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REPORT

OF EXPLORATIONS AND SURVEYS IN THE

COUNTIES OF ADDINGTON, FRONTENAC, LEEDS AND LANARK,

BY

MR. HENRY G. VENNOR,

ADDRESSED TO

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DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

SIR,—The report which I have now the honor to lay before you contains a summary of investigations made during the summer of 1872 in the section of country already partly described in my report for 1871; namely, the townships of North Burgess, South Sherbrooke and Bathurst in Lanark county; North and South Crosby in Leeds county; and Olden, Oso, Bedford, Loughboro' and Storrington in the county of Frontenac. These investigations, however, being still in progress, it will chiefly contain further details respecting explorations which have been in progress since the publication of my Report on Hastings County (Report of Progress, 1866–69, page 143, etc.,) and which have been steadily carried on from this last county in an easterly direction through Addington and Frontenac to my present field of labor. Respecting these explorations I have already handed you several brief reports or summaries of the progress made. These have been published in the respective Reports of Progress for the years 1866–69, 1870–71 and 1871–72. In the present report further details are given respecting the geological structure of the region, and they are now accompanied by a suitable map on the scale of four miles to one inch. This map, which may be considered a second edition and extension of that of Hastings county accompanying my report for 1866-69, is referred to in your Summary Report for 1870, where it is stated that in it would be found some important topographical information not given in any previously published map.

Regions examined.

Map.

Before proceeding to describe the geology of the section of country which has more immediately engaged my attention during the past two summers, I will first give a description of the characters and distribution

of a series of rocks met with in the counties of Addington and Frontenac, lying between Hastings county and the counties of Leeds and Lanark. These rocks separate the troughs or basins of rocks of Hastings county from similar troughs, now being traced out through Burgess, Crosby, Bedford and Loughboro' townships. I shall therefore go back to a point where the map and report on the county of Hastings terminated, and proceed in my description thence in an easterly direction in the order in which the various explorations were made. The geological features of the whole of the country examined naturally divide it into three parts, namely a western, a middle, and an eastern section, occupied respectively by the two sets of troughs and the series of rocks which, as above stated, separates them. The western section, of which this report chiefly treats, embraces the great granitic areas of Elzevir, Kaladar, Anglesea, Effingham, Abinger and portions of Miller and Canonto townships; the granite and gneiss areas of the northern portions of Kennebec, Olden, Oso and southern portions of Barrie, Clarendon and Palmerston townships; and the intermediate series of crystalline schists, slates and crystalline limestones, already noted (Report of Progress 1870–71, pages 310-11,) as stretching from the north-eastern quarter of Kaladar township, north-eastward into Levant and Darling townships.

Rocks of Addington and Frontenac counties.

Country divided into three sections.

Western section.

The middle section comprises the southern two-thirds of the townships of Kaladar, Kennebec, Olden and Oso, and the whole of South Sherbrooke and Bathurst, through which are spread out a great volume of granitoid gneisses, schists and crystalline limestones, with magnetic iron ores, and some deposits of apatite or phosphate of lime. And lastly, the eastern section embraces the townships of Burgess, Crosby, Bedford, Loughboro' and Storrington, including the great phosphate-bearing area, and in which granitoid gneisses, pyroxenic schists, crystalline limestones and dolomites with serpentine occur in lengthened irregular trough-like forms, often repeated, and to the south-eastward, passing under the unconformable sandstones and limestones of the Lower Silurian series. The rocks of this section appear to lie conformably on the red gneisses and limestones, which represent the middle section, and in their general characters bear a strong resemblance to the formations described by Sir W. E. Logan as existing in the neighborhood of Grenville on the Ottawa river,—a fact which will be again referred to. It may be further stated that the western section had never been previously geologically examined, but that in the middle and eastern sections some investigations had already been made by Mr. A. Murray, details of which are given in his report for the years 1852–53, now unfortunately out of print; and by Sir W. E. Logan, whose observations are embodied in the "Geology of Canada, 1863." The micrometer measurements, corrections and sketches made at that time by Mr. Murray have been embodied in the

Middle section.

Eastern section.

Resemblance to Grenville rocks.

Investigations of Mr. Murray and Sir W. E. Logan.

map which accompanies the present report, and I would particularly mention the townships of Bedford and Loughboro' as having been thus corrected. At the request of a number of persons, more or less interested in the various lines of railroad at present projected through this region, I have also repeated in this report the levels of all the principal lakes above Lake Ontario, as determined by Mr. Murray, and given in his report above referred to.

Western section.

Western Section.—In the Report of Progress, 1870–71, pages 310 and following, I briefly alluded to the general geological structure of this section, as follows:—" In my explorations of 1869 and 1870, the rocks of divisions B and C, the character of which had been previously studied in the great areas occupied by them in the townships of Madoc, Marmora, Tudor and Lake, were followed for a considerable distance in another area or basin, apparently connected at its south-west extremity in Elzevir with the one just noticed. This latter basin has been traced to the north-eastward through the village of Flinton, in Kaladar, and thence through Barrie, Clarendon, and Palmerston, into Darling, a distance of about sixty miles. It is not more than two miles in breadth in Elzevir and Kaladar, but widens very much to the north-eastward, and is limited on either side by a more elevated region of coarse gneissic and granitoid rocks." I also alluded to the occurrence among these gneisses of " great areas of fine-grained granitic rocks, consisting of little else than red orthoclase and white quartz, without any apparent marks of stratification," which might either be eruptive or indigenous. I wish now to lay before you some further details respecting these elevated regions of coarse gneissic and granitoid rocks bounding on either side the depression above described; and, also, to give a more minute description of the characters and distribution of the rocks in the depression itself. The area occupied by the gneissic and granitoid rocks on the north-western side of the depression, comprises the townships of Elzevir, Grimsthorpe, Kaladar, Anglesea, Effingham, Abinger and Miller; a barren and broken up hilly region, only partially settled, and with but few roads. That on the south-eastern side stretches from Kaladar through portions of Kennebec, Barrie, Olden, Clarendon, Oso and Palmerston, and into North Sherbrooke. In the north-western area the prevailing rocks are unstratified granites, which present one or other of the following characters:—

Characters of rocks.

1. Granite made up chiefly of flesh-colored, or occasionally brick-red, orthoclase feldspar and translucent quartz; with sometimes a very little greenish mica, and occasional crystals of specular iron and iron pyrites. This rock composes a very large part of the area examined, and appears to be the oldest.

2. Dark red, or brownish, coarse-grained, mottled syenite, composed of dark hornblende and red orthoclase feldspar, in nearly equal proportions,

with a very sparing admixture of quartz, and occasional crystals of iron pyrites.

3. Cleveable masses of flesh-red orthoclase feldspar, often largely mixed with black or brownish mica.

The above three varieties of rock graduate the one into the other. Their age is yet uncertain; but they appear to form the base upon which all the rocks yet to be described rest.

4. A great mass of white, micaceous, granitic gneiss, both coarse and fine-grained, and in some places without apparent stratification. It consists of a mixture of white feldspar and greyish quartz, in nearly equal quantities, besides a considerable amount of black or brownish-black mica irregularly distributed throughout the mass, and not, as a general rule, showing any parallelism. Occasionally, however, where the mass is much broken up by atmospheric or other agencies, large angular blocks are met with, in which one or more of the faces are covered with a fine layer or coating of mica.

5. Heavy dark-colored syenite, consisting for the most part of greyish and greenish hornblende, greyish-white feldspar, and a sparing addition of quartz and iron pyrites. This rock may possibly graduate into the coarser varieties of diorite described further on with the rocks of a higher series.

Country occupied by the above rocks.

In my report for 1869, (Report of Progress, 1866–69, p. 148,) allusion was made to these rocks as being very largely developed "from the neighborhood of Queensborough on the one hand, to Mazinaw Lake in Barrie on the other; and transversely from the vicinity of Flinton in Kaladar, to the north-west corner of Grimsthorpe." It was further thought probable, that they would be found coming to the surface in four north-east and south-west anticlinals, forming parallel ridges, and thus spread over "the western half of Anglesea, and the rough and unsurveyed township of Effingham." These statements, which were then partly conjectural, have through subsequent explorations been proved correct. It has been found that these granites and gneisses occupy a line representing the axis of an elevation, starting from near the twelfth lot in the third range of Elzevir, and running N.N.E. through this township into Anglesea, and thence through the south-east quarter of Effingham into Abinger. They are also extensively spread out to the north-westward and south-eastward in a number of subordinate transverse undulations. The course of the first of these transverse undulations may be represented by a line drawn from the south-east to the north-west corner of Elzevir, and passing into the adjoining portion of Grimsthorpe, a distance in all of about fourteen miles, along which the white mica granites and gneisses of (4) and occasionally the darker syenites of (5) are the predominant rocks. The white granites are particularly well seen along the road known as the "new

Four anticlinals.

White granite on Flinton Road.

Flinton road," between Bridgewater and Flinton Village in Kaladar. They occur from lots seven in the sixth and seventh ranges continuously to lots fourteen and fifteen in the tenth range of Elzevir, where they form the south-eastern portion of this granitic area. Much of the rock is a coarse-grained, white granite, with brownish-black mica irregularly distributed through it, and presents no appearance of stratification. Occasionally, however, it graduates into distinctly stratified gneiss, in which the mica is arranged in regular layers. Along the same road approaching the boundary line between Elzevir and Kaladar, the darker syenites of (5) are the most frequent rock masses; and both these and the white gneisses and granites are here much cut up by pale-white and sometimes flesh-colored veins, composed almost entirely of a very fine-grained mixture of feldspar and quartz, with here and there a little black tourmaline. North of the same road in Elzevir, similar white granites cover the remaining portion of the township and, passing into Grimsthorpe, rise into abrupt hills or mountains of considerable altitude. Two of these, known in the neighborhood respectively as the East and the West Mountain, are situated close to the line dividing the townships of Elzevir and Grimsthorpe, between lots twenty and twenty-eight, in the first and second ranges of the latter township, where they form the most elevated points of the country. The West mountain rises abruptly to the height of 250 feet, and from its summit a great stretch of country can be overlooked southward towards the river St. Lawrence. These hills, or mountains as they are called, may be said to form here the north-western extremity or limit of the granite mass in the first transverse undulation. Much of the rock is of a coarse syenitic character, and contains a large proportion of a dark-green hornblende, with very sparing admixture of quartz. Iron pyrites is also abundantly disseminated through the rock in small-sized grains or crystals. This rock would appear to pass into a coarse diorite, by the entire disappearance of the quartz, when the rock is composed of a greyish-white feldspar and a dark-green or greyish hornblende. The red granites also occur in many localities throughout the area just described, but in a very irregular manner, so as to render it difficult to determine their age in relation to the other rocks. Their greatest development is, however, to be found further north-eastward along the main axis of elevation, where they entirely replace the white gneisses. In the vicinity of the East and West Mountains in Grimsthorpe, they are unstratified, and often appear to be of more recent date than the white mica granites and even than the diorites of division B. (Report of Progress, 1866–69). This point, however, requires further investigation. The country underlaid by rocks of the foregoing characters, presents a very rough and mountainous surface. The soil is light and sandy, but little suited for cultivation, and supports a growth of small pines and hemlock. Hence,

Gneiss.

Syenites.

Veins of feldspar, quartz and tourmaline.

East and West Mountains.

Coarse diorite.

Soil.

the comparatively unsettled state of nearly three-quarters of the township of Elzevir, and much of Grimsthorpe. There are, however, to be found isolated patches of land suitable for agricultural purposes, as examples of which may be given the farm of Mr. Arnott on the twelfth and thirteenth lots of the ninth concession of Elzevir, also those of some other settlers further northward, on the fifteenth and sixteenth lots of the eighth, and the twenty-second lot of the tenth ranges in the same township. Mr. Arnott's farm is surrounded by bare rounded ridges of white granite, but he informed me that the soil was all that could be desired for farming purposes. Proceeding north-eastward from Elzevir we find these granitic rocks narrowing in the south-east and north-west corners of Grimsthorpe and Kaladar to a breadth of between five and six miles, owing to a transverse north-west and south-east depression which brings in the diorites and green slates of a higher series yet to be described; they then again spread out on a second transverse north-westerly undulation to over fifteen miles in Anglesea and in the north-western parts of Grimsthorpe and Kaladar. This second extension of these rocks in Anglesea is of a very irregular shape, and consequently it was found difficult to draw a line which would represent its true axis; but one drawn from the vicinity of the Kaladar Post Office, in the neighborhood of the twenty-seventh or twenty-eighth lot of the seventh range of Kaladar, north-westward through Anglesea, and into the north-east corner of Grimsthorpe, would probably prove to be the most correct. On this line the red granites prevail, and cover nearly the whole of Anglesea, extending from Loon Lake and the Scutomatto River, westward into the eastern portion of Grimsthorpe, in all a breadth of about nine miles. The north-western part of this area, owing partly to the almost impassable nature of the country, has yet been only partially examined; but specimens sent to me by Mr. Murdoch, P. L. S., who was then surveying this township, from prominent bluffs on lots ten, eleven and twelve of the twentieth range, and lots fifteen and sixteen in the sixteenth range, are similar to the granites and dark syenites already described as composing the East and West Mountains in the southern portion of Grimsthorpe. Wolf Lake, a small body of water situated on the corners of Grimsthorpe, Anglesea and Effingham, is also entirely surrounded by masses of red granite: as is also Deer Lake, eleven miles to the south-eastward, on the boundary line between Anglesea and Kaladar. In this last locality the white micaceous granites of Elzevir again come in, dipping at a low angle, and appear to overlie the red granites. At the time of my visit there were no settlers upon this Anglesea granitic area, which forms the second transverse undulation; it, however, had been extensively explored by "lumber-men" who had exported a great quantity of first class timber. Excepting a "lumber depot," or an occasional "trapper's shanty," little accommoda-

Mr. Arnott's farm.

Grimsthorpe and Kaladar.

Red granites.

Wolf and Deer Lakes.

tion is to be met with, while the absence of anything like even tolerable roads, and the frequent occurence of *brulés* and wind-falls make the working out of geological details an exceedingly difficult matter. From Anglesea similar rock masses—chiefly the red granites—continue north-eastward into Effingham and Abinger, where they again cover a very large area, probably along another and third north-west and south-east transverse undulation. They are, however, first considerably narrowed between Anglesea and Effingham by a transverse depression, the axis of which may be described as coursing midway between Muddy and Stony Lakes in the north-east quarter of Anglesea, north-westerly through Effingham into the south-eastern part of Cashel. This depression brings in a large volume of the overlying gneissoid and green slaty rocks, which have yet to be described. In Effingham and Abinger the outline of the red granites is very irregular and indefinite, and so difficult is the access to many parts of these townships that for the present I can only describe these rocks as occupying a large part of Effingham north-westward towards Weslemkoon Lake, an extensive sheet of water situated on the line between the latter township and Ashby, and probably also a portion of the eastern side of Cashel, while eastward they pass into the township of Abinger, where they cover a very considerable area extending along the Addington Road. Between the head of Mazinaw Lake and the Mississippi Road in Denbigh township the granite rises into an abrupt cliff, known through the surrounding country as "Denbigh" or "Eagle Hill," respecting the mineral wealth of which many fabulous tales are in circulation. It rises abruptly to a height of several hundred feet, and forms an almost complete barrier to the passage of wheeled vehicles in this direction. It was with the greatest difficulty that we succeeded in pressing our horses to its summit with only a light waggon-load of camp equipments and provisions. I have since, however, been informed that the road was in its worst possible condition at the time of our visit, owing partly to the extreme wetness of the season, and that now, through the outlay of considerable sums of money, it has been much improved. At the head of Mazinaw Lake in Abinger and Barrie, red granite forms the whole eastern and western shores, and is particularly well displayed around Big Bay in Abinger on the western shore, from lots twenty to twenty-five of the first and second concessions, where it is seen to be immediately overlaid by stratified gneisses, dipping at comparatively slight angles, and to which we will again refer. Eastward from Mazinaw Lake the spread of these granites becomes greatly diminished. They were found to cover a considerable portion of the south-eastern three-quarters of Abinger township, and thence passing into Miller township become so intermingled with and concealed by the overlying gneisses that their further course in this direction could not be determined. They, however, continue to be represented by

Bad roads: *brulés* and wind-falls.

Red granites in Effingham and Abinger.

"Denbigh" or "Eagle Hill."

isolated knolls of red granite, and these appear to occur along the crown of an anticlinal through Miller township, on either side of which are great volumes of gneissic strata.

The rocks immediately succeeding and resting upon this area of granite, are also crystalline, but clearly stratiform. They present a variety of characters from very quartzose and highly crystalline masses to schistose. Their dip, where immediately resting upon the granite, is almost invariably slight, and may be given as varying from ten to thirty degrees; but rapidly increases in ascending, until the beds are vertical. As might naturally be expected, the lowest rocks are the most crystalline. They appear to be made up from the debris of the granites upon which they rest, and are largely composed of red and greyish orthoclase feldspar, greenish or greyish-green hornblende and an abundance of grey and translucent quartz. Mica is also generally present in minute scales disseminated through the mass. Magnetic oxyd of iron and iron pyrites also occur in the form of crystals and irregular grains. It is worthy of note here, that among the lowest gneisses, the feldspar, which perhaps composes at least two-thirds of the rock, is generally of a pale flesh-color, although occasionally of a brick-red; while, ascending in the series, gneisses of a more uniform greyish color, and containing a smaller proportion of feldspar, are met with. In the latter, first hornblende, and then mica, form an important ingredient; then through an almost entire disappearance of the feldspar, the grey gneisses graduate into quartzose hornblendic and micaceous schists of varied shades of color. It is amongst these last that crystalline limestones first make their appearance, and in proximity to them the schists and gneisses are generally characterized by the presence of epidote, and occasionally by garnets.

Varieties of rock in the gneiss series.

The following are some of the chief varieties of rock met with in this gneiss series, continuing, for the sake of convenience, the enumeration used in describing the granites:—

6. Whitish grey micaceous gneiss, generally coarsely granular, and composed mainly of white feldspar and translucent quartz with the addition of black mica. This differs from (4) only in shewing stratification.

7. Red feldspathic gneiss, generally fine-grained, composed mainly of feldspar, which varies from pale flesh-color to brick-red, vitreous quartz, black and white mica, and, occasionally, disseminated crystals of magnetic oxyd of iron and iron pyrites.

8. Gneiss, varying in color from a whitish-grey to dark greenish-gray, and having the same constituents as (7) with the addition of greenish-black hornblende. In this variety the hornblende and mica largely prevail, and the mass often passes into a black mica-schist.

9. Fine grey hornblendic gneiss, characterized by the frequent occurrence of light yellowish-green epidote in irregular layers and patches.

10. Grey gneiss, holding lenticular streaks of white feldspar, and very much resembling an altered conglomerate. It also bears a striking resemblance to the so-called "Eye gneiss" of Norway. With 8, 9, and 10, are also associated some important bands of white crystalline limestone, holding a great deal of white and occasionally greenish mica. These bands of limestone will be again referred to. Respecting the white micaceous granites and gneisses of (4) and (6), it should be stated that their stratigraphical position is yet uncertain. They are, for the most part, locally distributed, but where most largely developed in Elzevir and Kaladar, immediately underlie the green diorites and slates of division B (Report of Progress, 1866-69), and probably will be found to form a part of this division.

Immediately to the south of the Effingham and Abinger granite areas, gneisses of the characters of 7, 8, 9 and 10, are first well seen south of Big Bay on Mazinaw Lake in Barrie township, where they form part of the northern border of the depression or basin already mentioned (Report of Progress, 1870–71, p. 311) as having been traced from the village of Flinton in Kaladar, north-eastward through Barrie, Clarendon, Palmerston and Levant into Darling township. They here have a transverse measurement of nearly four miles, with east and west strike, and steep incline to the southward. On the east shore of Mazinaw Lake, in lots twenty-eight of the fitteenth and sixteenth ranges of Barrie, a cliff, almost perpendicular, rises to the height of from two hundred and fifty to three hundred feet. It is known throughout the country as the "Great Mazinaw Cliff," and is entirely composed of a rather thinly bedded reddish gneiss, which dips at a steep angle to the southward. The thickness of the gneiss at this point is estimated at not less than 5,000 feet. Westward of Mazinaw Lake similar gneisses cross the Addington road, immediately north of lots twenty-five and twenty-six, striking to the E. and W., with a steep dip to the southward, and pass into Anglesea, where they cover a considerable portion of the north-eastern quarter of that township. Eastward of Mazinaw Lake similar rocks are largely developed in the vicinity of the two lakes, known by the Indian names of Kishkebus and Shahbomeka, whence their strike trends more north-easterly through the remaining northern portion of Barrie and into the south-west quarter of Miller township. In this last named township gneisses were found to be largely developed around Indian or Buck-shot Lake, Brulé Lake, Fortune's Lake, Little or Round Schooner Lake, Big Schooner Lake and Mackie's Lake Of this group of lakes, Indian or Buck-shot Lake is the most south-easterly. The rocks forming its shores consist for the most part of red granitic gneiss —probably a continuation of that at "Mazinaw Cliff,"—striking with the general lie of the lake, namely, N. E. and S. W., and dipping generally to the S. E., on the northern shore irregular, but always steep, on the

"Great Mazinaw Cliff."

western shore at from ten to twenty degrees, and at the eastern end of the lake at sixty degrees. Along the southern shore the dip could not be distinctly made out, except near the eastern end, where it is to the N. W. $< 60°$. On the southern side of the principal point, on the eastern shore of the lake, very coarse-grained hornblendic gneiss was observed, dipping to the N. E. $< 10°$, while on the northern side of the same point, the beds were vertical or dipping at a very steep angle. The next lake to the N. E. is Brulé Lake. It has a length of about four and one-quarter miles, along the line between the fifth and sixth concessions, and its course cuts in an oblique direction the general strike of the rocks, which, from one end of the lake to the other, is to the north-eastward. The rock is chiefly a red granitic gneiss, similar to that noted on Indian and Mazinaw Lakes. Along the southern half of the western shore scarcely any rock can be seen, but the northern half, up to the large bay at the head of the lake, is rocky. The dip at this part is to the north-west, at angles varying from 10°–20°; so also along the north shore. The eastern side is for the greater part rocky and in many respects resembles that of Mazinaw Lake in Barrie. The cliffs, however, are not nearly so high, and the dip is comparatively slight. Along the northern half of the eastern shore the rocks dip uniformly to the north-west at angles of from 15°–30°. On going down the creek from Brulé into Fortune's Lake, in lots twenty-eight and twenty-nine of the sixth and seventh concessions of Miller township, no exposures of rock are seen for the first half of the distance, but on reaching the timber slide, about half way down, an abrupt hill is seen on the left. At its base the rocks are concealed, but the upper half of the hill is seen to consist of grey gneiss, overlaid by crystalline limestone. The gneiss is hornblendic, and contains a small amount of a pistachio-green epidote. The limestone is white and contains quartz, tremolite and a little glassy actinolite.

Brulé Lake.

Granitic gneiss.

Fortune's Lake.

Gneiss and limestone.

The strike here is very irregular, but the dip is uniformly at a small angle. The shores of the creek for the remainder of the distance are low and marshy. Fortune's Lake runs a little east of north from lot twenty-eight in the seventh, to lots thirty-six in the ninth and tenth ranges, a distance of about two and a-half miles, and coincides with the general strike of the rocks. At its south-western extremity the rocks are not well exposed, but, where seen, are dark grey hornblendic gneisses, with strike to the north-eastward and in an almost vertical position, the incline being slightly to the N. W. The southern half of the western shore consists of red and grey gneisses, having the same strike and dip: while the northern half is occupied by white crystalline limestone, which conformably overlies the gneiss. The two small islands (see map) are composed of red and grey gneisses which extend across to the southern half of the eastern shore, the whole being clearly a continuation of those observed along the north-eastern side of Brulé Lake. On Fortune's Lake, the gneiss

Islands of gneiss.

often rises in hills to the height of several hundred feet. The limestone band last noted as occupying the northern half of the western shore of this lake, extends across to the northern half of the eastern shore, where, however, it occupies comparatively low land and is but little exposed. Skead's Creek flows out of the northern end of Fortune's Lake, and runs in a north-easterly direction into Mackie's Creek, a distance of one and three-quarter miles, the whole of which is navigable for canoes. Just north of the outlet of Fortune's Lake on Skead's Creek, the rock is again white crystalline limestone, with strike to the north-east and dip to the north-west, and thence it was followed along the creek through lots thirty-six, thirty-seven and thirty-eight, of the tenth and eleventh concessions to Mackie's Creek near the foot of Little or Round Schooner Lake, beyond which it has yet to be traced. The northern limit of this band of limestone, which for the present we may call the Fortune's Lake band, has not been satisfactorily determined, but a transverse measurement made at the northern end of Fortune's Lake shewed a breadth of over one mile of surface exposures; the dip, however, of these, although for the most part to the north-west, is sometimes uncertain, so that it is difficult to give an estimate of its thickness, and I am inclined to the opinion, that the band repeats itself through frequent foldings. Little Schooner Lake, from which Mackie's Creek flows, is situated towards the north-east corner of the township of Miller, and is the most northerly of the group of lakes under description. Its greatest length is transverse to the general bearing of the rocks, or north-west and south-east. Immediately upon entering this lake from the Mackie's Creek outlet, the Fortune's Lake band of limestone is lost sight of, and we come on a great volume of red and greyish gneiss similar in its characters to that observed towards the southern portion of the lake last named, and of which there can be no doubt it is a continuation. Both shores from the one end to the other, or from the outlet, to the Narrows between this and Big Schooner Lake, are occupied by these gneisses, which in places rise to the height of from two to three hundred feet above the water. Much of the rock shows no stratification, and, when weathered, resembles in general appearance the granites of Anglesea and Effingham; but in many places it shews a uniform dip to the north-westward at angles of from 45°–60°. The distance to the inlet or Narrows from the mouth of Mackie's Creek is a little over one mile. Proceeding up these Narrows, gneiss was observed for the first quarter of a mile, still dipping to the north-westward at a steep angle, when it suddenly gives place to white crystalline limestone. This transverse measurement of the gneiss, from the Fortune's Lake limestone band to that just mentioned, which, for convenience, we may call the Big Schooner Lake band, shews a distance of about ninety chains, and as the dip averages 45°, the total thickness may be estimated at something near 4,000 feet; this esti-

Skead's and Mackie's Creeks

Little or Round Schooner Lake.

Fortune's Lake limestone band.

Red and greyish gneiss.

Thickness of gneiss.

mate being 1000 feet less than that given for a similar body of gneiss at "Mazinaw Cliff" in Barrie township. The rock exposed on the remaining quarter of a mile of the Narrows, before coming to Big Schooner Lake, is entirely white crystalline limestone, dipping to the north-west at $< 45°$, and with this incline it continues south-westward along the north-western shore of Big Schooner Lake, running parallel to the Fortune's Lake band, and only separated from it by the 4000 feet of gneiss just alluded to. Big Schooner Lake has a length of nearly two miles in a general north-east and south-west direction, with a breadth averaging half a mile. As just mentioned, crystalline limestone occupies the whole north-western shore, where the band is a little over a quarter of a mile in breadth. The three large islands seen towards the centre of the lake, and the whole of the south-eastern shore, are composed of red and grey granitic and hornblendic gneiss, with uniform dip to the north-westward. Proceeding up the Narrows at the western end of Big Schooner Lake for about a quarter of a mile, we reach the entrance into Mackie's Lake, the general bearing or greatest length of which is at right angles to that of Big Schooner Lake, or north-west and south-east. Like Little Schooner Lake, it is transverse to the strike of the strata. Its north-western half is occupied by grey and reddish gneisses; these being a continuation of the bands observed along the south-eastern side of Big Schooner Lake, and the dip though almost vertical inclines slightly to the north-westward. Midway along the lake, the dip lessens to angles of from 35°–45°, and both shores are occupied by high bluffs of the red gneiss, which continue all the way to the head of the lake, where the dip was observed to be at a comparatively slight angle to the north-westward. A short distance from the head of Mackie's Lake, and south-eastward from it, a red unstratified granite again comes in, similar to that which has been already described as extensively spread out through Anglesea and Barrie; and it would here appear to occupy the crown of an anticlinal, and to separate the gneisses and crystalline limestones of Brulé, Fortune's, Little and Big Schooner and Mackie's Lakes, from a similar series of gneisses and limestones occurring further to the south-eastward, and which have yet to be investigated.

Limestone parallel with Fortune's Lake band.

Size of Big Schooner Lake

Mackie's Lake.

Granite like that of Anglesea and Barrie.

So far I have attempted to describe the characters and distribution of the rocks over the north-western granitic and gneiss area of the western section. I have shown them to consist of great bodies or masses of unstratified granite, occupying the highest portions of the country; of grey and reddish granitic gneisses, clearly stratified; and of white crystalline limestones.

The south-eastern area, occupied by rocks of similar characters, stretches from Kaladar through portions of the townships of Kennebec and Barrie, Olden and Clarendon, Oso and Palmerston, into North

South-eastern area.

Unstratified granites in patches.

Sherbrooke. In it, the red unstratified granites, although frequently met with, occur only in the form of isolated patches of irregular outline; while the stratified gneisses are continuous. A line, which might be called their *medial line* of distribution, would run from the vicinity of the Kaladar Post Office on the Addington road, through the north-west quarter of Kennebec, and midway between Gull Lake in Barrie and Clarendon and Cross Lake in Kenebec; thence between Hungry and Mink Lakes in Olden township, and through the northern part of the same township into North Sherbrooke. Beyond this, the gneiss region loses its elevation, and may be said to come to a point towards the junction of the Upper and Lower Mississippi Rivers near Playfairville in Dalhousie township. In Kaladar, white micaceous granites and gneisses prevail, and these continue from the neighborhood of the Kaladar Post Office, on the Addington road, through Kennebec, to the outlet of Gull Lake, in the township of Clarendon, where they give place to red and grey granitic and hornblendic gneisses. In Clarendon, the whole of the north-western shore of Gull Lake is occupied by obscurely stratified reddish gneiss, which continues up to its outlet on the Frontenac or Godfrey road, and from this position extends northward to Pine and Malcolm's Lakes, and southward along the same road to a position in Olden township, a little north of a point where this road connects with that running eastward through Olden and Oso.

Medial line of distribution.

White granites and gneisses.

Gull Lake.

Barren country between Gull and Cross Lakes.

The country lying between the south shore of Gull Lake and Cross Lake, in the township of Kennebec, is of a most rugged and barren description. It is occupied by alternate rocky ridges and swampy valleys; composed of an obscurely stratified reddish gneiss, which dips to the south-eastward at a comparatively slight angle, and is traversed by dyke-like protrusions of a coarse aggregate of quartz and flesh colored feldspar. To these dykes we will again refer. Proceeding north-eastward from the Gull Lake outlet through Clarendon into Palmerston, we reach the Lower Crotch or Crutch Lake. Here, red gneiss rocks are very largely developed, and extend all the way to the Upper Crotch or Crutch Lake, where they again form a most barren tract of country, unsettled and unfit for cultivation. The whole country between these lakes and Bolton's Creek in Oso township, is likewise occupied by gneiss of a similar character, and presents the same barren appearance. The dips could not always be precisely determined, but that to the south-eastward was the most common, and appeared to be at a slight angle. On the north-western side of this area, namely, towards the Crotch Lakes, the numerous streams and small creeks flow north-westward into the Upper Mississippi River; while on the south-eastern side they flow south-eastward into Bolton's Creek; the intervening country thus forming a water-shed. It is here, that the great impediment occurs to a direct line of railroad from Kingston to Pembroke, a fact which I pointed

Crotch or Crutch Lake.

Barren country.

Water-shed.

out to parties interested before the projected line was surveyed. Indeed there can be no doubt that to complete the railway, a considerable deviation will have to be made to the eastward, which would pass from about the centre of the township of Oso through the northern portion of South, and southern part of North Sherbrooke into Dalhousie township, and thence through a most favorable valley into Levant and Bagot townships, beyond which there is no great difficulty to be encountered. If, on the other hand, this deviation were not made, and the line passed through North and South Canonto and Blythfield, almost insuperable difficulties would be encountered.

Kingston and Pembroke Railway.

As already mentioned, this gneiss region rapidly loses its mountainous character, and narrows on its extension through the townships of North Sherbrooke and Dalhousie. It also becomes covered to the eastward by a deep soil well adapted for cultivation, and consequently is thickly settled. Throughout the whole area the characters of the rocks are so continually changing that it was impossible to find characteristic bands of gneiss which could be traced for any great distance. In many localities the beds are nearly horizontal, and consequently a band of gneiss which may have only a very small thickness is kept at the surface over a wide extent of country; while in other parts the beds are vertical, or nearly so, bringing in a great thickness in a very short distance. The dyke-like protrusions amongst these gneisses, to which I have already referred, were also noticed by Mr. A. Murray in this section of country, and in his Report of Progress for the years 1852–53 (now out of print) he describes one of them as occurring on a stream flowing from a small lake in Olden into Cross Lake in Kennebec. Mr. Murray says: "On the north side of this stream, about 1,200 yards eastward of the lake, this dyke was composed chiefly of reddish feldspar in large individuals, with which colorless translucent quartz was mingled in smaller quantity, with a very sparing amount of mica. In the widest part the dyke measured upwards of a hundred yards; its course was S. 7° W., and it obliquely cut the strata, which, consisting of hornblendic and micaceous slate, dipped E. S. E. Lateral branches from the dyke, on either side, cut the strata, generally in the direction of the strike; small strings and patches of magnetic iron ore were found in various parts both of the main dyke and the branches." Magnetic iron ore has been reported to exist in many places through the gneiss area, but in my explorations it was only met with in grains or crystals, which were finely disseminated through some band of gneiss, or in connection with one or more of the numerous dykes, and nowhere in sufficient quantity to be of economic importance. The entire absence of crystalline limestones in the section just described is a fact worthy of note; and although it may be rather premature to state positively, that all the available deposits of magnetic and other ores of iron occur, and are to be sought for, in

Good soil.

Beds nearly horizontal.

Dyke-like protrusions.

Extract from Mr. Murray's Report for 1852-53.

Magnetic iron ore.

Absence of crystaline limestones.

proximity to such limestones, still the accumulation of evidence over a great extent of country examined would appear to point in this direction.

Depression between the granite and gneiss areas.

I would next direct your attention to the deposits occupying the depression between the two granite and gneiss areas, which have been mentioned as stretching from the north-east quarter of Kaladar, through the centre of Barrie, Clarendon, and Palmerston, into Levant township. Throughout this area, the various rocks are so irregularly distributed as to render it difficult to arrive at anything like a clear and satisfactory sequence; and they are so often interrupted and intermingled with gneisses and crystalline limestones, resembling the inferior division A, (Report of Progress, 1866–69) that it has been found impossible to represent their distribution on a map. In Barrie and Clarendon townships, for example, the dip is as often to the N. W. as to the S. E., and in many places the beds are nearly horizontal. The general characters of the rock masses have already been given in the Report of Progress for 1870–71, page 311.

Character of rocks.

They are as follows:—

a.—Green diorites, massive and without the slightest appearance of stratification; cut by numerous veins of a glassy white quartz, containing a small quantity of copper pyrites.

b.—Green diorite slates, stained with oxide of iron, and in which the planes of cleavage are in the same direction as the bedding.

c.—Green micaceous and somewhat chloritic schists occasionally colored by peroxide of iron.

d.—Pyroxenic rocks, both massive and schistose, varying from some shade of grey to green, and graduating into, or overlaid by, very black mica schists, holding garnets in abundance.

e.—Conglomerates; composed of quartz pebbles enclosed in an arenaceous and micaceous matrix, similar to those described as occurring in Madoc and Elzevir townships. (Report of Progress, 1866–69.)

f.—Finely laminated, greyish mica slates, of a glossy lustre on fresh fracture.

g.—Dolomites, of drab, yellowish, flesh and pure white colors.

h.—Sandy, crystalline limestones, grey calc-schists, and impure earthy limestones; the latter interstratified with siliceous and micaceous slaty layers, and imperfect gneisses, and diorites.

A comparison of the foregoing, with the section given in the Report on Hastings County, Report of Progress, 1866-69, page 145, will at once shew

Resemblance of rocks to those of Marmora, Madoc, Tudor and Elzevir.

that we have here a series of rocks resembling those of Marmora, Madoc, Tudor and Elzevir townships; occuring under similar conditions, and like them filling up depressions in the older crystalline rocks. The diorites, green slates, schists and conglomerates, are particularly well developed around the village of Flinton, situated on the twenty-first and twenty-second lots of the third and fourth concessions of Kaladar. Here, much of the rock

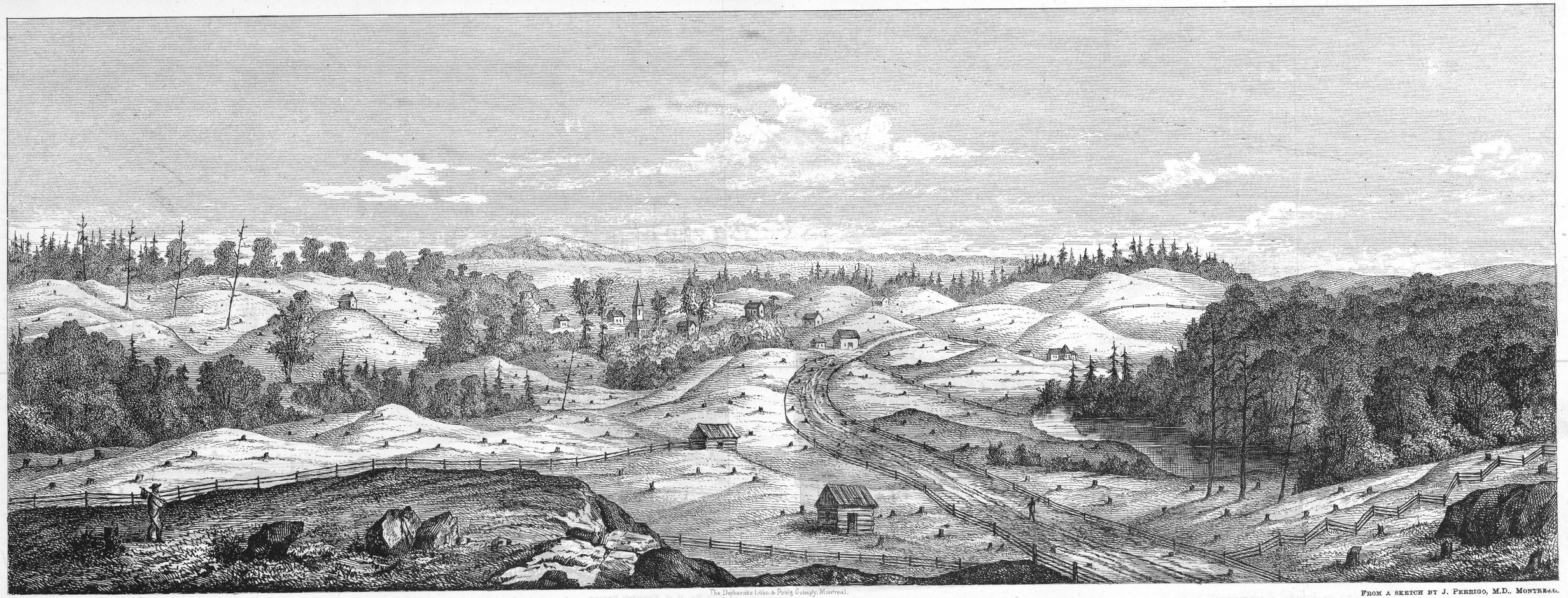
is a light green slate, graduating into a finely speckled hornblendic schist impregnated with reddish brown garnets. A short distance beyond this village, on the road leading to the Addington road, the first conglomerate is met with. In it, the pebbles, which are of quartzite, are enclosed in a matrix of sand and mica, or micaceous quartzite, and are clearly seen to be flattened out, and elongated along the plane of bedding. They are mostly small, or would appear to be so from an inspection of the mere worn surface of the rock; but, on fracture, the pebbles, which on the surface shew only perhaps a cross measurement of say from a-half to one inch, are found to have a length of from five to ten inches, the length being generally proportional to the thickness. They are easily removed from the matrix, and a number were found lying loose in the soil, near the outcrop of the band. In some localities, the character of this conglomerate changes in a most marked manner. Instead of interstratified layers of pebbles, we have alternate layers of vitreous quartz or quartzite and glistening mica schist, with here and there something like an enclosed pebble; and again—on the course of the same outcrop—we find these layers of quartz or quartzite pinched out into lenticular or eye-shaped forms, and entirely surrounded by mica schist. Still higher in the series, and about sixty chains farther along the Flinton road, a second conglomerate is met with of a coarser description. In it, the pebbles, which are much larger, and of different shades of color, are enclosed in a greyish and greenish hornblende schist. This is separated from the first by green slates and greyish hornblende schists with garnets, and similar rocks again overlie it. The general strike here, and throughout the north-eastern portion of Kaladar township, is to the N. N. E., with dip to the south-eastward $> 85°$. North-eastward from Flinton village, similar green schists, with an interstratified conglomerate, cross the Addington road a short distance above the Kaladar Post Office, namely, on lots thirty and thirty-one in the seventh, and thirty-one and thirty-two in the eighth concessions. They here follow the general course of the road, and form a high ridge along its western side up to the boundary line of Anglesea and Barrie. A little over a mile to the westward of the lots just named the country is composed of the rusty greenish diorites (*a*). These rocks shew no marks of stratification, but rise in rounded domes, or conical hills, and form a country similar to that seen to the north of the village of Bridgewater in Elzevir, represented in the sketch accompanying the present report. Light green and yellowish epidote runs through these massive diorites in strings and patches, and gives to the weathered surface of the rock a reticulated appearance. Continuing on the north-eastward course of these rocks, we again have a large development of the conglomerate on lot three of the Addington road range in Barrie township. Here it presents much the same general

Conglomerate.

General strike.

Diorites.

Conglomerate on the Addington road.



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DIVISION B OF MR. H. G. VENNOR'S REPORT.

FROM A SKETCH BY J. PERRIGO, M.D., MONTREAL.

VIEW AT BRIDGEWATER,

TOWNSHIP OF ELZEVIR, ONTARIO.

Shewing the aspect of the Country underlaid by the Diorite Rocks, with hills of Red Syenite in the distance.

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appearance as that already described, but the enclosed pebbles are much more numerous and more regularly distributed along the planes of bedding. On this lot I was surprised, at the time of my first visit, to find a five-stamp quartz crushing mill erected on one of the exposures of conglomerate. It had been used for crushing material taken from an opening in which there was no appearance of a vein, and, as might have been expected, no gold or silver was found.* Associated with this conglomerate, there are green slates and hornblende schists, similar to those described as occurring in Kaladar township, and these extend into the fourth lot of the same road-range, where they trend more eastwardly. On following the rocks, however, in this direction, the conglomerate is for a considerable space lost sight of, but is again well displayed in the northern parts of the thirty-third and thirty-fourth lots in the first concession of Barrie, and again in the southern parts of the twenty-ninth and thirtieth lots of the same concession, beyond which it passes into the township of Kennebec, and is lost sight of. In the intervals, between the exposures of the conglomerate, the exposed rocks are the green slates or garnetiferous hornblende schists, belonging to the same group. Westward of the Addington road in Anglesea, and between it and the Scoutomatto River, the country is occupied by dome-shaped hills of the massive, rust-colored and greenish diorites. (See Sketch accompanying Report.) These rocks extend northward from the first to the tenth concessions of this township, and also occupy a position on the Addington road, from the sixth to the twenty-fourth. White quartz veins, carrying the yellow sulphuret of copper, are of frequent occurrence in these diorites, and numerous openings have been made in search of copper ore by the settlers, but so far without profitable results. On lots fourteen, on both sides of the road, I observed a number of shallow pits or openings, from which copper pyrites had been taken some years ago by some parties from Kingston. The hand specimens shewn me, which were said to have been obtained from the surface quartz, were rich in copper pyrites, but these were doubtless picked specimens. The chief rock thrown out in the various blastings, was a milky white quartz, and large piles of this still remained beside some of the pits. On examining these piles of quartz I could detect but little copper ore, and the rock had a most barren appearance. At the bottom of one of the chief openings the quartz had almost entirely disappeared, although at the surface it was said to have measured from three to four feet. Nothing like well defined veins were observed, and apparently the quartz occurs merely in the form of

Quartz crushing mill.

Diorites.

Quartz veins holding copper pyrites.

* This mill was subsequently sold, and removed to the "Williams" gold-mining location in the township of Marmora, as mentioned in my last report (Report of Progress, 1870-71, page 133).—H. G. V.

lenticular shaped patches. As already mentioned, epidote is a marked feature in these massive diorites; it occurs in waving lines or strings, intersecting each other, and thus producing the reticulated appearance seen on the weathered surface of the rock. This massive form of diorite is the lowest rock in this series, and in Kaladar and Anglesea it is seen to adjoin the red granites, and also to penetrate them beyond the line of contact, in the form of fine-grained diorite dykes. From the east end of Loon Lake in Anglesea to the Addington road the surface is occupied by similar diorites, and they extend a few chains eastward into Barrie. No strike could be discerned in them, but in places there are indications of a dip to the north-westward. Similar massive diorites were also noted near the mouth of a small stream which empties into the eastern end of Loon Lake from the north-westward, where they appeared to be vertical and to strike W.N.W., which would carry them into the south-western corner of Effingham, and south-eastern portion of Cashel; but in this direction they have not been traced. Small exposures of dioritic rocks and speckled greenish schists were met with through Barrie township, eastward of the Addington road, namely, at the foot of Mazinaw Lake; near the "Marble Rapids;" at the western end of Missis-sa-ga-gon Lake; and in several other localities north-eastward into the township of Clarendon. These rocks possibly occupy in this direction the place of the massive epidotic diorites already described; but it is more probable that future explorations will prove that the latter continue on a W.N.W. course from Anglesea through Effingham into Cashel, and at some point in this direction, join similar rounded forms of dioritic rocks, extending from those of Madoc, Tudor and Grimsthorpe townships, along the western flanks of the great granite area of Elzevir and Anglesea. (See map of Hastings County, Report of Progress, 1866–69.) Should this prove to be the case, this granite area would be completely encircled by the diorites and associated green slates of division B. (Report just cited.) Northward on the Addington road, from the twenty-fifth lot, to where this road enters the township of Abinger, all traces of the diorites are lost, and a great volume of gneisses, belonging to the inferior formation, succeed, as already mentioned on page 148.

Epidote.

Position of diorite in the series.

Probable course of dioritic rocks.

The expansion of this area or basin through Barrie and Clarendon is referred to in a former Report, (Report of Progress, 1870-71, page 311) and also the fact that dolomites, slates and calcareous schists, with gneisses, prevail, to the almost entire exclusion of the diorites of division B. Dolomite intimately associated with silicious and fine shining mica slates, was first observed crossing the Addington road in Barrie through the fourth and fifth lots. It is rather compact, of a pinkish color on fracture, but weathers to a yellowish drab, and resembles in a marked manner many of the dolomites of Madoc township; particularly so, those occur-

Dolomites, slates, &c.

ring along the Hastings road, close to the Richardson mine, (Report of Progress, 1866-69, pp. 154, 155) where they are likewise accompanied by silicious slates. The strike of this dolomite on the Addington road, although obscure, appears to be to the north-eastward, and the beds to be in a vertical position. On the road the measurement across the strike is about 400 feet, but to the south-westward in Anglesea this volume rapidly lessens, and, shortly after crossing the boundary of Kaladar township, the dolomite either thins out, or is covered over and concealed. North-eastward from its position on the Addington road it becomes overlaid by the sandy limestones, calcareous schists, and imperfect gneisses (*h*), but is further traceable along a north-easterly out-crop from the third to the ninth concessions of Barrie, and thence to the "Marble Rapids" and Marble Lake on the Mississippi River, in which locality it is very largely developed. It was also traced along its south-eastern out-crop, on the line between the second and third concessions of the same township, to the northern end of a small lake or pond situated on the twenty-ninth and thirtieth lots of the third concession. Beyond this point the strike changes to the southward of east, and the measures are concealed by thickly wooded and rather low country. Around the small lake situated on the twenty-seventh and twenty-eighth lots of the third concession a great dead of drab magnesian limestone was noted, with masses of rock resembling the grey calc-schists of Madoc. Near Marble Lake, on the northern out-crop of this band several quarries have been opened; but very little stone has yet been raised from any of them. Dr. B. J. Harrington, who here accompanied and kindly assisted me in my explorations, spent some time in examining the limestone or dolomite in the vicinity of some of the quarries, and the following is an extract from his note book:—

Thickness of dolomite.

Marble quarries near Marble Lake.

"This marble in many of its characters resembles that found near the village of Bridgewater, but is for the most part much finer-grained. From its weathering to a light brown color, and crumbling rather easily, it would appear to be dolomitic.* The northern portion of the band is very finely granular, and is in some parts pure white and in others of a delicate flesh color. Here there is quite a large excavation made by Mr. Alex. Cowan of Brockville, and some very fine blocks of marble have been quarried. These, however, among other defects contain scattered crystals of tremolite. At a short distance from this opening, there is another in which the crystals of tremolite are absent and the marble very pure.

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* Analysis of a specimen from the same band on Mazinaw Lake. Geol. of Canada, p. 593.

Carbonate of Lime	53.90
" " Magnesia	45.90
	99.80

The centre part of the band is also white and flesh-colored, but is of much coarser grain. This portion occasionally contains scales of mica, as well as crystals of tremolite. The latter are in some places very abundant, and so much so, in one locality, that the rock is almost entirely composed of tremolite. The northern portion of the band is for the most part of a banded structure, shewing white and grey, or light bluish colors in alternate layers, each layer being about half an inch in thickness. A very good exposure occurs on the property of Mr. Cole, at a short distance to the north of his house. Here, the white layers, which weather brown, appear to be softer than the grey, and have weathered out, leaving these last in ridges; thus giving to the rock a striated appearance. If this portion was cut transverse to the stratification, and polished, it would doubtless have a fine effect. Other parts appear to be clouded rather than banded. Mr. Cowan has also opened a quarry on the southern portion of this band, but it was not examined. In the Bridgewater band of limestone, black tourmaline is found in crystallized masses, and a small amount of graphite towards its middle portion. At Marble Lake, on the property of Mr. Cole, there is a vein cutting the clouded marble, composed of quartz, black tourmaline and graphite." This clouded and banded limestone thus described by Dr. Harrington, and which was also noted by myself in a number of localities, bears a marked resemblance to a band which heretofore has been considered of Lower Laurentian age, and which occurs frequently through the townships of Olden and Oso, associated with the gneisses, etc., yet to be described as forming a part of the Middle Section of the country to which the present report relates. A description given by Mr. A. Murray in his Report 1852–53, now out of print, of a limestone met with on the Salmon River in Kennebec, a little south of Cross Lake, is so applicable to the one occurring in Barrie, that it may not be out of place to quote it here. After mentioning some very sharp bends in the Salmon River, previous to its entrance into Bull Lake, Mr. Murray says:—"In this crooked part of the stream, crystalline limestone is largely exposed in the rapids which it occasions. In the upper bend it is of a slaty character, and it is interstratified with a band or two of mica slates; at the lower, supposed to be on the fourteenth lot of the tenth concession of Kennebec, it is arranged in very regular alternate layers of white and bluish-grey: the bluish-grey layers are thinner and harder than the white; they appear to owe their color to the presence of a multitude of very fine scales of plumbago, each so small as scarcely to be discernible by the naked eye, and their hardness to an aggregation of fine rounded grains of quartz, not distinguishable, on weathered surfaces, from quartz sand; with these are present, a few, very small, modified cubes of iron pyrites. In the action of the water upon the rock, the hard thin bluish bands offer a greater amount of resistance than the white, which, being purer limestone,

Vein of quartz, tourmaline and graphite.

Limestone in Olden and Oso.

Extract from Mr. Murray's Report for 1852-53.

are more readily dissolved. The result is, that the latter stand out in relief, presenting sharp edges, while the intermediate more calcareous part is worn into rounded grooves, and the contrast of colors and forms presents a very distinct and striking picture of the stratified character of the rock. The grain of the calcareous part of the rock is generally rather coarse, but patches of it are tolerably fine and very white; these, however, rarely afford more than hand specimens, which are of a quality resembling statuary marble. The exposures in this part of the river, which so distinctly afford the evidence of stratification, appear to be in a nearly horizontal attitude, and hence, in the square mile which they occupy, very little thickness is seen. A few local and very limited contortions were observed, however, and in the neighborhood of these, tremolite was usually found in abundance."

Course of the Marble Lake band.

From Marble Lake this banded and clouded limestone was further traced through the ninth, tenth, eleventh and twelfth concessions of Barrie to Shawenego Lake, and thence through McClintock's Lake in Clarendon, to the Frontenac road, which it crosses on lots forty-one and forty-two. Beyond this point its course could not be clearly made out. It was again observed on the Mississippi road in Miller township, a short distance east from Playfair's Corners, where the strike was to the north-eastward, but in attempting to follow it in this direction, all trace of it was lost in a small lake called Grindstone Lake, situated a few chains to the north-east of this road, in the tenth and eleventh concessions. Another and similar band was also noted on Mosquito Lake in the extreme south-eastern corner of Miller township; and a third was followed along the entire length of Trout Lake in Palmerston and South Canonto townships. It is, however, probable that these are all portions of the one band; its out-crop being carried from Grindstone Lake by minor zig-zags, due to subordinate undulations, to its position on Trout Lake. From this lake it again resumes its north-easterly course, and continues through South Canonto into Levant, whither it has yet to be followed. So far, the limestones described occur along the north-western edge of the Barrie and Clarendon basin. Their south-eastern out-crop is not well defined, but exposures were met with towards the western end of Gull Lake in Barrie, as well as in several places between this position and Malcolm's Lake on the Frontenac road in Clarendon. In this last locality, and immediately to the northward of the Ardoch Post Office (lot 20 of the S.W. road-range) we observed the junction of the dolomitic limestones with the inferior gneisses, and the intervening groups a, b, c, d, e, f, appeared to be wanting; unless a rock which was noted as partaking somewhat of the character of (d), may possibly represent it. The rock referred to is a striated or banded hornblendic gneiss, shewing parallel layers of greyish and whitish colors. Thin beds composed almost entirely of dark green hornblende with

Junction of dolomitic limestones and gneisses.

garnets were also interstratified, and these weathered out in relief and gave to it a furrowed appearance in the direction of the strike, which is E.N.E. with a constant dip to the north-westward at a steep angle. This gneiss is immediately followed by the sandy, clouded limestones of (h), which for some distance from their line of junction, likewise hold interstratified hornblendic beds with garnets. The Frontenac road here affording an excellent opportunity for the transverse measurement and further examination of the rocks of this basin, a chained survey was made along it, northward to Playfair's Corners in the township of Miller. Shortly after leaving Macolm's Lake the limestones are much confused, and are thrown into hills, and present abrupt escarpments, with varied strike and dip; Large disconnected masses are scattered over the surrounding fields, and from their horizontal position more resemble the debris resulting from the decomposition and breaking up in situ of a patch of the Lower Silurian limestones, than an out-crop or exposure of crystalline limestone. Similar rocks were observed all the way northward to Swamp Creek, a distance of about four and a-half miles, for the whole of which distance the limestones form irregular hilly country, and present the appearance of a superficial deposit. The greater part of these limestones is of an arenaceous character, and of a brownish color on the weathered surfaces, but on fracture shews streaks of bluish and whitish colors. They are in places thickly interstratified with corrugated layers of siliceous slate or hornstone, and differ in a very marked manner from the crystalline limestones of the Laurentian formation—at least, so far as examined by me in this section of country. Imperfect bands of gneiss and hornblendic strata frequently occur with the limestones, but they occupy only a comparatively small portion of the country. Small exposures of grey calc-schists, similar to those of Madoc and Tudor townships, were seen a short distance above the point where the Mississippi River crosses the road. A little to the northward of Swamp Creek grey, speckled gneiss rocks are again brought to the surface, probably through a subordinate undulation, and occupy a few chains along the Frontenac road, beyond which the limestones and gneisses we have just been describing again come in, and continue northward along the road, to where they occur as already stated on lots forty-one and forty-two of this road-range, and where they may be said to form the limit of the basin in this direction. The width of the basin in Clarendon, as shown by the chained survey above mentioned, is close upon seven and a-half miles. In its extension into, and through Palmerston township, the extent and shape of it have not been clearly ascertained, and some further exploration is necessary both in this township and in Levant before the geological structure can be determined. In the Report of Progress, 1870-71, pages 311 and 312, I have alluded to a series of friable and silvery white mica schists, as ccupying portions of Palmerston and Levant, and which,

Measurement of the Frontenac road.

Limestones.

Calc-schists like those of Madoc and Tudor.

Resemblance of mica schists to those of the White Mountain series.

according to Dr. Hunt, bear a close lithological resemblance to the schists of the White Mountain series in New England, and to those found both to the north and to the south of Lake Superior. The position or horizon of these rocks is at present being worked out in Levant and Blythfield townships, and I trust in a future Report to be able to state something definite respecting them.

Middle Section.

Middle Section.—This section embraces the country lying immediately to the southward of the granitic area of Kaladar, Kennebec, Olden and Oso; namely, the southern portions of these townships and the whole of South Sherbrooke and Bathurst. In it, the characters of the rocks are undoubtedly Lower Laurentian, being in a marked manner similar to those given by Sir W. E. Logan in the Geology of Canada, and by Mr. Thomas McFarlane in a series of papers on the "Primitive gneiss formation of Norway," published in the Canadian Naturalist and Geologist, vol. VII.

Lower Laurentian.

Character of rocks.

The rocks met with are as follows:—great thicknesses of red, grey and whitish-grey gniess; for the most part clearly stratified, and with well defined strike and dip. Masses of hornblende rock and diorite, graduating into slate or schist often largely epidotic, with which are interstratified zones of rotten, rust-colored strata, or *fahlbands*. Large and important bands of crystalline limestone, and groups of calcareous strata, with which are also associated mica slates, some *fahlbands*, and workable beds and masses of magnetic iron ore. These rocks, as in the gniess region of Norway, are clearly interstratified, and maintain a general parallelism over a large extent of country. Their strike varies from E. and W. to N.N.E., and sometimes even to N.W., and their dip from S. to E. and N.E. at angles varying from ten or twenty degrees to vertical, in which respect they differ from most of the Laurentian rocks heretofore described in Canada and elsewhere. On this point Mr. McFarlane remarks: "It seems also respecting the Laurentian rocks of Norway, that a generalization is possible, as well with regard to the dip, as to the strike of the rocks constituting this group. The strata are almost always vertical or nearly so. This is the distinguishing character of the formation; and, *en passant*, let me remark the great difficulty hitherto experienced in all theorizings as to its origin. Horizontal and less inclined strata have indeed been remarked in several places, but they must be regarded as exceptional. The dip is almost always over 45°, generally 60° to 80°, while perfectly vertical strata are often observable." In portions of the townships of Kaladar and Kennebec, gneiss in an almost horizontal position covers a large area, and is followed by a series of schists, slates and crystalline limestones which are seldom inclined at a greater angle than 45°. With regard to the succession of these rocks, I think some general order may be observed. For example, the red and grey gneisses, almost invariably, immediately succeed and overlie the great areas of un-

Remarks by Mr. McFarlane.

Order of Succession.

stratified red granite; these are followed by gneisses in which hornblende becomes an important ingredient, and which almost imperceptibly graduate into the micaceous gneisses, schists and hornblende slates of the series. These again are overlaid by the calcareous groups and the more important bands of limestone. A similar succession of rocks would appear to be repeated between each of the bands of limestone—the volume of the intervening gneiss, hornblende rock and schist being to some extent proportionate to the thickness of the succeeding band of limestone. Whether this repetition of precisely similar rocks is due to frequent foldings of the strata, or whether they represent deposits made under like conditions during successive periods, or, still further, whether they may be looked upon as caused by repeated upthrows connected with faults, are questions yet undetermined, and which will require much detailed investigation. The possibility of upthrows connected with faults first suggested itself to me, while examining a series of granitic gneisses which crossed the Addington road in Kaladar, at a short distance below the road to Flinton Village. Here I found a great volume of stratified red gneiss, the planes of bedding well displayed, dipping at a slight angle to the south-eastward. On making a measurement transverse to the general strike, I observed that the out-crops of the different beds all presented a steep and abrupt face to the north-westward, and had the appearance of a gigantic flight of steps, or as if one plane of bedding after another, in succession, had slipped in the direction of the dip of the mass to the south-eastward. As I had previously examined this mass of gneiss in its extension a little farther to the south-westward, where the strata are inclined at a comparatively steep angle, and had estimated its thickness to be between one and two hundred feet, I was at a loss to account for its very sudden expansion in Kaladar. For on measuring as closely as possible the faces of the successive steps or out-crops—which I thought must represent the total thickness of the mass—I found it to be more than five times the above thickness. If, however, we suppose the 100 or 200 feet of gneiss to become inclined at a slight angle, and then to be traversed by parallel and almost equidistant breaks, connected with upthrows of the strata, the conditions observed in the gneiss hills of Kaladar would be produced, and the great apparent increase in the thickness would be accounted for. Respecting the sequence and distribution of the rocks occupying this middle section of country, my report must for the present be brief, as the work of examination is still in progress, and, in this thickly timbered country, is beset with so many difficulties, that any conclusions as to its geological structure would be premature. As mentioned in my last report, Report of Progress, 1871-72, page 120, the bands of crystalline limestone were made a special object of investigation; first, because they presented characters which

Repetition of strata.

Difficult country to work in.

Special investigation of limestone bands.

enabled them to be much more easily followed than any of the intervening gneiss bands; and secondly, because, that with them or in close proximity to them, there occur important economic deposits of iron ore and phosphate of lime or apatite. Therefore selecting the townships where these limestones were best represented, a section was made through Olden and Oso, which also extended a short distance into Bedford township. This line of section starts from near Conboye's Lake, situated on lots twenty in the tenth and eleventh concessions of Olden, and runs in a south-easterly direction through Sharbot Lake in Oso to the head of Crow Lake in the same township, and thence to the shores of Bob's Lake in Bedford, a total distance of about eleven miles. On this line no less than five apparently distinct bands of crystalline limestone are met with, separated by volumes of reddish granitic and dark hornblendic gneisses; they are as follows in ascending order, but at present no estimate of their respective thicknesses can be given:

Five distinct bands of limestone.

1. White Lake and Bolton's Creek band; crossing the boundary of Olden midway between Conboye's Lake and Sharbot Lake.
2. Upper Sharbot Lake, Playfairville, and Lanark village band; crossing Sharbot Lake at the Narrows in the first concession of Oso, where it is underlaid by much mica-slate, and is followed by dark hornblendic slate.
3. Lower Sharbot Lake, Maberly Lake and Bennet Lake band; crossing at the outlet of Sharbot Lake into the Fall River, and again at the extreme eastern end of the lake. This consists in reality of two bands, separated by a volume of gneiss, which is seen to form the promontory on lots six, seven, eight and nine, in the second concession of Oso.
4. Crow Lake, Rock Lake, and Silver Lake band; crossing the line of section at the extreme northern end of Crow Lake, at the boundary line between Bedford and Oso.
5. Bob's Lake, Tay River, and Myers' Lake band; occurring at the extremity of the line of section in Bedford, at the northern end of Bob's Lake.

The dip throughout this line of section is constant to the south-eastward, and varies from an angle of 28° to 60°. On another line of section made eight miles to the eastward of this, at about the centre of the township of South Sherbrooke, the four uppermost of these bands of limestome were again crossed, and a sixth met with, namely:—

Farren's or Sherbrooke Lake band.

6. Farren's or Sherbrooke Lake band, averaging two chains in width, and running E.N.E. along the southern shore of this lake in the first concession of the township. On a third line of section, made ten miles further to the eastward, from the village of Playfairville through Bathurst township, the second, third and fourth bands were again crossed.

Band (2) crosses the Mississippi River diagonally at the bridge in Playfairville; (3) is crossed at the bridge over the Fall River on the twenty-second lot in the tenth concession; and (4) on the line between the seventh and eight concessions of the same township. Continuing the line of section southward, gneiss was the only rock seen; but as the country here was covered by a considerable depth of soil, it is probable that the two remaining bands of limestone (5) and (6) are concealed. It will be seen from the foregoing, that the White Lake and Bolton's Creek band (1) was only noted on the first section line through Olden and Oso; it is probable that its further course north-eastward would carry it to the north of the townships of South Sherbrooke and Bathurst, namely, through the southern portions of the townships of North Sherbrooke and Dalhousie, which have yet to be examined. The total distance, represented by these lines of section, on which at least three of the bands of limestone were constant, is between eighteen and twenty miles.

Country covered by soil concealing the rocks.

As already mentioned, ores of iron are of frequent occurrence in the neighborhood of these limestones, and some of these have been mentioned in my last report, (Report of Progress, 1871-72, pages 121, 122). Heretofore, no attempt has been made to assign them to any fixed geological horizon; it now, however, appears that these iron ores occur along lines which bear a certain relation to the course of some of the bands of limestone and form distinct horizons which can be followed, and in which other deposits of iron may be sought for. Immediately above the sixth and highest band of limestone, magnetic iron ore occurs in South Sherbrooke in two places, namely, at the Bygrove mine on the third lot of the first concession and at the Fournier mine on the fourteenth lot of the same range; also in other places on the same horizon to the eastward through Bathurst and to the south-westward through Bedford. At the base of the fifth band, magnetic iron occurs along the northern shore of Meyer's or Christie's Lake in South Sherbrooke, in the eighteenth, nineteenth and twentieth lots of the third concession, at the mines known as the "Watson" or "Meyer's, Lake mines." Immediately below the fourth or Crow and Silver Lake band of limestone, magnetic iron ore occurs at the Foley mine, in the tenth lot of the eighth concession of Bathurst, whence it is traceable through the eleventh, twelfth and fourteenth lots of the same concession; and here for the first time we find apatite or phosphate of lime in considerable deposits, closely associated with, and even in some instances intermixed with the iron-ore, a fact already alluded to (Report of Progress, 1870-71, page 313.) In the remaining third, second and first bands of limestone, no magnetic iron ore, so far as I am aware, has yet been met with, although at the base of each of these rust-colored strata occur. It is worthy of note, however, that the great bed of hematite in Dalhousie township, upon which is situated the "Dalhousie mine," (see plan accompanying this Report)

Iron ores.

Bygrove and Fournier mines.

"Watson" or "Meyer's Lake" mine.

Foley mine.

Dalhousie mine

occurs in a position between the first and second of these bands of limestone, and is not far removed from the base of (2). From the foregoing it will be seen, that in the section of country so far examined by me, magnetic iron ore has been found only in connection with the three highest bands of limestone; while in the other bands, it is represented by only rust-colored beds of gneiss and quartzite.

Eastern Section

Eastern Section.—This section comprises the townships of North Burgess, North Crosby, Bedford, Loughboro' and Storrington, which immediately border upon the waters of the Rideau. These townships have been already incidentally alluded to by Sir W. E. Logan, Mr. Alexander Murray, Dr. Hunt and myself in previous reports of the Geological Survey, but so far the facts mentioned have had more reference to the minerals of the limestones, and to economic deposits, than to the characters and distribution of the rock masses. These rocks, while they resemble in many respects those we have just been describing, yet present some important differences, and it is probable they represent beds somewhat higher in the series. The rocks most frequently seen are of the following characters, describing them in what appears to be their ascending order:—

Previous observations.

Character of the rocks.

1. Gneiss, largely composed of reddish feldspar and colorless quartz, in which the stratification is obscure.
2. Pyroxenic gneiss, coarsely granitoid in its lower portion, but towards its summit graduating into a pyroxenic schist, which holds small garnets in great abundance. It is traversed by a net-work of fine-grained granitic veins, of white and flesh-red colors, and is frequently cut by dykes of a fine-grained, black, glittering dolerite. Apatite or phosphate of lime occurs in this rock, and often forms deposits of economic importance.
3. Gneiss, largely composed of red orthoclase and quartz, of various shades of red and grey, in which the stratification is very obscure. Apatite or phosphate of lime also occurs in it in irregular grains and lenticular veins or pockets.
4. Limestone, coarsely granular, and highly crystalline, containing scales and crystals of a yellowish-brown mica, plumbago, and disseminated grains of apatite. It is associated with white and rust-colored strata, composed of quartz and orthoclase.
5. Reddish feldspathic and very quartzose gneiss, stratified and thinly bedded, holding light claret-colored garnets in great abundance, distributed along the planes of stratification.
6. Gneiss, fine-grained and micaceous, composed of alternate thin beds of grey and flesh-red colors. It is cut by a net-work of thread-like veins of reddish feldspar and quartz, which appear to emanate from lenticular patches of a similar character, occurring on the planes of bedding.

7. White and highly crystalline granular limestone, with which are interstratified bands of reddish gneiss, and white strata composed of quartz and orthoclase.
8. White and greenish, granular pyroxene, and granitoid pyroxenic rocks, holding apatite or phosphate of lime in disseminated grains and irregular veins. The veins show aggregations of crystals of apatite and black mica in a pyroxenic gangue.

This last group occurs at the summit of the series, and occupies the centre of the North Burgess synclinal.

Distribution and surface features.

The geographical distribution of these rocks—as in the county of Hastings—shows a series of north-east and south-west undulations, corresponding with anticlinal and synclinal forms, the latter occupied by the upper rocks 2, 3, 4, 5, 6, 7 and 8, in long irregular and comparatively narrow troughs. These undulations are crossed at intervals by south-east and north-west ridges which intersect and limit the synclinal valleys. The axes of these north-east and south-west undulations in the townships above named form four irregular and curving lines, roughly parallel to one another, marking, as far as ascertained, two anticlinals and two synclinals. In the remarks which follow, I shall confine myself to the first or more north-westerly of these anticlinal axes, and to the synclinal which immediately adjoins it to the south-eastward; the second or more south-easterly anticlinal not having yet been fully investigated. This first or north-western anticlinal may be represented by a line drawn from the north-eastern corner of North Burgess south-westward between Black and Pike Lakes, through the centre of North Crosby, and thence through the southern arm of Wolf Lake in Bedford, and through the entire length of Canoe Lake into Loughboro' township. Along the whole of this line, the red and obscurely stratified gneiss (1) forms the crown of the anticlinal. In North Burgess to the north-eastward, and in Bedford, to the south-westward, this rock occupies but a comparatively small portion of the country, but in its intermediate position in North Crosby, a north-west and south-east line of elevation causes it to spread over the greater part of this township, where it is thrown into a series of high hills, known by the name of the Westport Mountains, which border upon the waters of the Rideau, from the Narrows between North Burgess and North Crosby, north-westward to the head of Wolf Lake in Bedford. This transverse elevation of the gneiss in North Crosby separates the troughs in North Burgess from those in Bedford. On descending the Westport Mountains to the Rideau,—here represented by Sand, Mud and Wolf Lakes—there is a very sudden change in both the physical and geological aspect of the country, which thence, to the south-western quarter of North Crosby is flat and cultivated. This change is apparently caused by a fault, running in an east and west direction, which brings the horizontal limestones of the

Parallel undulations.

The Westport Mountains.

Fault.

Contact of Silurian and Laurentian rocks.

Lower Silurian formation into abrupt vertical contact with the Laurentian gneiss. The gneiss (1), however, greatly diminished in volume, is still seen along the crown of the anticlinal from Wolf Lake to the southern extremity of Canoe Lake in Bedford. This break or fault is the first of a series of parallel faults which occur to the south-westward, through the townships of Bedford, Storrington and Loughboro', and which will be described in a future report.

In the Report of Progress for 1871–72, page 123, in connection with notes on the phosphate locations of North Burgess and Bedford, I briefly alluded to the south-eastern of these two synclinals or troughs, stating that in it the detailed sequence of the rocks had yet to be investigated but that the workable deposits of phosphate of lime appeared to me to "occur in a certain belt or zone of pyroxenic and gneissic strata, and in the form of lenticular bedded masses, and irregular veins." I further stated that "this belt or zone, which was found to have a thickness of from 2,600 to 3,900 feet, lies in a long irregular trough, the axis of which may be described as running from the north-east to the north-west corner of North Burgess, thence south-westward through South Crosby into the south-east corner of Bedford township—between Devil and Opinicon Lakes—and still further in this direction through the townships of Storrington and Loughboro'." These statements now require to be somewhat modified, and in further describing the south-eastern trough, it seems advisable to subdivide it into two parts, namely :—

Position of phosphate deposits.

1. *The North Burgess Phosphate Basin.*
2. *The Bedford, Storrington and Loughboro' Phosphate Basin.*

Whether these basins form portions of one or two distinct synclinal forms, remains to be determined.

The North Burgess Phosphate Basin.—The general characters and sequence of the rocks occupying both of these basins has been already given in the list, page 162 numbers (2) to (8) inclusive but the following section made in North Burgess furnishes some further details of importance, and will better illustrate what I have further to state respecting the distribution of the respective rock masses. This section was made at the extreme south-western end of Black Lake and on the northern side of the basin; the strike of the rocks being to the east and west, with dips varying from 45° to vertical.

North Burgess phosphate basin.

Section at Black Lake.

a. Pyroxenic gneiss, varying in color from grey to a greyish blue, sometimes speckled; it is both massive and schistose, and towards its summit becomes garnetiferous, the garnets being mostly small and of a pale claret color. It is cut in many places by a net-work of fine-grained whitish granitic veins, and an occasional doleritic dyke. Apatite or phosphate of lime occurs as described in (2) of the more general and immediately preceding section.

b. Reddish contorted quartzose gneiss, also holding a little apatite, and black mica, in irregular veins or pockets.

c. Coarse white crystalline limestone, with which are interstratified masses of a white and rust-colored aggregate of quartz and orthoclase, and an occasional band of gneiss. The limestone is characterized by an abundance of disseminated plumbago, and grains of a greenish-blue apatite, as well as of a dull greenish pyroxene and small crystals of yellowish-brown mica.

d. Thin-bedded gneiss of a brick-red color.

e. Banded reddish and very quartzose garnetiferous gneiss, composed of alternate thin layers of reddish feldspar and cellular colourless quartz. The garnets are small, and are thickly distributed along the planes of stratification.

f. Whitish granular pyroxene, and rock composed chiefly of quartz and orthoclase, but in which both apatite and mica occur, either in the form of aggregations of crystals, or as grains and crystals disseminated through the mass.

g Thin-bedded grey and reddish, cleavable gneiss, cut by a network of fine-grained feldspathic veins, and with interstratified layers of a like character.

h. Massive, and granular, white, crystalline limestone, with disseminated plumbago, and yellowish-brown mica, with which are interstratified numerous small bands of reddish orthoclase gneiss.

i. Pyroxenic rocks, similar in character to those of division (*f*), but much more extensively developed. These appear to occupy a position at the summit of the series, but it is not improbable that they may prove to be merely a repetition of (*f*) brought to the surface by a subordinate undulation.

The pyroxenic rocks of (*a*) are very largely developed in North Burgess, immediately to the north of Black or Salmon Lake Creek in the western portion of the seventh, and between this creek and the southern shore of Pike Lake, in the eighth concessions. Their strike coincides with the general outline of the north-western shore of the lake, namely, first to the N. E. and then to the N. N. E., and the dips which are constant to the south-eastward are at angles varying from 40° to 60°. Towards the northern extremity of Black or Salmon Lake, these rocks are overlaid and concealed by a great patch of horizontal Potsdam sandstone; but similar pyroxenic gneisses were again noted, on the northern side of the trough, through the twelfth, eleventh, tenth, ninth, and eighth lots in the seventh concession, where the strike is still to the north-eastward, and the dip to the south-eastward, but at a very steep angle. Proceeding north-eastward, into the eighth concession, these rocks were further traced from the seventh to the first lot, where they are

Potsdam Sandstone.

in an almost vertical position, and strike east and west. Thence striking in the same direction they extend to and along the northern shore of Otty Lake, on the front portions of the fourth, third, second, and first lots of the same concession. It is extremely probable that a similar and abrupt change of strike, concealed by the overlying Potsdam sandstones, affects the pyroxenic rocks of Black or Salmon Lake, connecting them with those first followed through the twelfth, eleventh, tenth, &c., lots of the seventh concession. On the course of the pyroxenic gneisses (*i*) through North Burgess, large deposits of apatite or phosphate of lime are of frequent occurrence; many of these, which have already been described in the Report of Progress, 1871–72, pages 124 and following, are still being worked successfully, and will be further noticed in a future Report, which it is proposed to accompany with a suitable map shewing the position of every shaft or other opening, from which phosphate of lime has been extracted.

Map.

The outcrop of these pyroxenic gneisses, on the southern side of the North Burgess trough or synclinal, occurs to a large extent under the waters of the Rideau, but they again occupy a considerable area from the eleventh to the sixteenth lot of the third, and from the fifth to the seventeenth lot of the fourth concession of this township, where the strike is to the E. N. E., with dips to the northward at steep angles. And I would here note, *en passant*, the uniformly steep dip, and often even vertical position of the rocks, on the southern side of these synclinal forms, while that on the northern side is almost invariably at angles, varying from 40° to 60°. Another section, made from one of the foregoing lots, namely, lot eleven in the fourth concession, may here be given, as illustrating the characters and sequence of the rocks on the southern side of this synclinal in North Burgess. It is as follows:—

Section on the southern side of the North Burgess basin.

a. Banded, and thin-bedded gneiss, more or less pyroxenic, with east and west strike, and steep dip to the northward. This rock extends transversely to its strike, from Hogg's saw-mill southward to the Rideau.

b. A marked rust-colored, quartzo-orthoclase rock, sometimes weathering opaque-white, when it much resembles the surface appearance of the white crystalline limestones.

c. Coarse-white and easily disintegrating crystalline limestone, with yellowish-brown mica and scales of plumbago; it often encloses fragments of rusty-colored quartzite, in which plumbago also occurs. Bands of rust-colored gneiss are also interstratified with the limestone.

d. White and rust-colored quartzo-orthoclase rock similar in character to that of division (*b*).

e. White-weathering pyroxenic, and quartzo-orthoclase rock with

apatite in grains and bunches of crystals; and a great deal of dark colored mica in crystals of various sizes.

f. Thin-bedded feldspathic gneiss, characterized by an abundance of garnets, and composed of alternate layers or beds of colorless cellular quartz and reddish feldspar. This gneiss is much fissured, and is cut by veins of pink calcite, holding numerous beautiful crystals of a pale-green apatite, greyish pyroxene, and an abundance of very black mica.

g. White-weathering pyroxenic, and quartzo-orthoclase strata, similar to (*e*).

h. Reddish orthoclase gneiss, and whitish orthoclase and pyroxenic rocks, much confused, and traversed by a multitude of white granitic veins.

This, and the section previously given, the one on the northern and the other on the southern side of the North Burgess phosphate basin, will show at a glance the characters and sequence of the rocks which occupy it, and I shall now briefly notice the further distribution of the more important of these rocks. On the northern side of the basin, and almost immediately overlying the pyroxenic gneisses (*a*) we have an important band of crystalline limestone (*c*). This was first observed on the boundary line between North Crosby and North Burgess, a few chains south of Black Creek, and was traced eastward through the sixth concession, to the twenty-third lot in the same concession, where it runs into Black or Salmon Lake. Crossing the bay at the southern end of this lake, it was again seen occupying the opposite shore on lots twenty-one, twenty and nineteen in the sixth concession; where it runs into Black or Salmon Lake. Crossing the bay at the southern end of the lake, it was again seen occupying the opposite shore on lots twenty-one, twenty and nineteen in the sixth concession; whence, changing its course, it runs north-eastward through the last named lot, across the base of a long promontory, and passes beneath the main body of the lake. It, however, continues to occupy points on the shore, towards the rear ends of lots eighteen, seventeen and sixteen in the sixth, and fifteen in the seventh concessions, and also forms part of an island situated near the centre of the lake on the line between these two concessions. The further course of the limestone in this direction is concealed by the patch of Potsdam sandstone already referred to, but a band of similar character was again noted along the northern shore of Long Lake, towards the fronts of the tenth, ninth and eighth lots of the sixth concession, where it is in a similar relative position to the pyroxenic gneisses, as the Black or Salmon Lake limestone just described, and of which there can be little doubt it is a continuation. From Long Lake this limestone was further traced through the fronts of the sixth and seventh lots, and

Black or Salmon Lake.

Long Lake.

Otty Lake.

the centre and rear portions of the fifth, fourth and third lots of the sixth concession, where it forms a part of the shore of Otty Lake. Beyond this point its course is again concealed by the Potsdam sandstone. Its southern out-crop was followed north-eastward through the rear parts of lots twenty-five, twenty-four and twenty-three of the fourth concession, and front portions of the same numbered lots in the fifth concession, beyond which its course changes, and it thence appears to strike in an easterly direction to an indentation of the Rideau, known as Horse Shoe Bay, on the seventeenth lot of the third concession, where it is folded back upon itself so as to double the width of its out-crop. It then strikes in a westerly direction from the sixteenth lot of the third, through the seventeenth and eighteenth lots of the fourth concession to Black Creek, where, making a sharp turn, it resumes its easterly course following the northern bank of the creek, through the fronts of lots seventeen, sixteen, fifteen, fourteen and thirteen, in the fifth, and rear portions of the same numbered lots, and the twelfth lot in the fourth concession. The course of Black Creek from where the band strikes it as above described indicates the junction of the crystalline limestone with the pyroxenic gneisses. Proceeding eastward, the same band of limestone occupies the strip of land between Loon Lake and Burgess Bay on the Rideau, and after coursing through the rear and front portions of the ninth, eighth and seventh lots in the fourth and fifth concessions, again passes beneath the waters of the Rideau at Murphy's Point in Noble's Bay, on lots seven on the line between the same two concessions, beyond which it is lost sight of. It may be mentioned that in a map now in preparation the course of these two out-crops of limestone, on the opposite sides of the Burgess synclinal, will be clearly shown. This map will, I trust, also afford a much clearer understanding both of the outline of this synclinal, and of the distribution of the rocks which occupy it.

Map.

It is unnecessary to go over the same ground in describing the further distribution through North Burgess of the remaining rocks of the sequence. I would, therefore, simply state that the course just sketched out for the crystalline limestone (*o.*) will also indicate sufficiently that of the banded and quartzose garnetiferous gneiss through the township. In this gneiss the garnets, which are mostly small and of a claret color, are always present, but in some localities are much more numerous than in others. An average estimate of the thickness of this garnetiferous gneiss may be given as 600 feet, and it is overlaid by a body of red gneiss, averaging at least 600 feet more, making in all a volume of gneiss estimated at 1,200 feet. The centre of the trough is occupied by reddish and white quartzo-orthoclase and granular pyroxenic strata, which are much confused, and irregularly distributed. These are particularly well displayed in North

Thickness of garnitiferous gneiss.

Burgess, between Long Lake and Noble's Bay, through the centres of lots eight, nine and ten of the fifth concession, and four, five and six of the sixth concession, where the dip of the beds is slight, while sometimes they are nearly horizontal.

A doleritic dyke was traced from the centre of the first lot, in a westerly direction, to the rear portions of the fourth and fifth lots of the fifth concession, and thence to the fronts of the ninth and tenth lots in the sixth concession. It is composed of a fine-grained, black, glittering dolerite, weathering to a greyish-white, and holds disseminated grains of pyrites. The strike of this dyke is from N. 80° E. to E., with steep underlie to the northward, and in width it varies from four, to one hundred feet. In the *Geology of Canada*, 1863, pages 37 and following, mention is made of a number of doleritic dykes, similar in character to the one just mentioned, in North Burgess, and these were traced by Sir W. E. Logan for long distances, on an almost east and west strike, through Grenville and Went worth, north of the Ottawa River; their width varying from a few feet to one hundred yards. In these townships the rocks are in many respects similar to those of North Burgess, both in their general characters and mode of distribution, and they, also, like them, contain phosphate of lime and mica; the latter in sufficiently large crystals to be of economic value. It is more than probable that in both of these localities, namely, North Burgess, in Lanark County, and Grenville and Wentworth, north of the Ottawa, the rocks are of the same geological age, and represent a very recent portion, if not the summit, of the Lower Laurentian series. In the townships of Burgess, Bedford, Storrington aud Loughborough, these rocks are intersected by numerous veins, carrying baryta and lead ore, which likewise cut the overlying and unconformable Calciferous formation, but do not, so far as known, extend into the inferior gneisses and limestones which occupy the area described in this Report as the middle section. Further, it will be remembered, that in the county of Hastings, and townships of Madoc, Marmora, Lake and Tudor, similar veins, carrying baryta and lead ore are found intersecting the calc-schists, dolorites and gneisses of Division C. (Report of Progress, 1866-69, page 163), which in like manner occupy troughs or depressions in the older rocks. These facts suggest some questions of great importance, which when satisfactorily answered will throw much light upon the age of these trough-forms of rocks both in Hastings, Lanark and Ottawa counties, and will further, perhaps, enable us to arrive at some definite conclusion respecting the range of *Eozoon Canadense*, in the Laurentian system.

Dolerite dyke.

Veins of baryta and lead ore.

Range of Eozoon Canadense.

In addition to the dykes of dolerite which traverse the rocks in North Burgess, there are also large and important veins, composed of white orthoclase and opaque-white quartz. One of these occurs a few chains south of the mouth of Black Creek, at the south-western end of Black or Salmon

Veins of orthoclase and quartz.

Lake. This vein was of an opaque-white colour on the weathered surface, and varied in width from three to eighteen feet. It is composed of large cleavable crystals of milk-white orthoclase and white quartz in irregular forms, together with hornblende in similar forms, and in scattered crystals. The crystals of hornblende occupy the sides of the vein, and are arranged transverse to its strike, while the irregular forms occur towards the centre portion, and are distributed along a medial line on the strike of the vein. Silvery-white mica in small scales, and light greenish-yellow pyroxene also occur occasionally. The strike of the vein is N. 30° E., with a steep underlie to the north-westward, and it was traced upwards of an eighth of a mile in this direction. A similar, or probably an extension of the same vein, was again crossed in the "Old Kingston road," in the seventeenth lot of the seventh range of North Burgess, where the strike is still N. 30° E. Such veins belong to the second class of mineral veins (described, Report of Progress, 1863-1866, page 187) which are found to cut the Laurentian, but have not been observed to intersect the Silurian rocks.

Bedford, Storrington and Longhboro' basin.

2. *Bedford, Storrington and Loughboro' Phosphate Basin.*—This synclinal or trough is occupied by rocks precisely similar to those of North Burgess, consequently the sections already given may still be referred to. It is situated about ten miles to the south-westward of the last named township, from which it is separated by the waters of the Rideau and by a great patch of Lower Silurian limestones, both of which conceal the structure of the intervening phosphate bearing rocks. As this second basin has as yet been only partially investigated, I shall at present attempt little more than a sketch of its general outline, with some observations on the probable course along which deposits of phosphate of lime may be expected to occur.

A line, which may be said to represent as nearly as possible the axis of this synclinal, runs from about the centre of Wright's Island,—situated in the Rideau, towards the north-west corner of South Crosby township,—south-westward through the south-eastern corner of Bedford, and midway between Buck Lake and Opinicon and Rock Lakes in Storrington and Loughboro' townships. The outline of this trough is clearly indicated by two out-crops of white crystalline limestone, a north-westerly and a south-easterly one, which converge on their south-westward course until they meet or almost meet at the extreme south-western end of Buck Lake in Loughboro'. This limestone is supposed to represent division (*c*), as given in the section page 165, where, it will be remembered, the limestone was stated to be immediately underlaid by pyroxenic and orthoclase gneisses, through which apatite or phosphate of lime was of frequent occurrence. The north-western out-crop of this limestone is first seen coming from under the Lower Silurian limestones, at about half

a mile south-westward of the village of Newboro', where it is not far from the Chaffey iron mine on Mud Lake. From this position it was followed by occasional exposures along the shore of Mud Lake on the Rideau, eastward, to the northern extremity of Wright's Island, and thence close to Mr. Chaffey's Mills, through the twenty-fifth lot of the ninth concession of South Crosby, beyond which it passes into Bedford, and keeping to the south of Massasagua Creek, curves through the sixteenth, fifteenth and fourteenth concessions of this township and passes beneath the north-eastern end of Buck Lake, close to its outlet into the creek just named.* Its course thence is south-eastward through the entire length of the eastern arm of this lake in Loughboro', the breadth of which almost corresponds with the width of the limestone. Several islands in this arm are entirely composed of white crystalline limestone, and some of these rise abruptly out of the water to a perpendicular height of from sixty to seventy feet.

Wrights Island.

By the long continued action of the water, these masses or islands of limestone have been fashioned into grotesque shapes, and hollowed out into deep caverns, and two of the former, towards the northern extremity the lake, are distinguished respectively by the names of the "Devil's Pulpit," and "Devil's Arm Chair." The eastern side of the long promontory which divides this lake into two arms, is also in part occupied by white crystalline limestone, which is closely associated with masses of white quartzo-orthoclase rock. Towards the south-western extremity of this eastern arm of Buck Lake, the out-crop of limestone just described forms a junction with that on the south-eastern side of the trough or synclinal, which may here be said to terminate.

The south-eastern out-crop of this band on the opposite side of the trough was traced along the greater part of the northern shore of Opinicon Lake, in South Crosby and Bedford; thence in a south-easterly direction along the road leading from this lake to the south-eastern end of Rock Lake in Storrington, where a fault occurs which throws the out-crop of the limestone in a westerly direction to Stonehouse Lake, a small lake situated—as nearly as I could determine—on the rear portions of lots six and seven of the thirteenth concession of the township last named. From this position it resumes its original south-westerly course, and was thence followed to its junction with the limestone of the eastern arm of Buck Lake in Loughboro'. The greatest distance observed between these two out-crops of limestone on opposite sides of the trough, is about two miles and a-half. Immediately underlying this limestone along the whole of its course, there occurs a belt of gneissoid strata abounding in garnets, and towards its upper portion becoming thin-bedded and schistoze, in which

* I have been unable to find any correct map of this lake, and it will require to be re-surveyed.

deposits of phosphate of lime frequently occur, but to what extent is not at present known. During the summer of 1872, while engaged in endeavoring to connect these rocks with those of North Burgess, I was followed by a number of persons who were on the look out for new phosphate locations, some of whom afterwards opened numerous trial pits on the strike of a certain band of gneiss in which I informed them it was probable the phosphate of lime would be found; and I have since learned through letters kindly forwarded to me, both by Mr. Edward Schultze and Mr. William Davis, of Perth, Ont., that a number of these trials have already proved, in a measure, successful. On lot six in the thirteenth concession of Bedford, and not far from the shore of Devil Lake, there occurs an exceedingly promising deposit, from which a very good quality of phosphate of lime has been obtained; but as is usually the casewhen inexperienced hands are employed, an immense amount of useless rock has also been removed, and has been piled up upon the very ground on which an opening should have, perhaps, first been made. From this lot the phosphate bearing rocks were traced south-eastward through the fifth and fourth lots of the sixth concession, as well as through the third, second and first lots of the twelfth concession of Bedford, to the northern end of the western arm of Buck Lake. Along this course phosphate of lime was frequently noted, and more particularly so on the last named lot in the eleventh and in the twelfth concessions. The long promontory, which separates the two arms of Buck Lake in Loughboro', like wise consists of reddish, banded gneiss, occasionally interstratified with beds characterized by an abundance of garnets; and in proximity to some of these, on the western side of the promontory, a few déposits of apatite have been observed. While engaged in exploring this promontory, and the country contiguous to Buck Lake, I was besieged by settlers who assured me that they had abundance of "phosphuret" — as they term it — on their lands, but in most instances the specimens shown me were crystals or fragments of greenish pyroxene, a mineral which abounds in many of the veins throughout this section. Other specimens, however, brought to me were undoubtedly true phosphate of lime, and in such cases every encouragement was given to the land-owners to follow up their discoveries. In this connection I may state that a great hindrance to the development of phosphate lands, both here and elsewhere, is the ridiculous prices asked for them by land-owners, who, unfortunately for themselves and others, have heard of some of the enormous prices recently stated to have been paid for such lands in North Burgess. It must, however, be borne in mind that in this latter township, phosphate deposits have been more or less worked for upwards of twenty years, and this in a country which is well cleared and settled, and abounds in roads; yet even here, up to the present time, there are

Promising deposit of apatite.

Hindrance to the development of phosphate lands.

only one or two phosphate mines that can be said to have turned out well. Besides, the sales recently made in North Burgess include the fee-simple of the lands as well as all the mining rights, and, in some instances, also valuable farms, and good mill sites, with easy access to navigable waters; yet with all these advantages, the general opinion amongst experienced men still is, that the prices paid have far exceeded the actual value of the lands. In the phosphate-bearing section around Devil and Buck Lakes in Bedford and Loughboro' townships, there are none of these advantages. The country is rough and almost uncultivatable, heavily timbered, and traversed by but few roads: while access to navigable waters is, at least for the present, an expensive and difficult matter. Besides this, the ground is new and comparatively unexplored, and it will probably be years before the country is in a suitable condition for even systematic prospecting. In view, therefore, of these facts, I would strongly urge upon the settlers throughout this section of country the better policy of throwing their lands open to intelligent prospectors, and giving them sufficient time to make a fair trial of the ground. Mr. Edward Schultze, a gentleman whose name has been already mentioned in this and in a previous report, and who has for some time both bought and mined phosphate of lime in North Burgess and South Crosby for export to Germany, has recently turned his attention to the Bedford and Loughboro' phosphate-field; and in a letter recently received from him, he speaks in most favorable terms of a number of localities opened by him in both of these townships; all of these openings being on, or in proximity to the course of a belt of gneiss, which maintains a fixed relation to the course of the band of limestone already described through Bedford and Loughboro'.

Better policy suggested.

The phosphate mine described as Cowan's Location No. 19 (Report of Progress, 1871–72, page 129), is situated on the southern side of this second trough or synclinal, and the produce can be shipped from Mr. Cowan's wharf on Opinicon Lake, and sent without change, *via* the Rideau Canal, to Kingston, Montreal and ports in the United States. From the Opinicon Lake mine, phosphate-bearing rocks can be traced south-westward along a part of the northern shore of Rock Lake in Storrington, to the fault or break referred to on page 163, and which also throws the rocks we are now describing in the same direction. Beyond this fault to the south-westward, the course of the gneiss has not been clearly made out, but in many localities between the fault and the Opinicon Lake mine, phosphate of lime is reported to exist. None of these localities, however, have yet been examined, and further notice of them will have to be deferred to a future report, in which I shall also describe the distribution of the succeeding rocks in the centre portion of this trough, and also the geological structure of the remaining portions of Bedford, Storrington and Loughboro' townships.

Cowan's phosphate mine.

Levels of Lakes.

Levels of Lakes.—In compliance with the request mentioned page 138 of this report, the levels of some of the principal lakes above Lake Ontario, as determined by Mr. Alexander Murray, and given in his Report of Progress, 1852–53, now out of print, are here repeated.

Name.	Townships.	Height in ft.	Falls into
Loughboro' Lake	Storrington & Loughboro'	166·12	Rideau River.
Sloat's Lake	Loughboro'	189·05	Lake Ontario.
Knowlton Lake	"	217·53	Mud Lake.
Mud Lake	"	217·53	Desert Lake.
Desert Lake	Bedford	217·53	Birch Lake.
Birch Lake	"	217·53	Devil Lake.
Devil Lake	"		Rideau River.
Canoe Lake	"	229·97	Desert Lake.
Batting's Mill Pond	"	287·00	Wolf L. & Rideau R.
Green Bay & Bob's L.	"	384·80	Tay & Rideau Rs.
Crow Lake	"	398·88	Mud Lake.
Sharbord Lake	Oso and Olden	505·29	Madawaska & Ottawa Rs.
White Lake	Olden	555·29	Sharbord Lake.
Cross Lake	Kennebec	412·84	Long Lake.
Long Lake	Sheffield	365·69	Beaver Lake.
Beaver Lake	Sheffield	307·22	Salmon R. & B. of Quinte.

ECONOMIC MINERALS.

The minerals of economic value known to exist in the three sections of country described in the foregoing Report, are the ores of iron, lead and copper, phosphate of lime, sulphate of barytes, plumbago, mica, garnet rock, and building and paving stones. Of these the most important are the ores of iron and lead, phosphate of lime, plumbago and mica.

Iron ores.

Iron Ores.—In my last Report (Report of Progress, 1871–72, pages 121–123) the principal iron mines, viz: the Chaffey, Yankee, Bygrove, Fournier, Christie's Lake, Foley and Dalhousie mines were briefly described, and partial analyses of all but one of the ores were given. In the foregoing pages of the present Report, I have further attempted to show the true geological position or horizon of the ore beds in these mines, and I shall now describe the Meyer's or Christie's Lake iron ore deposits, of which no particulars were previously given; and then give a summary of the work done at the Dalhousie Iron Mine since the year 1870.

Meyer's or Christie's Lake mine.

Meyer's or Christie's Lake Mine (Watson Mine.)—This location is situated on the eighteenth, nineteenth, and twentieth lots of the third concession of South Sherbrooke, and embraces an area of 259 acres; the openings made, are on the first and last numbered lots. On a high bluff on the north shore of the lake, on lot eighteen, three beds of iron ore have been uncovered, and to some extent worked during the past summer. The strata, which here consist of dark greyish and greenish hornblendic gneiss, dip to the southward at angles varying from 15° to 80°. The uppermost bed of ore, and the nearest to the lake, has been uncovered for about

thirty-five feet in length, by twenty-four feet in breadth, and a considerable mass of ore has been exposed. No walls have yet been reached, and I think it is probable that the uncovering has been extended on the face of the bed rather than across its out-crop. In the second and underlying bed a breadth of eighteen feet of ore has been uncovered, and can be traced by openings made on its course for a distance of upwards of 150 feet. In the third and lowest bed a well defined foot wall of gneiss has been struck, and a solid mass of ore is exposed measuring eighteen feet in width. The extreme distance between the openings on this property on the strike of the ore beds, is nearly one mile, and the distance between the top of the upper and the bottom of the lower bed of ore is about 300 yards. Several hundred tons of ore have been taken out, but operations have been chiefly confined to the determination of the extent of the deposits, which is now pretty satisfactorily known. An experimental shipment of the ore has been made to Cleveland, and it is reported to have given perfect satisfaction to the smelters, and it has further been ascertained that this ore will produce a quality of iron well suited for the manufacture of Bessemer steel. An analysis made by Dr. Harrington of a sample of the ore which I brought from this location, gave as follows:

Shipment of ore to Cleveland.

Metallic iron	65.62 per cent.
Titanic acid	2.83
Phosphoric acid	0.05
Sulphur	not determined.

Analysis.

It may be further stated that the facilities for mining here are favorable; the position of the ore on a high hill affords easy and cheap drainage, and a ready means of disposing of the *debris*, and these mines can probably be worked for a considerable time before resorting to expensive underground operations. Respecting the facilities for the shipment of the ores a gentleman of long experience in matters pertaining to the transport of iron ores from Canada to the United States, and who has recently thoroughly examined the Christie's Lake deposits, writes me as follows:—"The facilities for transporting ore, either by rail or water, from this property to the Lehigh Valley and the western markets, are unusually favorable. The Ontario and Quebec railroad, now under construction, passes one and a-half miles north, and intersects the Kingston and Pembroke Railroad about eight miles west of the mine. This junction is thirty-four miles north of Kingston; about ten miles to the eastward it will intersect the Brockville and Ottawa Railroad at Perth." Five different routes are then given by which this ore can be forwarded to the St. Lawrence, and thence to any part of the United States. For present consideration the last or fifth only need be mentioned.

Facility for mining and transport.

This is given as follows:—"In cars, per scow up Bob's Lake, and per Kingston and Pembroke Railroad, to Kingston, (25 miles); thence by

Route.

canal barges or lake crafts, to Oswego, Fairhaven, Buffalo, or Cleveland. This would be the cheapest and most desirable route. The mine being situated at the base of a high hill, on the water's edge of Meyer's Lake, scows might be constructed to carry six or more cars, which could be run from the scow into the mine or open cutting; the same method could be adopted on reaching the Kingston and Pembroke Railroad, on the west side of Bob's Lake, which point is 25 miles from Kingston. The ore by this route would cost per ton :—

Cost of the ore delivered at Cleveland.

	Delivered at Cleveland, O.
Mining, in open cutting.....	$0.75
Loading in cars, in do.....	0.05
Towing up Bob's Lake.....	0.10
R.R. freight to Kingston (25 miles)	0.50
Lake freight to Cleveland.....	0.70
Duty*.....	0.40
Gold.....	2.50
American currency at 10 per cent..	$2.75

Kingston ore docks.

At Kingston, where ore docks are being constructed by the Kingston and Pembroke Railroad Company, the ore can either be dumped into Erie canal barges for Oswego, &c., &c., or into lake schooners seeking return freights westward; three-fourths of these vessels discharge their western cargoes at Kingston, returning generally in ballast. Freights range from 64 cts. to 75 cts. per ton to Cleveland, including loading and discharging."

The accompanying plan and sections of the Dalhousie Mine are taken from drawings and measurements kindly furnished by Mr. Gerald C. Brown, M. E. The sections afford an excellent illustration of the character and mode of occurrence of the ore deposits.

Dalhousie Mines. Plan and Sections.

Description of works.

Dalhousie Mine.—Before the spring of 1870, the shafts No. 1 and 2 (see plan) had been sunk to the depth of 35 and 30 feet respectively, and from between these two shafts the ore had been partly removed. The ore had likewise been removed on the south side of No. 1 Shaft, as far as the middle of the road. Between the months of May and October inclusive, of the year 1870, both of these shafts were sunk to between 60 and 70 feet, and the stopes were extended to the break on the south and nearly as far as No. 3 shaft on the north, and downwards to within 8 or 10 feet of the bottom of No. 1. Early in November the incoming waters from the fall rains overcame the power of two horses, working a derrick, to keep it out, the works consequently filled and remained full of water until the following June. Between November and February, 1871, the No. 3 shaft, being above the water level in Nos. 1 and 2, was sunk, and the stopes

* It is expected the duty will be repealed at an early date.

connected with it were worked to the extent shewn in the accompanying section. During the same fall, No. 4 shaft was begun and sunk to the depth of 22 feet. The yield of ore from May, 1870, until the end of February, 1871, was 3,850 tons of 2,240 lbs., costing, not including plant, $1.25 per ton, and including plant, $1.46 or 21 cents additional, The contract price of hauling the ore to Perth, during the winter of 1870-71, was $1.00 per 2,240 lbs. The ore contains no rock, and does not pass into, but separates easily from, the walls, which are smooth and well-defined. No work was done from the month of February, 1871, until the following month of June, when a horse-pump was put into No. 1, and this shaft and No. 2, and the stopes connected therewith, were further extended till towards the end of the year, when the water overcame the power of the horse pump and work was supended. During January and February of 1872 the drift was extended from No. 3 shaft to within twenty-five feet of No. 4 shaft. The production from January to the end of February, 1872, was sent to Perth in loads which averaged four and a quarter tons, at $1.05 per ton. During the spring and summer of 1872 the No. 4 shaft was sunk to ninety-four feet, and the stopes were afterwards extended to the dimensions shewn in the plan. The production from February, 1872, to the end of February, 1873, was forwarded to Perth at $1 per ton, in loads which averaged three and three quarter tons, thence to the Rideau canal at 60 cents; thence to Kingston at $1.25 to $1.50, and thence to Cleveland at from $1 to $1.50. The total production from 1870 to 1873, has been rather over 11,100 tons. The wages of the hands employed have varied from 80 to 90 cents per day, with board.

Yield of ore

Total production from 1870 to 1873.

Phosphate of Lime.—In my last Report (Report of Progress 1871-72) I dwelt at some length, on the phosphate of lime deposits in the townships of North Burgess, South Crosby and Bedford, and on page 124 of that Report some nineteen locations are mentioned in which work to a greater or less extent was being carried on. Respecting these, I have little further to state, except that in the greater number of them all work has since ceased; the only locations in which anything like systematic and profitable mining is at present in progress, are those worked by Mr. Anthony for an English company, on the tenth and twenty-first lots of the sixth concession of North Burgess (No. 8 and 13 of my former list), and by Mr. Alex. Cowan, on the eleventh and twelfth lots of the seventh concession of the same township, and the first lot of the seventeenth concession of Bedford, near Opinicon Lake, (Nos. 7 and 19 same list). These are perhaps amongst the largest and best defined deposits of apatite which have yet been discovered, and should these fail we can have little further to hope from discoveries of this mineral in the future. The reason given for the cessation of work in most of these locations is the very high rate of

Phosphate of lime.

freight to England, which cannot now be obtained for less than fifty shillings sterling per ton.

Plumbago.

Plumbago Mine.—In the township of North Elmsley, on the twenty-first lot of the sixth concession, a mine of plumbago has been for some time in operation, under the management of Mr. Munsey, who was formerly engaged at the Howse iron mine in Bedford. The plumbago occurs in thickly disseminated scales in a sandy, calcareous and quartzose rock, which in some places graduates into an impure limestone. It is undoubtedly a stratified deposit. At the mine the dip of the beds is slight, both to the north-west and north-east, thus forming a rather flat anticlinal. On breaking through the crown of the anticlinal, the miners came upon a soft, sandy and brownish-colored rock, which yielded a very large percentage of plumbago. The surface-opening is about ninety feet in diameter, and the excavation from ten to fifteen feet deep. Much of the plumbaginous rock, which was being mined at the time of my visit, was obtained at the rate of 40 cents per ton, being of an earthy and easily disintegrating character. From the mine to the mill at Oliver's Ferry the rate of carriage did not exceed 35 cents per ton. The extent and geological position of this deposit has not yet been determined.

Cost of mining

Freight

Process for dressing the plumbago.

The material, both hard and soft, is put through a ten stamp mill, and the produce—a mixture of sand, lime and plumbago—passes through three revolving buddles, which effect a tolerably complete separation. Thus, the material round the outer rim of the third buddle is composed of nearly pure plumbago, which is shovelled into shallow iron trays placed over a furnace. When sufficiently dry it is passed into a reverberatory chamber, where it is further freed from any sulphur or arsenic which may be present, and is then ready for *bolting*. This *bolting* is carried on in an upper story of the mill, to which the granular and cooled plumbago is carried by means of an elevator, and is finally there packed in clean flour barrels. The coarser portions are again ground, and, when sufficiently reduced, packed and sold for lubricating purposes. The demand for this purpose is considerable, and rapidly increasing.

Mica.

Mica.—The workable deposits of mica in North Burgess have already been mentioned in the *Geology of Canada*, and more recently by Mr. Gordon Broome, in the Report of Progress, 1870-1871, page 321. The chief and only worked deposit described by Mr. Broome, was that on the seventeenth lot of the ninth concession of North Burgess, which was last worked by Mr. Baker, of Perth. Last year I visited this location, and found that all work had been suspended. The ground in the vicinity of the openings or pits is covered by the refuse, and the spoil from the pits, and it was evident, that before work could be again resumed, a considerable outlay of money would be required in order to clear the ground of

this *débris*, and put the mine into proper working order. The mica is still said to be abundant on both the sixteenth and seventeenth lots on the ninth range, but I do not think it can again be mined with the same profit as heretofore, as at present the demand for it is limited to comparatively large sizes. Should the demand, however, increase, these lots may yet become valuable. Mica is nearly always present in the veins and bed deposits of phosphate of lime, but for the most part only in small crystals, which are distributed along the sides of the beds or veins. In some localities it occurs in large crystals, but they are nearly always of too dark a color or too imperfect for economic use. Further, it is worthy of note that on the sixteenth and seventeenth lots of the ninth concession, "Baker's Mine," the mica is found free from phosphate of lime, in an earthy and easily decomposing pyroxenic rock. It is not a vein deposit, but apparently an extensive bed, striking south-westerly along the eastern shore of Pike Lake in North Burgess, into the township of North Crosby, where, on the seventeenth lot of the third concession, it was at one time worked to a slight extent by Mr. Poole, of Perth. There is little doubt that hitherto the best quality and largest sizes of mica have been obtained from within ten to twenty feet of the surface.

I have the honor to be, Sir,

Your obedient servant,

HENRY G. VENNOR.

Office of the Geological Survey of Canada,

May, 1873.