning not as well developed as common. Siliceous; quartz not less than 25, often 50, per cent, in small colourless to bluish grains. A trace of reddish feldspar in some samples; possibly a stain. A little epidote associated with biotite in some specimens.

SPECIMENS: S225-48; S410-47; A118-47 (Crombie); S446-47; GS 0375; K10-50, K530-50?; GS 0301-48, 0508; A58-1-48; B9-48.

UNIT No. 30

Clear to translucent quartz 30 per cent. Pink to reddish feldspar, maximum size 0.2 inches, 30 per cent, euhedral and usually not twinned. Evenly distributed fine-grained biotite, 20 per cent.

(Definitely seems a stranger in this lot.)

SINGLE SPECIMEN: A126-47.

UNIT No. 31

Weathered surface light brownish grey. Fresh surface buff to brownish or very light grey (about 10 YR 7/2) flecked with black biotite; one sample has an olive-green cast. Biotite 5 to 15 per cent, mostly in small flakes or clusters of flakes. Feldspar buff to faintly pink, mostly fine-grained, but occasional prisms up to ¼ inch long. Most specimens show some euhedral feldspars in the finer-grained groundmass. Reddish or pink colour occurs in some specimens but may be due to hematite; it is not uniform through individual crystals. Quartz is abundant, 35 to 50 per cent, usually evenly distributed, and relatively fine grained; maximum size less than 0.1 inch. In some samples quartz has a suggestion of sugary texture. Very minor hornblende. (Rather greater range in appearance of these specimens than is common in one unit.)

SPECIMENS: Crombie 449; K49-50; B50-1-48, B50-2-48; A145-48; B62-48; C53-48 (Crombie); A122-47, A172-47; GS 0438.

UNIT No. 32

Weathered surface distinctly pink to reddish, especially in fresh exposures. In general about 10R 6/2 to 10R 8/2 where newly exposed; some samples show dark brownish grey surface suggestive of iron staining, but cause not known. Fresh surface pale reddish brown, 10R 5/4, to greyish pink, 5R 8/2; typically with irregular dark streaks. These dark streaks suggest biotite, but are, in large part, stringers of dark quartz grains; this makes rocks appear much more mafic than it actually is. Biotite usually 5 per cent or less; maximum estimated 10 per cent. Very siliceous: quartz, water clear to bluish, or dark grey in very irregular masses up to ¼ inch diameter, 40 to 60 per cent. Feldspar distinctly pink to reddish—some of which may be hematite staining. Contains some large prismatic grains of grey plagioclase, but twinned crystals are not abundant. Some large "flashing" faces suggest intergrowth of quartz in the feldspar crystals. No hornblende in available samples.

SPECIMENS: GS 0575, GS 0394, GS 0378, GS 0602, GS 0392, GS 0589; S206-47, S256-47, S145-47.

UNIT No. 33

Weathered surface light buff to grey, fine grained, low in dark minerals. By field observers this rock was almost universally described as "pink", "pinkish", or "pinkish grey", and, in some places, it is distinctly pinkish, especially when contrasted with the abundant grey types above. This is due to a "salmon pink" feldspar (5YR 8/4). A sample from Berge Lake shows about 10 per cent small black biotite flakes in aggregates up to 0.1 inch diameter; no sign of foliation; clear, grey, or faintly bluish quartz, 40 per cent; buff feldspar in stubby prisms up to 0.1 inch long; some shows good polysynthetic twinning; not evident in hand specimens whether or not two feldspars are present. Except for slight changes in colour of feldspar or size of biotite aggregates, other samples are similar. In some, quartz may increase slightly and it may mark a faint foliation as tiny parallel stringers and lenticles.

SPECIMENS: GS 0313, GS 0591; B267-1-48; A67-48; B87-48, B188-47; S33-47, S213-47; Crombie 589-47, Crombie 433-A-47.

UNIT No. 34

Weathered surface light pinkish grey, fine grained, with bluish grey quartz grains, in some samples. Fresh surface buff to definitely pink in colour (5R 8/2), medium grained with dark specks due to clusters of biotite and/or grey quartz. Black biotite, 5 per cent or less, in small flakes which form lenticular aggregates up to ½ inch long but are usually about 1/10 inch and evenly distributed. Quartz 30 to 50 per cent, clear to translucent grey. Feldspar is nearly all salmon pink, some in large irregular grains up to 0.15 inch diameter. Twinning striations are not common but are present.

SPECIMENS: S498-47; B267-48, B70-48, B61-4-48; A93-1-48; K632-50.

UNIT No. 35

Weathered surface light pink to reddish. Some samples have preserved fair glacial polish. Fresh surface definitely more reddish than 34, due to reddish feldspar (*ca.* 5R 6/4). Quartz coarse grained and bluish (irregular mass up to ½ inch) in some places, but mostly finer grained, interstitial to feldspars and about 35 per cent. Some is slightly yellowish. Dark minerals very low—3 to 5 per cent. In some samples feldspar about 50 per cent, in grey irregular to rounded grains up to 0.2 inch diameter in a matrix of fine-grained pink feldspar. In other samples almost completely pink feldspar, in prisms and as fine-grained matrix. Good twinning lamellae are rare.

SPECIMENS: A82-47; B57(?)-48; S84-47, S199-47; A149-48; B88-47.

UNIT No. 36

Greyish pink 5R 8/2 to 5YR 7/2, fine grained aplitic. Coarsest-grained sample shows 35 per cent quartz, yellowish as in 35. Balance pink feldspar and 2 per cent small aggregates of fine-grained biotite. Others about same proportions but quartz is finer grained, more rounded and suggests a grit in texture. Dark minerals very low.

SPECIMENS: GS 0581, GS 0122; S203-47, S186-47.

UNIT No. 37

Much as 36. Feldspar is a little more reddish and texture coarser and "crumbly" in appearance on fresh surface.

SPECIMENS: A128-1-47, A38-47 (Stanton).

UNIT No. 38

Weathered surface pinkish buff to pink. Medium grained and low in dark minerals. Fresh surface pinkish buff with dark spots due to biotite and dark quartz (*Cf* 34), and in some respects very similar to No. 33 above. Quartz 35 to 50 per cent, faintly bluish to clear or translucent grey. Average grain size about 0.1 inch but some aggregates larger. Biotite 2 to 5 per cent. No foliation. Feldspar pink but due more to pink spots than to uniform colour of the grains.

SPECIMENS: A171-47, A160-48; GS 0398; A31-48, A54^{+}-48; GS 0366.

APPENDIX C

DETAILS OF THE SULPHIDE OCCURRENCES SHOWN ON MAP 10

Map No.	Observer[1]	Field Notebook Reference	REMARKS[2]	Location
1	J.D.A. 1946	A23	"some beds high in iron oxide, probably from py".	W. Berge L.
2	J.D.A. 1946	A24	"py. scattered throughout" rk. with well developed hbl. needles.	W. Berge L.
3	J.D.A. 1946	A12	Some grains of py. in m.g. grey granite.	W. side Berge L.
4	J.D.A. 1946	A13	Numerous small fractures in dk. grey-bl. f.g. rk. with feld. biot. and hbl. Some stringers of quartz. Many fractures have py. and cp. assoc.	
5	J.D.A. 1946	A14	Scattered py.	
6	J.D.A. 1946	A5	Sulphides, py., dissem. in porphyritic andesite. Most py. alongside qtz.-feld. stringers cutting porphyry.	Berge-Barbara L.
7	J.D.A. 1946	A145	Considerable po., iron rust in many places, in hbl. gn. ("probably altered agglomerate").	E. of Frances L.
8	J.D.A. 1946	A146	Much dissem. po. in agglomerate.	
9	J.D.A. 1946	A146	ca. 800′ to N.E. in hbl. gn., highly oxidized, with much po. through it.	
10	J.D.A. 1946	A139	Some po. visible in hornblendite.	
11	J.D.A. 1946	Near A84	Heavy pyritization. Strong mag. anomaly. Within 500-700′ of:	E. shore of Ralph L. near drillers camp.
12	J.D.A. 1946		Some py. in porphyritic gs.	Near No. 1 post Elb. 9.
13	J.D.A. 1946	A78	Py. in c.g. porphyritic gs. with hbl. well devl. Small quantity of calcite.	N. Barbara L.
14	J.D.A. 1946	A84	Some py. in massive knobby hornblendite.	E. of Ralph L.
15	J.D.A. 1946	A72	Strong magnetic anomaly. Highly rusted, f.g. well-cleaved rks. some bands grey, sandy, app. seds. Some bands dk. green, hbl. needles (prob. volc.). Some bands with pink garn. Pyrite in stringers and grains.	N. Berge L.
16	J.D.A. 1946	A69	Py. in f.g. dk. grey-green hbl'ic gs. and in qtz. veins cutting this.	N. Berge L.
17	J.D.A. 1946	A53	"Pyrite scattered through rk. Po." Rk. varies from biot. sch. to qtz.-biot. sch. to qtz.-hbl. schist to hbl'ic. gs. with qtz. introduced to give spotted or streaked appearance.	N. end Berge L.
18	J.D.A. 1946	A262	Quartz and sulphides in garnetiferous seds. and tuffs.	960′ N. of No. 3 of Elb 43.
19	J.D.A. 1946	A234	F.g. flow bx.—small hbl. needles vis. under lens. "Some po."	Between Elb 39-42.
20	J.D.A. 1946	A231	"Acid zone in dior., high in dissem. po". Two small trenches.	800′ from No. 1 Elb 34 just N. of "A" Mine.
21	J.D.A. 1946	A251	Some py. in green weathering hbl. gn., sch., and hornblendite.	Near No. 1 of Faust 7; two trenches on qtz. veins containing much py. Faust 1, 5, 7, 9.
22	J.D.A. 1946	A210	Considerable iron oxide—py. (po.?) in f.g. dk. green hornblendite.	S.E. Frances L.
23	J.D.A. 1946	A201	Some py. in impure quartzite.	N. Motriuk L.
24	J.D.A. 1946	A160	V.f.g. po. dissem. in lamprophyre dyke ?	

[1]For full identification of observer see list on page 7.
[2]For abbreviations see Page 292.

Map No.	Observer	Field Notebook Reference	REMARKS	Location
25	J.D.A. 1946	A161	In sheared rk. (gouge). Prospect pit. Much fine dissem. py. (po.?) in f.g. dior.	N.W. Frances L.
26	J.D.A. 1946	A158	Some py. in thinly banded (less than 1″) seds. Seds. are f.g. well-bedded, siliceous, varying grey to green. Some bands have hbl. needles, some garnets, py.	E. Frances L.
27	J.D.A. 1946	A153	Large and small masses and grains of po. in qtz.-hbl.-dior.	E. Frances L.
29	J.D.A. 1946	B138	"Widely dissem. py." in qtz.-feld.-biot. gn.	800′ N. from No. 3 of Elb. 146.
30	J.D.A. 1946	B140	Sulphides and sulphide weathering; contaminated dior.	E. bdy. Elb 29.
31	J.D.A. 1946	B100	Diorite showing mineralization and Fe weathering.	N. Fraser L.
32	J.D.A. 1946	B109	Some min'l in parts of large otc. [Interbedded seds. gs.]	S.W. Motriuk L.
33	J.D.A. 1946	B112	[Some py. and po. in Spec. B112F.]	
34	J.D.A. 1946	B77	Sulphides in porphyritic hbl. gn.	
35	J.D.A. 1946	B79	Some sulphides in hbl. gn. (weathering pinkish).	
36	J.D.A. 1946	B62	Sulphides in f.g. silicified hbl. gn.	W. side W. Eric Lake
37	J.D.A. 1946	B66	"Large amounts of sulphides" at S. end of outcrop. Rock is fairly well mineralized.	
38	J.D.A. 1946	B70	Pyrrhotite? in silicified and chloritized gs.	
39	J.D.A. 1946	B43	"Portions with py. also noted" [in gs.].	Shore Ralph L.
40	J.D.A. 1946	B56	Mineralized acid flow.	S. end W. Eric Lake.
42	J.D.A. 1946	B33	"Volcanics (agglomerate) at this point are highly mineralized".	
43	J.D.A. 1946	B35	Small amounts of py. in granite.	S.W. Berge L.
44	J.D.A. 1946	B146	Dissem. sulphide mins.—"high percentage granodiorite".	N. Muter Ck.
46	J.D.A. 1948 (Hunter)	B6	"Some f.g. py."	
47	J.D.A. 1948	B15	Some qtz. and sulphides in gs. cut by granite dykes. There is also rust in several large qtz. veins.	E. of Shortie L.
48	J.D.A. 1948	B20	"Much py." in seds. or tuffs and qtz. stringers interbedded with gs. Qtz. is perpendicular to foliation in gs. "Several well sheared zones, and qtz. and sulfide throughout this area."	S. Cockeram L.
49	J.D.A. 1948	C2	Some sulphides in schistose gs. (small amounts).	S. of outlet Cockeram L.
50	J.D.A. 1948	A65	Mainly gabbro—some incls. of volcs. at south end. Considerable patches of gossan on tip of ridge. Py., po., cp., mg.	E. White Owl Lake.
51	J.D.A. 1948	A15	"Xls of py. scattered through". Cleavage planes rusted. In siliceous Wasekwan sediments. Consid. mg. in small xls.	W. of Anson L.
52	J.D.A. 1948	A19	"Some po." in f.g. pillowed lavas.	
53	J.D.A. 1948	A22	Scattered cubes of py. in granite.	W. Shore of Anson L.
54	J.D.A. 1948	A80	Sl. fracturing in granite with slight rust and sulphide—py. and po.	N.E. Cockeram L.
55	J.D.A. 1948	A2	Few scattered grains py. and po. in gs.	N. of W. Bay Cartwright Lake.
56	J.D.A. 1948	A6	Sulphides in "faults" in pillowed, massive and amyg. lavas.	
57	J.D.A. 1948	A10	Some grains py. in sed., tuffs, and some flows.	W. Anson L.
58	J.D.A. 1948	A14	Py. and some mg. in tuffs.	
59	J.D.A. 1948	A53	Scattered grains and small concentrations of py. in dior.	W. Shore Cockeram L.
60	J.D.A. 1948	A48	Small amounts of py. in fractures in dior.	W. Cockeram L.
61	J.D.A. 1948	A36	Sparse sulphides in "gabbro" (?) at A36.	

Map No.	Observer	Field Notebook Reference	REMARKS	Location
62	J.D.A. 1948	A28	"Some po." in "dacite porphyry" interbedded with pillowed and amygdaloidal flows.	N.E. Moses L.
63	J.D.A. 1948	A29	Some scattered py. in f.g. volcanics—pillowed.	
64	J.D.A. 1948	A32	Sparse dissem. py. in dior. or gabbro.	
67	J.D.A. 1948	A25	Sulphides in f.g. (chilled?) dior. or gs.	N.E. Cockeram L.
69	J.D.A. 1948	A2	Few scattered grains of py. and po. in gs.	
73	J.D.A. 1948	A147	Min. with py., cp., sph.?; considerable gossan. Au? In grey granodiorite and included volc. cut by 8″ qtz. veins, fractured. Four pits on claims J.G.1 and 4.	N. Arbour L.
74	J.D.A. 1948	A142	Consid. (1%) dissem. py., po., cp. in f.g. feldspathic gs. with long needles of hbl. (30%).	N. Arbour L.
75	J.D.A. 1948	A139	Consid. dissem. sulphides in shearing and gossan at contact of gabbro and green volc. Mostly py. Trace cp.	N. Arbour L.
76	J.D.A. 1948	A109	V. f.g. dissem. py., rather abundant, dissem. in rk. composed of feld., 60+ % brown hbl.	N. edge Faust 124 cl.
78	J.D.A. 1948	A68	Few small masses of py. in gabbro.	E. side Cockeram L.
79	J.D.A. 1948	A57	Some py. in femags. in dior. and qtz. dior. N. of Keewatin R.	W. side Cockeram L.
80	J.D.A. 1948	A191	Sample of f.g. dk. gn'ic. rk. with tiny stringers of qtz. containing po. (From X-ray core.) [Enough mg. so that core can be picked up by hand magnet.]	
81	J.D.A. 1948	A185	Cp. and po. in qtz. vein in gs.	E. Berge L. and Keewatin River.
82	J.D.A. 1948	A187	Po. and rusty zones. Some quartz.	
83	J.D.A. 1948	A184	Sparse dissem. py. in porphyritic gs.	N.W. Arbour L.
84	J.D.A. 1948	A162	Scattered grains of py. in f.g. volc. or dior.	S. side Arbour L.
85	J.D.A. 1948	A180	V. sparse py.—few grains only—in a f.g. dior. or alt. volc. inclusions in grey granodiorite.	S. of Arbour L.
86	J.D.A. 1948	A168	"Considerable sulphides" in qtz.-hbl.-feld.-garn. gn.	S. . Arbour L.
87	J.D.A. 1948	A173	"Scattered grains of py." along cleavage planes of "alt. volc."	S. of Arbour L.
88	J.D.A. 1948	A196	Scattered grains of py. in granodiorite.	E. Berge L.
89	J.D.A. 1948	A197	"All through these otcs. are tiny fractures containing py. Also dissem. grains."	Berge L.
90	J.D.A. 1948	A198	Interbedded g'wke (?) and gn'ic. plag. amphib. (gs.) shows py. in gs. bands and in g'wke.	W. of No. 3 of Elb 91.
92	J.D.A. 1948	A199	Sparse po. in g'wke.	
93	G.C.M. 1955	M213	A little dissem. py. (and cp. ?) in basaltic gs.	No. 4 of Elb 86.
94	J.D.A. 1948 (Hunter)	B5	Small grains py. in gs.	N.E. Moses L.
95	J.D.A. 1948	B37	Fine grained massive flows with py.	N. of Moses L.
96	J.D.A. 1948	B39	With qtz. in gs.	N.W. Moses L.
97	J.D.A. 1948	B173	Sparse sulphides in qtz. dior.	S. Arbour L.
98	J.D.A. 1948	B187	Some sulphides in gs.	S. Arbour L.
99	J.D.A. 1948	B49	Sulphides are present and rust is plentiful vicinity of shear between diorite (?) and pyroxenite.	Near Wheatcroft L.
100	J.D.A. 1948	B50	Small amts. of sulphides in some places, in dior.	W. of Cockeram L.
101	J.D.A. 1948	B54	Some py. in dior, cut by pink granite.	E. of Wheatcroft L.
102	J.D.A. 1948	B76	Qtz. veins up to 2′ with "fairly extensive rust zone associated—but no sulphides visible", cutting gs. (and gabbro?)	S. shore Cockeram L.
103	J.D.A. 1948	B99	Sulphides in gs. band.	Keewatin R.
104	J.D.A. 1948	B87	Py. "in appreciable amts."	N. of Cockeram L.
105	J.D.A. 1948 (Hunter)	B102	"Rust zones and sulphides common" in gs. cut by numerous apl'ic. stringers.	Keewatin R.

Map No.	Observer	Field Notebook Reference	REMARKS	Location
106	J.D.A. 1948	C5	Sulphides in small amts in gs.	E. Cockeram Lake.
107	J.D.A. 1948 (Hunter)	B210	"Band of rusty material" following strike in gs. [Mineralization?] About 6'wide.	N.W. Arbour L.
109	J.D.A. 1948	B185	Small amts. sulphides in mass. f.g. and porphyritic gs.	N.W. Arbour L.
111	J.D.A. 1948	B218	"Sulphides are present in fairly large amounts and rust zones are common" [in dior. or gabbro intrusive into gs.].	N. Arbour L.
112	J.D.A. 1948	A152	Py. in rk. described as granodiorite. From map of Carr and Jenny cl. by A. J. MacBeth. 1948.	N.E. Cockeram L.
113	A. J. Mac-Beth 1948		Py. in gabbro on S. edge Cl. P17175 [Carr 21].	N.E. Cockeram L.
114	J.D.A. 1948 (Hunter)	B219	"Sulphides occur—mainly in the f.g. flows in porphyritic gs. with some breccia".	E. of Keewatin R.
115	J.D.A. 1948	B219	"Rust is common, but no free sulphides" in severely schisted volc. breccia—porphyritic and non-porphyritic.	
116	J. T. Randell (Rept. dated 12/3/47)		0.25% Ni in "hornblendite" from N.W. cor. of W.H.M. 7 cl. [Field work of S. V. Burr.]	
117	J. T. Randell 1947		1.3% Ni in sulphides from hole N 12 in acid volc.	N. side of W.H.M. 19.
118	Doramal Mines	Geol. Map	Local fine po., py., and cp. +carb.	W. of Minton L.
119	Doramal Mines		"A little fine po. and cp."	W. side D.D.M. 13.
120	J.D.A. 1947	A56	"Some py. shot through" f.g. gs. Small qtz. stringers. Some shearing 020° with biot. + chl. assoc.	N.E. Hughes R.
122	J.D.A. 1947	A58	Some qtz. py.	
123	J.D.A. 1947	A59	Gossan and py. in small draw—shows in swamp. Str. 070°. Similar to SGM. at Hughes L. Rk. is almost slaty.	
124	J.D.A. 1947	A61	Py. and cp. in gs.—sheared.	Hughes R.
125	J.D.A. 1947	A62	Some py. in places in acid volc	Hughes R.
126	J.D.A. 1947	A63	Schistose gs. with consid. dissem. py. and mg. and consid. iron rust. Some cp.	
127	J.D.A. 1947	A67	Some py. in hbl.-feld. gn.	Trail W. of Eagle L.
128	J.D.A. 1947	A88	Py. and cp. with qtz. in porphyritic gs.	Trail W. of Eagle L.
129	J.D.A. 1947	A69	Some sulphides, po., py., along edge of N-S break in gabbro.	
130	J.D.A. 1947	A76	Highly rusted sheared zone, less than 1" wide, in seds. and tuffs. Interbanded with porphyritic andesite, and breccia.	Eagle L.
131	J.D.A. 1947	B116	Py. in alt. volc.	Eagle L.
132	J.D.A. 1947	A91	Py. in gabbro.	N.W. Tulune L.
133	J.D.A. 1947	A96	Scattered grains of po. in gabbro (di. ? gs. ?)	Raven L.
134	J.D.A. 1947	A97	Some po. in "di".	
135	J.D.A. 1947	A99	Shearing with consid. diss. py. and po. in gs.	Eagle L.
136	J.D.A. 1947	A99	Py. and po. in schistose porphyritic gs.	½ mi. W. of 135
137	J.D.A. 1947	B140	Scattered sulphides in rk. [not indicated].	

Map No.	Observer	Field Notebook Reference	REMARKS	Location
138	J.D.A. 1947		Much dissem. po. in rusty zone in dark green - dk. grey f.g. rk.—probably qtzitic seds. interbedded in gs., which to S. 200′ is porphyritic hbl. sch. cut by irregular granite dykes and bodies. 400′ further S. is mass of coarse qtz. and pk. feldspar granodiorite containing py. and cp.	
139	J.D.A. 1947		A little py. in mass gs.	N.E. of Auni L.
140	J.D.A. 1947	A106	A little py. in fractured, but not lineated, v.f.g. gs.	S. Eagle L.
141	J.D.A. 1947	A107	Some scattered sulphides (py.+mg.) in m.g. "hbl. dior" and "qtz.-hbl.-dior" with num. gs. inclusions and cut by veinlets of light granitic material.	S. Eagle L.
142	J.D.A. 1947	A109	Some scattered py. in f.g. mass. gs.	
143	J.D.A. 1947	A114	Scattered py. on fracture planes in fol. gs.	E. of Auni L.
144	G.C.M. 1955	M307	Some rusty zones—py., ga. (?) asp. (?) in pill. gs.	E. of Auni L.
145	J.D.A. 1947	A117	Sulphides in rusty qtz. cutting gs. and granodiorite.	E. of Auni L.
146	J.D.A. 1947		To S.E. of 145, in highly sheared and alt. pill. gs. with chl. and introduced feld.	
147	J.D.A. 1947	A127	Scattered py. in m.g. hbl. granite which "could be sheared".	Island, Chepil L.
148	J.D.A. 1947	A131	Sheared qtz.-feld. porphyritic volc. Consid. shearing at 015° along W. edge of otc. with much rust. Py. visible in small masses.	S.E. shore Pill L.
149	J.D.A. 1947	A138	Much qtz. and rust in banded seds. and tuffs. Scattered otcs. on N. end of hill—most are highly rusted and some patches of rusty ground [= gossan?].	Hughes L.
150	J.D.A. 1947	A139	Much rust in pillowed gs.	Hughes R.
151	J.D.A. 1947	A140	Some scattered py. in pillowed gs.	Hughes R.
152	G.C.M. 1955	M277	Dissem. py., cp., and mg. in gabbro.	Tulune L.
153	G.C.M. 1955	M281	Sparse dissem. cp. in rounded sil. frag. incl. in v.f.g. gs.	Tulune L.
154	J.D.A. 1947	A148	Scattered sulphides in gs. (trachyte?).	Hughes R.
155	J.D.A. 1947	A149	Scattered py. and some rust on fracture planes.	
156	J.D.A. 1947	A159	Some sulphides, py., po. in hbl. granite cutting gs. and banded iron-form.	
157	J.D.A. 1947	A160	Scattered sulphides.	
158	J.D.A. 1947	A161	Consid. rust and sulphides f.g. grey granite.	Tulune L.
159	J.D.A. 1947 (McTavish)	B152	Py. scattered through rk. (agglomerate and gs.) Qtz. stringers increase and chl. found in shear zone and "py. is scattered through the rock".	
160	J.D.A. 1947	B153	Scattered py. in f.g. gs.	
161	J.D.A. 1947	B155	Py. and asp. in chl. sch.	
162	J.D.A. 1947	B162	Scattered py. [in lamprophyre dyke?] gs. outcrop.	
163	J.D.A. 1947	B163	"Well mineralized with py. and asp." in large incl. of volc. in granite or dior.—incl. alt. to chl.+ep.	Hughes R.
164	J.D.A. 1947	A163	Much rust, magnetite. Alt. volc. cut by grey quartzose granite.	Hughes R.
165	J.D.A. 1947	A164	A great deal of rust. Some po. also free mg. Magnetic anomaly.	
166	J.D.A. 1947	A165	Silicified and rusted gs.	Arbour L.
167	J.D.A. 1947	A167	Consid. py. and rust.	Arbour L.
168	J.D.A. 1947	A180	"Po. (?) scattered throughout [f.g. grey micaceous seds. with some tuffs (?)]—Considerable in some portions. Some quartz stringers. Probably these on which trench was opened."	Hughes R.

Map No.	Observer	Field Notebook Reference	REMARKS	Location
169	J.D.A. 1947	A200	Scattered py. in acid lavas.	Cartwright L.
170	J.D.A. 1947	A192	Some shearing and rust.	Cartwright L.
171	J.D.A. 1947	A191	Much scattered py. in diorite. (Py. up to ½" across.)	Cartwright L.
172	J.D.A. 1947	B12	Dissem. py. in dior.	Hughes L.
173	G.C.M. 1955	M234	Sp. dissem. py. in good cubes in dior.	Hughes L.
174	J.D.A. 1947 (McTavish)	B80	C.g. py. dissem. in porphyritic volc.	Chepil L.
175	J.D.A. 1947	B95	Some f.g. py. in pink granite.	Eagle L.
176	J.D.A. 1947	B112	Cp. and py. in c.g. flow or dior. intrusion. Rust.	Tulune L.
177	J.D.A. 1947	B134	Some py. in gs. cut by very small granitic stringers.	Tulune L.
178	J.D.A. 1947	B143	F.g. py. in gs. which has [apparently not in the same place] 6" wide chl. sch. zone with qtz. stringers along this zone.	Auni L.
179	J.D.A. 1947	B144	F.g. py. in fractures in porphyritic gs.	Auni L.
180	J.D.A. 1947	B166	"Small scattered sulphides. In 'pk. granite' at contact with gs. Gs. has chl. and ep. alt'n. and has formed a 'breccia filled with carbonate'."	E. side Muskeg L.
181	J.D.A. 1947	B225	M.g. "diorite" locally altered to chl. sch. Contains py.	HughesR.,E. ArbourL.
182	J.D.A. 1947	B265	Pyrite in m.g. gn'ic hbl.-biot. granite.	E. Cartwright L.
183	Company Report		Sulphides: In sediments on V.M.C. 23, in a shear zone and dissem. in seds. and sills nearby. Mainly po. with lesser amts. py. cp. sills nearby. Mainly po. with lesser amts. py. cp. sph. and ga. Assays very low; not related to amt. of sulphide [!].	
184	J. T. Randell for Dormal Mines		"DDH 12, 100' S.W. of 74+00 on Base Line, cut 30' massive sulphides". Values: less than 0.38% Cu, 0.15% Ni	DDM & Bang groups.
185	A.P.F. 1948		Qtz. in f.g. Bl. Trout Dior. 2-5% py. and 5-10% chloritized amphib. Pits south of cabin on Bl. Trout Lake.	
186	A.P.F. 1948	K5+2750	Trace of sulphides in variable gneissic rk. predom. hbl.-felds—mapped as hybrid inclusions in granite.	Beatty Creek.
187	A.P.F. 1948	B18+2480	Slight cp. in andesite.	
188	A.P.F. 1948		2% pyrrhotite (?) in basic inclusions in hybrid rk. [mainly granite-hbl. gabbro mixture].	
189	A.P.F. 1948	C59	Sulphide in hbl. gabbro which is cut by qtz. stringers and granite dykes. Rusty along fractures. Severe local magnetic anomaly in area. [Worth prospecting, says A.P.F.]	
190	A.P.F. 1948	C59+3600	Rusty places locally in hbl. gabbro [due to sulphide or hbl.?].	
191	A.P.F. 1948	C64+1500	2% sulphides reported in hybrid rock ["hblendite and biot. syenite"].	S. Carbert L.
192	A.P.F. 1948	B13	Some cp. in hybrid, predom. hbl.-biot. gn.	Keewatin R.
193	A.P.F. 1948	D6	1-2% sulphides in granite.	Black Trout L.
194	A.P.F. 1948	E8	Sulphides in parts of Bl. Trout Dior.	W. side Black Trout L.
195	A.P.F. 1948	⊟5	"Specks of sulphide" in Bl. Trout Dior.	Black Trout L.
196	A.P.F. 1948	M16	Trace of sulphides in Bl. Trout Dior.	
197	A.P.F. 1948	M17+2200	Granite "mineralized near contact" with hbl. gabbro.	
198	A.P.F. 1948 (Oliver)	Δ126	Qtz. mica schist, as float, with high py. and some cp.	
199	A.P.F. 1948	Δ417	Spotty mineralization in flows or seds. cut by granite. Rusty.	Black Trout Lake.

Map No.	Observer	Field Notebook Reference	REMARKS	Location
200	A.P.F. 1948	Δ419+2600	Spotty mineralization in trench; assoc. with garnet tourmaline bands and iron-formation. [Ruth cl.]	Black Trout Lake.
201	A.P.F. 1949 (Allen)	A24	Slight min'l. in Black Trout Diorite.	Amy L.
202	A.P.F. 1949	A120+3000	In pink granite porphyry. Sparse sulphide.	
203	A.P.F. 1949	A156	Pyrite in Wasekwan amphibolite.	
204	A.P.F. 1949	A166	Quartz-filled shear, traced for 100′ to overburden. Width 5-15 ft. Rusty and white quartz. Cutting greenstone?	
205	A.P.F. 1949	A199+4000	Specks of sulphides in v.f.g. Bl. Trout Dior.	Lasthope L.
206	A.P.F. 1949	A232+5900	Pyrite in rusty zone about 18″ wide between quartzite and sheared andesite.	Lasthope Lake Mines area.
207	A.P.F. 1949	A242+4850	Pyrite, very slight, in Black Trout Dior.	Lasthope L.
208	A.P.F. 1949	F255+3000	Trace cp. in ⅛″ qtz. along shear lines of "Basic gn."	Lasthope Lake Mines area.
209	A.P.F. 1949	A223+6190	1-2% py. in Wasekwan andesite.	Lasthope L.
210	A.P.F. 1949	A329+1400	"Slight" mineralization in f.g. to m.g. massive hbl. "gabbro" cut by pk. aplite.	N.E. Lasthope L.
211	A.P.F. 1949	A232+3840	Considerable mineralization (pyrite) (in small shear?) in gs.	
212	A.P.F. 1949	F325+1050	Pyrite ("some") in f.g. siliceous rk. with incls. of gabbro.	Wasekwan Lake.
213	A.P.F. 1949	F347+4000	Pyrite—Frequent specks in what Fawley calls laminated seds. and Bateman, sheared granite gn.	
214	T.A.O. 1949		Vein stripped discontinuously for 40 ft. Best exposure 4′ qtz. and 2′ min. wall-rock. W.R. shows deep brown gossan. Flows weather very light grey to green. Intruded by quartz and feld. porphyry along foliation planes. S. end sand beach.	Pool L.
215	T.A.O. 1949	0231	Few grains sulphides in gabbro and a few 1′ granite dykes 200′ away.	Pool L.
216	T.A.O. 1949	0227+100	Py. and cp. in f.g. gs. assoc. with qtz. veins, granite stringers and feld. porphyry dykes.	Pool L.
217	T.A.O. 1949	0224+9700	Some py. in f.g. black gs. intruded by granite stringers and qtz.	Pool L.
218	T.A.O. 1949	0269+200	Sparse py. in f.g. amphibolite.	Franklin L.
219	T.A.O. 1949	0216+1000	Small amt. py. and cp. in gs.	
220	T.A.O. 1949	0184+1300	A little py. and mg. in quartz stringers cutting flows.	
221	T.A.O. 1949	0125+800	Sp. py. in recrystallized rock.	W. Boiley L.
222	T.A.O. 1949 (Caldwell)	K151+8000	Some py. in good gs. and seds (?). With a little quartz.	N.W. Pool L.
223	T.A.O. 1949	K148	"Flecks of asp." in massive white rk. [=qtz.?] in trench.	N.W. Pool L.
224	T.A.O. 1949	K143+3800	Visible gold in qtz. veins cutting plag.-amphib. Str. veins 055°. Blasted. [Assay results, nil.]	N.W. Pool L.
225	T.A.O. 1949	K143+800	Rare pyrite in grey granite.	N.W. Pool L.
226	T.A.O. 1949	K143+3000	Rare pyrite in dark grey sed.	
227	T.A.O. 1949	K181+2000	Few specks of py. in dior. (hbl. gabbro).	
228	T.A.O. 1949	K179+1000 −1600	Rare sulphides in grey biot. granite which is sheared in places.	N.E. Pool L.
229	T.A.O. 1949	K173+120	Sulphide in 4′ quartz vein in gs. Mostly py., some cp., a little bn.	Pool L.
230	T.A.O. 1949	K30	Sulphide "small bits", in grey biot-rich places, in pk. granite cut by peg.	S.W. of Keith L.

Map No.	Observer	Field Notebook Reference	REMARKS	Location
231	T.A.O. 1949	K229+6400	Pyrite [presumably in minor am'ts.] in mass. grey bi. granite.	Story L.
232			Prospector reports that several years ago he found arsenopyrite on a sand ridge (north side) N. of E. end Wilmot L. This asp., when roasted and panned, showed gold.	
233	T.A.O. 1950 (Davies)	H215–216	In hbl.-plag. gn., some cp. with some qtz. introduced along shears.	W. of Patton L.
234	T.A.O. 1950	H191+1760	Some py. with qtz., in gs.	S.E. Lemon L.
235	T.A.O. 1950	Spec. H107-50	Sulphides in f.g. hbl.-qtz.-feld. gn.	
236	T.A.O. 1950	Spec. H132-50	Sulphides in dense f.g. hbl. (=gs.)	S. Lemon L.
237	T.A.O. 1950	Spec. H140-50	Py. and cp. in hbl.-dior. type (probably fragment in granite).	
238	T.A.O. 1950	H211-212	Specks of sulphide in dioritic-type rk.	
239	T.A.O. 1950	H171+2000	Minor am'ts. of sulphides + qtz. stringers in hbl.-biot.-plag. gn.	W. of Wilmot L.
240	T.A.O. 1950	H171+8500	Very fine small crystals, sulphides. Spec. H91-50.	
241	T.A.O. 1950	H172	Few grains of py.	
242	T.A.O. 1950	Spec. H93	Minor py. in hb'lendite.	
243	T.A.O. 1950	Spec. H101	Sulphides in hbl.-plag.-qtz. rk.	W. of Sarah L.
244	T.A.O. 1950	H164+4800	Very fine scattered crystals of py. in hbl. gabbro.	Wilmot L.
245	T.A.O. 1950	O315	Sulphides. [Variety not stated.]	
246	T.A.O. 1950	O300	"Seams of sulphide" in impure quartzite. [Pyrite?]	
247	T.A.O. 1950	O301	Prospect pit.	Wilmot L.
248	T.A.O. 1950	O288	Sulphide mineralization in small boulder.	Sarah L.
249	T.A.O. 1950	O290	Specks of sulphide in f.g. massive dior. or gabbro.	Sarah L.
250	T.A.O. 1950	O291	A little cp. and py.	
251	T.A.O. 1950	O284	A little gossan in gs. cut by little stringers and veinlets of qtz.	Sarah L.
252	T.A.O. 1950	O285	A little gossan, in gs. cut by little stringers and veinlets of qtz.	S.W. end Irene L.
253	T.A.O. 1950	O282	"Few grains of py." [in gs.?].	Binks L.
254	T.A.O. 1950	O267	"Little seams of py. and cp. small veinlets of calcite", in f.g. mass. volcanic (gs.) with larger hbl. phenocrysts. [Doubtful outcrop.]	Wilmot L.
255	T.A.O. 1950	O268	"Fair amt. of py. in some samples." Rock mainly hbl. needles, oriented, with 10-20% calcite scattered throughout.	
256	T.A.O. 1950	O269	Gossan at O269 but no sulphides noted.	
257	T.A.O. 1950	O265	Few specks of py. in hbl.-gran. and qtzite. "Rusty gossan common."	Wilmot L.
258	T.A.O. 1950	O47	"Some py. visible" in biot. sch.	
259	T.A.O. 1950 (J. D. Allan)	A61	Some cp. in groundmass of congl.	N. side Congl. L.
260	M.S.S. 1948 (Caldwell)	⊙243+280	Sulphides (py.) in c.g. diorite, scattered throughout.	Wilkin L.
261	M.S.S. 1948	⊙225	Pyrrhotite in gs.	Tod L.
262	M.S.S. 1948 (Caldwell)	⊙193	Band of po., py., mg. 50′ wide. Str. 080 (?)	E. side Stanton L.
263	M.S.S. 1948	⊙194	Basic rk. str. 080° Dip 70° S. (gs.?). Sulphide zone at S. end 20′ wide (indefinite). Garnets assoc. in many places.	On Island.

Map No.	Observer	Field Notebook Reference	REMARKS	Location
264	M.S.S. 1948 (Caldwell)	⊙135+630	A little py. in hbl.-olig. gn.	S. of Laurie R.
265	M.S.S. 1948	⊙133+900	Bn. and cp. in "igneous gn."	S. of Laurie R.
266	M.S.S. 1948	⊙82+1000	A few small flecks of py. visible with lens in grey hbl.-qtz. dior., massive	Dunphy L.
267	M.S.S. 1948	⊙66	Small am't. of py. in sm. otc. grey hbl.-biot.-granite or qtz. dior.	Dunphy L.
268	M.S.S. 1948	⊙41+2280	"Small showings of py." in hornblendite. At 2460 a 5′ wide belt of gabbroic-looking rk. [Hornblendite.]	Dunphy L.
269	M.S.S. 1948	⊙37+2560	Heavy py. along contact of gs. and interbedded qtz.-mica sch.	Dunphy L.
270	M.S.S. 1948 (Hanna)	⊙213	On southeast bay of Tod Lake reports malachite, in Sickle seds. [Stanton was apparently not sufficiently impressed to save the sample, for no number was assigned.]	Tod Lake
271	M.S.S. 1948	⊙128+3580	Sulphides (py.) in qtz.-musc.-olig. gn.	S. Eager Dam.
272	M.S.S. 1948	⊙86+3720	Pyrite [sparse ??] in hbl.-qtz.-olig. gn. cut by pegs. 2′ wide.	S. Eager Dam.
273	M.S.S. 1948	⊙73+4140	F.g. sulphides, not determined. In gs.	N.W. Arc L.
274	M.S.S. 1948	⊙70+310	Sm. amt. po. [in gabbro].	W. Snake L.
275	M.S.S. 1948	⊙57	Some py. in gabbro.	Snake L.
276	M.S.S. 1948	⊙814	Occ. speck of cp. in impure buff granite with black hbl. and pinkish feldspar.	Vaughan L.
277	M.S.S. 1948	⊙723	"Locally a little min'l. (cp., py.) in fractures in gs.". Some interbedded chert on N.W. edge of hill.	Laurie R. at Tod Lake.
278	M.S.S. 1948	⊙731	Locally, dissem. po. min'l. in f.g. hbl'dic. gs. Some minor faulting [cutting 1½′ qtz. vein?].	
279	M.S.S. 1948	⊙219	"Possibly some py. along seams" in f.g. qtz.-feld.-biot. seds. with cherty interbeds, contorted."	Laurie R. to N. Tod L.
280	W. J. Farley	Rept. Caimito Claims	Low Au values. [Some cp. in drill core, subsequent drilling.]	Laurie L.
281	M.S.S. 1948	⊙610	"Strongly rusted zone in rather coarse hbl.-plag. gn. with consid. garnets. Seems to have been some silicification with introduction of fine diss. sulphide (py. and po.). Rust zones as bands and irregular areas over ca. 10-15′, but does not appear to be continuous and could not be followed far along strike. A little quartz introduction zone appears to be at or near contact of garnet hbl.-olig. gn. with sed.".	S.W. Eager Lake.
282	M.S.S. 1948	⊙539	Sl. garnetif. hbl.-plag. gn., cut by occ. small peg. In places py. min'l.	Eager L.
283	M.S.S. 1948	⊙524+650	"Locally contains odd grain of cp." in lighter grey biot.-hbl.-qtz.-olig. gn.	
284	M.S.S. 1948	⊙481+6650	Hbl.-(biot.)-olig. gn. [=gs.?] dark grey. Locally carries a little dissem. po.	S. of Eager Dam.
285	M.S.S. 1948	⊙480+1200	Quartz containing a little pale coloured diss. py. In grey qtz.-biot-olig. gneiss. On south more hornblendic rk. and contains dissem. py.	S. Eager Dam.
286	M.S.S. 1948	⊙107+900	Occ. a little py. and po. in grey qtzitic sed. (variable) between two bands of dior. Dior. locally carries a little py.	
287	M.S.S. 1948	⊙52	A little sulph. assoc. with carb. filled fractures in gs. (and glassy qtz.).	
288	M.S.S. 1948	⊙71	"A little py." in pk. granite dyke cutting grey granodiorite.	Dunphy L.

Map No.	Observer	Field Notebook Reference	REMARKS	Location
289	M.S.S. 1948	⊙85	Some diss. py. in hbl'dic gn.	
290	M.S.S. 1948	⊙86	Some diss. py. in hbl'dic gn.	
291	M.S.S. 1948	⊙28	Sulphide in hbl'dic. rk. cut by 6″ feld-qtz. vein.	Dunphy L.
292	M.S.S. 1948	⊙34+5100	"Contains a little sulphide (py.)" in recrystallized andesite or diorite.	Dunphy L.
293	M.S.S. 1948	⊙36+300	"Quite strongly min. with py.", green platy andesite. "Some sulphide" in adjacent otcs.	
294	M.S.S. 1948	⊙49+4100	A little py. and po. in sil. f.g. green rk. cutting gabbro.	
295	M.S.S. 1948	⊙52	Again a little sulphide.	
296	M.S.S. 1948	⊙1	Fine py. dissem. in dykes of acid felsite cutting gs. and interbedded tuff or sil. seds.	Dunphy L.
297	M.S.S. 1948	⊙179+5000	Small amt. dissem. py. in garnetif. greenstone and cut by quartz.	Dunphy L.
298	M.S.S. 1948	⊙175	Minor cp. and py. in grey qtzitic seds. Some rust. Some stripping 20′. Str. 050°. Dip 85° S.	Dunphy L.
299	M.S.S. 1948	⊙143	Heavily rusted interbedded gs. and seds. Rust due to fine dissem. py. and po. (in quartzites). 2 or 3 small "pop shots" placed in the zone.	Dunphy L.
300	M.S.S. 1948	⊙118+11250	"Locally a little dissem. py.", in f.- m.g. dior.	Dunphy L.
301	M.S.S. 1948	⊙126	"Some py." in typical dior. (gabbro).	Dunphy L.
302	M.S.S. 1948	⊙137	Some po. in green flows in interbedded volc. and seds.	Dunphy L.
303	M.S.S. 1948	⊙425	Py. assoc. with small qtz. stringers and lenses. In creek bed qtz. veins up to 14″ wide.	Creek between Snake and Pyta L.
304	M.S.S. 1948	⊙420+1350	Brown sugary rk. cut by 4″ qtz. veins filling fractures. Locally rusty and occ. fine py.	Portage from Pyta to Snake L.
305	M.S.S. 1948	⊙395	"Sm. outcrops . . . could be sed. (Dacite porphyry 150′ south). A little py. min."	S. end of Snake Lake.
306	M.S.S. 1948	⊙360+2100	Occ. a little py. in apl'ic. hbl.-biot. granite or qtz. dior. cut by a little qtz.	W. Snake Lake.
307	M.S.S. 1948	⊙390+3600	Locally a little py. and po. in dioritic gabbro along E. edge of high hill.	N.W. Pyta L.
308	M.S.S. 1948	⊙348+1150	Small rusty zone due to oxidation of dissem. po.	E. Snake Lake.
309	M.S.S. 1948		Some rust at ⊙348+1650.	
310	M.S.S. 1948	⊙350+2300	Some rust but no sulphide in glassy wh. gash veinlets of qtz.	E. of Snake L.
311	M.S.S. 1948	⊙327+50	Considerable dissem. po. and py. in gabbro (?).	Snake Lake.
312	M.S.S. 1948	⊙285+2250	Grey f.- m.g. biot. qtz.-feld. gn. (=aplitic granite). Locally very rusty and contains a little fine py.	
313	M.S.S. 1948	⊙283+3800	"Hybrid zone. Granite; consid. gs. mat'l. rather high in po. May account for magnetic att'n. Also some granitic to dioritic rk., mass and containing numerous small ⅛″ red garnets. Some seems quite dioritic".	Dunphy L.
314	M.S.S. 1948	⊙283+4300	A little py. in qtz. porphyry.	
315	M.S.S. 1948	⊙270+3500	Dioritic, massive, with a little po. locally.	Dunphy Lake.
316	M.S.S. 1948	⊙276+50	Gs. containing some diss. py.	
317	M.S.S. 1948	⊙255+1400	"Small workings. Pit 4′x 4′x 3′ in a rusty lens in garnetif. gs. (both HW and FW). Cut by a little wh. to sugary qtz. Strike lens 065° Dip 80°. Zone extends ca. 25′. Max. width 3½-4′. Large am't. of rust but no sulphide seen. Development of coarse amphib. xls. No obvious value. Other small rusty sections in vicinity."	Dunphy L.
318	M.S.S. 1948	⊙215+1100	Sparse po. (coarse) in quartz veinlets cutting qtzitic seds.	Between Dunphy and Snake L.
319	M.S.S. 1948	⊙215+1200	A little po. ? in rhyolite?	

Map No.	Observer	Field Notebook Reference	REMARKS	Location
320	M.S.S. 1948	⊙239	A little po., in gs. cut by a few qtz. stringers.	Dunphy L.
321	M.S.S. 1948	⊙239+2400	A little po. and py. in dk. green alt'd. gabbro cut by buff f.g. felsite.	
322	G.C.M. 1950 (J. D. Allan)	A18	Sulphides reported in gn.	Laurie L.
323	G.C.M. 1950	A26	Scattered po. in "hbl. gabbro".	Laurie L.
324	G.C.M. 1950 (Caldwell)	K454	"Rare and highly dissem." py.	Laurie L.
325	G.C.M. 1950	K460	"Rare and dissem.", "sparse" py. and po.	Laurie L.
326	G.C.M. 1950	M349	Much (?) dissem. f.g. py. in biot. sch. interbanded with gs.	Laurie L. near Sask.
327	G.C.M. 1950	M355	Pyrite (and MoS_2 ?) in qtz.-biot.-garn. sch.	
328	G.C.M. 1950	M375	Dissem. py. and po. (?) assoc. with hbl. (chloritized) in sheared hbl. granite.	
329	G.C.M. 1950	M264	Dissem. py. and qtz. veins in gs.	Laurie L.
330	G.C.M. 1950	M292	Sparse dissem. py. in granitic gn.	Caimito Grp.
331	G.C.M. 1950	M297	Sp. diss. py. in gs.	
332	G.C.M. 1950	M207	Dissem. py., in coarser hbl. of gs.	Laurie L.
333	G.C.M. 1950	M58	V. sparse sulphide in qtz.-biot.-hbl. rk.	Laurie L.
334	G.C.M. 1950	M68	Sparse dissem. po. in gs.	Laurie L.
335	G.C.M. 1950	M77	Sparse po.	Laurie L.
336	G.C.M. 1950	M78	Qtz. and diss. f.g. py.	Laurie L.
337	G.C.M. 1950 (Caldwell)	K380	Very sparse py. in gs.	Tod L.
338	G.C.M. 1950	K382	Dissem. py. in gs.	
339	G.C.M. 1950	K386	Rusty zone 15-20′ along water's edge. Py. and possibly po.	Tod L.
340	G.C.M. 1950	K340	Minor amt. (<1%) sulphide (po.).	Tod L.
341	G.C.M. 1950	K341	Rare cp.	
342	G.C.M. 1950	K345	Small amt. of py.	Tod L.
343	G.C.M. 1950	K348	Gossan and sulphide. Tr. Au, Nil Ni.	
344	G.C.M. 1950	K359	Consid. sulph.: py., po., asp. (?)	
345	G.C.M. 1950	K306	Minor py. in gs.	Laurie L.
346	G.C.M. 1950	K312+5800	Extremely rare dissem. sulphides in gs.	Laurie L.
347	G.C.M. 1950	K312+6750	Some visible sulphide and gossan.	
348	G.C.M. 1950	K194	"Minor amts. of sulphide present."	Laurie L.
349	G.C.M. 1950	K11+5600	Trace of py. in gs.	Laurie L.
350	G.C.M. 1950	M767	Sparse dissem. f.g. sulphide in Sickle.	Tod L.
351	G.C.M. 1950	M650	Dissem. py., po. and bn. (???). Much transported limonite.	Tod L.
352	G.C.M. 1950	M642	Sparse py. in hbl. sch. (gs.)	
353	G.C.M. 1950	M602	Dissem. po. in gs.	Tod L.
354	G.C.M. 1950	M611	Dissem. po. in gs.	
355	G.C.M. 1950	M538	Sparse py. in f.g. gs. (?) with some interbedded qtzites.	Tod L.
356	G.C.M. 1950	M528	V. sparse sulphide in basic tuffs (?).	Laurie L.
357	G.C.M. 1950	M531	Py. assoc. with hbl.	
358	G.C.M. 1950	M508	Py. dissem. in qtz.-biot.-feld. gn.	Laurie L.
359	G.C.M. 1950	M514	Dissem. po. and cp. in gs.	
360	G.C.M. 1950	M492	Sulphide stain and gossan in gs. Grab sample = 0.03 oz. Au.	Laurie L.
361	G.C.M. 1950	M490	Po., py., and cp. in small amts. in tuff (??) interbands in qtz.-biot.-feld. gn.	Laurie L.

Map No.	Observer	Field Notebook Reference	REMARKS	Location
362	G.C.M. 1950	M451	Dissem. py. in basic tuff.	Laurie L.
363	J.D.A. 1947	B168	Scattered sulphides in remnants of gs. in heavily contaminated pk. granite.	Muskeg L.
364	J.D.A. 1947	B176	"Diorite contains py. along small fracture planes."	Muskeg L.
365	J.D.A. 1947	B218	Wh. streaks of carb. in amygdaloid carry py.	E. Hughes R.
366	J.D.A. 1947	B222	"Great deal of py." in m.g. pk. biot. granite.	N.E. Arbour L.
367	J.D.A. 1947	B223	Grey hbl. granite "contains py."	E. Hughes R.
368	M.S.S. 1947	⊙275+2250 −2400	"Locally highly mineralized". [Abundant f.g. dissem. py.] in hbl. porphyry. [Large hbl. xls. in f.g. matrix.]	Farley L.
369	M.S.S. 1947	⊙280+6800	"Locally some fine py'ic min'l." in porphyritic andesite.	Farley L.
370	M.S.S. 1947	⊙281+2350 −2750	"Locally a little cp. min'l." in glassy wh. qtz. in dior.	Farley L.
371	M.S.S. 1947	⊙269+3300 −3500	In one place a little cp. and py. found in fracture in andesite cut by grey granite stringers.	
372	M.S.S. 1947	⊙270	Locally consid. min'l. in f.g. green andesite (py., cp.). Rust along fractures. Small workings over area 20'x20'. No apparent structure or regularity.	
373	M.S.S. 1947	⊙271	Hblendite with sp. diss. py. [Angular pushups.]	
374	M.S.S. 1947	⊙540+2300 −2350	Qtz. veins with some rust. "Small workings." In "chl. schist. rk., containing reddish garnet".	
375	M.S.S. 1947	⊙540+2400 −2450	Chl. sch. some rust and dissem. py. mineralization.	
376	M.S.S. 1947	⊙555	"Impure grey granite, loc. siliceous. In places min. with po. and py."	Brooks Bay Barrington L.
377	M.S.S. 1947	⊙559	"Some py. min. in m.g. dioritic rock or coarse andesite."	Island E. of Brooks Bay.
378	M.S.S. 1947	⊙395	Py. and trenching. See M.S.S. 1947, ⊙395 and G.C.M. 1955, M309 for details	N.W. Farley L.
379	M.S.S. 1947	⊙396	as No. 378.	
380	M.S.S. 1947	⊙397	as No. 378.	
381	M.S.S. 1947	⊙348	D.D.H. core. Logs of hole 23 (just S. of camp). See notes for 21 Aug., 1947, for details.	Farley L.
382	M.S.S. 1947	⊙222	SGM prospect at Pump L. (see text).	S. of Farley L.
383	M.S.S. 1947	⊙222+3000	Pillowed andesite. Local x-fractures, rusty, min. with py.	W. of Farley L.
384	M.S.S. 1947	⊙226	Pushup of dk. grey banded tuff or qtz'itic. sed. with fine py. throughout. [Some cp. in spec.]	Farley L.
385	M.S.S. 1947	⊙229+7350	Locally rust and py. min'l. [in andesite]. Locally cut by small white to rusty qtz. veins.	S. Farley L.
386	M.S.S. 1947	⊙181	Some py. min'l. in altered and sheared dior. [=Bl. Trout. Dior.]	S. Hughes L.
388	M.S.S. 1947	⊙191+0−300	Locally cut by rusty to white qtz. veins, min. with py. and cp.	Hughes L.
389	M.S.S. 1947	⊙134	A little fine dissem. sulphide in m.g. hbl. dior. Chiefly py., possibly a little po. and cp.	Hughes R.
390	M.S.S. 1947	⊙145	Sparse py. in good m.g. gabbro or hbl. dior. with greenish weathering hbl. Looks like Lynn L. gabbro.	N.E. Hughes River
391	M.S.S. 1947	⊙146	Some py. min'l. in somewhat streaky and granitized dk. grey f.- m.g. hbl. dior.	
392	M.S.S. 1947	⊙146+5550	Some py. min'l. in f.- m.g. hbl. dior.	
393	M.S.S. 1947	⊙9+650−750	Mass green, sl. rexlized chl. andesite. Contains a little cp.	N. Westdal L.

Map No.	Observer	Field Notebook Reference	REMARKS	Location
395	M.S.S. 1947	⊙77+4400	"Some coarse cp. min'l. but generally barren" in lensy quartz vein, 4′ wide, cutting streaky gs. Rept'd traced for 150′ but does not appear continuous.	Hughes R.
396	M.S.S. 1947	⊙459+4850	"Some cp. mineralization" [very sparse].	E. White Owl L.
397	M.S.S. 1947	M333-55	"A little dissem. po. and cp. assoc. closely with hbl." in diorite.	E. White Owl L.
398	M.S.S. 1947	⊙539	F.g. hbl'dic. rk. locally sheared, chloritic and mineralized with fine py.	Barrington L., S. of Brooks Bay.
399	M.S.S. 1947	⊙453+3950	Wh. to rusty qtz. veinlets [cutting granodiorite] carrying a little malachite stain.	S.E. White Owl Lake.
400	M.S.S. 1947	⊙364+850	Sm. otc. andesite slightly mineralized with pyrite.	Farley L.
401	M.S.S. 1947	⊙370	Sulphide mineralization (py.) common. Some shearing in places.	White Owl Lake.
402	M.S.S. 1947	⊙375	Mass andesite and fine porphyritic andesite. Some fine py. or po. min'l. locally.	White Owl Lake.
404	M.S.S. 1947	⊙239	Sparse py. dissem. and on fracture planes in siliceous rk. probably g'wke. [Not rept'd. in notes.]	Narrow Lake.
405	M.S.S. 1947	⊙239+3850	Consid. glassy and sugary wh. qtz. in andesite. Some py., cp. (possibly some Au ?) Otc. has been prospected.	N. Narrow Lake.
407	M.S.S. 1947	⊙343+3400 −3500	"Granitized sheared greyish rk., cut by some qtz. Could be volc. Becomes very heavily rusted and mineralized (pyrite). [Probably andesite incls. in gabbro.]	S. Nickel Lake.
408	M.S.S. 1947	⊙341	Locally a little py. in gabbro.	S. shore Nickel L.
409	M.S.S. 1947	⊙320	Showings of God's Lake. See text.	Nickel L.
410	M.S.S. 1947	⊙306	Py. and Au rept'd. to 0.60 oz. from siliceous granitic mat'l.	Trenching S. side Nickel Lake.
412	M.S.S. 1947	⊙265	Mostly angular pushups of granite but also qtz. some of which shows vugs from py. weathering, and in some pieces xl. faces suggesting growth in open vugs.	
413	M.S.S. 1947	⊙267+2050	Small shear in granite has py. and cp. Consid. malachite and azurite stain. Str. 140° Dip 75° N.E. Length 2′, width 8″ at most. Just a small lens. A little carbonate present.	
414	M.S.S. 1947	A 220+1460	V. slight py. min'l. in hbl. diorite.	Ashley Ck.
415	M.S.S. 1947	A226	V. slight py. min'l. in hbl. diorite.	
416	M.S.S. 1947	A248	[Minute stringers of py. and cp. in spec.]	Barrington Lake.
417	M.S.S. 1947	A350	Sparse py. showing in spec. from large inclusion (?) in grey granite.	Barrington Lake.
418	M.S.S. 1947	A358	Similar to 417.	Barrington Lake.
419	M.S.S. 1947	A131	Sparse py. in andesitic gs. or f.g. dior.	Ellystan Lake.
420	M.S.S. 1947	A244+10400	"Some mineralization" [in biotite-carb. sch.]	N. Farley Lake.
421	M.S.S. 1947	A154	Sparse py. in f.g. feldspar porphyry.	W. of Simpson Lake.
422	M.S.S. 1947	A160+4620	A little py. in feldspathic flow [dacite?].	S. Farley Lake.
423	M.S.S. 1947	A169+7780	"Some py." in hbl.-qtz. gneiss [calcareous tuff?]	S. Farley Lake.

List of Abbreviations Used in Appendix C

alt.	altered
alt'n.	alteration
amph.	amphibolite
amt.	amount
amyg.	amygdaloidal
apl'ic.	aplitic
app.	apparently
asp.	arsenopyrite
assoc.	associated
att'n.	attraction
bdy.	boundary
biot.	biotite
bl.	black
bn.	bornite
bx.	breccia
ca.	circa
carb.	carbonate
c.g.	coarse-grained
chl.	chlorite
congl.	conglomerate
consid.	considerable
contam.	contaminated
cp.	chalcopyrite
devl.	developed
dior.	diorite
dissem.	disseminated
dk.	dark
ep.	epidote
feld.	feldspar
femag.	ferromagnesian
f.g.	fine-grained
fol.	foliated
form.	formation
F.W.	footwall
ga.	galena
garn.	garnet
gn.	gneiss
gn'ic.	gneissic
gs.	greenstone
g'wke.	greywacke
hbl.	hornblende
H.W.	hangwall
incl.	inclusion
loc.	locally
mass.	massive
mag.	magnetic
mat'l.	material
metam.	metamorphic
mg.	magnetite
m.g.	medium-grained
min.	mineralized
min'l.	mineralization
musc.	muscovite
num.	numerous
occ.	occasional
olig.	oligoclase
otc.	outcrop
peg.	pegmatite
pk.	pink
plag.	plagioclase
po.	pyrrhotite
prob.	probably
py.	pyrite
qtz.	quartz
qtzitic.	quartzitic
rept'd.	reported
rexlized.	recrystallized
rk.	rock
sch.	schist, schistose
sed.	sediment
S.G.M.	Sherritt Gordon Mines
sil.	silicified
sl.	slight, slightly
sph.	sphalerite
sm.	small
sp.	sparse
spec.	specimen
str.	strike
sulph.	sulphide
tr.	trace
v.	very
vis.	visible
volc.	volcanic
W.R.	wall-rock
wh.	white
x.	cross
xl.	crystal

APPENDIX D

POSITIONS OF LAKES AND OTHER PLACES WITHIN THE DISTRICT

INCULDING NEW LAKE NAMES

NAME	POSITION	
AMER LAKE	56°33′N	101°20′W
AMOEBA LAKE	56°37′N	101°12′W
AMY LAKE	56°32′N	100°48′W
ANSON LAKE	56°45′N	100°47′W
ARBOUR LAKE	56°56′N	100°47′W
ATOMIC LAKE	56°01′N	101°17′W
AUNI LAKES	56°55′N	100°34′W
BAGSHAW LAKE	56°37′N	100°45′W
BARRINGTON LAKE	56°55′N	100°15′W
BARRINGTON RIVER	56°46′N	99°42′W
BEATTY CREEK	56°36′N	100°31′W
BELLEAU LAKE	56°44′N	100°38′W
BERGE LAKE	56°54′N	101°00′W
BETTY LAKE	56°52′N	101°09′W
BINKS LAKE	56°41′N	101°28′W
BLACK TROUT LAKE	56°33′N	100°38′W
BOG LAKE	56°48′N	100°31′W
BOILEY LAKE	56°41′N	101°14′W
BROOKS BAY	56°57′N	100°22′W
CALLINAN LAKE	56°35′N	100°46′W
CARR LAKE	56°53′N	100°48′W
CARTWRIGHT LAKE	56°47′N	100°43′W
CHEPIL LAKE	56°51′N	100°36′W
CLOVERLEAF LAKE	56°39′N	100°51′W
CONGLOMERATE LAKE	56°35′N	101°30′W
CORBERT LAKE	56°40′N	100°35′W
CRAIG LAKE	56°40′N	101°47′W
DOT LAKE	56°54′N	100°59′W
DOUG LAKE	56°59′N	100°39′W
DRYBROUGH	56°31′N	101°14′W
DUFRESNE LAKE	56°43′N	100°47′W
DURAND LAKE	56°41′N	100°36′W
EAGER LAKE	56°33′N	101'38′W
EAGLE LAKE	57°00′N	100°33′W
EATON LAKE	56°36′N	101°00′W
ELB LAKE	56°46′N	101°01′W
ELIZABETH LAKE	56°47′N	100°21′W
ELLIS LAKE	56°31′N	100°49′W
ELLYSTAN LAKE	56°51′N	100°23′W
END LAKE	56°59′N	100°27′W

NAME	POSITION	
ERIC LAKE	56°52′N	101°02′W
EX LAKE	57°00′N	101°07′W
FARLEY LAKE	56°54′N	100°25′W
FAUST LAKE	56°46′N	100°57′W
FINCH LAKE	56°34′N	100°57′W
FOSTER LAKE	56°45′N	100°59′W
FOX LAKE	56°38′N	101°37′W
FRANCES LAKE	56°48′N	101°07′W
FRANKLIN LAKE	56°45′N	101°02′W
FRASER LAKE	56°47′N	101°06′W
FREDETTE LAKE	56°36′N	100°44′W
GAP LAKE	56°47′N	100°36′W
GARBUTT LAKE	56°38′N	100°52′W
GEMMEL LAKE	56°44′N	101°15′W
GERMAN LAKE	56°33′N	101°07′W
GLAD LAKE	56°54′N	101°09′W
GNEISS LAKE	56°30′N	101°35′W
GOLDSAND LAKE	56°58′N	101°02′W
HASSETT LAKE	56°37′N	101°32′W
HATCHET LAKE	56°37′N	101°42′W
HERMAN LAKE	56°59′N	100°30′W
HOPE LAKE	56°45′N	100°57′W
HUET LAKE	56°54′N	100°48′W
HUGHES LAKE	56°50′N	100°31′W
HUGHES RIVER	56°46′N	100°01′W
HUGO LAKE	56°50′N	100°37′W
HUNTER LAKE	56°37′N	100°54′W
IN LAKE	56°48′N	100°43′W
INLET LAKE	56°58′N	100°04′W
IRENE LAKE	56°43′N	101°28′W
JAC LAKE	56°32′N	100°35′W
JIM LAKE	56°57′N	100°28′W
JONES LAKE	56°42′N	101°14′W
JUNE LAKE	56°47′N	100°11′W
JULY LAKE	56°49′N	100°02′W
KAY LAKE	56°52′N	100°41′W
KEY LAKE	56°56′N	100°31′W
KUKRI LAKE	56°34′N	101°32′W
LACKNER LAKE	56°35′N	100°34′W
LARSON LAKE	56°50′N	100°09′W
LASTHOPE LAKE	56°38′N	100°48′W
LAURIE LAKE	56°35′N	101°57′W
LAURIE RIVER	56°13′N	100°36′W
LITTLE BRIGHTSAND LAKE	56°57′N	101°10′W
LOW LAKE	56°54′N	100°31′W
LUCAS LAKE	56°49′N	100°16′W
LYNN LAKE	56°51′N	101°03′W

NAME	POSITION	
MacBRIDE LAKE	56°52′N	99°57′W
MAC LAKE	56°53′N	100°23′W
MACKEY LAKE	56°34′N	100°34′W
MADOLE LAKE	56°35′N	100°51′W
MAIL LAKE	56°44′N	101°08′W
MARROW LAKE	50°52′N	100°30′W
MARSH LAKE	56°48′N	100°18′W
MARY LAKE	56°47′N	100°49′W
MAY LAKE	56°41′N	101°00′W
MAYNARD LAKE	56°46′N	101°01′W
McGAVOCK LAKE	56°32′N	101°25′W
McVEIGH LAKE	56°46′N	101°00′W
McWHIRTER LAKE	56°35′N	101°41′W
MELVIN LAKE	57°08′N	100°15′W
MERLE LAKE	56°53′N	101°09′W
MINTON LAKE	56°54′N	100°54′W
MISKWA LAKE	56°42′N	100°50′W
MONIQUE LAKE	56°42′N	101°13′W
MORE LAKE	56°48′N	100°13′W
MOSES LAKE	56°47′N	100°48′W
MOTRIUK LAKE	56°47′N	101°11′W
MURRAY LAKE	56°30′N	101°39′W
MUSKEG LAKE	56°54′N	100°39′W
NAIL LAKE	56°46′N	101°10′W
NAYLOR LAKE	56°39′N	101°14′W
NICKEL LAKE	56°52′N	100°17′W
NORRIE LAKE	56°49′N	100°42′W
OMEGA LAKE	56°49′N	100°19′W
ONE ISLAND LAKE	56°46′N	100°25′W
OWENS LAKE	56°39′N	100°45′W
PASKWACHI BAY	57°16′N	101°56′W
PATTON LAKE	56°39′N	101°16′W
PHOEBE LAKE	56°35′N	101°07′W
PICKEREL NARROWS	56°14′N	100°31′W
PILL LAKE	56°55′N	100°37′W
POLE LAKE	56°48′N	100°39′W
POOL LAKE	56°43′N	101°12′W
PORTAGE LAKE	56°58′N	100°25′W
POTATO LAKE	56°46′N	100°58′W
PYTA LAKE	56°34′N	101°36′W
RALPH LAKE	56°52′N	101°06′W
RAVEN LAKE	56°59′N	100°36′W
RAY LAKE	56°47′N	100°57′W
REDWIN LAKE	56°35′N	101°22′W
RESERVOIR LAKE	56°46′N	100°59′W
ROBERTSON LAKE	56°35′N	100°56′W
RON LAKE	56°49′N	100°37′W

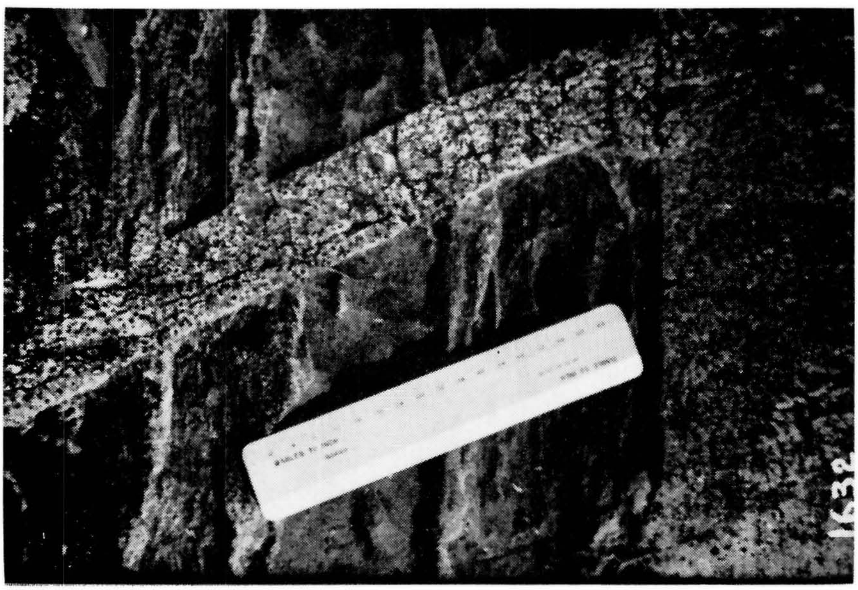
NAME	POSITION	
RUSSELL LAKE	56°15′N	101°30′W
RYAN LAKE	56°44′N	100°34′W
SARAH LAKE	56°41′N	101°29′W
SHANNON LAKE	56°39′N	101°24′W
SHEILA LAKE	56°51′N	101°05′W
SHORTIE LAKE	56°46′N	100°53′W
SICKLE LAKE	56°38′N	100°40′W
SIMPSON LAKE	56°52′N	100°28′W
SNAKE LAKE	56°37′N	101°36′W
SPIDER LAKE	56°51′N	100°05′W
STAN LAKE	56°48′N	100°30′W
STAR LAKE	56°56′N	100°08′W
STICK LAKE	56°56′N	101°01′W
STORY LAKE	56°41′N	101°04′W
STROOD LAKE	56°44′N	101°42′W
STUART LAKE	56°43′N	101°01′W
SUMMIT LAKE	56°38′N	101°13′W
SUTTIE LAKE	56°48′N	101°32′W
SWEDE LAKE	56°52′N	100°25′W
SYNDAL LAKE	56°37′N	101°02′W
TALON LAKE	56°30′N	101°43′W
TOD LAKE	56°34′N	101°46′W
TOW LAKE	56°48′N	100°12′W
TROPHY LAKE	56°13′N	100°57′W
TULUNE LAKE	56°58′N	100°38′W
VANDEKERCKHOVE LAKE	57°02′N	101°25′W
VAUGHAN LAKE	56°40′N	101°44′W
VERONICA LAKE	56°53′N	101°10′W
WABAN CREEK	56°48′N	100°50′W
WASEKWAN LAKE	56°44′N	100°56′W
WEBB LAKE	56°51′N	100°08′W
WELLMET LAKE	56°57′N	100°04′W
WELLS LAKE	57°15′N	101°00′W
WESTDAL LAKE	56°46′N	100°29′W
WEST ERIC LAKE	56°52′N	101°03′W
WEST LYNN LAKE	56°51′N	101°03′W
WHEATCROFT LAKE	56°49′N	101°00′W
WHITE OWL LAKE	56°54′N	100°22′W
WILEY LAKES	56°43′N	100°54′W
WILKIN LAKE	56°42′N	101°44′W
WILLIE LAKE	56°36′N	100°42′W
WILLMOT LAKE	56°41′N	101°24′W
WOLF LAKE	56°38′N	101°34′W
WYE LAKE	56°52′N	101°13′W
YOUNG LAKE	56°42′N	100°57′W
ZED LAKE	56°55′N	101°16′W

A. Banded iron formation, near Gordon Lake. Note the low percentage of chert.

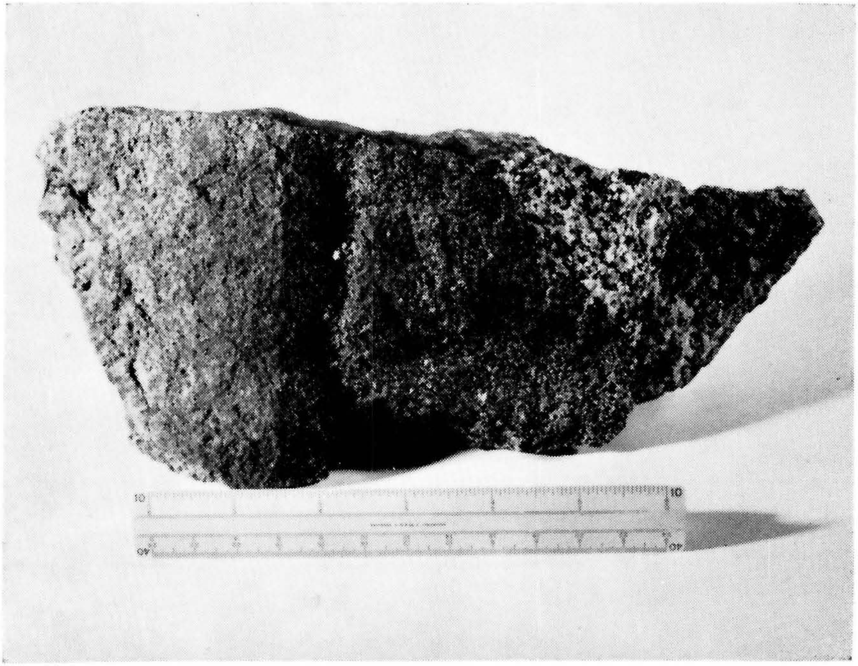
B. Xenoliths of gneissic "greenstone" in diorite are cut by dykes from the diorite.

Plate II.

A. Diorite cut by gabbro dykes, Tulune Lake.



B. Dykes of red siliceous granite cut tonalite and "greenstone". East side of Cockeram Lake.



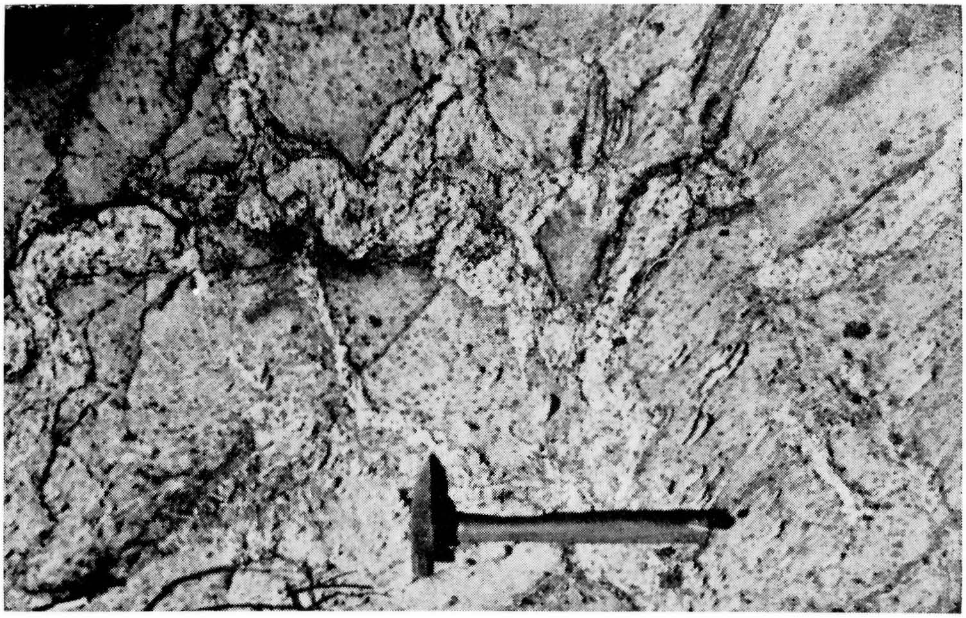
A. Speciment from Chepil Lake, showing intrusive types of three ages. Note at left the vertical chilled margin against the dark rock in centre. Coarse-grained rock at right cuts both the earlier types.

B. Mica schist forms the matrix around quartz-feldspar lenses in altered conglomerate. The lenses are probably remnants of pebbles, Lasthope Lake.

A. Kisseynew-type gneisses.

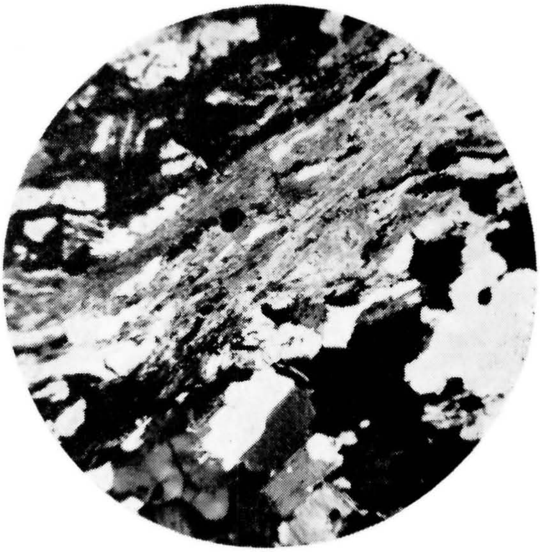
B. Kisseynew-type gneisses.

Photos by T. A. Oliver



A. Kisseynew-type gneisses.

B. Sillimanite knots in Kisseynew-type gneisses.
Photo by T. A. Oliver.



A. Photomicrograph of a sillimanite-bearing knot in the Kisseynew-type gneisses. Note that the sillimanite and mica "stream" round the quartz grains.

Photos by T. A. Oliver

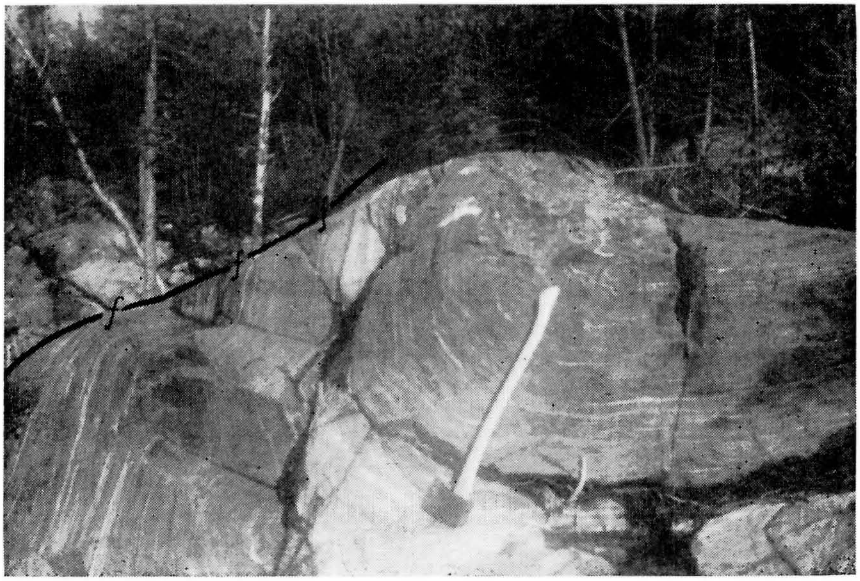
B. Dyke cutting gabbro at Tulune Lake. The darker core is hornblende. The white margins which cut the core are feldspar.

A. The folding of the Willis Lake structure can be illustrated by folding a sheet of paper. The thumbs represent the zone of main movement.

Photo by Michael J. Sym.

Photo retouched to emphasize crossbeds.

B. "Arkose" at Monique Lake. Top of formation is indicated by the crossbedding.



Fault in rocks of the Sickle series on the south shore of Eager Lake. Dragging caused by the fault produced a local reversal of dip.

INDEX

PROVINCE OF MANITOBA

Department of Mines and Natural Resources

MINES BRANCH

GEOLOGICAL MAPS AND SECTIONS

LYNN LAKE DISTRICT

N.E. 7, 10, 11, 12, 14 (East), 15, 16: of 64C

BY

G. C. MILLIGAN

To Accompany Publication 57-1