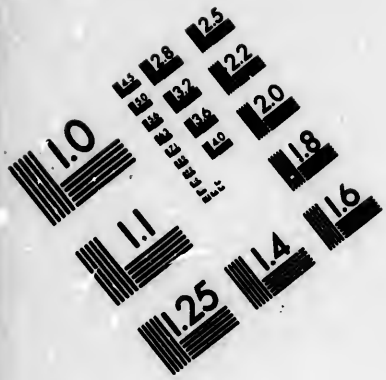

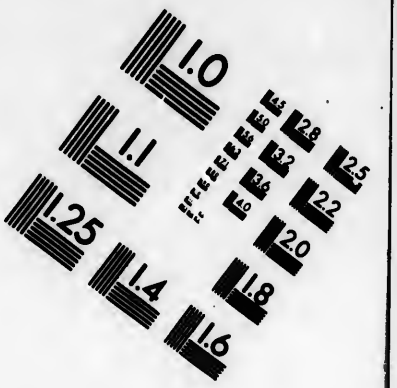

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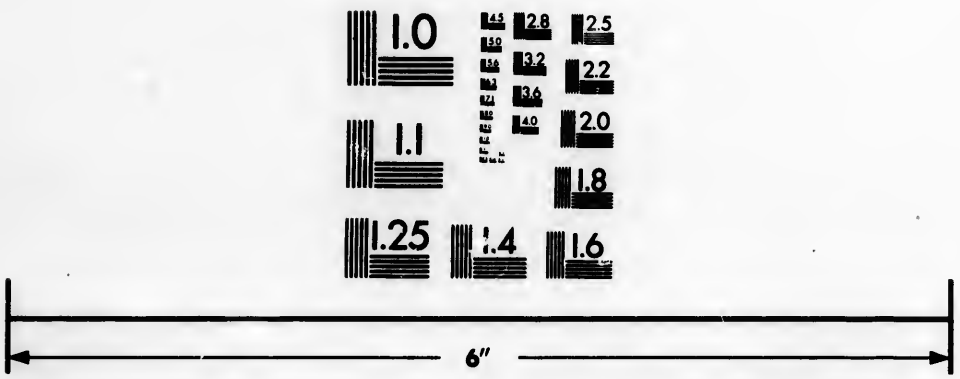

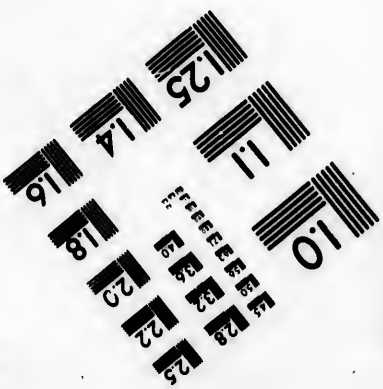

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THIRD REPORT

ON THE

GEOLOGICAL SURVEY

OF THE

PROVINCE

OF

NEW-BRUNSWICK.

BY

ABRAHAM GESNER, F. G. S.

PROVINCIAL GEOLOGIST, &c.

SAINT JOHN:

PRINTED BY HENRY CHUBB, MARKET-SQUARE.

1841.

REPORT.

TO HIS EXCELLENCY

MAJOR-GENERAL SIR JOHN HARVEY, K. C. B. & K. C. H.

Lieutenant Governor and Commander-in-Chief of the Province of New-Brunswick, &c. &c. &c.

MAY IT PLEASE YOUR EXCELLENCY,

I have the honour to present to Your Excellency, the Third Report on the Geological Survey of the Province of New-Brunswick; accompanied by a collection of mineral specimens, which have been procured during the explorations of the past season; and by a Geological Map of that part of New-Brunswick which has been examined.

In order to carry Your Excellency's instructions into effect, in bringing to light the natural mineral wealth of the country, I beg leave to state, that my attention has not only been directed to the discovery and application of coal, iron and other important productions of the mineral kingdom, but also to the developement of limestone, marl and other agents usefully employed in agriculture, as well as to materials used in the erection of buildings and in the arts. With the assistance of my son, and of other persons when their labour was required, an effort has been made to meet the wishes of Your Excellency and the other branches of the Provincial Government; and it will be seen, in the following Report, how far the means used have been successful, and how evidently they are disclosing the most permanent foundation for enterprise

and Provincial wealth. I have also continued my exertions in the analysis of soils, and such substances as are calculated to renovate those soils, and thereby to increase their fertility. A work, devoted to the Agriculture of New-Brunswick, is gradually advancing, and will be completed immediately after each district has been submitted to examination; at which time, a full account of the Œconomical Geology of the Province will also be ready for the press. In the former and present Reports, it has been found impossible to supply more than the topographical part of the work: my time has been found insufficient for the perfect investigation of every part of the subject; and, especially, for the full examination and description of the once living plants and animals, discovered in the rocks. To this part of the Geology of New-Brunswick, I hope to be able to direct my attention at some future period.

A collection of rocks, minerals and other important substances belonging to New-Brunswick, has been commenced and will be placed at Your Excellency's disposal. At present, it is deemed unnecessary to submit the specimens of those rocks, minerals, &c. as the collection, like the survey, is as yet incomplete. The specimens which accompany this Report, refer only to the Œconomical Geology of the District explored during the past season.

INTRODUCTION.

The most common objection to bringing into operation any of the dormant resources of this country, is the high price of labour; but this is the result of inactivity in applying such resources, and not the cause why immigration is retarded and the price of labour kept up. In the present state of the Province, there is no inducement offered to British capitalists or labourers to embark for our shores, unless they are disposed to devote their money or their exertions to agriculture; and as the fertility of the soil of New-Brunswick has been greatly underrated abroad, or is not known at all, such persons take up their abode in other countries. Besides these, there are vast numbers of persons, who are acquainted with the different arts of manufacture and mining; or, perhaps, common labourers, who are deterred from visiting the country, solely because they cannot find employment in the branches they pursue in their native land.

Capitalists in the Mother Country say, "shew us the objects upon which our funds might be profitably laid out, and we are ready to enter into any reasonable investment;" but so long as the natural channels of wealth remain closed, by being unknown and unexplored, so long will they withhold the means of improving them, either by the application of labour or money.

But a few years ago, Botany Bay, or Australia as it is now called, was considered important only as a place of confinement for criminal offenders. It was Britain's great prison-house; but no sooner were the advantages possessed by this new Colony discovered; no sooner was the mineral or other natural wealth of that portion of the Globe made known, than emigration was directed thither to an astonish-

ing extent: but, while the resources of Australia have been rendered attractive, those of other British settlements have been overlooked. Many similar instances might be brought forward, to establish clearly the importance of supplying correct information, respecting the Agricultural, Mining and Manufacturing prospects of Districts, remotely situated from the centre of emigration. It is here the answer is found, why none but a few poor labourers settle upon our soil. The Manufacturer, Miner or Mechanic will not venture abroad, unless due encouragement is offered to his pursuits, and sufficient employment is held out as his reward; nor will the higher classes risk their funds in a country, whose real value is to them unknown. It is true, perhaps, that a powerful means of retarding emigration, has existed in the system formerly pursued, in granting lands in the American Colonies; and, by the combined effects of all these circumstances, the influx of British settlers into these Provinces has been prevented, and the advancement of their best interests has been checked to an alarming degree. If the United States have increased in strength and importance, beyond the British Provinces, they have done so, from the application of British capital, labour and skill introduced into them, by the current of emigration; while the Provinces themselves have struggled on, almost without aid. Extensive grants of land have been made to persons who do not reside in the country, and who do not cultivate the tracts to which they have title: hence, large areas, that could not be obtained by persons who would clear them, remain in their original wilderness state. Large grants had also been made to individuals, whose descendants still remain on some portions of them. but are unable to improve the whole. Nor has the law of escheat produced that salutary effect, which might have been expected from it. Thus, the borders of the rivers, the finest groves of timber, and some of the most fertile land, were placed beyond the reach of the industrious settler; who, if he obtained land, was frequently compelled to fix his residence beyond the bounds of tracts, owned by absentees; remote from any settlement, and where he was unable to make a road, over which his first supplies must be transported, and his surplus earnings finally conveyed to market. These were the difficulties the emigrant formerly had to oppose; fortunately for the Provinces, they are now nearly overcome, and the population of the country has advanced in spite of all impediments; although the dread of these obstacles, doubtless, still deters many from emigrating to this country.

Almost all the moral and industrious emigrants to New-Brunswick, whatever have been their occupations, have succeeded in securing to themselves a competency; and many have obtained wealth. The lower class of labourers, when they have devoted themselves to steady habits and industry, have been successful; and where there are instances to the contrary, they may generally be attributed to idleness and intemperance. The inquiry made by persons in the Mother Country, who are desirous to settle in New-Brunswick, is, what employment will they find there?—and when they are informed, that the principal occupation of the inhabitants is lumbering in the dense forests, amidst the deep snows of winter, they have no desire to venture upon a pursuit with which they are altogether unacquainted. Thousands of emigrants, after they have landed in the Provinces, embark for the United States; where a greater variety of employment in mining, manufacturing and other divisions of labour, affords them an opportunity of choosing that kind which is most congenial to their former habits. It is in vain to ask the miner or manufacturer to settle in a country where his branch of business is not known, and to which the productions of his art are exported.

It is by offering encouragement to the different trades and occupations of the Mother Country, by unlocking the available natural treasures of the Provinces—the objects from which their labour will yield them profit and a competency—by directing them to the natural wealth contained in the earth, the soil and the forest, that they will be disposed to immigrate, and to open and improve those resources that abound in almost every section of the country.

It has been too often supposed, that countries abounding in mines are unfavourable to agriculture: but such an opinion is extremely erroneous; for, although the soil in the immediate neighbourhood of metallic veins is often unproductive, those veins are not of so frequent occurrence, or so extensive, as to affect the fertility of any considerable tract. In proof of this, it is only necessary to refer to Great Britain, whose mineral productions have been the great source of her wealth. It is equally certain that New-Brunswick, almost equal in extent to England, is not only capable of being rendered a Mining, but also an Agricultural Province. At the present period, the great supply for exportation from the Province, is derived almost altogether from the forests, which are yearly declining before the axe of the lumberman; and every other division of labour suffers from those pursuits,

that scarcely render the shippers of timber a profit. It is also evident, that those who are engaged in the laborious occupation of bringing timber or lumber to market, do not improve either in their moral or pecuniary condition; nor do they acquire such habits as will tend to render them the most useful inhabitants.

It is not intended to imply, that the exportation of timber should be discouraged; but it is wise, that other, more permanent and inexhaustible, natural productions of the country should receive that share of attention they merit; so that both foreign and domestic capital may be applied to those objects, which can alone secure to the Province the enduring rewards of enterprize.

The pioneers who first visited the forests, remote from any dwelling, and discovered groves of timber that once overshadowed the soil, conferred a favour upon their successors, and secured for a time a revenue to the Province; so will those who, by their foresight, may be the means of bringing into operation, other and more permanent objects of enterprize. The most important of all the resources of the Province are her mines and mineral productions; and the time cannot be very distant, when the Geological Survey will be found not only to have aided the cause of the natural sciences, but also to have secured to New-Brunswick a benefit of the highest order.

Geology may be called a new science. Forty years ago, it was blended with vain and absurd theories; but, by the labours of most eminent men, in Europe, by the united efforts of those whose object it was to collect the facts, as they are recorded in the earth, a noble enquiry has been elevated, a science has been born, alike remarkable for its interest and value to mankind.

Although Great Britain had been explored from time to time, at great national expense, still it has been deemed necessary by Parliament to commence a new Geological Survey, with the advantage of the knowledge gained by recent discoveries in the science; and experience has already proved the vast utility of this undertaking. Other Powers are equally active in this important work, and each reconnoisance returns a satisfactory reward. Even in Newfoundland and Upper Canada, Provinces whose geographical situations are far less favourable than that of New-Brunswick, these surveys have been commenced, and are advancing with zeal and alacrity.

The advantage of possessing a good geological map of the Province, is by no means inconsiderable; by the co-

pletion of such a work, it may be ascertained at a single glance, what is the nature of the rocks, the situation of the most valuable minerals, the character of the soil, &c.; and other topographical information is afforded by the reports connected with it. Thus, persons who are desirous of immigrating, or purchasing wild land, may become acquainted with such facts, as will induce them to enter into agricultural or mining pursuits; and the Government would be made acquainted with such details, as would enable it to act with advantage upon certain data. So great has been the demand for the Geological Reports already published, by persons residing abroad, that I have been unable to supply them; and it has been regretted that a greater number of them was not printed.

It is very evident that, for a long period to come, the inhabitants of these Colonies must depend upon the natural resources of the country, for the support of their commerce and the objects of their industry. But, although the time may be distant, when the more delicate and skilful operations of manufacture will be performed, necessity will soon require the opening of mines of coal, iron, copper and lead. If the attention be directed to the fisheries along the coast, it will be seen that they are becoming less and less productive. The supply of timber from the interior will also decline, and each year the cost of bringing it to market increases, by reason of the lumberman having to extend his labour farther from the navigable streams. Indeed the time has arrived, when, in almost every section of the Province, the finest forests have been felled and removed. Should an unfavourable change take place in the British market for the timber of these Colonies, it requires not the knowledge of a statesman to foretell the result. At the present time our timber is given in barter for European coal and iron, and other goods; a vast amount of which might be saved to the country by the application of our own resources.

The soil of the Province is capable of supporting a population twenty times greater than the present; and would, under an improved state of husbandry, supply an abundance of grain for its inhabitants; but, from the neglect of agriculture, large quantities of foreign bread are now required for the people. It is, therefore, evident, that the permanent strength of the Province must consist in her agriculture and minerals; and Geology is the chief science by which these are to be improved and brought to bear upon the future wants of the country.

Prior to 1833, M. M. Elie de Beaumont and Dufrénoy were employed to make a geological map of France, and the descriptions were given by the former gentleman, in his lectures at the College de France, of the district of Brittany and Normandy. Not only have maps of this kind been found extremely useful in directing the miner, but they have also greatly promoted the interests of agriculture, in the countries where they have been constructed. A geological map of New-Brunswick, accompanied by an account of the soil in each district, and the proper mode of renovating and cultivating each variety, is certainly very desirable; although it cannot be obtained without the aid of the Legislature.

Perhaps there is not a country in the world, whose population increases so rapidly and steadily as that of Great Britain. It is on this account that she has been able to occupy so many Colonies abroad, to strengthen herself at home, and defend the nation from numerous foes, who have been jealous of her power. So limited is the surface of Great Britain that the population overflows; and, attempering themselves to every climate, her people find their way to every country upon the face of the earth. It is, therefore, remarkable that emigration has not been extended, in any considerable degree, to New-Brunswick; where ample encouragement is now offered to every agriculturist, who lands upon her shores.

Large tracts of land still remain ungranted, in the district explored, and may be obtained from the Province upon favourable terms. At the sources of the small rivers emptying into the Petitcodiac, and the streams flowing into the Kennebeckasis and Washademoak, there are thousands of acres of wilderness lands, equal in fertility to any in America. The higher grounds are covered with the sugar maple, interspersed with butternut and sumach; while the lofty elm and ash are common on the intervales.

It has been deemed proper to introduce these brief observations here, that reports unfavourable to the agriculture of New-Brunswick may be corrected; and although they relate more to the topography, than to the geology of the Province, they may be useful to persons who have never had an opportunity of visiting the district under consideration. For geographical information and maps of the Province, it becomes me to offer my sincere acknowledgments to the Hon. J. S. Saunders, Surveyor General of the Province.

The General Mining Association of London have a lease, for sixty years, of all the mines and minerals of Nova-

Scotia. But notwithstanding coal and iron and other valuable minerals are abundant in that Province, the Association hitherto has deemed it most advantageous, to work only the coal mines of Sydney and Pictou. The Province receives £4000 per annum on twenty thousand chaldrons, Newcastle measure, and two shillings for every chaldron raised above that quantity. It is from this source, that the whole of the casual revenue is derived.

At Sydney, upwards of five hundred men, three steam engines and ninety horses are constantly employed; and during the year 1839 the miners produced no less than seventy thousand tons of coal.

At Pictou, six steam engines, one hundred horses and five hundred men are employed; and, during the year 1839, forty-eight thousand tons of coal were exported from that place, to the United States and the British Ports along the coast.

As the demand for coal is rapidly increasing, the Association has not only laid out the great profits arising from the mines, but also other capital. The company have opened new shafts, laid down expensive rail-roads, &c. in order to meet the increasing demand. It is from these circumstances, that persons unacquainted with the facts have supposed, that the Association has not realized the interest of the great amount expended; but when those works are completed, they will return vast profits. It does not appear, that the price of labour has any effect upon the working of the Pictou and Sydney mines: the *scarcity* of labour, only, is complained of; and the miners earn from seven to ten shillings per day, each. Admitting the low estimate of one hundred and twenty thousand tons to be the annual production of the Sydney and Pictou mines, the yearly amount of profit received by the Association will be £30,000.*

The only coal mines worked to any extent in the United States, are those of Pennsylvania; and it may be said, that these are the only mines of coal discovered in the Union, that can be worked advantageously. This coal is the *anthracite*, and is not adapted to the production of steam, nor very convenient for domestic use. Now, when the vast extension of steam navigation, and the increased application of steam power are considered, it must be obvious, that the coal mines of Nova-Scotia and New-Brunswick are not only of Provincial importance, but also the richest resources of the nation.

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* See Appendix B. to "*Report of the House of Commons*"—page 140.

But a few years ago, it was scarcely known that coal existed in Nova-Scotia; but, by the application of science and skill, hidden mineral wealth has been discovered, a new trade has been opened, and the importance of the country has been greatly increased. All these results have taken place, under every objection that can be urged against mining in new countries.

Besides coal, extensive deposits of iron, copper, lead and manganese have been discovered in New-Brunswick, and may be rendered available. Also, the deposits of salt, gypsum, granite, porphyry, &c. known to exist in the interior, may hereafter become the sources of wealth.

Besides attending to the geology of that part of the Province which has been submitted to examination, I have endeavoured to collect useful topographical information, and to examine the best sites for rail-roads, canals, locks, bridges, &c.; and if, besides the minerals and soil, the scenery has been occasionally noticed, it has been for the purpose of shewing that the country is rich in those natural beauties, which adorn the exterior of the earth.

There is, in the examination of the natural productions of the country, an object to be gained beyond the benefits arising from the discovery of useful minerals; and an appeal may be made to the liberality of the Legislature, in promoting the advancement of a science, which has proudly distinguished the British Government, amidst the emulations of other European Powers. The science of geology has not only been found of the highest interest, and admitted to rank next to astronomy; but it has proved of incalculable benefit to mankind, by revealing the secrets of the earth, and disclosing those materials which constitute the strength and happiness of nations. The vast sums of money granted by the British Parliament, for the exploration of each part of the United Kingdom, and for collecting the objects of natural history contained in them, are evidences of the utility of such examinations; as well as of a love of science and national refinement.

The same spirit of enquiry has flown across the Atlantic; and the American General Government and its various local legislatures are vieing with one another in geological research. It has been remarked by Professor Phillips, of King's College, London,* that "one of the most obviously useful applications of science, is in the Colonies sent forth by a commercial people; and perhaps no more important ser-

* Lardner's Cyclopædia, Vol. 2, page 206.

vice could be rendered to Australia or Canada, than by accurate Geological Surveys, such as are now proceeding steadily in the United States of America." Of the British American Colonies, New-Brunswick has been among the first to enquire into the natural resources of the country; and the enquiry has already developed important objects of Provincial wealth, previously unknown.

It may be fairly asked, to what useful purpose can the education received in our institutions of learning be directed, if the proper objects upon which that knowledge can be usefully applied, be permitted to remain concealed? It is not only by affording the means of information, but by directing that information to its ultimate objects, that these ends will be gained, which can alone secure the prosperity of any country.

In 1839, the Legislature of New-York granted $6,500, to be continued annually, until a Geological Survey of the whole State should be completed. In this work, several scientific gentlemen are employed. It not only embraces the geology of the country, but also its zoology, palæontology, and other branches of natural history. By the united labours of these men, a museum will be formed, of much interest; and it is to be hoped that the time will arrive, when all the natural productions of New-Brunswick, also, will be brought together, and when they can be examined almost at a single glance, by those who feel an interest in them, and who will employ them for the general good of the Province.

The advantages arising from the Geological Survey of New-Brunswick are already beginning to appear. Formerly, all the granite employed in buildings was imported from the United States and Nova-Scotia; but since the discovery of the excellent and convenient quarries on the River Saint John, the importation of granite has been discontinued. These quarries are owned by Justus S. Wetmore, Esquire, and have been worked during the past season, by Messrs Small and Barker, who deserve much credit for their skill and industry. Upwards of six thousand tons have already been removed to Fredericton, Kingston and St. John. It is used extensively in re-building that part of the City of Saint John, which was destroyed by fire in 1839. The price of the rough granite delivered at the wharves is 14s. per ton; the imported varieties cost about 24s. per ton; hence a saving to the Province of £3000 has been effected in a single season, at the very onset of the opening of these quarries. The above sum would pay all the expenses of the Geological

Survey to its completion; and this great saving has been made on the article of granite alone. From these facts it may be seen, how important Geological Surveys are to the prosperity of a country.

A mining lease has been obtained from the Province, for a tract containing coal, in the County of Westmoreland; and applications have been made for other mining leases, for that part of the Province. Lime-kilns have also been erected, for the purpose of calcining lime for agricultural and other purposes, and the mineral resources of the Province have begun to claim the attention of wealthy companies in Great Britain.

During the past summer, W. J. Henwood, Esq. a highly accomplished English Geologist, was employed to make some examinations in the Counties of Gloucester and Restigouche. As this gentleman was sent out by a private company, the result of his examinations have not all been published. Such as have appeared, in the Mining Review of London, are highly interesting and creditable to him.

My own labours have been chiefly devoted to such objects, as may be immediately applied to useful purposes; such as the most important minerals, and those necessary to agriculture. The *palæontology* of the district examined, and the classification of the organic remains found in the various formations, could not be attended to. This is a part of the work, which I hope to be able to complete, when sufficient time is allowed for that purpose. In a country where the discovery of different mineral substances occurs frequently, the examination and analysis of these minerals require much time and patient investigation. I have not, therefore, been allowed to perform this last division of my task in a manner satisfactory to myself: this Report may, however, be a guide to those who may follow, and to such as are disposed to bring the resources of the country into operation.

Besides the duties of the Survey, it requires much patience to test the minerals, constantly presented for examination by the inhabitants; and this part of the work, although it may not always have given satisfaction to the applicants, has been performed according to the best of my ability.

In conclusion, I may be allowed to observe, that the success of the geological exploration, hitherto, is at least a recommendation in its favour; however imperfectly the work may have been performed.

COUNTY OF SAINT JOHN.

Being unable to complete the exploration of the County of Saint John, during the season of 1839, my labours of this year were first directed to that object; and as it was deemed proper, that as much information should be gained, as the circumstances would admit, of the *Westmoreland Coal Field*, in order to assist persons who were desirous of opening mines in that quarter, a further exploration of a part of the Coal District was made; the results of which proved the propriety of the measure, by the discovery of deposits previously unknown.

Beginning with that part of the County of Saint John, which had not been previously examined, the syenitic district, described in my second Report, was found to occupy almost the entire space, between the slates of that County and the conglomerate of Hammond River and Sussex. Upon a closer examination than had been previously allowed, the rocks of this district, as it extends towards Shepody, were found to be almost exclusively of igneous origin, but so variable in their character, as to render their classification extremely difficult. In many places, naked, barren and precipitous hills, are composed of hornblende and feldspar, in crystals of small size; or, more rarely, of from half an inch to an inch in diameter. Sometimes the feldspar is red, and the rock resembles the red feldspar granite of Charlotte County; but in these instances, the mica is absent, and instead of quartz, the rock contains augite. One variety resembles the kind of which Pompey's Pillar is built: it is very beautiful when polished; and, were it properly cut, it would be admired, if used for the casements of doors and windows in buildings of granite. Again, there are vast masses composed of crystallised hornblende, with and without sulphuret of iron; these varieties pass into greenstone, containing a small proportion of feld-

spar. Other kinds are also seen side by side, and resembling dikes and veins; but they are so disposed, as to render it difficult to determine which should claim priority of origin. Here, as in other parts of the primary and trappean districts of the Province, quartz, hornblende, feldspar, mica, and sometimes augite, are mixed in such variable quantities, that they cannot be classed with any of the kinds described by some mineralogists; nor can the stubborn rules of some theorists be made to apply, to the almost endless variety of composition, which has been formed by the hand of Nature, in the recesses of the earth. It has been thought, however, most proper, to apply the term "*syenite*" to this assemblage of rocks; a compound of hornblende and feldspar being most abundant. The connection of this district with the granitic and trappean country of Charlotte and King's Counties, its geographical situation and frequently identical composition, shew that it belongs to the same system, whose origin must be ascribed to heat; and, from the trap dikes in the granite and syenite, it is evident that those rocks were first formed.

The country occupied by these rocks, which run in a north-easterly direction, and form a narrow belt between the Kennebeckasis and Shepody Mountain, is very broken and uneven. The depressed tracts between the mountains are occupied by small lakes, many of which have no outlets, and therefore their waters rise high during the floods of spring and autumn; others are drained through deep and narrow gorges, into the rivers of the coast or larger streams of the interior, and abound in fine salmon and trout. The surface of the land is strewed with boulders and partially covered with thin beds of gravel, derived from the rocks beneath. These, with the scantiness of the soil, are unfavourable to agriculture; but fortunately, this sterile tract is limited, and some of the slopes, especially on the south side of the mountains and hills, are capable of being converted into small but excellent farms.

The chain of high lands, composed of crystalline rocks, extending along this part of the Province, from the boundary of the United States to the County of Westmoreland, form a ridge, against which the slates, greywacke and greywacke-slates, and limestone, running almost parallel to the coast of the Bay of Fundy, lean, and upon which they repose. But there is a group of schistose rocks, containing no organic remains, and situated directly on the coast, as seen at Mispeck, Black River and other places, which dip towards this ridge, and do not appear to have been affected by the eruption of the chain already mentioned. This group will be more par-

ticularly noticed hereafter. The former slaty rocks may be classed with those so ably described by Mr. Murchison, who has denominated them "*silurian*"; while the latter are evidently *primary*.

The schistose rocks of the silurian group were evidently produced by the action of water upon pre-existing materials; and those materials are found in the rocks dipping beneath them, and upon which they now rest. The strata thus produced were evidently deposited horizontally, whereas they are now highly inclined; and their elevation must be attributed to the force, by which the crystalline rocks were raised and fixed in their present position. It is also evident, that the accumulation of these strata, from the detritus of older masses, took place beneath water; into which the plants, now found in a fossil state, had been conveyed by land floods. The changes produced in the strata, their displacement, the eruption of the syenitic rocks, and other phenomena, referable only to heat, probably took place at that period, when the calcareous, arenaceous and argillaceous strata were raised above the surface of the water. But the production of trap dikes and veins, common in every quarter, may have occured at a subsequent period.

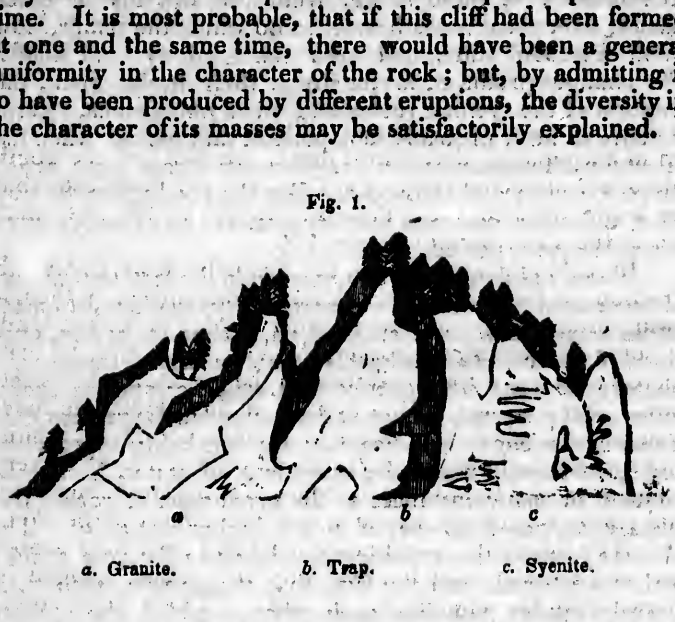
These opinions receive support from the fact, that almost all these stratified masses, wherever they are found to meet the igneous rocks, have suffered such changes as heat only would produce. How far heat is capable of transforming sedimentary deposits into granite and other crystalline rocks, under great pressure, cannot be determined in the present state of chemical science. It is, however, far from being improbable, that strata formed under the operations of water, have contributed in many instances to the production of rocks, frequently supposed to be of much higher antiquity. The intimate relation this syenitic ridge holds to the true granite farther westward, and the fact, that these rocks, with their several varieties pass into each other, establish the opinion that they are of contemporaneous origin. When we find the slates and limestone reposing on and shelving from them in all directions, it appears obvious, that they were elevated subsequently to the deposit of the sedimentary strata, placed along the flanks of the mountains, formed by their upward motion. The granite and other rocks of that class have long been considered of primary origin; yet the causes by which they were produced, may not have ceased to act, until long after the greywacke system was laid. Nor can it be discovered, how far those causes may have acted upon, and

changed detrital accumulations, situated above the theatre of their more intense action.

It should not be supposed that all the strata, now seen in highly inclined positions, were thrown up by one convulsive effort of the earth. It is far more probable, that they have been elevated at different periods; each of these periods being recorded in the different degrees of dislocation and elevation of the strata, and the variety of changes which have succeeded each other in the once heated rocks beneath.

The following wood-cut is a representation of one of the instances, seen in this part of the country, where crystalline rocks, of different characters, are placed side by side, as if they had been thrown upwards at three separate periods of time. It is most probable, that if this cliff had been formed at one and the same time, there would have been a general uniformity in the character of the rock; but, by admitting it to have been produced by different eruptions, the diversity in the character of its masses may be satisfactorily explained.

Fig. 1.



a. Granite. *b.* Trap. *c.* Syenite.

The syenite reaches from Robinson's Inn, on the side of the Kennebeckasis, to within three miles of Gondola Point. The soil on this rock is, in general, but scanty; and, in situations where there are no beds of sand and gravel, or clay, it has been produced by the decomposition of the hornblende and feldspar of the rock, by the operations going forward upon the surface.

From Gondola Point to, and including Darling's Island, the rocks are a coarse claret-coloured sandstone and conglomerate. Frequently this conglomerate, as seen at the

entrance of the river, as well as at the point and mouth of Hammond River, is composed of syenite, limestone of different colours, quartz, feldspar, and trap, in masses varying in size from a cubic inch to a cubic foot. The whole of these different rocks are identical with those forming the hills southward; there is, therefore, no doubt, that the conglomerate was produced by the cementation of fragments, brought down by water from the hills above; and it is curious, that the farther the rock is situated from the mountain-home of its pebbles, the more those pebbles are worn and rounded, from the longer action of the water, by which their angles were worn off. Here, also, the current of water, which transported these pebbles and broken fragments to the places where they are now consolidated, flowed in an opposite direction to that, which has acted upon the superficial detrital beds, and which, by conveying with it large boulders, has cut those peculiar grooves on the surface of the rocks, that still remain as testimonials of its existence. The strata at Gondola Point dip in an opposite direction to those, situated on the south side of the anticlinal ridge of syenite, already described; but the angle of their inclination is from 20° to 40° less, than that of the strata already referred to.

In making a section from the Kennebeckasis, in a south direction, to Cape Mispeck, the formations appear in the following order. The syenite, forming a ridge of broken land, for some distance on the south side of the river, may be considered *primary*, from its relation to the granite farther westward. Leaning against the syenite, a fine crystalline limestone, capable of affording excellent marble, occurs; or, in situations where the limestone is absent, clay-slate, frequently very ferruginous, and containing the remains of marine animals and land plants alternately, appears, in strata almost perpendicular. The limestone is extremely hard and frequently sonorous; and the clay-slate has evidently been much changed in character by the application of heat. These facts considered, in connection with the vertical position of the slate and the strata associated with it, are evidences that the syenite has been elevated, subsequent to the forming of the calcareous and argillaceous deposits above it; especially as those evidences become less manifest, according to the distance they are situated from the plutonic rock.

Succeeding these, there is an extensive class of strata, also running in north-east and south-west directions, belonging to the greywacke group. Some of the lower members of this group are argillaceous; as, those near the Penitentiary, where

there are indications of anthracite; others are arenaceous, as those at Little River, where there are fossil trees. Near Mr. Anthony's and at Hannah's farms, this system of rocks is met by a coarse conglomerate, which, with the older slates of the shore, extend in the direction of Loch Lomond.

Proceeding a number of miles farther eastward, through the forest, a similar section exhibited the same facts; so far as they could be discovered, under the difficulties existing in an uncleared part of the country.

The beds of clay, common on the surface, have, no doubt, been produced by the restoration of the argillaceous strata back to their primitive state; and the deposits of sand and pebbles are the result of the disintegration of the grey-wacke, sandstone and conglomerate. That the whole of these beds have been laid by the agency of water, is evident, from their similarity, in arrangement, to those forming daily under the influence of powerful currents.

MISPECK.

Between Little River and Anthony's Cove, there are extensive and deep beds of diluvial sand and gravel; and at Red Head, one of these presents a high and steep embankment, fronting the sea. These deposits rest upon beds of clay, marl and marly clay, belonging to the tertiary deposits of the Province; and similar to those on the opposite side of the harbour. They contain the remains of numerous species of shells; many of which are still common on the shore. These shells were not only found, where the sea had worn away the tertiary beds, along the coast; but also on the roads to Mispeck and Loch Lomond, at the bases of the hills, and in the ravines, two miles inland. At Anthony's Cove, they may be seen in the clay, where it is intersected by the road. In all these instances, they are from ten to thirty feet above the present high water mark.

Leaving the Cove, and advancing toward the Cape, there occurs a coarse conglomerate, which presents a surface very uneven and unfit for vegetation. Towards Port Simonds, a coarse reddish sandstone, conglomerate and a light red clay slate, occupy the shore, and extend in a north-east direction towards Loch Lomond, The conglomerate, which appears to form the uppermost strata in this quarter, is composed of pieces of slate, or lydian stone, augite and syenite, trap and quartz; which materials are much more firmly ce-

mented, and the rock is far more compact, than any of the new red sandstone series; a fact, which has resulted from its greater age, and the increased pressure it has sustained. The sandstone, or greywacke, is composed chiefly of grains of quartz, feldspar and mica; and is very hard and compact. Beneath, and interstratified with this rock, is a firm light red and buff-coloured argillite or clay-slate; which, from its extreme hardness, is sonorous, like clinkstone. All these strata have had their origin in the debris of older rocks; and the loose, water-worn pebbles of former shores, are now consolidated, while the masses whence they were derived can no where be found.

These rocks belong to one and the same formation; and extend along the shore of the Bay of Fundy, to the distance of fifteen miles, in a north-east direction, until they reach the syenitic ridge, already described. The general dip of the strata is north-west, from 25° to 40°; which is almost directly opposite to the inclination of the slates and greywacke, farther north.

All the older slates, conglomerate and sandstones, are filled with innumerable veins of white quartz, sometimes associated with talc and chlorite. These veins run in all directions, and are from half an inch to five feet in thickness. In the slates of Saint John, and those forming the upper series, these veins are comparatively scarce and small; and at Little River, they are absent altogether. In the apparently older and lower strata, no organic remains have been discovered; while in the upper series, at the last mentioned places, and near Jeffrey's Hill, the remains both of marine animals and land plants, were found. From these and a variety of other circumstances it appears, that the silurian group of Mr. Murchison is clearly developed in New-Brunswick.

From the greater hardness, and almost flinty state, of the slates, sandstones and conglomerates of Port Simonds; the presence in them of large and numerous veins of quartz, associated with chlorite and talc; and, so far as they have been examined, from the absence of organic remains, they appear to be more ancient than rocks of a similar kind, which appear farther north; and although the whole of these rocks belong to the greywacke group, (as it has been distinguished,) yet it is evident, that the upper series, which rests unconformably upon the lower, is a more recent formation, and one that bears a close resemblance to the silurian rocks of Europe.

The Mispeck River passes through a deep, narrow and tortuous channel, and over several falls; emptying the water

of Loch Lomond and its tributaries, into the sea, at Port Simonds. At its mouth there is a very convenient harbour; with a valuable assemblage of mills, owned by George Ball, Esquire, to whom we must express our obligation, for aid in exploring this part of the coast. Northward of the mills, there is a high ridge of hard argillite, sandstone and conglomerate, filled with enormous veins of quartz. It is six miles in length, and, upon an average, three miles in breadth. This ridge is almost entirely barren. The rocks are too hard to be acted upon by common meteoric operations, and therefore a soil has not been formed; except in depressed situations, where peat, cranberries and whortleberries are produced abundantly. Along this range of high and almost barren land, there are numerous small lakes, several of which have no outlets.

The tertiary deposits already noticed, appear on the south side of the entrance of the harbour, at Thomas' Cove, and other places farther eastward. They here consist of beds of clay, succeeded by thick deposits of marl; in the manner they appear at Anthony's Cove and near Red Head. It is difficult to determine the thickness of this deposit of clay. The marl will average twelve feet in thickness; and consists of two varieties, the dark brown, and the light blue. Above these, are deposited beds of diluvial sand and gravel, from ten to fifteen feet in thickness. The marl is exposed on the shore, and along the sides of the ravine; where it may be readily procured for Manure.

The thickness of the marl stratum could not be accurately ascertained, at each of its sites: it is, nevertheless, abundant. Its general aspect, when wet, is like that of common clay, of a light blue, black or grey colour. The lighter, or buff-coloured kinds, contain more clay, and consequently are not so active as the darker varieties; which exhale a sulphurous odour, like the stagnant pools in salt marshes.

As most of the soil in this part of the country is gravelly or sandy, the marl is peculiarly applicable for manure. Fifty loads to the acre would change the character of the land altogether, and render it permanently fertile. Even a dressing of twenty loads to the acre, would greatly improve the crop.

ANALYSIS OF THE BLUE MARL FROM THOMAS' CREEK.

Alumina,	26.20
Silica,	31.50
Lime,	14.20
Potash,	10.20
Protoxide of Iron,	12.40
Water,	4.10
Loss,	1.40
	100.00

From what has been already stated, the inhabitants will not find it difficult to discover marl at other places than those mentioned; and it is to be hoped, that they will immediately avail themselves of the advantages to be gained, from having extensive collections of manure situated on their farms. Composts of marl, sea-weed, and the fine peat abundant along the whole coast, with barn manure, when it can be conveniently obtained, will afford the best means of renovating the soil. The composts may be most conveniently formed, by alternate layers, each six inches in thickness, of each material, piled to a height of four or five feet.

Each variety of the marl effervesces in strong acid; a test by which it may be immediately recognised. These deposits of mineral manure are extremely valuable; as even the most barren soils in this district might be rendered fertile by their application; and they would afford a profit, if shipped to other places along the coasts, to be used in the manner already noticed.

The older slates, conglomerates and sandstones, of the lower greywacke group of rocks, extend along the shore, from Cape Mispeck to Black River and Emerson's Creek; and their inclination, so far as it could be discovered, appears to be to the south-east. But, to the distance of fifteen miles along the shore, and ten miles in a north-easterly direction, their strata are so much distorted, broken and intermixed with varieties of trap rock, that the discovery of their true dip is rendered almost impracticable. At a few places only, the character of those rocks appears to remain unaltered; for, in general, they have apparently undergone a change in their position, as well as in their chemical and mechanical features, by operations justly to be attributed to the application of heat, directed from beneath. In consequence of the admixture of the schistose with the trappean masses, even a detailed description of them would be imperfect. The strata known to be of sedimentary origin, are associated with others, in equally well defined beds, which are different in mineral composition; being frequently a mixture of volcanic matter, with, evidently, the mud, sand and pebbles, from which the greater part of this series of rocks has been derived. There are here, and on other parts of this coast, numerous strata, which closely resemble pumice rendered compact by time and pressure; and collections of a kind of "trap tuff," containing flakes of scoriaceous matter, like cinders. All these, and several other beds, remarkably mixed, are broken through by the trap rock; which has penetrated the strata

at right angles, and also insinuated itself between the layers of stratified rock. The trap rock, composed of crystals of hornblende and feldspar, and sometimes of quartz and chlorite, is coarse grained; and frequently changes into a fine grained, green chlorite, and ash-coloured talcose slate. Expanded layers of this rock are frequently found, in immediate contact with large ejected masses of the pure white quartz.

It is impossible to account for the formation of these rocks, unless it be presumed, that at the period when the well defined beds of the greywacke system were forming, there were, in their vicinity, active volcanoes; from which were ejected the trap, and also the ashes, cinders and scoriaceous matter now seen mingled in the strata, formed during their operation. It was observed, that wherever these compact and almost vitrified slates occupied the surface, there is but little soil, and sterility prevails; but the trappean, the ash-coloured, the chloritic and talcose slates, and the trap itself, by being more capable of disintegration, is covered with a fine growth of spruce and cedar, occasionally varied with beech and maple.

The above rocks present, on the shore, steep and inaccessible cliffs, from fifty to one hundred and fifty feet high. At the bases of many of these cliffs, there are fifteen, and sometimes twenty fathoms of water. Frequently, broad, shelving masses overhang the waves, constantly beating beneath them. Whenever the shore is precipitous, detached rocks, constantly falling, from the undermining effects of the sea, render the passage of the traveller extremely dangerous. Loose blocks of stone are also frequently falling into fissures, opened in the softer kinds of slate, by the descent of the water from the brooks above.

BLACK RIVER.

At Cape Spencer, about three miles west of Black River, and at the farm of Mr. John Dowd, the trap contains numerous veins of the specular oxide of iron, which is sometimes beautifully crystallised in the veins of white quartz, and mingled with carbonate of lime. The carbonate of lime also appears crystallised in hexagonal prisms, lining the fissures and small open spaces in the rocks. With these minerals, there occurs a bright green chlorite, with talc, and occasionally a fine white asbestus. At a high, sloping cliff, on the east side of West Beach, and associated with the above minerals

in the trap rock, we discovered *magnesite*; a peculiar mineral, containing *magnesia*. It occupies a considerable vein in the cliff, and is united to that variety of specular iron ore, called *micaceous*, and also to talc and chlorite. When taken from situations where it has not been exposed to the air, it resembles white quartz; but, by being exposed to the weather, the mineral absorbs carbonic acid gas from the atmosphere, becomes decomposed, and falls down in a white powder, like the carbonate of magnesia of the shops. This powder is the hydro-carbonate of magnesia.

From the constant decomposing influence of the atmosphere, acting upon the magnesian minerals, by imparting to them carbonic acid, the whole cliff is crumbling down; and these minerals are constantly falling to the beach, where they are washed away by the sea. Magnesite is used in the manufacture of porcelain, and may also be employed in the manufacture of sulphate of magnesia (Epsom Salt).

We ascended the cliff with some difficulty, and found the specular iron ore more abundant; it runs in veins, in all directions, through the rock, accompanied by the magnesian compounds. Half a mile farther eastward, there is a vein or dike of very pure white quartz, upwards of forty feet in thickness. It resembles drifted snow, and may be seen at some distance from the shore. The talc and chlorite were also observed here; and the quartz contains large and transparent crystals of that mineral. Still farther east and near the farms of Messrs. Evans, the rocks were observed from the water to have a peculiar brilliancy. Upon landing, they were found to be coated with a thin plate of the specular iron, which reflects the light like a common mirror. A number of these plates were removed, and they are highly splendent specimens. The talc and chlorite are also common in this district, and beautiful crystals of limpid quartz were collected in the fields adjacent.

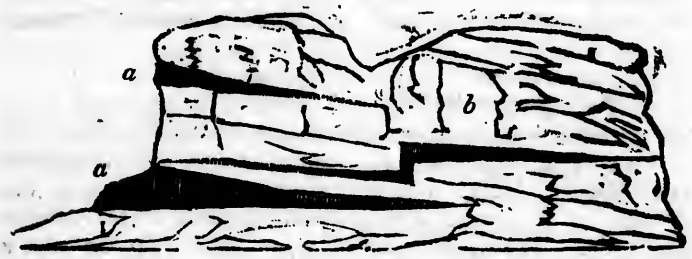
Black River resembles the Mispeck stream; being derived from lakes in the interior, and poured into the Bay of Fundy through a deep, narrow and tortuous channel, opened in the trap and slates already described. There are here an excellent saw mill and a superior flour mill, with iron machinery, constructed by Mr. George Moffat, and owned by R. D. Wilmot, Esquire.

The iron ore had been found here, by removing the rocks near the mills; where, it is probable, an extensive vein is concealed beneath the enormous blocks of stone, piled along the side of the river. Quartz and chlorite are also seen

in considerable veins. The ore was again observed on the road leading to Emerson's Creek, and between the Creek and Loch Lomond. Although it is very probable, that there is a sufficient quantity of the specular iron ore in this quarter, we were not successful in discovering any valuable vein; and the uncleared state of this part of the country, is unfavourable to geological examinations.

At the entrance of Black River, the chlorite and other slates contain broad masses of trap between the strata, as represented by the following cut.

Fig. 2.



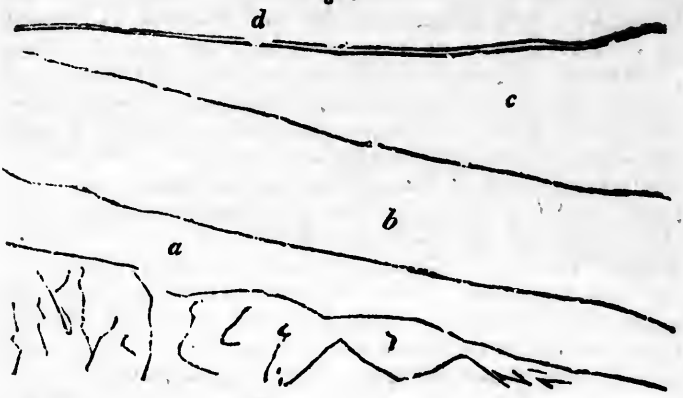
a. a. Trap. *b.* Chlorite Slate.

EMERSON'S CREEK.

At Emerson's Creek, the before-mentioned rocks are met by the new red sandstone, which rests upon them unconformably, and extends along the shore eastward, to the distance of two miles. On the west side of the creek, a bed of sand and gravel, forty feet thick, reposes directly upon the marl and marly clay; but the latter emerge from beneath the detrital deposit, about a furlong farther westward. The marl was also observed on the east side of the creek, and near the bridge. It may be obtained in great quantities, and applied to the uplands, at a moderate expense.

The following section will shew how it occurs, westward of the entrance of the creek, and will also depict the elevation of the shore.

Fig. 3.



a. Stratum of Clay.
b. Marl containing shells.
c. Beds of Sand and Gravel.
d. Soil.

The beds above the slate dip eastward, at an angle of 15°. The discovery of this marl will prove very advantageous to the large settlements in this quarter. It is admirably adapted to sandy and porous soils. The strongest kinds can be readily discovered, by dropping a little of the marl into diluted nitric or sulphuric acid. That which produces the greatest degree of effervescence, contains the most lime and potash, and is consequently more powerful as a manure. In general, the best marl contains the greatest quantity of fossil shells. The inhabitants may be assured that their crops will be greatly increased, by the application of this kind of manure to the soil.

About a mile northward of Mr. Richard Daley's farm, there is an extensive ridge of limestone, belonging to the group of older slates, before mentioned. This limestone is of a light brown colour, and well adapted to agriculture. Being covered with a heavy growth of timber and underbrush, it could not be followed far on the surface: it is, however, abundant; and probably extends in an east and west direction several miles.

TEN-MILE CREEK.

The older schistose rocks, with numerous dikes of trap, occupy a considerable tract between Loch Lomond Lakes

and the shores of the Bay of Fundy. There are roads, through a negro settlement of fifty families, and "Hibernia," an Irish settlement, of twenty-five families.

Near the mills of James Brown, Esquire, the above rocks are met by the new red sandstone of Quaco; which extends in a narrow belt to the westward, as far as Emerson's Creek. Between this belt and the shore, the sandstones and shales of coal measures rise to the surface, and may be viewed on the banks of the stream, near Mr. John Brown's farm. They also appear on the east side of the creek, and extend to Rogers' Point, near Quaco; being occasionally covered with new red sandstone. Westward of Gardner's Creek, they again appear on the shore, and are met by the new red sandstone, which rests unconformably upon them. The junction of these two classes of rocks is shewn in the section below.

Fig. 4.

a. Sandstone and Shale of Coal Measures. *b. b.* New Red Sandstone.

The strata of shale and sandstone, westward of Ten Mile Creek, dip south-west at an angle of 30°, and contain small seams of coal. None of the coal strata discovered will exceed eight inches in thickness; but there may exist much wider strata, beneath the surface, notwithstanding this coal basin is very limited. These rocks also contain the remains of numerous plants, belonging to the coal period. Calamites are very common; and fossil trees, twelve inches in diameter, appear in the cliffs on the shore; but no remains of the cactus were discovered during our examinations in this quarter; which seems remarkable, as they are numerous along the coast of Chignecto Bay. The bark of these fossil trees has been changed into coal; and their distinctive characters

have been so entirely removed, that the species to which they belong cannot be determined with any degree of accuracy.

The destruction of the new red sandstone, near Gardner's Creek, by the violence of the sea, is very remarkable; but as this part of the subject has been briefly referred to in a former report, we may conclude it, with the following view of a worn cliff, which had not been visited when that report was written.

Fig. 5.

PORPHYRY.

Between Emerson's Creek and the farm of the Messrs. Cody, there is an extensive ridge of Porphyry, connected with a hill of trap rock, that has been forced through the greywacke, now seen along its flanks. The base of this porphyry is compact blue feldspar, through which crystals of white feldspar are disseminated. Sometimes, these crystals are so fixed, as to represent something like Chinese characters; and one variety closely resembles graphic granite. It is an excellent and most durable rock for building; and, after it is properly cut and polished, is extremely beautiful, and by no means inferior to the porphyry of the ancients. This rock crosses the road near a branch of the Mispeck, where vast supplies may be cheaply procured.

OBSERVATIONS

ON THE

SLATES AND GREYWACKE OF THE COAST.

Taking a general view of the greywacke and slate rocks, as they extend from the Scoodic on the American boundary, in a north-easterly direction, along the coast of the Bay of Fundy, to the County of Westmoreland, they appear to be situated along the side of a vast basin, or trough, which is occupied by the waters of the Bay; and, perhaps, it would not be speculating too far, to assume, that the opposite side of this basin or trough appears in Nova-Scotia, where the schistose rocks are seen sloping from a granite ridge, and dipping towards the centre of this basin.

The great eruptions of trap and other volcanic rocks, which have been forced through portions of these formations, have not altered their general direction and inclination so far, that their bounds and former conditions cannot be understood. This great class of strata, to which the term greywacke has been generally applied, admits of a division; as one part of the class is very different from the other, in position, composition and organic remains; and as each division corresponds, in its principal characters, with the cambrian and silurian systems of Professor Sedgewick and Mr. Murchison, as they exist in Europe, these terms have been adopted, as equally applicable to an extensive class of rocks in New-Brunswick.

In an economical point of view, the value of these rocks is considerable. At many places they will supply excellent materials for buildings, paving of streets, and for ornamental purposes. At Campo-Bello they contain lead; and at Diggeguash, copper; and iron is abundant in them. The latter metal, in different combinations with sulphur and oxygen, is capable of yielding a number of the metallic salts, employed as articles of commerce and in manufactories. The limestone is important for manure, and will afford excellent marble; and it is satisfactory to know, that since the Geological Survey of the Province was commenced, attention has been directed to several of these natural productions, while the soil is also improving under the application of substances, which had before remained unnoticed.

ELEVATED COAST, RAISED BEACHES, AND ESTUARIES.

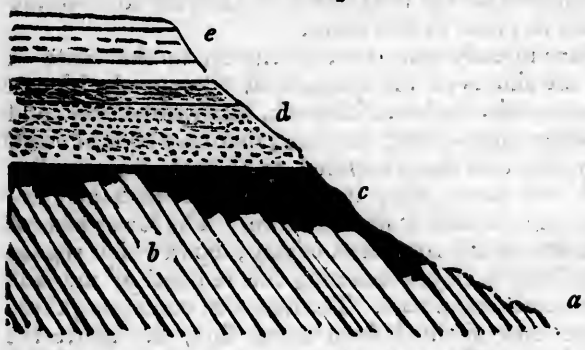
Having now completed the examination of the formations, bordering upon the Bay of Fundy; and, so far as was practicable, having endeavoured to discover the valuable minerals contained in them, and to point out the uses to which they may be applied, we have also incidentally shewn some of the evidences of an uplifting of the coast; and now, in concluding this part of the subject, will adduce some of the leading facts in proof of that event.

We have already seen, that at Lubec, in the State of Maine, on the shores of the Scoodic, at Chamcook, Mace's Bay, Manawagonis, St. John, Mispeck, Emerson's Creek, and numerous other places along the coast, there are beds of sand, clay, marly clay and marl, exposed to the sea, forming low and almost level tracts, along its border, and frequently extending to some distance from the shore. The lower beds of this deposit are chiefly composed of clay; upon which repose the marl and marly clay, containing the remains of myriads of marine animals and plants. The deposits, containing these remains, are now situated from ten to forty feet above the level of the highest tides; which rise, along this part of the coast, on an average, about thirty feet at spring tides.

The shells of marine animals are chiefly contained in the marl and marly clay; which also abounds in the relics of marine plants, similar, (so far as they can be examined in their decomposed state,) to those still growing on the shore. In these deposits, upwards of thirty specimens of shells have been discovered; including the *testacea* and *crustacea*. Twenty-four of these species inhabit the present ocean; the remaining six are supposed to be extinct. Future examinations may disclose species, at present unknown; and this statement, therefore, is intended to apply only to present discoveries. Many of these shells, such as those of the *mya mercenaria*, *pecten*, *arca*, *mactra*, &c. are well preserved; while the *solen ensis*, and two species of *mytili*, are scarcely capable of being removed. The claws of *crabs* remain very perfect; and the bones of fish, although changed, are not destroyed. The valves of many of the shells remain in contact, and bear no marks of having been transported; but evidently lived and perished, in the situation where they are now found. They not only appear on the shore, but sometimes also at a distance of two and even three miles from it; and are thrown up, in sinking wells. The surface above these

deposits is generally very level, and often meets the higher grounds, as the water meets the shore. Above these several beds and the organic remains contained in them, there are deposits of sand and gravel, from one to fifty feet in thickness; which, at some situations, are like the common detritus of the surface; but at others, they consist of the water-worn pebbles of ancient beaches. The section below will explain the situation of these several deposits, as they are seen on the coast.

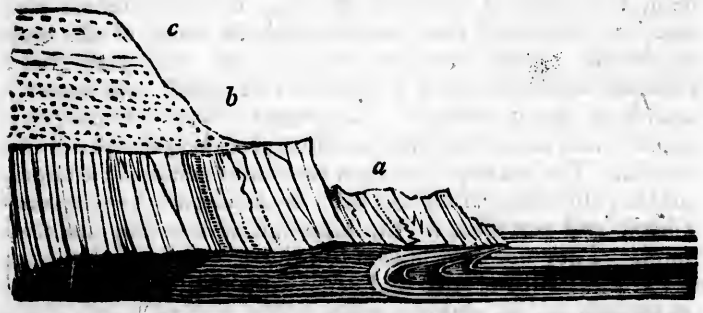
Fig. 6.



a. High water mark. *b.* Strata of Slaty Rocks. *c.* Clay.
d. Marl containing Shells. *e.* Beds of Sand and Gravel.

Again, there are a number of instances in which the ancient sea-beach has been raised above the highest tides of the present sea; and the water-worn pebbles of the former shore are elevated from ten to thirty feet above their ancient level, in situations where the marl and clay of the tertiary beds are absent. The following section, taken near Cape Mispeck, exhibits one of these raised beaches.

Fig. 7.



a. Greywacke rocks. *b.* Pieces of Greywacke. *c.* Sand and fragments of Shells.

From these facts it is evident, that, while the shells and marine plants were in a living state, the sea occupied a higher relative level than it does at present; or, what is an equivalent, the land was much lower than it now is, and has been raised, at an average, a height of twenty feet along the shore.

Thus it is obvious, that a whole line of coast on the north side of the Bay of Fundy has been, within a period comparatively recent, raised from the sea.

To account for the beds of sand and pebbles, situated above the shells contained in the marly strata, it might seem necessary to suppose, that previous to the final elevation of the coast, submergence had taken place; and, during that submergence, those arenaceous beds were spread over the fossiliferous deposits. Of such an event, there is, indeed, palpable evidence in Grand Manan; where the whole side of an Island, twenty-five miles long, has been thus depressed.* But those beds of sand and pebbles might have been laid above the calcareous and argillaceous deposits, by changes afterwards going forward upon the surface, and by the rushing of floods into estuaries of the sea.

If we examine the Rivers emptying into the Bay of Fundy, along this line of coast, they will be found broken by falls near their mouths; but the streams that do not pass through this raised district, empty themselves into the sea quietly, in an ordinary manner. The Scoodic, the Magaguadavic, the Saint John, Little River, Mispeck, Black River and others, exhibit falls; while the Petitcodiac, Memramcook, Tantamar and Aulac are without them; and there is evidence to shew, that this breaking of the River beds was coeval with the elevation of the coast.

The River Saint John takes its rise about four hundred and fifty miles in the interior of the country; and, with its tributaries, conveys the water from a large part of the Province to the sea. Between Saint John and Fredericton, which are eighty-five miles apart, the river now passes through a belt of alluvium, which is irregularly distributed on both sides of the stream; a part being raised high enough to afford meadow, and to admit of cultivation. This alluvium is of recent formation, and contains the remains of recent animals and plants. The shells are all fresh water species. This alluvium increases yearly, and is overflown by the floods of spring and autumn.

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*See First Report on the Geology of New-Brunswick—page 10.

At a number of situations, along the valley occupied by the stream, and especially in the neighbourhood of Fredericton, there are beds of sand, clay and gravel, which rise above the level of the highest floods, and which were evidently produced by operations now discontinued. The materials, entering into the composition of these beds, are not like those forming the common diluvial detritus of the country. The beds are very regular, and most frequently present flat surfaces above the level of the water.

The beds of Marl, &c. in limited and detached portions, and containing Marine shells, were found on the side of the canal, cut by the "Saint John Mills and Canal Company," above the Falls; also, at the mouth of the River, on the shores of Grand Bay, the Kennebeckasis, Belleisle, and on the side of the main stream, near the Reach; they are identical with those collected from the marl beds, on the shores of the Bay of Fundy.

With a knowledge of these facts, it is impossible to withhold the opinion, that there was a time when the sea flowed in freely above the present Falls, and occupied an extensive portion of the great valley of the Saint John. At the present period the tide rises only about twenty inches, above those Falls; and the quantity of fresh water is too great, to allow any marine, moluscous or crustaceous animals to take up their abode there. The beds of sand, gravel and clay, on the shores of the ancient sea and its estuaries, still continue, with the remains of shell fish and sea weeds that flourished upon them. Without incurring the charge of rash speculation, we may look back to a period, when the sea flowed smoothly into the lower part of the Saint John, through openings since obliterated. At present, the tide never enters the river until near high water; and the quantity of sea water admitted at the narrow outlet of the falls, scarcely renders the water brackish three miles above. When the coast was uplifted, the water of the river, in endeavouring to escape, forced the barrier between it and the sea at its weakest point, and the former channel of the river and its estuary were drained down to their present level; and thus, the change of level produced the falls, at the entrance of the stream, as they now exist. The same remark may be applicable to other rivers of the district, where the water is compelled to pass over the elevated edges of strata, that were once buried beneath the sea. But the Saint John is the most remarkable instance. Here, the united waters of a large river, four hundred miles in length, and averaging half a mile in width to

the distance of a hundred miles, is forced through an opening but little more than a hundred yards wide, and over an irregular fall, more than twenty feet high at low water.

The *submarine forest* of Grand Manan, and the raised beaches along the coast, shew that great changes have taken place in the level of the country, since the land, its vegetation, and the shelly inhabitants of the sea, were nearly such as we now find them, upon adjoining lands and in adjacent waters. But the periods of these revolutions in the earth have been too far distant from each other, to come within the reach of human history or tradition.

The effect produced upon the physical condition of the country, by this uplifting of the land, is truly remarkable. By this great and evidently sudden elevation of the earth, vast tracts of low and sunken soil have been drained, and rendered capable of cultivation; and the stagnant lakes and pools of the interior, which generated fœtid and unwholesome gases, have been converted into lively streams, which purify and refresh the air. The great system of drainage of the country has become accelerated in its motions; and the springs, whose waters are now filtered through the rocks, are free from noxious matter, created by stagnation.

The sea also, by having retired from large tracts, has left a rich and fertile soil behind; and the beds of shells and sea-weeds, its own gifts, have been safely deposited for manure, to renovate the former sterile lands. The scenery of the country has been changed and rendered beautiful; the once sullen river now rolls in a foaming torrent into the ocean, and fine alluvial meadows have risen from the waters, to smile beneath the waving wheat and fragrant clover.

The phenomena of raised beaches do not appear to be confined to any part of the world. They have been observed on the coast of Great Britain, by Maclaren, Laskey, Gilbertson, Sir Philip Egerton and others. The raised beaches of Ireland have been described by Messrs. Murchison and Sedgewick; and those of other parts of Europe, by Mr. Lyell and other geologists.

TERTIARY FORMATIONS.

It would be impossible, in the present state of our knowledge, to give an accurate description of the tertiary deposits of the Province: such a description should only be attempted, after all other formations have been examined and com-

pared one with another. Hitherto the superficial strata of sand, clay, and marl, both in Nova-Scotia and New-Brunswick, have been classed with diluvial accumulations; but from recent discoveries in both Provinces of separate and distinct beds, which have not been removed by diluvial currents, and are situated beneath the common debris of the surface, I have fully ascertained that this peculiar group of strata exists at many situations in great perfection.

Since the publication of my work on the Geology and Mineralogy of Nova-Scotia, I have discovered chalk abounding in fossil shells in that Province; and the occurrence of the tertiary strata in New-Brunswick, establishes two new groups in this quarter of the world. The beds of sand, clay, marl and marly clay, already mentioned, I have assigned to that division of the tertiary strata, called by Mr. Lyell *newer pliocene*, (more recent.) I have not adopted those terms from the agreement of the mineral character of the strata of this Province with those of Europe; but from the predominance of recent shells, which is evidently a far better guide in making the classification than any other. Until the whole of New-Brunswick has been explored, it would be improper to compare those strata with European deposits; for, until the whole group could be brought into comparison, errors would evidently arise.

From what has been already stated, under "*Raised Beaches*," it will be seen that these beds which have been elevated from the sea, since many recent species of moluscous and crustaceous animals had become its inhabitants, belong to the tertiary group; but they were mentioned under that head for the purpose of proving, that a whole line of coast has been uplifted: hereafter, they will be considered as forming a part of the class of strata now referred to.

ANIMAL REMAINS.

Besides the remains of many species of shell-fish just noticed, the relics of *vertebrated animals* have been found. The jaw of a shark was discovered in the indurated clay of the Belleisle, with fragments of shells. Both the jaw, and some of the teeth are very perfect, and but little mineralized. I had also received from a friend, a few pieces of an enormous bone, which had been sawed and greatly injured. From the great thickness and solidity of some of these pieces, they were supposed to belong to an animal of the mammalia class;

but they are too small in size, and the original bone has been too much injured, to admit of having their true nature understood. Afterwards, a portion of a jaw was discovered, having distinct impressions of the remains of sockets of four teeth. The canal and cavities were filled with blue tertiary clay, containing several fossil shells. This bone, although much decayed, is but partially mineralized, and the softer parts have been eaten by *teredos*. Whether it belonged to the same animal that possessed the lesser fragments, is by no means certain. The locality where these relics were found, has been discovered; but the waters of the rivers and lakes were too high at the time of my exploration along the Saint John and its lower branches, to make a successful search for these interesting relics. They will claim my earliest attention as soon as a convenient opportunity offers. From all these circumstances, and a comparison of the part of a jaw with other animal remains, I have been led to think that it might probably have belonged to some saurian reptile, notwithstanding the difficulties of deciding correctly in a case like the present.

Since the above was in the press, I have received Professor Hitchcock's able report on the Geology of Massachusetts; and find, that not only has the existence of tertiary deposits been fully established in that State, but also the remains of *vertebrated animals*, and *saurians*, have been found in them; which throw a great light upon similar relics discovered in this Province. The chief part of these fossils was found by the learned Professor in the tertiary strata of "Gay's Head." In treating of *vertebrated animals*, he says, "the bones and teeth of these animals are more numerous at Gay's Head, than any other organic relics. They are found in the greatest abundance in the osserus conglomerate, already described; but they also occur in the green sand, and in a yellowish sand, associated with the green sand. For the most part the bones are not mineralized, but frequently they are black when broken; and sometimes they are thoroughly impregnated with iron ore. In general, they are much broken, and often rolled. In one instance, however, I noticed a succession of large vertebræ; one or two occasionally being absent, for a distance of ten or twelve feet. Some of these are nine inches thick, and as much in length. All the varieties of teeth that accompany these bones, which I could find, after a protracted search, are exhibited on plate XI. The flat teeth are evidently those of a shark: probably, also, the triangular teeth belong to the shark; and these are

more numerous than the others, and rather more broken, though all of them are often very much injured. We ascertain, then, with considerable confidence, the remains of the crocodile, and two or three species of shark, in this cliff. None of the vertebræ, or other bones which I have described, however, seem to be those of the shark. They bear a much nearer resemblance to those of huge saurian reptiles, which I have examined in the geological collections of New-Haven and Philadelphia: one of the vertebræ, in particular, appears very much like those of the plesiosaurus. At present, I am inclined to believe that the bones at Gay's Head belonged to the lizard tribe, though I dare not speak on this point with confidence."

It is stated by Provost, that the remains of reptiles (crocodiles,) are characteristic of the tertiary plastic clay, near Paris;* and they are known to exist in the tertiary strata of England, as described by Mr. Mantel, and several other geologists.

HAMMOND RIVER.

Before this part of the subject is closed, it is necessary to remark, that upon a re-examination of the country, in search of lead ore, reported to have been found in this quarter, the limestone of the greywacke system was observed to extend eastward, as far as Mr. Richard Sherwood's farm, near Titus' Mills, on the Hammond River. It here contains graphite or plumbago, which is superior in quality to any other found in the Province. The true deposit of this mineral has not yet been discovered; but a number of large and beautiful masses have been found in the soil, near the calcareous rock. This plumbago, in its natural state, is equal, if not superior in value, to any brought from Europe, in the best lead pencils; and the discovery of the vein, evidently existing in the rock, would be very interesting and important. The limestone is of a pure white colour, and very crystalline, and therefore constitutes good marble.

WESTMORELAND COAL FIELD.

Having completed the exploration of that part of the district, intended to receive the labour of last year, but which

* Ossemen's Fossiles, Tome 2d, p. 342.

was found too extensive to be examined before the winter appeared, it was deemed advisable to return to the exploration of the Westmoreland coal field; the outlines of which had been discovered last season. Indeed, it could not be supposed, that a single individual, accompanied by persons unacquainted with the subject, could accomplish, in a single season, a perfect geological *reconnoissance* of a tract of country, one hundred and fifty miles long, and, upon an average, forty miles in breadth.

The principal object to be gained, by making a more minute survey of a part of Westmoreland, was, that of affording information to persons, who are desirous of opening its mines. This object has in some degree been gained; but, before much capital is expended in opening these mines, the most careful, patient and scientific examination should be made, by the persons who are willing to work them. The Province has now performed her part, by directing her inhabitants to new and most important objects of enterprize and wealth; which only require the application of capital, skill and industry, to render them of permanent utility to the country.

It is of the utmost importance, in deciding upon the site wherein to open a coal mine, to determine with accuracy where the greatest number of favourable circumstances exist. In the first place, it is necessary that there should be one or more coal strata, of sufficient extent to ensure a full supply; and each stratum must be sufficiently thick to compensate the expense of sinking shafts, striking levels, &c. The kind and quality of the coal must be duly considered, and the demand justly estimated. In almost every country, however, the consumption of coal must not only be continual, but must constantly increase; especially in America, where its discovery is as yet by no means adequate to the demand; and this important mineral is not found to exist in any valuable quantities, along the coasts of the *United States*. Many years, however, must yet elapse, before the different ports in the Union can be supplied from these Provinces, in which coal is inexhaustible. The draining of mines adds much to the expense of working them; and therefore, protection from the influx of water into the adits, should be carefully studied. It is but seldom that an outcropping of any magnitude appears at the surface; and it is necessary, on account of the loose matter spread over the rocks and superficial beds, to bore downwards to considerable depths, in order to ascertain where the richest deposits are situated.

But it is not the object of a Geological Survey, to extend its operations to the absolute working of any mine. That object is simply the discovery of the earth's mineral wealth; while those who will avail themselves of these discoveries, will be protected by the patronage of the Government and the Legislature; who, having pointed out the objects to which capital and industry can be profitably devoted, invite the enterprising to improve them, to their own advantage and the increase of the revenue. Notwithstanding there are many instances, in which Governments have worked such mines at their own expense, and have received the profits arising therefrom; it is not probable, that any part of the revenue of New-Brunswick will ever be devoted to such purposes.

To resume, however, our subject:—The facilities for transporting the productions of mines, are of much consequence. Hence, they should be opened (other circumstances coinciding,) as near to some navigable bay or river as possible; and the best sites for canals, locks, railroads, &c. should be taken into consideration; but the most important of all these conditions is, the absolute quantity of good coal; which, if it be merchantable, and existing in thick beds, is capable of overcoming almost every obstacle, and of raising and transporting itself, by the aid of steam.

Besides the profits arising from the coal mines of Pictou, in Nova-Scotia, vast sums have been expended in laying down railroads, and facilitating the transit of coal to the harbour. All this expense has been incurred, under a knowledge of the most certain return of vast profits, to be derived from them. Similar outlays in England and other parts of Europe have been compensated by great profit.

It was with a view to hasten the practical working of the coal of Westmoreland, that a part of the past season was devoted to that quarter; and it is not to be doubted, that the Province will soon reap advantages from these operations, independently of the benefit arising from other useful discoveries, far more than will be equivalent to the expense that has been devoted to this important inquiry.

Having given, in my last report, an account of the situation, extent and quality of the coal, as it appears at Taylor's and Cornier's farms, at Stephen's, near the sources of Turtle Creek, and also at the Dutch village and Scheick farm, &c. in Sussex; the banks of the Petitcodiac were again examined, in order to discover how near the outcropping might be found to the navigable part of the stream.

The rocks, from the Bend of Petitcodiac to the Belleveaux village, are chiefly new red sandstone; and there are but few situations, even in the deepest parts of the ravines, where the strata belonging to the coal series are uncovered; the surface being occupied by the former rock, or the detritus derived from it. At the Cape Belleveaux village, strata of coarse conglomerate, sandstone and shale are intersected by the river; and form a low cliff along its side, to the distance of a mile. The strata here run north-east and south-west, and they are very highly inclined. Not far from this cape, the coal appears under circumstances, similar to those described in a former report, as they appear at Taylor's farm, on the opposite side of the peninsula, between this river and the Memramcook. It is associated with a highly bituminous shale, which burns freely, leaving a great quantity of ashes. Some of the shales at the Cape contain sulphuret of iron, in crystals, and have been the theatre of operations for the "*mineral rod*," whose superstitious votaries have supposed, that the bright iron pyrites contained gold and silver.

The river, at this place, is two miles wide, at high water. Monsieur BELLEVEAUX was the first inhabitant of the fine French village here situated: he is now ninety-six years old, and was one of those Acadians who were driven from Nova-Scotia, during its early troubles. His name is given to the settlement, where a numerous progeny has sprung up around him.

On the west side of the river, thick beds of new red sandstone and conglomerate, with gypsum and limestone, overlie the coal measures; as may be seen at the farm of John Edgett, Esquire. From the peculiarly broken and uneven appearance of the country, wherever they are situated, they may be readily distinguished from other formations, in the unsettled forest, farther west.

Some information had been received, of indications of coal at Frederick's Brook, a branch of Weldon's Creek, emptying into the Petitcodiac, between its mouth and the Bend. Assisted by Mr. Edgett and two other persons, acquainted with the woods, I proceeded to examine the brook and the ravine through which it passes; and having chosen a season of the year, when the streams were low, which enabled us to wade along the bed of the brook, we collected all the information the means employed could afford.

The first indications of coal were observed near a meadow, formed by an ancient beaver-dam, about three miles from the River, and the same distance from its confluence with

the Memramcook. The sides of the ravine and bottom of the brook, are composed of sandstone, shale, bituminous shale and coal; frequently concealed beneath detritus and the rubbish of the forest. The strata are intersected by the stream; and run nearly east and west, with a general dip to the south. The coal was found most abundant above the Beaver-dam, and exists in several separate strata, the largest of which is about nine feet in thickness; but the great quantity of loose rocks, coal and shale, in the bottom of the brook, rendered it impossible to ascertain the thickness of the coal strata, with desirable accuracy, without incurring an expense not authorised. The quality of the coal is superior to that of the Memramcook or Stephens' farm, mentioned in my last Report: a quantity of it was collected and fired in the bed of the stream; it ignited readily, and burned with great splendour.

Almost all the shale, to the distance of a mile along this stream, is highly charged with bitumen; and, from a fire kindled farther up the brook, it became ignited, and continued to burn for several days, until it was extinguished by a heavy rain. The advantages offered at this place for mining, are superior to those of Taylor's and Cornier's farms, on the Memramcook, of Stephens' farm, at the head of Turtle Creek, and other places farther westward; where the distance from navigation is an obstacle, not to be overcome without great expense. A level route for a Railway may be followed to the River, which is navigable for large ships; and the distance, to transport the coal by Railway, would not exceed three miles. Advantage may be taken of the brook, in searching for the thicker beds of coal. In the month of July, the water may be confined by a dam above, and the sand, boulders, &c. removed at a moderate expense. The strata, to the distance of a mile and a half, may be laid bare; and the site where they contain the richer deposits of the bituminous mineral, could be ascertained without difficulty, and with the fullest confidence of success in working them.

NEW RED SANDSTONE.

Having completed the examination of all the country, bordering upon the Bay of Fundy, my next object was to extend the survey in a northerly and westerly direction, until the whole Province should be explored. The first district entered upon, is composed of a group of rocks, known in

Europe under the denomination of *New Red Sandstone*; which, from its general character of agreement with the European formations, thus designated, may be considered equivalent to them; and as having been produced at a similar epoch, and by the same means. This district forms a part of the extensive sandstone tract, explored last season; and which has been laid down on the Geological Map of the Province, as accurately as circumstances would admit. The area of this rock, examined during the summer of 1840, extends from the Head of Belleisle Bay, on the St. John, in a north-easterly direction, along the division line between King's and Queen's Counties, to the Cocaigne and Shediac Harbours, on the Gulf of the Saint Lawrence; and, in a southerly direction, to the Kennebeckasis and Petitcodiac Rivers, meeting the tract described in the previous Report. The examination of this district has completed the survey of the whole new red sandstone country, in this division of the Province; which will, however, be again noticed, after the local details have been given.

Several sections were made across a chain of moderately elevated lands, situated between the Petitcodiac and the head of the Washademoak and Cocaigne Rivers. About three and a half miles northward of Mr. Pitfield's Inn, on the former stream, and on the road leading to Butternut Ridge, several salt springs issue from the earth, and flow into the North River, a branch of that stream. The water yields twelve *per cent.* of *chloride of sodium*, (common salt,) and contains a small quantity of iodine. These springs were formerly the resort of herds of Moose, Carriboo and other wild animals, which resorted to them to procure salt. From this circumstance, similar springs are called by the American hunters "*salt licks.*"

In this quarter, there are vast quantities of black, decomposed peat, and other decayed vegetable matter, spread along the sides of the hills, and covering some of the low grounds. It appeared extraordinary, that these substances should be so abundant at a place, where there are few sphagneous or peat plants, and where the surface is covered with a fine growth of timber: but, upon examination, I found, that formerly there had been an extensive peat bog at this place, which, by the bursting of a natural dam, had been drained; and the ancient peat, at several places, has thus become changed into a substance, resembling coal, and shews how vegetable matter is capable of being converted into the bituminous mineral, found in vast deposits in the earth. The upper

portion of this ancient bog has been used for manure, by a farmer living near it. It produces an excellent crop, but is not durable. Its fertilising properties would be greatly increased, by forming it into composts with lime, which may be obtained a short distance farther northward.

Four miles north of the above springs, is the flourishing settlement called "*Butternut Ridge.*" This Ridge is a somewhat elevated and very extensive deposit of limestone, resting directly upon the upper strata of new red sandstone. From its peculiar position, I have denominated this limestone "*lias,*" after a formation in a similar position in Europe; and not from its chemical or mechanical character; although, in these respects, it has in general an agreement with the lias limestone, on the other side of the Atlantic. The lias limestone of Butternut Ridge stretches along the country, in a north-east and south-west direction, to a distance of ten miles, and appears in detached portions beyond those limits. Its general breadth is about two miles. The upper portion of this formation consists of thin beds of dark coloured limestone, containing narrow strata of argillaceous marl. The strata comprising the middle portion of the deposit, are thick compact limestone, of a light blue colour, occasionally containing beds of rubbly limestone. In the lower division of the formation, the strata are more frequently separated by narrow argillaceous beds; and where it meets the new red sandstone, it is mixed with that rock. A number of strata were observed, which are sufficiently compact to afford good marble. The rock receives a good polish, and is frequently very beautifully striped, with light and pale blue lines. Encrinites, ammonites and several species of bivalve shells, were discovered in this limestone; but sufficient time has not been allowed me, to examine carefully these organic remains, and to compare them with those of the lias of England. These remains of moluscous and crustaceous animals, embracing several varieties of shells, are evidences, that the whole formation was originally collected beneath the sea, notwithstanding it now forms an elevated ridge in the interior of the country. The soil in this settlement, and along the ridge and surrounding country, is of a superior quality, and yearly produces the finest crops of wheat and other kinds of grain. The highlands are covered with beautiful groves of beech, birch and sugar maple, intermixed with thrifty butternut trees; but the settlers are making many inroads into the stately forest, which stands around their fields like a towering wall, protecting them from the violence of the gale. The lower

grounds are occupied by cedar thickets; and along the upland hollows, the elm and ash afford that grandeur and wildness so peculiar to the American forests. The apple, plum and currant have been introduced into these groves, and flourish beside the aboriginal trees of the dense and dark wilderness. The sumach also thrives well on these grounds. Vast numbers of fallen pines are scattered over this part of the country; many of which still remain sound and fit for use. By Indian tradition it appears, that before the country was settled by Europeans, it was overrun by fires; the pines were killed, and fell before a violent gale of wind, and have been succeeded by a growth of other trees. Perhaps this Province has never been visited by greater calamities, than those produced by the dreadful ravages of this destroying element; nor does it appear, that great fires have been more common since the country became inhabited. At certain seasons of the year, the forest is subject to ignition from natural causes; and the fire spreads until it is arrested by a falling rain, by wide rivers or by the sea.

SMITH'S CREEK.

Smith's Creek, a branch of the Kennebeckasis, runs in a north-east direction from Sussex Vale, and meets the Anagance, a branch of the Petitcodiac. It passes through a level valley and a tract of fine intervale. Walled in, on each side, by high hills of new red sandstone and conglomerate, after it diverges from the main stream, it winds its way through a narrow valley, having a very picturesque mountain, called "*Pisgah*," at its confluence with Salmon River. Truly characteristic of the rocks beneath, the soil on the hills and slopes is very fertile, and produces excellent crops. Occasionally, small tracts of light sand occur, covered with peat from four to ten feet in thickness. The peat in these bogs might be advantageously employed for manure, by being formed into composts with lime and gypsum, which are abundant in this quarter. Near the sources of this stream, there are two salt springs, on lands owned by his Honor the Chief Justice. They are not materially different from those already described.

Approaching the valley of Sussex from any of the heights, on either of its sides, the scenery is truly pleasing. This extensive and fertile settlement is situated in the centre of a cluster of hills and mountains. Its fine fields, frequently decorated with lofty elms and open groves, which scarcely

prevent a distant view, are creditable to the loyal descendants of the pioneers of the forest; who now, besides the rich natural scenery of the country, enjoy its more necessary and substantial blessings.

MILL STREAM.

The "*Mill Stream*" is also a branch of the Kennebeckasis. After extending in a north-easterly direction through a notch in the hills, northward of Sussex Vale, it proceeds along a broad trough in the sandstone, until its branches become interwoven with those of the Washademoak. This trough-like valley far surpasses in magnitude Sussex Vale; and extends from the head of Belleisle Bay, on the River St. John, directly across the country, in a north-easterly direction, to the Parish of Salisbury, in the County of Westmoreland, where it disappears in the low, level land of the gulph shore; that part of it which is nearest the Saint John, being occupied by Belleisle River and a fine navigable bay. This valley is from two to four miles broad, and about seventy miles long, and follows a direct north-east course from the Belleisle, being seldom intruded upon by the adjacent hills. Its south-west side is bounded by a chain of hills, extending from the trap rocks of Kingston, along the north-west sides of the Kennebeckasis and the Petitcodiac above the Bend. On its opposite side, a similar chain of high hills extends in a direction parallel to the Washademoak. The soil, in general, is a red sandy loam, easily worked and highly productive. There are a few small tracts of light sand, with, occasionally, beds of clay. Even these are capable of being rendered fertile.

In one of the low tracts in this quarter, I observed that the freshet had swept away the peat, and uncovered the bed of what had been a lake, but which is now a bog, bearing whortleberries and cranberries. In removing the lower stratum of peat, in search of the bones of an elk or common moose, which had perished in the bog, I found the tracks of muskrats, wild ducks and herons in the sand, beneath seven feet in depth of the peat. The tracks are still perfect, having only a little of their sharp outline worn off. They were evidently made on the shore of an ancient lake; which has since been filled up, by the growth of sphagneous plants.

In some of the swamps, there are collections of bog iron ore, of considerable thickness, and capable of supplying large

quantities of iron. The oxide of this metal is filtered through the sand, and may be seen along the sides of the brooks and small rivulets. The high lands are composed of new red sandstone, conglomerate, and, occasionally, the limestone already described.

The new red sandstone and conglomerate, accompanied with limestone, gypsum and salt springs, extend in a westerly direction to the peninsula of Kingston, and the north side of Belleisle Bay, where they are met by trap rocks. All the higher grounds are covered with hard wood, and the soil is of a superior quality. The population is greatly scattered; and large tracts of excellent land still remain almost unexplored, and in their original state. Between the before-mentioned valley and the Washademoak, there are several new settlements of English and Irish emigrants, who, having overcome the first obstacles of settling in a new country, are now gaining an honest independence.

Belleisle Bay is a beautiful sheet of water, connected with the Saint John, at the head of the Long Reach. Its average breadth is about two miles. The hills of conglomerate, on the north and part of the south sides, render its shore very picturesque. Although this part of the country was without an inhabitant a few years ago, much of the forest along the Bay is now replaced by fine farms; and still more of it is fast disappearing before the industry of the people.

GENERAL VIEW

OF THE

NEW RED SANDSTONE OF WESTMORELAND AND KING'S COUNTIES.

We may now take a view of the new red sandstone of the south-eastern side of the Province. In this district, it is not intended to include detached portions of that group of rocks, as they appear at Quaco, in the eastern part of Westmoreland, and at the entrance of Petitcodiac or Shepody. The tract of country now under consideration extends, from the north side of the coal field of Westmoreland and the syenite of the County of St. John, in a north-westerly direction, to near the Washademoak and the line separating King's and Queen's Counties, and the Cocaigne River, emptying into the Gulf of St. Lawrence. I have applied the name of "*new red sandstone system*" to this series of rocks, from their general agreement with that group, as it appears in England and other parts of Europe; as I have no desire to introduce a new term, in any instance where an old one can be properly applied.

On this system of rocks are situated the extensive and flourishing villages of Hammond River, Hampton, Kennebeckasis, Belleisle, Studville, Sussex, Butternut Ridge, Petitcodiac, Shediac and the scattered settlements, yearly extending from them, upon the wild lands. A reference to the Geological Map, now in course of preparation, will shew the boundaries of this tract, so far as they could be determined in the present state of the country.

The rocks belonging to the new red sandstone group, or "*saliferous system*" of some authors, are readily distinguished from those of the coal measures, by their red colour;

although, occasionally, their colour will not be found to be a sure indication of their existence; as grey and white strata are sometimes associated with them. Some of the sandstones and shales, also, in Nova-Scotia and New-Brunswick, which belong to the coal formations, are of a bright red colour, and resemble some of the argillaceous and sandstone strata of the series, situated above them. The predominance of the red arenaceous rock, and the red soil and detritus derived from it, are, however, the best general guides to the strata belonging to the group under consideration.

The deposits belonging to the new red sandstone system are either *argillaceous* (clayey), *arenaceous* (sandy), or *calcareous* (containing lime). Among the argillaceous strata, there are some that contain a considerable portion of lime, and therefore constitute *marl*; but, in general, they do not possess sufficient calcareous matter, to effervesce in the acids, and therefore cannot be classed among the marls. I have observed, that in Nova-Scotia and New-Brunswick, although these rocks have a general agreement with the same group in England, they contain less lime. When high cliffs are exposed, bands of white, grey and yellow colours appear; and between the strata there are also, frequently, narrow seams of crystallized sulphate of lime. At Cape Blomidon, in Nova-Scotia, the gypsum appears to form white strata, from six inches to two feet in thickness, and abounds in beautiful crystals of selenite.

The arenaceous beds are composed of sandstones, of different degrees of hardness; and are very variable, in regard to the size of the grains and fragments, entering into their composition. Even in the finest varieties, grains of quartz, feldspar, hornblende and mica are distinguishable; and the cementing matter is oxide of iron. With these kinds may be classed the compact freestones, that will afford excellent building materials; and the coarse-grained strata, which pass into conglomerate. The conglomerate in this district is more common in the lower beds than in the upper, and frequently rises from beneath the before-mentioned sandstones, forming hills from one hundred to five hundred feet high. In general, it is composed of rounded masses of granite, syenite, trap, quartz-rock and slates, with hornblende, feldspar and, sometimes, limestone. The masses are firmly secured to each other, by an admixture of fine sandstone and the cementing matter, the oxide of iron. Some varieties of this rock contain chlorite-slate, talcose-slate, mica-slate, and the usual ingredients of primary rocks, cemented by the same

materials, in a finely comminuted state. There is also a variety of conglomerate, composed of fragments of trap rock.

The calcareous strata of the formation frequently pass into the limestones already mentioned, which sometimes contain a small quantity of magnesia; but this ingredient is too scanty to admit of the term "*magnesian*" being applied to the strata. There are also argillo-calcareous strata, resembling red shale; and others consisting of indurated clay. But so much are all these strata varied, in their chemical and mechanical character, that one description would scarcely apply to more than one locality.

All these rocks are distinctly stratified; and the argillaceous beds are laminated. The sandstones also occasionally present oblique lamination, and afford ample proofs that they were formed beneath agitated water. The strata of this system repose unconformably upon the upturned edges of the strata belonging to the great coal formation; which are seen at the bottom of numerous ravines, creeks and rivers, where the more superficial rocks have been worn away by currents of water. From these and other facts, I am induced to believe, that the coal field in this part of New-Brunswick occupies the whole of its eastern side; and that coal might be obtained at many sites, by penetrating through the new red sandstone, spread over a considerable part of its area. When all these circumstances, and the dimensions of the Westmoreland coal field, with an outcropping of coal, extending forty miles along the country, are duly considered, it may be seen of what importance New-Brunswick is destined to become, not only to herself and her sister Colonies, but to Great Britain and the United States; whose supplies of coal must, to a great extent, be dependent on these Colonial resources.

The strata of the new red sandstone system are, at some places, nearly horizontal *(Westmoreland)*; at other situations, they are highly inclined *(Hampton)*; and their inclination in different directions shews, that they have been disturbed, to a greater or lesser extent, since they were deposited. The whole thickness of the new red sandstone, independent of the lias-limestone and beds of gypsum, I have estimated at six hundred feet. It must not be supposed, however, that this is the thickness of the rocks at all places. Frequently the formation is thinned off; and, from causes to be noticed hereafter, there are large tracts, where the thickness of the formation is reduced to thirty, twenty and even ten feet only.

Reposing upon these strata of sandstone, conglomerate, marly clay and indurated clay, we find a deposit of limestone, which has been denominated the "Lias," from its agreement with a similar deposit in England and elsewhere. This limestone is not spread out over the red marly rock with any degree of uniformity, but is collected in separate tracts, and in layers of variable thickness; as they are seen at Hammond River, north of the Finger Board, Midland Road, Smith's Creek, Sussex Vale, Butternut Ridge, and many other places.

The structure of this rock is sometimes slaty, and contains bitumen: this is the *bituminous marlite* of some Geologists. This variety appears in Sussex near the Church, at Butternut Ridge and Hammond River. It is very fetid, and, when struck with the hammer, yields an odour, capable of producing nausea. This fetid variety has been employed in the United States for hydraulic cement, and should be submitted to experiment at Saint John, where a water-proof cement is much required. More frequently, this limestone occurs in thick, compact strata, of dark brown, green, red and light yellow colours; and these colours are sometimes so mixed in veins, clouds, &c. that the rock would afford a handsome marble.

Almost all these compact limestones are traversed by fissures, in a vertical direction; which are filled with clay, marl and, sometimes, water-worn pebbles. The rock is also penetrated by cracks, most frequently in a north and south direction, as if it had been under some peculiar magnetic influence.

In general, both the sandstones and limestones of the whole series, have their strata running in a north-east and south-west direction; but the dip is too variable, to admit of any correct inference being drawn from it. The whole area of these rocks, however, appears to have been a vast trough or basin, in which the strata were deposited; some by slow and quiet operations, and others by more violent causes. The existence of trap and other rocks of that class, situated along the south and north sides of this basin, and the presence of trap dikes, will, to a great degree, explain how the strata have been thrown from their original levels.

MINERAL CONTENTS.

LEAD.

Galena, or *sulphuret of lead*, occurs in the limestone near the mills of Mr. Coates, on the road leading from the Finger Board to the head of Belleisle. It is scattered through the rock, in small crystals and narrow veins. This ore, by analysis, yields a small quantity of silver; but the quantity of galena and the silver contained in it, are too small to pay the expense of working either. This argentiferous galena is identical with the same ore, discovered in the lias-limestone of Nova-Scotia.

IRON.

Bog iron ore is abundant, in many of the swamps and low grounds of Sussex. On the farm of Mr. John Jeffries and adjoining lands, there are extensive collections of this ore. It appears to be derived from the decomposition of iron pyrites, contained in the soil and rocks beneath. The oxide, (rust,) being formed by the absorption of oxygen from the atmosphere, is washed into the bogs and swamps, where it is daily accumulating. The quantity of ore at this place is sufficient to supply a number of furnaces. The same ore also occurs at Studville, Hampton and other parts of the district under consideration. *Sulphuret* of iron is common in the sandstones and limestone. From its beautiful metallic appearance, it has been supposed, by many of the inhabitants, to contain gold and silver; but it is worthless, even as an ore of iron. Considerable quantities of iron sand may be collected at the entrance of the Petitcodiac, and near the property of John Edgett, Esquire. It is magnetic, and can be raised by the needle of a common compass. The same magnetic sand was observed, in small quantities, at Sussex Vale, where it is sometimes mixed with iserine.

SULPHATE OF LIME, OR GYPSUM.

Besides the foregoing minerals, the new red sandstone system contains vast deposits of *sulphate of lime* or *gypsum*. The localities of this mineral are too numerous to require description: they are common on the Hammond River, at Sussex Vale, and along a whole line of country, between the Midland Road, leading to Kingston, and the sources of the North River, a branch of the Petitcodiac; a distance of thirty miles. In any of these beds, I have been unable to discover distinct stratification. Sometimes the rock is laminated, and beautiful crystals of selenite may in general be procured; but this lamination is the result of crystallization, and not of stratification. The gypsum often rises above the red marly rocks, in rude, naked columns, or in broad, white masses, without any covering of soil or vegetables upon them; and it descends into the earth to an unknown depth. It cannot be supposed that these gypseous beds were deposited above the surface of the rocks, where they repose. It is evident, that the sandstones have been worn away from them, by former currents of water, and thus they remain protruded, in shapeless masses, above the earth's surface. At Hammond River, Sussex Vale, and near the Mill Stream, the masses of gypsum were found to contain on their sides, fragments of sandstone, conglomerate and limestone, where they are in contact with these rocks. This is certain evidence, that the sulphate of lime was collected subsequent to their formation; and although the means whereby the large accumulations were made, are at present beyond the reach of science, it appears most probable, that the gypsum has been segregated from the surrounding rocks, and collected in depressed situations on their surface.

ROCK SALT.

It is remarkable, that wherever the deposits of gypsum are found, there are salt springs; which evidently rise from deposits of Rock Salt, situated in the rocks of this formation. We have already noticed the salt springs of Hammond River, Sussex Vale and Butternut Ridge; and may now briefly make a few remarks on their situation, as compared with those of Europe.

It was formerly believed, that all the principal deposits of Rock Salt were contained in the new red sandstone series;

which, on this account, has been called the *saliferous system*: but it appears from recent discoveries, that in Durham, Northumberland and Leicestershire, (in England,) they proceed from the coal system. The salt works of the Alps are supported from oolite; and in the volcanic regions of Sicily and Auvergne, salt springs are numerous. Again, it was believed, that Rock Salt had been derived from the evaporation of sea-water; and the situation of beds of salt, nearly on a level with the sea, was considered as a confirmation of this opinion. But many of the salt mines in Wurtemburg and Central Germany, are upon plains of considerable elevation; and while some deposits are near the sea, others are far from it, and elevated more than five thousand feet above its waters. In New-Brunswick, the beds of Rock Salt from which saline springs rise, are nearly on a level with the present ocean, and in situations where it is probable that the sea might have flowed, at some remote period. It is, notwithstanding, very difficult to frame any hypothesis, in regard to the origin of deposits of Rock Salt in the earth, which will be free from objection; and it is necessary, that further discoveries should be made, with respect both to their situation, and to the combinations which *sodium* is capable of forming, when placed under peculiar circumstances. In some of the West India Islands, in England and other parts of the world, the water of the ocean is admitted into large natural or artificial basins; and, by the evaporating power of the sun's rays, the water escapes and the salt is deposited: frequently, indeed, the process is carried on without the aid of art. Now the briny springs of Cheshire in England, of Nova-Scotia and New-Brunswick, are in such situations, as will favour the opinion of the Rock Salt beneath having been produced by these simple means; nor is it impossible, that in other countries and in more elevated situations, the same mineral may have been the result of volcanic heat, applied to the sodium and chlorine of the salt.

On the west, as at Kingston, on the south side of the Washademoac, and near Hampton Ferry, the sandstones and conglomerate are found associated with trappean and volcanic matter; which has penetrated the beds of new red sandstone, forced them from their original horizontal position, and changed their chemical character. Sometimes, also, the sandstones and shales of the carboniferous period rise, and appear at the surface in small areas, in the district referred to.

From the facts we have endeavoured to bring forward, and without entering upon any theoretical speculations, suf-

ficient evidences are presented to the mind, that there was a period in the history of this country, subsequent to the accumulation of sandstones, shales and coal of the carboniferous period, when there existed such a depression in this part of the great coal field, that its surface was beneath the common sea level. Into this depression the detrital matter, derived from pre-existing strata, was carried by water, and there deposited in strata of sandstone and conglomerate, as they are now seen in their consolidated state. The pebbles forming the conglomerates have all been rounded by attrition; and, in figure, are like those which have undergone the action of water, along sea coasts, or where fragments of rocks are exposed to the wearing influence of currents. Even the sources from which those pebbles were brought, are, in some instances, discoverable; and thus it is seen, that causes still active upon the earth, were in operation at remote periods in its history. The mixture of these pebbles with sand, their position, their variety and figures all prove, that their history is identical with those of the loose beds, now found upon the surface and along the coasts.

The sandstone and marl are only the same materials, in a more finely comminuted state. They were longer exposed, or, from their original chemical composition, they might have been more readily broken, or were exposed to the more violent effects of the element beneath which they were lodged; afterwards to form the solid mountain and fertile field, where they are again undergoing the same disintegrating process, which they had previously endured. It is by these natural operations that the earth has been rendered productive, and its once solid, barren and almost impervious matter has been broken down, and spread abroad, to supply necessary food for its numerous inhabitants.

That the limestone was also collected beneath the sea, is fully attested, by the remains of marine animals contained in it: but whether by the labour of coral insects, like the islands in the Pacific Ocean, or from the waters of calcareous springs, is not so readily determined; as time and great pressure have, in some degree, obliterated many particulars in its apparent history.

The brine-springs, rising from certain parts of this group, may be considered as the water which, in rising to the surface, passes through and is consequently saturated with salt, contained in the earth. These beds of salt occupy only limited patches; as fresh water springs frequently rise at no great distance from them.

VALLEYS OF DENUDATION.

When we see the strata of rocks, on the opposite sides of a valley, coincide in their mineral character, inclination and other general features, the enquiry follows, by what means could the valley have been excavated or worn out, through strata that were once evidently continuous? In all parts of the world, there are evidences of the rocks having been exposed to the denudating influence of water. It is not certain, however, that all valleys have been formed by wearing away of certain tracts, while hills on each side have remained. In many instances, the valleys have been produced by the elevation of the rocks along their sides; and these have, by some geologists, been called *valleys of dislocation.*— In the district I have just described, there are several deep and broad valleys, which have been evidently produced by *denudation;* among which is the remarkable level tract, called *Sussex Vale.* That many of the strata, on the sides of this beautiful settlement, were once extended across the valley, seems evident. The strata appearing on the tops and sides of many of the hills are similar, and dip in the same direction. Like the links of a broken chain, they agree in their character, notwithstanding there now exists a broad open space between them. *Pisgah* and *Piccadilla,* two eminences, each upwards of four hundred feet high, are composed chiefly of conglomerate, and separated from each other a distance of three miles. The composition of the strata and the inclination, in each of these eminences, are alike; and there is sufficient evidence to shew, that the level valley between them has been scooped out by the action of water, as represented in the cut below.

Fig. 8.

a. a. a. Conglomerate. *b. b.* Valley of Denudation.

Besides this valley, there are others of different dimensions. The largest of these commences at the head of Belleisle Bay, and extends in a northward direction, directly

across a section of the country, to near the coast on the Gulf of St. Lawrence. Along the centre of this trough-like valley, Studholm's Millstream and the Belleisle discharge their waters. This valley will average from two to four miles in breadth, and is upwards of fifty miles in length; being enclosed between hills from two to five hundred feet high, running parallel to each other. From the head of the Belleisle to the northeastern extremity of this majestic fosse, the rocks on each side, at numerous places, correspond in position and composition; and although there are a few projecting headlands on the sides of this valley, they are not more frequent than projecting masses of rock on the confines of the Saint John River.

Another great valley is occupied by the Kennebeckasis, a branch of which (Smith's Creek) inclines more to the northeast, after leaving Sussex Vale. This valley continues onward to the County of Westmoreland, when it is occupied by the Petitcodiac, turning to the southward of the Bend.

The valley of Hammond River is less in its dimensions, but possesses the general character of those already mentioned. All these valleys are occupied by rivers and their tributaries. The mountains and hills have their longest diameters between the southwest and northeast; and the whole surface of the country is grooved and channelled in those directions. It may not be proper to infer, that all these valleys have been formed altogether by the action of water; for it is evident, that the currents that have produced these results, were created in natural pre-existing channels, which were afterwards greatly enlarged and modified through their influence.

Many of the naked hills of conglomerate still bear the marks of abrading currents, which evidently swept by them with irresistible fury. It is only from sources like these, that the thick beds of gravel, sand, pebbles and other detrital matter, spread over every part of the Province, were probably derived. In viewing the sides of the elevated ridges of rock, we easily discover those peculiar indentations and depressions, characteristic of the shores of rivers, where there are accumulations of detrital matter; although they are now thickly covered with the green forest. From these and numerous facts, which it is unnecessary to detail, it may be safely inferred, that these deep grooves in the earth are, for the greater part, valleys of denudation; that there was a time, when the strata were in unbroken and continuous beds; but, by the action of currents of water, they have been grooved out, and many of the hills and mountains, as they now ap-

pear, are only remaining portions of those beds, which resisted the currents to a greater degree, than the matter that once occupied the intervening valleys.

It is true, that there is the most satisfactory evidence, that mountains have been raised, the earth uplifted and filled with dikes and veins, or overspread with vast masses of trappean and scoriaceous matter, through the operations of volcanoes, which have been more or less active, during the formation of each class of stratified rocks. The evidences of these operations are abundant in the County of Charlotte, and other parts of the Province. They also appear in the Parish of Kingston, Hampton, Bull Moose Hill and many other situations, immediately connected with the tract of country now under consideration; and although those operations may have been the cause of the elevation of eminences, near the theatre of volcanic action, the absence of the like effects along the chains of mountains and hills before-mentioned, leaves the phenomena alluded to, to be attributed to the action of another cause, which has greatly modified the features of the country.

In an economical point of view, the new red sandstone system is very rich in minerals. The iron ore, salt, lime and gypsum are very important, and form a considerable part of the valuable resources of the country.

AGRICULTURAL CHARACTER

OF THE

NEW RED SANDSTONE DISTRICT.

The ranges of new red sandstone afford the most fertile land in England and other parts of Europe. Its agricultural character in Nova-Scotia and New-Brunswick is very remarkable. Wheat, potatoes, barley and all the productions of the climate, vegetate quickly and ripen early on these rocks. The abundance of this rock in New-Brunswick is of itself sufficient to render it an agricultural country. The ready disintegration of the rocks, when exposed to meteoric influence, soon affords a good soil; even in situations where the original soil may have been removed, and the rocks uncovered. It is true, that the members of this group of rocks are sometimes covered with beds of sand, gravel and other kinds of detritus, which have been deposited upon them by former currents of water; but this circumstance does not affect the general character of the rocks beneath; for, wherever the soil is red or claret-coloured, or has been formed by the decomposition of their strata, it is always fertile; and, although there are, here and there, patches of soil consisting of the debris of other rocks, yet the red marly group has been also spread over large areas, in a fine fertile covering.

Besides these advantages, lime and gypsum are frequently abundant in such districts, and may be applied to renovate the less productive lands.

In general, the high lands are covered with a heavy growth of maple, beech, birch and sometimes oak, intermixed with Butternut. The low grounds and moist slopes produce spruce, fir, white-birch and cedar. Pine flourishes on the sandy ground, and the intervales are covered with the lofty ash and elm.

KINGSTON.

Having completed an examination of the Coal Field of Westmoreland, the new red sandstone district, and all the formations along the coast of the Bay of Fundy, the Survey was extended farther northward. Between the St. John River and the Kennebeckasis, which run nearly parallel to each other for a distance of twenty miles, there is a small peninsula, from four to seven miles wide. This peninsula is composed almost entirely of trap rocks, excepting a narrow band, crossing from Long Island to "The Reach," where the syenite and limestone, previously noticed, are seen forming an elevated and broken ridge. The trap rock is extended across the St. John, along the whole length of the Reach; and does not terminate, until it has formed Bull Moose Hill, and some high and uneven land between the Hill and the road to Long's Creek. A ridge of this rock also extends along the south side of Belleisle Bay, and another in the high lands between Kingston and the entrance of the Mill-stream. The rock, forming almost the whole of this Parish, is composed of varieties of trap; chiefly of two kinds. In one, hornblende is most predominant, and we have a compact greenstone; in the other, feldspar is most abundant, and sometimes in crystals of considerable size. Besides the rocks formed by the admixture of these two minerals, there is another, which is peculiar. Although the rock is composed essentially of the above minerals and augite, these minerals are not crystallised, but compose the cementing matter of breccias, and sometimes beds of considerable thickness. H. T. De La Beche, in his Report of the Geology of Cornwall and Devon, has discovered a rock, under the name of trappean-ash, and shews the manner by which it was produced, from volcanic sand and ashes. According to that description, the scoriaceous rocks of Kingston must bear a close resemblance to it, and was probably produced by the same causes; as there is abundant evidence to support the opinion, that all the rocks of Kingston are of volcanic origin. Surveyors have observed, in running lines over those rocks, that the compass-needle is frequently so much attracted from its true direction, that it is rendered useless. On a ridge of land southward of the village, and at several other places in this quarter, our magnetic instruments were greatly affected. Upon examination, the rocks in these situations were found to contain the magnetic oxide of iron, and sometimes magnetic iron pyrites; and even at localities where those minerals were

not discovered, the trap itself is sufficiently magnetic, to produce a variation in the poles of a balanced magnetic bar. Not only are the rocks volcanic in their character, but the features of this trap district correspond with those of countries, where the lava is still flowing from the earth, and where showers of volcanic ashes are falling to the ground. The whole surface is thrown up into high and irregular mounds, many of which are of considerable altitude. Steep cliffs and highly inclined planes are common; and the whole surface appears to have been broken up by one general disruption.

There are numerous lakes situated on the most elevated parts of the hills and mountains, which appear to be arranged in rows, parallel to the shores on either side. In general, they are small, circular and very deep; and have no outlets, except such as appear to have been excavated by the flowing of the water over their sides. One of the most remarkable of these lakes is situated at the head of a deep gorge, which opens towards the Kennebeckasis, called the *Pick-waa-ket.* This lake bears evidence of having been the mouth of a crater; and the broad and deep ravine below, with the lofty walls of trap on each side, may have their origin explained in a satisfactory manner, by presuming them to have been the effects of former earthquakes.

The rocks frequently contain veins of quartz, with chlorite; hornstone and red jasper sometimes occur; but, in general, the trap of this district is not rich in minerals. Iron, in different states of oxidation, is the most abundant; notwithstanding, no vein of sufficient dimensions for working, was discovered on the peninsula of Kingston.

On the midland road, and about ten miles eastward of Kingston Church, the trap rock is met by the new red sandstone and conglomerate. Near the line of junction, it is overlaid by limestone, which forms a ridge of limited extent. The lower strata contain much sand, and they may be called calcareous sandstone. The upper strata are more pure, and will afford marble, capable of receiving a good polish. The trap rocks extend in an easterly direction, along the high lands eastward and northward of Hampton Ferry; and the sandstone reaches along the upper part of Belleisle Bay. I had received information, that copper ore had been found on the farm of Robert Noble, on the north side of the Bay; but upon examination, the rock was found to be conglomerate, and there were no indications of any kind of ore near this locality.

Along the south side of the peninsula of Kingston, from nearly opposite Gondola Point to the Finger Board, the sandstones and conglomerates are seen shelving from the sides of the mountain. These rocks rest directly upon the trap, by which they appear to have been forced from their original horizontal position; and the lower grounds are covered with boulders of those rocks, which appear to have been rolled from the mountain above.

The trap rock appears eastward as far as Coates' Mills, about a mile north of Mr. Baxter's Inn. It is here seen crossing a ravine at the mill-dam, and is peculiar, on account of being distinctly stratified. The strata run east and west, and dip to the northward at a high angle. Some of the layers are greenstone, composed chiefly of small crystals of hornblende; these strata are alternate with others, that appear like a coarse sandstone or fine conglomerate, which has been changed and rendered compact by the heat, attributed to the eruption of trap dikes. But they are different from any of these strata, and instead of the grains of sand, or the small pebbles entering into sedimentary deposits, they consist of a kind of scoriaceous matter, resembling consolidated pumice; in which there are flakes of mineral matter, having a strong resemblance to the cinders of Etna. Some of the strata appear to consist entirely of ashes, rendered compact by time and pressure; but which are far more friable than the common varieties of trap. These strata have been already called *trappean ash*, and were probably produced by the consolidation of volcanic ashes. The manner by which these successive layers of greenstone and trappean ash were formed, cannot now be fully explained. From the discoveries of Mr. De la Beche, it may be asked, may not the strata of trappean ash have been derived from showers of volcanic ashes, and the greenstone from the lava that flowed over them from time to time? Beautiful crystals of specular iron ore were found in the fissures of the greenstone, and the red oxide of iron fills many of the larger crevices.

In a country where rocks have been formed by the operations of water, as almost all the stratified formations evidently have been; and where also, it is evident, vast accumulations of trap rock have been forced to the surface of the earth, by the agency of volcanic heat; it cannot be surprising, that these two classes of rocks are sometimes so blended together, as to render it extremely difficult to draw a line of distinction between them; and this difficulty of discriminating

between one and the other class, would be always greater, in cases where both of those causes have been in operation at the same time.

In some instances it would seem, as if these conglomerates, as seen along the side of the Kennebeckasis, above Hampton, and on the north side of Belleisle Bay, had been produced by volcanic action; as were the greenstones and other rocks of that class. The pebbles, contained in the conglomerate, have been evidently worn by attrition in water; while the cement which binds them together appears, at many places, to be of volcanic origin. Now in this instance, the lava might have covered beds of pebbles, and sealed them together; and thus the successive collections of pebbles, made by currents of water, and the streams of liquid lava that issued from the crater, with cinders and ashes, would produce the effects now exhibited; and that such anomalous results are brought about, can be proved by examining volcanoes still in action. Associated with the rocks above mentioned, and besides the different mixtures of hornblende and feldspar, there are certain beds of ancient cinders; and particular layers, resembling pumice that has become consolidated by great pressure. There are also fragments of jasper and other silicious minerals, mixed in these deposits, which might have assumed their present character, at the time they became imbedded and were submitted to intense heat. When these facts are attentively considered, the most rational idea that presents itself is, that the volcanoes, which have evidently been in operation in this quarter, threw out the greenstones and other trappean matter of their period, and also ashes, cinders, scoria and a substance resembling pumice; which, by being mixed with sedimentary matter, have produced these somewhat peculiar stony masses, as they are now seen.

Immediately succeeding and resting upon these rocks, the limestones already mentioned repose in unconformable strata; the red sandstone and common conglomerate being absent. The calcareous rock in this quarter is very cavernous; and deep pits are produced in the earth, by the breaking down of the roofs of large cavities, formed by the action of water upon the calcareous rock. These operations are much more active in the spring, when the frost is escaping from the soil. I had been informed, that a spacious cave existed in this place, a few years ago; but upon examination, its entrance was found broken down, and the passage into the hill completely filled up with broken masses of limestone; so that I could only penetrate a few yards into the entrance of a once spa-

cious cavern. There still remain a number of small chambers, affording a place of retreat for otters and other wild animals. A brook, running along the basset edges of the limestone strata, enters a part of the cave, disappears, and after flowing along a subterraneous passage for a quarter of a mile, emerges beneath the water of a mill-pond, situated below.

This limestone contains sulphuret of lead, disseminated in small crystals, through the rocks. It has been reported, that formerly the Indians procured a sufficient quantity of lead from this cave, to supply them with bullets; but, after a diligent search, wherever the rocks are exposed, only a small vein of galena was discovered; and the rock contains an insufficient quantity of the ore mixed in it, to render a working for the lead profitable. It may nevertheless be remarked, that this limestone is evidently metalliferous; and, perhaps, when its surface becomes more exposed, by the clearing away of the timber now growing upon it, valuable veins of this ore of lead may be found. The limestone here contains the remains of numerous shells: their cavities are filled with calcareous spar; and the bivalves may be taken so perfectly from the rock, as to represent their originals in all their primitive beauty. The classification of these fossil shells is deferred, until the whole of the lias formations in the Province have been examined.

The trap rocks form all the high lands northward of Belleisle Bay; and were explored from the Saint John, eastward, to Bull Moose Hill. They may be seen in almost every ravine, and in the cleared lands of two Scotch settlements, recently formed on each side of the main road, leading from the Bay to Fredericton. These rocks are similar to those of Kingston, containing veins of jasper, calcedony, hornstone and quartz.

SPRINGFIELD.

In this Parish, the mountainous ridge of trap, already described, meets the new red sandstone system on the south, and the rocks of coal measures on the north.

One of the highest eminences in the Parish of Springfield is called Bull Moose Hill; from having been the resort of droves of Moose, in former times. It is a bold promontory, five hundred and eighty feet, by trigonometrical measurement, above the level of the St. John; and is the termi-

nation of the mountainous ridge of trap rock already noticed. The new red sandstone and conglomerate form its upper and southern sides; to the northward, the trap appears immediately beneath those rocks. From this hill, the eye may wander over the wild forests, which, in a north-east direction, are still unbroken; and the undulated area of the sandstone imitates the surface of the sea. One vast, rich and variegated assemblage of forest trees, waves in majestic grandeur over the earth, like fields of wheat before the harvest. The great valley of the Belleisle and Studville, with its scattered settlements and farms, shew where the industry of man is employed; and which, from year to year, is notching the dark and silent groves with cultivated fields. To the south-west, the track of the Saint John is discernible, as it passes the granitic and trappean mountains of the Reach; and the peculiar features of each formation are faithfully delineated, in the cliffs and slopes of Kingston and the more mellow surface of Sussex.

IRON ORE.

About a mile and a half westward of Bull Moose Hill the soil becomes more scanty, and the trap rocks are frequently uncovered. The rock here may be called a syenite, being composed of crystals of hornblende and feldspar, from the twentieth of an inch to an inch in diameter. This rock apparently reaches, from north to south, several miles; and is connected with the great trappean mass, underlying the chain of high hills, stretched along the north side of Belleisle Bay. The inhabitants of a new settlement, recently made on the mountain, had discovered a quantity of ore, which they had supposed to be black-lead; but which, upon examination, was found to be common bog and shot iron ore. These ores have collected in considerable quantities, on the farms of Mr. Eli Northrup and Mr. Elnathan Benson, and are still accumulating on the low grounds in that quarter. The magnetic needle was observed to be much affected, in proceeding westerly from the hill; and the trap began to assume a ferruginous appearance, until crystals of the magnetic oxide of iron were discovered, mixed with the hornblende and feldspar of the rock.

On ascending the hill, near Mr. Northrup's house, the iron was found more abundant, until large boulders, some of which would weigh a ton each, were discovered to be a rich,

compact iron ore. These boulders are scattered over the above farms, in the soil of the adjacent forest, and to a distance unknown; for the area occupied by them was too extensive, to allow us to examine every part of its surface. Ascending the hill in the clearings and woods adjacent, these boulders of ore become more numerous, and may be seen in the walls thrown up to protect the meadows. The solid syenite, or as it may be called at some places syenitic trap, was found to become more mixed with the iron, until it passes into a compact ore. The detrital matter and other rubbish, covering the surface and the rocks beneath, prevented us from ascertaining that point where the ore is most pure; but the rock, in a long belt, extending nearly east and west, and for a quarter of a mile in breadth, is copiously impregnated with the iron. The ore was found in the forest, near Mr. Benson's farm, where it occupies the surface, over a space twenty feet wide, and apparently runs in a vein, along the mountain, to a great distance. Crossing the road, it again appears about two hundred yards north of Mr. Benson's house, and the vein is covered with boulders of ore. Every pains was taken to ascertain the course, thickness and inclination of this evidently inexhaustible bed of iron; but the detritus on the surface, the quantity of soil and decayed vegetable matter in the forest, were difficulties our means would not allow us to encounter.

This ore is associated with crystals of hornblende and feldspar. The former is of a deep green colour, and the latter of a milky white. It also contains iserine. When recently broken, the lustre is highly metallic; but, on being exposed to the air, it soon becomes tarnished, and recent cracks are beautifully irised. Sometimes it exists with the hornblende alone, and again, in the richer specimens, only a few crystals of feldspar are to be seen. It acts powerfully upon the magnetic needle, and compasses are useless for a considerable distance on each side of the vein. The boulders in the fields are known by their rusty appearance. Several specimens attract iron filings, possess polarity, and therefore may be called loadstone. A mass taken from the common variety yielded sixty per cent. of metallic iron.

How far this enormous metallic deposit extends in an east and west direction, we were unable to determine; but judging from the effect it had upon the compasses, it doubtless continues to the distance of several miles. From these facts, it is believed to be one of the most extensive veins of iron ore in the British Provinces; being sufficient to supply America

with iron for thousands of years. A similar kind of iron ore is abundant in Sweden; where numerous quantities of the best kind are smelted, and shipped to Great Britain. At Dannemora, the site of the most important mines in Europe, this kind of ore exists in a bed several hundred feet thick. This Provincial ore also agrees in character, with the magnetic oxide of iron of New Jersey, ably described by Professor Rogers, in his Geological Report of that State.

There are a number of advantages offered, for the erection of iron works in this district. The ore is situated at a distance of only three miles from a fine navigable bay; and in the midst of a forest of excellent hard-wood, which may be converted into proper fuel; while Belleisle River and one of its branches will afford an abundant supply of water power, to propel the necessary machinery. Should the supply of fuel fail, from the yearly demand made upon it, coal could be supplied from the Grand Lake, Long's Creek, or other parts of the extensive coal field, situated a short distance farther northward. The situation of this iron on the confines of a fine agricultural country, where the population is rapidly increasing, is also an advantage not to be overlooked. That the ore is capable of being worked, is evident from the fact, that in Sweden, immense quantities of excellent iron are produced from a similar kind; and in New Jersey, there are extensive mines in operation, which yield a corresponding combination for the furnaces.

So far as we have been able to examine the rocks, containing the iron ore, near Bull Moose Hill, they appear to be unstratified, and to hold an intermediate relation to the granite and trap rocks, previously described. The most abundant of the varieties it presents is, a mixture of hornblende and feldspar, sometimes containing grains of quartz and iserine. The magnetic oxide of iron not only enters largely into the vein already mentioned, but is associated with the above minerals in many different proportions; those proportions always increasing, as the vein is approached.

In 1838, we discovered an enormous deposit of iron ore at Coot Hill, in Queen's County, consisting chiefly of the hydrate and argillaceous oxide of iron. At this locality, the ores are interstratified with argillite, or clay-slate, and have resulted from a sedimentary deposit. That the rocks containing the iron, in the Parish of Springfield, are of igneous origin, cannot be doubted; and the elevation of the metallic vein from beneath appears equally certain. The crystalline state, and magnetic qualities of the ore, are of themselves

sufficient evidences to prove, that it has been under the influence of the earth's internal heat. Now it is remarkable, that if the slate rocks, on the west side of the Long Reach, had been continued across the Saint John and pursued the absolute course of the formation, in a north-east direction, they would have reached the exact point, where the syenite now exists; and had the bed of argillaceous oxide of iron followed its own course with the slate, it would have appeared at the same point, where the magnetic oxide is now found.—The distance between the two points, where the argillaceous oxide, on the one hand, and the magnetic oxide, on the other, appear, is about twenty-five miles; but as soon as the slate, containing the iron of Coot Hill, reaches the Saint John, it is cut off; and its natural and proper place, as is generally the case in every country, is occupied by syenite, trap and other rocks, known to be of volcanic origin. That the slate, containing the ore of Coot Hill, was once continued across the Saint John, at the Reach, appears probable; from the fact, that the old red sandstone and mountain limestone, placed above it, cross the river and crop out, a number of miles eastward from its shore. But, instead of being continued across the stream, and keeping company with the superincumbent strata in the usual manner, the place of the schistose strata is occupied by rocks of volcanic origin; and only a few detached and broken masses of the slate are to be found.

The inquiry may, under these circumstances, be made, how far are these two deposits of iron related to each other? Is it not probable, that the slate formation, with its ore, was once perfect and continuous, along the whole line of country where the iron appears? May not the crystallized magnetic oxide have resulted, from the heat applied to the hydrate and argillaceous oxide of the slate; and may not the slate itself, by the application of the same heat, have been converted into crystallized rocks, by those mighty operations, which have been going forward in the earth, from the earliest period in its history?

The bog iron ore has been produced by the oxides of the metal, after they had been formed through the agency of the atmosphere. These oxides are conveyed, by the rain and melting snow, into the low grounds, where they are yearly accumulating. This variety would be found useful to mix with the magnetic ore, during the process of smelting.

WICKHAM.

It is somewhat remarkable, that each of the formations, as they appear on the west side of the Saint John and opposite the peninsula between the Belleisle and Washademoac, and as far westward as the Ocnabog Lake, should be separated by deep ravines, through which creeks empty into the main river. The millstone grit is separated from the common sandstones and shales of the coal measures, by the Ocnabog Lake and River; on the south side of which it may be seen, having attained its greatest elevation, and forming a ridge of land, above the level of the more recent rocks of the coal series. It is separated from the old mountain limestone, near Mr. Merritt's farm, by a deep ravine and brook; but, between the old red sandstone and carboniferous, or old mountain limestone, cropping out at this farm, there is no depression or indentation, and at their line of junction they mingle together. The old red sandstone is separated from the slate, at a deep creek, about two miles southward of the outcropping of the limestone; and at the place where the slate meets the granite, a similar line of demarcation was observed.

During my exploration of this part of the country, a visit was made to the granite quarries, discovered in 1838.* These quarries are now owned by Justus Wetmore, Esquire, and have been leased to Messrs. Barker and Small; who have commenced working them, upon a plan highly creditable to their skill and enterprise. A large wharf has been built, with powerful hoisting apparatus; buildings have been erected, and fifty men were constantly occupied in quarrying and cutting the stone. A number of vessels are employed, to transport the rock to Saint John, Fredericton and Kingston, where it is used for buildings. Thus a dreary and almost forsaken village now rings with the sound of hammers, and the bustle of industry. This beautiful and durable rock might properly be called *gneiss*, being distinctly stratified and occasionally containing pieces of older granite. The strata incline to the south, and, by being separated from each other, they afford the greater facilities for quarrying them into blocks, which may be obtained forty feet long.—From being situated directly upon the shore of the river, every advantage is offered for their shipment. This granite has already taken the place of the American and Nova-Scotia

* See First Report on the Geological Survey of the Province of New-Brunswick, page 76.

varieties, and has afforded a practical illustration of the advantages of the geological survey, and the vast saving that can be made, by employing the natural resources of the Province.

The old mountain, or carboniferous limestone, crosses the Saint John River, and crops out at several places on the farms of Messrs. Carpenter, on the east side of the "Head of the Reach." The rock is very compact and capable of affording good marble; its usual colours are white, grey and dark brown. The formation on this side of the river is more extensive, than it was discovered to be on the west side, having been followed to the distance of several miles, on a line nearly parallel to the Washademoak. It runs about east-north-east, and the strata dip north-north-west, at a high angle. The whole formation abounds in the remains of marine animals. Among these are ammonites, encrinites, the astrea, orthis, pectenite and several species of terebratulæ; but a particular description and classification of these moluscous animals, and their comparison with those of the European limestone, we have been unable to supply, from want of sufficient leisure.

In general, the different valves of the shells remain in contact with each other as perfectly, as if their inhabitants were still alive; from which it may be inferred, that these animals perished suddenly, and not by old age, or other causes whereby the valves would have become separated. So perfect are the shells of these former inhabitants of the sea shore, that when the rock is broken they fall out, and exhibit all the beauty of the living shells. The space between the valves, which was formerly the abode of the living animal, is sometimes empty; but frequently it is filled with crystals of calcareous spar. The univalves, in general, do not exhibit this sparry structure. Whole strata are almost entirely composed of these remains. The rock, where it reposes upon the sandstone, is generally of a red colour, and its fossils become more scanty.

The limestone will be found highly advantageous to the soil in this quarter: several of the farmers have proposed to erect kilns, for its calcination, and to apply it to their lands without further delay. Judgment and skill are required in the erection of lime-kilns; and such a model should be selected, as has been found to require the least quantity of fuel, and to afford the most powerful degree of heat.

Immediately beneath this limestone, the old red sandstone appears, and the outcrop may be seen along the shore

of the river, to the distance of two miles and a half. The strata pursue the course of the limestone above, and observe the same general dip. The rock is of a dark red colour, and composed of grains of quartz, feldspar, hornblende, slate, &c. in a coarse state. It extends into the forest eastward several miles, but the exact point where it is discontinued was not discovered. Although the soil resting upon this sandstone is sometimes very thin, it is productive, and a number of fine farms are seen upon this rock, on the margin of the river.

It was expected, that this formation would be found resting upon the slate, and the slate upon the granite, in the manner those rocks are situated on the west side of the river; but at the broad point of land between the Belleisle and Washademoak, the slate and granite are cut off, and the situation they might have been expected to hold, is occupied by trap rock, which extends eastwardly to the sources of Long's Creek. This rock also constitutes the remainder of the high land between those two rivers, and may be seen forming elevated and broken cliffs, on the side of the Saint John, at the head of the Reach. The trap may be observed in sharp precipices, near an old fort, opposite Van Wart's farm. It is a dark-coloured greenstone, containing numerous veins of quartz, mixed with chlorite.

It may be readily perceived in this quarter, how much the physical condition of a country depends upon the nature of the rocks entering into its structure. Wherever the Saint John passes across strata of sandstone, it is open and expanded, and consequently bordered by broad tracts of alluvium; but no sooner does it meet the granite, trap and older stratified rocks, than it becomes narrow, deep and more rapid. Between the head of the Reach at Fredericton, the river will average nearly half a mile in width; but as soon as it meets the trap and granite of the Reach, it becomes contracted to a quarter of a mile. These circumstances are readily explained from the fact, that the sandstones offer but a feeble resistance to the action of currents, and therefore, by being worn away, afford a wide channel for the stream; while the unstratified and more consolidated rocks, by offering a greater resistance to the water, compel it to pass along a narrow and deep opening. Again, when the stream has nothing to contend with but beds of gravel, sand and clay, it becomes greatly enlarged on the surface; of which an instance is seen at Grand Bay, a few miles above the falls. Thus geology and geography have an intimate relation to each other; for the

physical features of a country cannot be understood, without a knowledge of its rocky structure.

There is a fine level and fertile tract of upland, at the entrance of the Washademoak River. This beautiful sheet of water is rendered a lake, by the Musquash Islands, extended across its mouth, and thickly studded with lofty elms. Its outlet is deep and narrow, and about three miles in length. The alluvial matter, forming the Islands, occupies an area of more than three square miles. This River, at its entrance, separates the mill-stone grit, of this part of the Grand Lake Coal Field, from the carboniferous limestone and old red sandstone beneath. These rocks extend eastward, on the north-east side of the Saint John and south-east side of the Washademoak, to the distance of about eight miles; so far as present discoveries reach. They then disappear beneath the mill-stone grit; the trap already mentioned meets the mill-stone grit on its south-east side, and composes all the high and broken lands, between the Washademoak and Belleisle Bay and River; reaching eastward through Bull Moose Hill to the source of Long's Creek. Thus it will be seen, that the several formations of granite, slate, old red sandstone and carboniferous limestone are discontinued in the Parishes of Wickham and Springfield, being succeeded by the rocks of the coal measures, new red sandstone and conglomerate.

A ridge of conglomerate was observed along the north side of the Belleisle Bay and River, with strata shelving from the trap. Wherever the conglomerate is in contact with this rock, it has undergone great changes. The rock is rendered more compact, its pebbles are frequently almost obliterated, and shew that they have been partially fused and converted into a kind of jasper. All these metamorphic characters have evidently arisen, from the great heat applied to them, in the manner already pointed out. The trap rock in this quarter is a greenstone, somewhat variable in its character. Large masses are of a slaty and brittle nature, and contain iron pyrites; other kinds are more soft and yielding, being readily affected by the frost, rain and atmosphere. There are also portions of the rock containing small vesicles, most frequently empty, but occasionally filled with carbonate of lime, constituting that variety of trap, called *amygdaloid*. Large veins of white quartz occur in these rocks, and are often associated with a remarkably fine white iron pyrites, which has been mistaken by some of the inhabitants for gold; and some of the situations where it is found are therefore kept

in great secrecy, on account of the supposed value of this mineral. There are also veins of fine red jasper, capable of bearing a high polish; frequently, these veins are mixed with calcedony, both compact and cellular; the latter having the cells filled with black oxide of manganese. Some of the strata of sandstone, near the Washademoak, are suitable for buildings and grindstones: they are, however, coarse grained, and inferior to those of Cumberland Bay.

WASHADEMOAK.

Having procured Indians and canoes, in order to ascend the Washademoak, I proceeded to explore the rocks, where they are exposed on the banks of that stream and its tributaries. Such a method of conveyance is necessary in a part of the country, which is but partially inhabited. It may be stated here, that this river forms an important branch of the St. John. It is navigable for large vessels thirty-five miles from its mouth; in the spring and autumn, boats and rafts of timber descend it, from a distance of sixty miles in the interior.

Like other navigable waters of the Province, (the Kennebeckasis, Belleisle, and Grand Lake,) this river extends in a north-east direction from the St. John, and parallel to the rocky formations of the country. Timber is rafted downwards upon it, from the head of Cocaigne River, which empties into the Gulf of St. Lawrence, to the St. John. This beautiful stream is thinly inhabited along its shores, to the distance of twenty miles from its mouth: between Long's Creek and New Canaan, a distance of thirty miles, there are but few settlers; and many thousands of acres of the neighbouring land still remain ungranted, being merely occupied here and there by a squatter. This circumstance is remarkable, as the soil in general is good, and the river and roads now opening, afford the necessary facilities for communication.

This river, in its whole length, passes over and intersects the grey sandstone and conglomerate of the Grand Lake coal measures; which repose upon the carboniferous limestone and other rocks to the south-east, in the manner already noticed. After passing through a narrow and deep channel, on the south side of the Musquash Islands, the rocks may be seen to advantage on the south side of the stream, a few miles above its embouchure. The sandstones here are composed of silicious particles, mica and occasionally fragments of slate. The strata are well defined, and frequently

do not exceed an inch in thickness; so that their structure appears slaty. Their inclination is inconsiderable.

On the south-east side of a small cove, the shore is strewed to the distance of half a mile with loose masses of hornstone, jasper, Egyptian jasper, calcedony and quartz.—The jasper is chiefly of a red colour, and passes into a milky calcedony, being arranged in spots and clouds, and shaded with smoky imitative figures. Associated with the jasper, is that variety called *Egyptian jasper*, which is distinguished from the other by peculiar zones, circles and clouds of different colours. With these, a few small pieces of carnelian were found; but, in general, this mineral is too much fractured to afford good specimens. These minerals evidently belong to some trap dike in the neighbourhood. The sandstones here form cliffs on the shore, or appear beneath its broken fragments.

About two miles and a half from the entrance of Long's Creek, and a short distance from its banks, there occurs a light blue shale or slate-clay, and an outcropping of good coal. This stratum of coal, so far as it could be explored in the forest, is about a foot in thickness, and is probably accompanied by more valuable deposits than have yet been discovered. Seven miles above the creek, the river becomes shallow, the water passing through a groove, worn out of the sandstone and a conglomerate that generally forms the upper strata. From this place to New Canaan there are a number of shallow places, and the water, by passing along an inclined plane, runs with great rapidity during the freshet seasons.—In the month of August, the water is too scanty to float a canoe, and we were compelled to wade several miles along the channel of the stream, carrying the canoes and baggage over the rapids. At "Long Rapid", the south side of the river is bounded by a long, low cliff, and the fossil remains of vegetables appear in the bed of the stream. They are chiefly large trees, lying prostrated in and between the strata. The exterior of each tree has been converted into coal; while the centre is composed of lignite. Their trunks appear to have been decayed before they were changed into stone, and they are all flattened by the pressure they have sustained. The remains of *cacti*, large *calamites* and other tropical herbage, may be seen in almost every rock; not having any resemblance to plants now flourishing upon the soil. Still nearer the sources of the Washademoak, there is a flourishing settlement, called *New Canaan*. The river is here skirted with intervale, and although the soil is light and sandy, it is

very productive. The inhabitants along this river would derive great advantage, from having the loose boulders of rock, large sunken trees and other impediments to navigation removed: canoes might then ascend at any season of the year, with the supplies required by the lumbermen and other pioneers of the forest.

The soil, over a large tract, having been derived chiefly from the sandstones of the coal measures, is light and deficient of lime: but, from the detritus of the red sandstone, situated farther north, the fertility of many tracts has been greatly improved, and they are now capable of extensive cultivation. The whole surface of this part of the country is very low and level, presenting an even flat plane, excepting a few gentle undulations and hollows, where the brooks wind their way onward towards the sea. Along the banks of the river there are collections of alluvium, that have been brought down by the freshets, and thrown up like a wall on each of its sides. Again, there are considerable distances, where the sandstones form almost perpendicular cliffs, and the stream passes through an excavation; which appears as if it had been formed by art.

The sources of this river meet those of the Cocaigne, and both rivers take their rise in extensive carriboo plains, peat bogs and wide tracts of barren sands, where a search for minerals would be useless. Adjoining these tracts, there still remain large quantities of excellent pine and spruce timber.

On descending towards the St. John, we were directed to a peculiar spring, on the farm of Mr. David Fowler, on the north side of the river, at the Portage two miles above the ferry. The water of this spring contains a large proportion of sulphurated hydrogen, and possesses medicinal properties. It is a singular fact, that although it contains no chloride of sodium, or common salt, it has been the resort of different races of wild animals; birds also frequent it during the summer season, and drink of its waters. Great numbers of wild pigeons were seen around it, at the time of our explorations in this quarter. The spring is similar in its character to another, appearing on the side of the Salmon River, which will be noticed hereafter.

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GENERAL REMARKS

ON THE

GREAT NEW-BRUNSWICK COAL-FIELD.

Before we proceed to the local details of the formations of the Grand Lake, it is necessary to make a few general observations on the Great Coal-Field, situated between the primary rocks of the County of Charlotte and King's County, and the Straits of Northumberland, on the Gulf of St. Lawrence. Only the south and south-east sides of this coal-field have yet been explored; the west, north and north-east sides still remain to be examined, and its limits, therefore, in the latter directions, yet remain unknown. The division of this coal-field, situated southward of the St. John, is the segment of a large circle, described between the Keswick above Fredericton, and the Ocnabog below Gagetown, and touching at Skin Creek and the head of the Oromocto. Its south-eastern side extends along the trap and syenite rocks of Springfield, and the dividing line between King's and Queen's, Westmoreland and Kent Counties, to the Straits of Northumberland. From one of the branches of the Oromocto to the Saint John, and from thence eight miles eastward of the entrance of the Washademoak, the old red sandstone and carboniferous limestone appear, cropping out from beneath the mill-stone grit, along a distance of upwards of thirty miles. These formations have been already described. From what I have been able to discover, I believe, that this coal-field extends in a northerly direction to Bathurst, a distance of one hundred and fifty miles, and to Miramichi, one hundred and twenty miles, and from the latter place along the coast to Shediac, which may be estimated at seventy miles. Until the north-east side of this vast coal tract is ex-

plored, it would be impossible to give a correct account of its area; but it may for the present be considered equal to five thousand square miles!!! We are aware that in making this statement, we must necessarily be exposed to remark; but it is nevertheless supported by the most unquestionable facts; and we have only to appeal to them, in vindication of what is here recorded. This tract may, perhaps, bear the reputation of being the largest coal-field ever discovered on the globe. Over the whole of this vast area, the conglomerates, sandstones, shales, ironstone, and frequently coal, appear at the surface, filled with innumerable remains of plants, that have long since ceased to exist, but whose relics, as they are seen in almost every rock, bear ample testimony of the herbage of former periods. This vast expanded tract, in every part, abounds in tropical plants; many of which have evidently been changed into enduring beds of coal, while others have been converted into different kinds of mineral matter; and form the most faithful record of the changes this earth has undergone, since it first came from the hands of its supreme Architect. To distinguish this extensive tract from the Westmoreland district and other coal-fields in the British Provinces, we have designated it by the name of the "GREAT NEW-BRUNSWICK COAL-FIELD"; which, for its magnitude and wealth, will be better known, long after its first geological pioneer has ceased to travel over its surface.

I now proceed to give such local details, as the past season has enabled me to gather; hoping to be prepared, by the ensuing summer, again to enter upon its examination.

GRAND LAKE.

Our canoes were next conveyed across a portage, from the Washademoak to the Grand Lake, a distance of four miles. The rocks of the peninsula, between the river and the Lake, are the sandstones belonging to the coal series, being overlaid to a limited extent by the detritus of new red sandstone, where that rock is absent; and thus a far more fertile soil has been produced, than could have resulted from the arenaceous strata beneath. It may be necessary to state, for the information of those, who may not be acquainted with the topography of the Province, that the Grand Lake is about forty-five miles from St. John, and thirty from Fredericton. It is only separated from the main river by a collec-

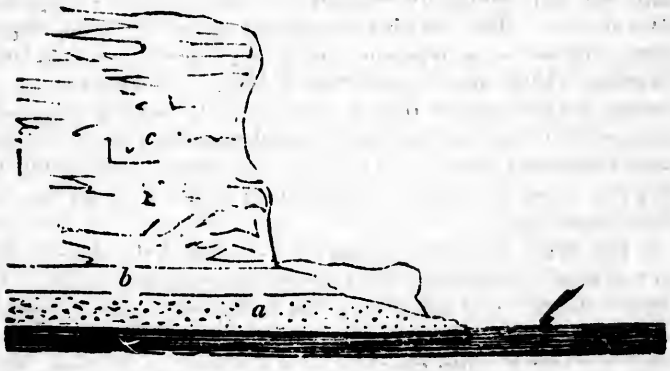
tion of alluvium, about a mile wide, and communicates with the Saint John through a narrow and deep channel, called the Jemseg; which, by running obliquely to the River, is four miles in length. This beautiful sheet of water also communicates with Maquapit and French lakes, by similar channels, opening through the alluvium forming the intervales. All these lakes and channels are navigable, and no obstacle to the passage of large vessels is presented; except by a bar where the Jemseg opens into the Grand Lake, and which, during the summer months, will not allow even small craft to pass. The Legislature, however, during the last season, granted a sum of money, and a Dredging Machine has consequently been employed in opening a deeper passage, at the junction of the Jemseg with the Lake. From the almost constant current down the Lakes, the alluvium which is made upon their shores, and by rivers emptying into their northern extremities, is swept onward towards the main river, and has not only formed extensive tracts of intervale, but has choked up the natural outlets of the water; and it may therefore be feared, that although the channel has now been excavated, it will not remain open any great length of time.

Commencing on the north-east side of the Lake, the new red sandstone may be seen at *White's Point*, where it is associated with conglomerate, and forms a considerable cliff on the shore: it then extends to a small cove, where the edge of the formation is thinned off. The point also between Young's Cove and Cumberland Bay, is composed of the same rock, which occupies a limited tract, running in a north-east direction, and parallel to the group, as seen at Studville and Butternut Ridge. The strata are nearly horizontal, and repose directly upon the sandstones of the coal series; the formation being at many places only a few yards in thickness. At the point between Young's Cove and Cumberland Bay, the character of this formation may be seen at the cliff. The lowest strata, or those which rest upon the grey sandstones of the coal group, are of a dark red colour, containing particles of hornblende, quartz, mica and feldspar. Several layers will afford good freestones. These strata are succeeded by a soft and brittle argillo-calcareous deposit, from five to ten feet in thickness, containing the remains of numerous marine plants. The most common variety is a plant resembling the *laminaria saccharina*, or the sea weed known in America by the name of "*kelp*." The original vegetable matter is entirely removed, and nothing remains but a cast of the plant, which may sometimes be removed from the rock in a very perfect

state, although the specimens soon crumble down when exposed to the air. These plants, the productions of the ocean's boundary and surface, now enter into the composition of the rocks on the shore of a fresh water lake; such are the vicissitudes which organic matter has undergone, during the successive geological periods which have occurred upon the earth. At the top of the cliff, and immediately beneath the soil, there are a few strata of coarse red sandstone without fossils, and from four to ten feet in thickness; and thus, no sooner is a change observed in the organic character of the rock, than a corresponding change is observed in its mineral characters; which shews that each class of strata was originally formed, under conditions essentially different from the others. The remaining part of the shore on the side of the Lake, and the country eastward, is almost entirely composed of the conglomerates, sandstones and shales of the coal measures.

Directly on the opposite side of the Lake, and at a place called the Red Bluff, the same argillo-calcareous sandstone is found, reposing upon the dark red strata, as represented by the following wood-cut.

Fig. 9.



a. Conglomerate. b. Dark red Sandstone. c. Argillo-calcareous Sandstone.

The conglomerate in this instance evidently belongs to the coal formations beneath; between which and the new red sandstone the dark red variety holds an intermediate situation; and in some degree partakes of the character of both formations. Similar facts are exhibited at *White's Point*,

where the strata are almost perfectly horizontal, decreasing in number and thickness, until the subjacent rock appears at the surface.

Those comparatively small patches of new red sandstone appearing in the vicinity of the lake, may be considered as detached portions of the great mass, situated to the south-east. They appear to have been collected in depressed tracts of the carboniferous series, and are but thin deposits, when compared with those of Sussex and the County of Westmoreland. Instead of terminating abruptly, as is frequently the case, their edges are thinned off, and were observed at several places to be not more than a foot in thickness. These circumstances also render a correct delineation of their boundaries, upon the Geological Map, liable to objections. Again, the surface of the rocks has been acted upon by powerful currents, which were the only adequate causes of the wide distribution of their materials, over the surface of other rocks. That these currents have proceeded from the north towards the south is evident, from the debris of each formation being spread abroad, southward of the solid strata from which it has been derived. This thinning off of the beds and distribution of detrital matter, would lead a cursory observer to believe the formation to be much greater than it really is; and frequently renders the marking of its limits an arbitrary act. But, in an agricultural point of view, those circumstances are extremely beneficial; for, frequently, the situations which would have been filled, under other circumstances, by the almost barren sands of the coal formation, are occupied by the fine, marly sandstone and clays of the superincumbent group; and thus a far greater area of fertile land has been produced, than would have resulted under other conditions.

It is true, the same causes that scattered the detritus of the red marly sandstone, also acted upon the less productive strata beneath; and have, in a few instances, spread abroad the barren sand; but as the rocks of the coal series, in general, are much more capable of resisting those causes, the effect has not been so great. The fertility of vast tracts has been greatly improved, by the dissemination of the marly clays and sandstones; which, had they remained in their original condition, would have been confined to narrow limits. In these, and numerous other effects, it is easy to be observed, how beneficially the powerful operations of former ages have contributed to the growth of plants and food for the earth's inhabitants.

The shores of the Grand Lake are strewed with boulders of granite, mica slate, syenite and trap: from whence these came, it is difficult to determine. The surface in all directions is low and level, and strongly contrasted with the abrupt hills and mountains of granite and trap rocks, farther south. No sooner does the majestic river descend from the flat grounds of the new red sandstone and coal formations, at the entrance of the Washademoak, than the scenery is changed from the tame aspect of those rocks, to rugged and uneven grounds, where the effects of volcanic agency are every where manifest.

The tide rises in the Grand Lake about six inches, which is somewhat less than its elevation in the Belleisle and Washademoak. It must not be supposed, however, that the sea flows so far up the river and into the Lake: this is by no means the case; but the effect is produced from the sea rising a few feet above the level of the river at and before high water. The result is obvious: the fresh water, being unable to escape, accumulates; a regurgitation takes place, and the lakes and rivers rise, more or less, even a hundred miles above the entrance of the main stream. The common rise at Indian Town is twenty inches; in the Grand Lake six inches; above Fredericton and one hundred miles from the sea, the rise gradually lessens from three inches to one inch, until it becomes imperceptible.

A considerable part of the shore of the Lake is covered with fine sand and shingle, or beds of pebbles, produced by the decomposition and disintegration of the sandstones and conglomerates. Under the constant heaving influence of the waves and meteoric changes, the rocks are gradually yielding, and the lake is becoming wider and more shallow. The coarser materials remain upon the shore, while the fine sediment is carried downward by the current, and yearly contributes to the collections of alluvium, at the foot of the lake and along the main stream. The sand and shingle, thrown up by the agitated waters, have formed barriers across the outlets of small streams and indentations; and thus large ponds, and finally meadows exist, where at some former period, the lake uninterruptedly prevailed. Wherever the beach is composed of sand, an embankment has been thrown up by the waves, about one hundred feet wide and ten feet high; and while many of the elms and white oaks along its borders have been undermined, the trunks of others, a little more remote from the shore, are half buried in the sand.

At a place called "The Little Keyhole," an embankment of sand has cut off a quantity of low ground, and converted it into a large pond and tract of "wild meadow;" the whole occupying an area of a square mile. The pond has a narrow outlet when the freshet is low, and large quantities of herring and alewives enter, to deposit their ova. Their retreat is then cut off, and they are dragged from the pond in nets, prepared for the purpose. This natural fish-pond is owned by Mr. Calkin, who, for the sake of the traveller it may be said, keeps a good Inn near its border.

Near this locality, a quantity of the granular argillaceous oxide of iron is mixed with the sand, and occurs in a soft, argillaceous sandstone; which, by being washed away, leaves the ore scattered along the beach. It appears in small spherical grains, or masses, from the size of a pea to a musket ball, and is identical with the *Fer oxidé brun granuleux* of Hauy. Between the Little Keyhole and Long Point, a distance of two miles, the red sandstone rests upon the dark red micaceous variety, and both lie upon the sandstones and conglomerate of the carboniferous series. Long Point is a peculiar bar of sand, thrown up by conflicting currents. It is a narrow ridge, a mile and a half in length, having its extremity carried to the south.

On the south side of the Point, the shore is composed of conglomerate, and the new red sandstone is altogether absent. This conglomerate consists of pebbles of quartz, slate, hornstone, trap and syenite. The pebbles of quartz are frequently transparent, and many of them would afford good polished specimens. This rock extends a mile and a half along the shore, and contains the remains of numerous trees, which are embedded in and between its strata, and lie prostrate in all directions in the solid rock, both beneath the water of the Lake and at the highest part of the shore.

These trees are from four inches to two feet in diameter; their cortical parts have been converted into coal, and the wood itself changed either into sandstone or heavy compact mineral masses, in which all the distinctive characters of the wood and the vegetable fibre remain, perfect and distinct. The sulphate of barytes enters into the composition of the latter variety, and is frequently beautifully crystallized, in rays proceeding from the original pith towards the circumference of the plant. Many of these specimens would be very beautiful, were they carefully polished across the fibres of the original wood. With the sulphate of barytes appears also the sulphuret of iron, in bright yellow crystals, filling up

former cracks, and enclosing the knots of original trees. Both the fossils and the strata containing them embrace much iron pyrites. This mineral, by attracting oxygen from the atmosphere, is finally changed into the sulphate of iron or copperas, which is often seen incrusting the fossil trees and the edges of the strata exposed to the weather. So perfect is the resemblance of these fossil trees to decayed wood, that they are readily observed by the inhabitants, and supposed by them to be petrified beech and maple. But they are very different from any trees now growing in the Province, and closely resemble the coniferæ of tropical climates; evidently belonging to that herbage, from which the bituminous coal in this quarter has been produced. One *phytolithus transversus (stienhauer)* and one *calamite* were found; but none of the cactæ were observed.

Large sections of these trees are broken up by the waves, and lie scattered along the shore; where they become partially polished by attrition.

It appears, that previous to the process of fossilization having taken place, these trees were in a decayed state; broken trunks and limbs of them being found in the conglomerate.

That the pebbles now forming the rock once constituted the shore of an ocean or inland sea, there can be little doubt: upon that ancient shore these rafts of trees were probably drifted, and were buried in the sand and pebbles of the coast. Finally the whole became consolidated, and by the geological changes that have taken place in the strata, they now form the bottom, shore and cliffs of a fresh water lake. All these facts can be satisfactorily explained; and, although it may seem surprising, to see a prostrate forest of tropical trees now presented to us in stone, an admirable method of elucidation is afforded, by the rafts of timber of the present climate, which have become embedded in the sand and gravel of the existing shores of the lake; and which are slowly advancing to the condition of their tropical predecessors. Similar fossil trees appear, under the same circumstances, at Minudie in Cumberland, Nova-Scotia, where they are situated above veins of coal; and from a great variety of evidences it is very certain, that a vast deposit of this important mineral is situated beneath the conglomerate and other rocks already noticed.

SALMON RIVER.

From the northern extremity of the Grand Lake, the Salmon River, a beautiful stream, extends in a north-east direction to the sources of the Richibucto, emptying into the Straits of Northumberland, in the Gulph of Saint Lawrence. At the junction of the former stream with the Lake, an outcropping of coal was discovered a few years since, and has been worked to a limited extent. This situation is peculiarly favourable for mining, and for transportation of the coal. The River is sufficiently deep to admit vessels of a hundred and fifty tons burthen, and the mines are situated only three hundred yards from the landing place. The stratum of coals already found is only twenty-two inches thick, and, in general, at a depth of eighteen feet below the surface. The coal and shale, and sandstone associated with it, are nearly horizontal. A number of small shafts have been opened, and a considerable quantity of coal has been raised, within the last four years. During the past season, the operations were discontinued: I am, however, informed by M. H. Perley, Esq. the proprietor, that they will shortly be resumed. To that gentleman I am indebted for an account of the borings, which have been made at this place: the statement of which is contained in the Appendix to this Report.

The same coal stratum again occurs at Crawford's farm, a mile and a half farther northward. It has also been opened at this place, and might be worked with considerable advantage. This part of the coal field is not covered with the new red sandstone and conglomerates, but the surface is occupied by beds of plastic clay, which are highly important in securing the mines from the influx of water from the surface.

In the neighbourhood of these mines, there is a deposit of the argillaceous oxide of iron (clay iron stone); the thickness of which could not be accurately measured, from its being partially covered by the water of the Lake. From this kind of ore, almost all the iron in Great Britain is made; and it is probable, that a sufficient quantity might be procured at the mouth of the Salmon River, to supply a smelting furnace at the very spot where coal for fuel might be taken from the earth.

The coal stratum also appears at Barton's Point, Newcastle Creek, Coal Creek and other parts of this district. At the latter place, and within an extent of six miles, twenty

levels have been run into the south bank of the stream. A considerable quantity of coal has been removed; advantage having been taken of the section, made in the rocks by the stream. These mines are not worked; the thickness of the stratum and shallowness of the river being unfavourable to their employment.

At Brown's Mills, six miles from the mouth of the creek, the coal was exposed in erecting a dam. It also occurs on Newcastle Creek, where it is worked advantageously by Major Ewing. The produce of this mine is however small, not amounting to more than three hundred chaldrons per annum. Fredericton is chiefly supplied from this quarter. The coal at all the above places is, in general, of a good quality; but, like almost all superficial strata, the sulphur it contains renders it rather unpleasant for domestic purposes. It is, nevertheless, superior to the imported varieties, for the forges of blacksmiths.

At the before-mentioned places, and at others not necessary to be noticed, the coal stratum is from fifteen to twenty inches in thickness, and extends beneath an area of sixty or seventy miles in circumference, at an average depth of ten feet below the surface. It rests upon and is covered with beds of fine, light-blue slate clay or shale. This shale, when first taken from the earth, is somewhat compact; but, by being exposed to the atmosphere, it undergoes a great change, and is soon converted into a fine, soft, tenacious clay. Its decomposition is hastened by the presence of the sulphuret of iron. These beds contain vast quantities of fire clay; which is a substance of considerable value. Formerly, the fire clay used in the Province was imported from Great Britain; but the coal measures at the Grand Lake will supply the demand, at a far cheaper rate. These shales are associated with the grey sandstones already described: some of these, in the vicinity of Salmon River, contain large quantities of the decomposing sulphuret of iron, and are admirably adapted to the manufacture of copperas. The sulphur, by absorbing oxygen from the atmosphere, forms sulphuric acid; which, by combining with the iron, produces sulphate of iron, or the copperas of commerce. Large specimens, brought from Salmon River, became covered in a few days with an efflorescence of the sulphate, and required immersion in a solution of gum, to prevent their decomposition. At present, all the copperas used in the Province, is imported from Great Britain and the United States.

When the uniform thickness of the coal, the regularity of its distance above the waters of the Lake and its tributaries, and also its distance below the surface, the apparent absence of faults, and various other circumstances connected with its quality, horizontality, &c. are considered, there can be no doubt, that only one, and that the most superficial stratum, has yet been discovered; nor could it be expected, that an outcropping of the lower and richer deposits would appear at the surface, where all the strata rest upon a nearly level basis; and indeed, even should there be any faults, whereby the lower strata might have been elevated, the rocks are too much concealed by detritus and thick set forests, to admit of their being discovered without much labour. There can be no doubt, that there are other and far richer deposits of coal, beneath the one already discovered; but at what distance from the surface it is impossible to calculate, in consequence of the almost horizontal position of each stratum in the coal series.

In my examinations of the coal district of Nova-Scotia, I found that each coal basin contained, as usual, a number of separate and distinct coal strata. At Sydney, Cape Breton, they are numerous. In the eastern section of that Island there are no less than fourteen veins of good coal; and each of them is over three feet in thickness. At Pictou, Nova-Scotia, the main coal band is no less than thirty-six feet in thickness, and many other strata are each from a foot to two yards thick. At Tatmagouche three beds have been discovered; at the Joggins, on Cumberland Bay, I have measured no less than nineteen veins; also at Memramcook, Shepody, and other parts of the Westmoreland Coal Field in New-Brunswick, several strata were discovered during the explorations of the past and present season. These are from two to ten feet in thickness. Although the coal of Westmoreland differs in character from the bituminous strata of other parts of the Province, it is evidently contemporaneous with other deposits of the great coal region of New-Brunswick. Reasoning by analogy and on a comparison of the coal basins belonging to the same vast district, it cannot be supposed that there exists only a solitary stratum at the Grand Lake; but it must be believed, on the other hand, that there are a number of deposits of coal in that quarter. The coal already discovered is only a few feet below the surface: were it the lowest in the series, the millstone grit would probably have been penetrated by the borings; and there are no val-

leys of denudation here, which indicate that the upper coal strata have been removed.

The difficulties that prevent successful mining at the Grand Lake, at present, are the narrowness of the stratum now worked and the depth at which the lower deposits are situated. Similar obstacles have frequently presented themselves in England, but they have been overcome by capital and industry. At Monkwearmouth, near Sutherland, a shaft has been sunk fifteen hundred feet below high water mark, and sixteen hundred below the surface of the ground. Even at this great depth, and under an influx of water of three thousand gallons per minute, the lower coal strata have been penetrated, and ultimate success has rewarded the labour and enterprise of Messrs. Pemberton, the indefatigable proprietors. At the period when an attempt was made, to explore the deeper deposits of coal at Grand Lake or Salmon River, by boring, the surrounding country was unexplored; but, during the Geological Survey, all the formations, from the granite up to the coal series, have been found where they cross the Saint John. From these, data have been obtained, which shew that the coal may be reached at a less depth, near the main river; and a sum of money would be well employed, in boring at a judicious site, in the neighbourhood of Gagetown, or on the north side of the Washademoak. The result of such an enterprise would be of the highest importance to the Province, and there could be no doubt of its final success. There are a number of steamboats running on the river, and along every part of the coast. Almost all the fuel, consumed by these boats, is imported from England. As steam navigation and manufactories increase, so will the demand for coal become urgent; independent of the supply, which will always be required, to meet the wants of the United States; where this important mineral does not exist under such circumstances, as can ever diminish, to any considerable degree, the price of British fuel.

The bituminous shale, underlying the coal at Grand Lake and Salmon River, abounds in the remains of plants, that flourished upon the earth, at some remote period in its history, and when its condition was different from any that succeeded. These plants have not all been converted into coal: many of them are but partially carbonized; others have had their situations filled up with the clay where they were embedded. In other instances, the bark only has been changed into coal; but all point out the character of the vegetation and the climate, that preceded a new epoch, when

other plants were to be supported on the soil. All these fossil plants were evidently the productions of a warm climate, and such as could not have flourished in these latitudes, under their present temperature. The *cacti* are less numerous here than in Nova-Scotia; while the *ferns* appear to be more abundant. It is very difficult to class these plants with any existing species, as they have now no living representatives. Fern leaves are abundant; and two species of grasses were taken from the floor of the Salmon River mines, which, with their stems and leaves, had been changed into coal.

These fossils are admirably preserved; and the impression of almost every fibre can be distinctly traced on the shale, which has been stamped with their figures. The soft rock containing them requires to be thickly coated with gum to prevent its decomposition. A particular desoription of these plants must be deferred for the present: it may, however, be remarked, that it appears evident from the fossil flora of the coal period, that the plants, laid up to supply mankind with fuel, were scattered in distinct groups over the country where they lived. In one coal basin, one species is most abundant; in another, a different class is found; and probably the coal, in some instances, was derived from one kind only.

In the conglomerate of Long Point, we have seen large trees deposited among the pebbles, now forming the strata; and which, during the lapse of ages, have been converted into solid rock. Far beneath these, the tender herbage of a tropical climate has been changed into coal, which is wrapt in the foliage of remote ages. Still farther downward, the carboniferous limestone contains the remains of shell-fish, entombed side by side in ponderous mountain masses. Such are the facts geology discloses; notwithstanding the science may be said to be even now in its infancy.

It is not necessary, in the present day, to bring forward any argument, to prove the vegetable origin of coal: the evidences, as they are offered in the earth and in the coal itself, being considered by almost all geologists sufficiently clear, to establish the fact; and it seems evident also, that at different periods in the earth's history, its plants have been collected in vast quantities, and converted into fuel, the most important object of the mineral kingdom. The situation of the carboniferous strata shews that they were deposited in depressed situations; and from the nature of their sandstones and shales, it is evident, that those depressions or basins were filled, from time to time, by detrital and sedimentary matter;

but it does not always appear equally obvious, that the plants from which the coal has resulted, have been transported. In many instances, those detrital and sedimentary beds might have been carried into basins, and there buried the herbage that flourished in them.

Many of the arenaceous strata, on the shores of the Grand Lake, will afford excellent freestones for buildings: they have been quarried on the farm of Mr. John Syphers, where the rock is compact and very durable. Another quarry has been opened about a mile below Mr. DeVeber's mills, on the Salmon River. The grey sandstones extend along the whole length of this stream, to the sources of the Richibucto, and from thence to the mouth of that river.—The former stream passes, in a tranquil manner, through a deep groove worn out of the strata, by the action of the water. The whole surface of the country here, and to the distance of sixty miles in a north-east direction, is only about twenty feet above the level of the lake. Viewed from a high tree, it appears like an extensive *prairie*, covered with a dense forest of spruce, with occasionally a grove of pine.—The river, pursuing its way along a crooked bed, is frequently skirted with rich intervale, and shaded with majestic elms. The soil of the uplands is light and sandy. About eighteen miles from the lake and mouth of the stream, at a place called "Cast-away Island", a spring issues from the rocks, which will fill a hogshead every fifteen minutes: the water has a very unpleasant taste and odour, and was formerly believed by the Indians to be poisonous. By analysis, sixteen fluid ounces were found to contain—

Carbonic Acid,		
Sulphurated Hydrogen,		
Sulphate of Magnesia.....	4	grains.
Sulphate of Soda.....	17.5	,,
Oxide of Iron.....	4	,,

The water is mildly aperient, from the sulphates of soda and magnesia contained in it. The iron gives it tonic properties.

Ascending the stream still farther, the intervale diminishes, and the river runs along a smooth channel, from fifteen to thirty yards wide. Several miles above the spring, there is a deposit of the red oxide of iron; which was discovered beneath the fine sand at the level of the water. In times of freshet, it is covered, and its situation can then only be

known, by the yellow colour of the water descending from it. It will yield a large supply of the yellow ochre, used in painting.

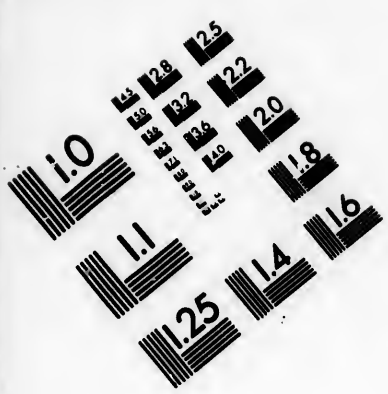
So far as vision extends, in every direction, from the upper part of the river, the surface presents one vast level tract, in many places occupied by groves of towering hemlocks. Not a rock was observed, except such as belong to coal measures, which are often displayed in great beauty, on the banks of the stream, and wherever they are not covered by beds of clay and sand, or other members of the tertiary group, or the common detritus of the surface.

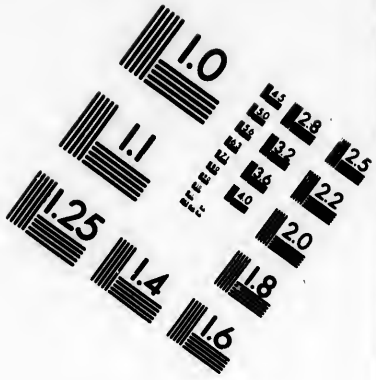
ALLUVIUM

OF THE SAINT JOHN.

It may not be improper, in concluding the present Report, to take a brief view of the extensive collections of alluvium which have been formed, and are still accumulating along the banks of the Saint John. This majestic stream, having taken its rise about four hundred miles in the interior of the country, receives vast supplies of water from the numerous branches, tributaries and lakes communicating with it; until it is poured into the sea, through a narrow outlet, near the city. It not only conveys to the ocean the surplus waters of a large part of New-Brunswick, but also drains a part of the State of Maine, belonging to the United States.

Of all the agents employed in modifying the surface of the earth, water is the most active. Its operations commence in the falling of the gentle shower, and do not cease until after the mighty torrent has lost its fury in the sea. The particles of the hardest rocks become loosened by atmospheric changes, and are swept downwards from the mountain's brow, to form new deposits in the valleys; by currents of water even large rocks are torn from their native beds, and transported to great distances. The soil thus formed is always deposited along the lowest levels; and the matter there collected, whether consisting of large stones, gravel, sand, or mud, is identical with the rocks from which it was derived, unless changed by some chemical affinity existing between its atoms. From the *debris* of the surrounding country, all the low intervale has been produced. Each succeeding freshet brings down a new supply of mud and sediment, which is added to former accumulations, and yearly increases their fertility.





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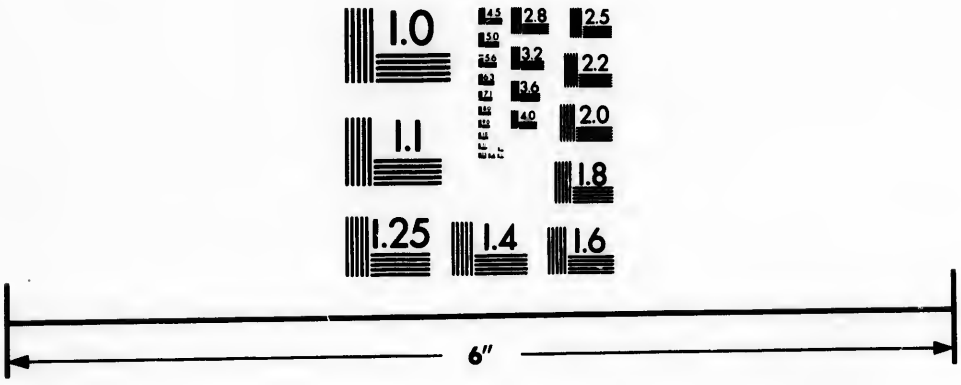

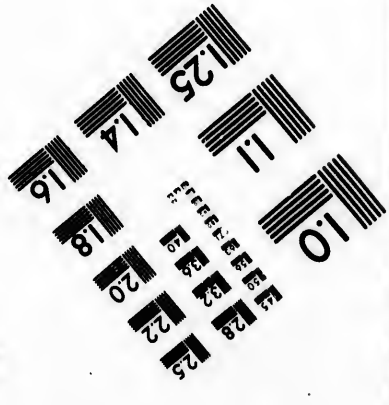

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The alluvial deposits along the Saint John contain the relics of animals and plants, still belonging to the country, and suffering transportation through the medium of water. Along the deep water-courses and channels worn out by the freshets, abraded banks, and newly opened ditches, I found rafts of timber, boards, shingles, leaves, bones of birds and quadrupeds, and fluviatile shells, all buried in the alluvium, where they are deposited, in the same manner that the remains of organized bodies appear in the solid rocks. The sediment accumulates on the borders of the river more readily than near the upland. This arises from the particles of alluvium being thrown down before they reach the more remote places; hence, all the coarse materials, by falling first, will be found upon the banks of the river, and the fine particles only are conveyed, in times of freshet, to the lowest and most remote parts. Thus the river runs between two alluvial walls, thrown up by the greater deposit along its margin. The Mississippi and other large streams exhibit the same phenomena.

From the annual freshets that overflow all the low lands along the Saint John, those lands are rising, and, consequently, improving in quality, by being rendered capable of producing the finer grasses; and the time is drawing nigh, when all the sunken tracts along this noble stream will become so elevated, by yearly accessions of diluvial matter, that they will only be covered by water during extreme floods, and can be extensively cultivated.

From the slow movement of the current, this river may be considered a lake during the summer season; but in the spring and autumn the violence of the flood sweeps down immense quantities of sand, gravel and mud: but, as the river may be said to be dammed up at its mouth, the sedimentary matter cannot escape, and by the back current of the tide it is deposited along the banks and low places, which are yearly receiving new deposits. In the mean time the channel is kept freely open, and the sediment brought down is not permitted to lessen its depth; the water always securing for itself a free passage.

When we look back and consider what was the condition of this river valley previous to the collections of alluvium along its borders, we see the site of an ancient estuary of the sea meeting a lake. The elevation of the coast has been already adverted to, and the evidences of that event have been noticed. From all these it appears evident that the physical character of the country has been greatly changed, at a period compa-

ratively recent in geological chronology. The precise nature of the revolutions, by which the physical geography of this part of the Province has been altered, may never be perfectly understood; but that they have all improved its most important character, and especially its agricultural condition, is evident; and the wisdom and goodness of Supreme Intelligence are everywhere manifest.

I have the honor to be,

Your Excellency's most obedient

And very humble Servant,

ABRAHAM GESNER, F. G. S.

PROVINCIAL GEOLOGIST, &c. &c.

Saint John, N. B., January 1st, 1841.

APPENDIX A.

Page 23.—Since the notice of the animal remains in the tertiary strata of New-Brunswick went to the press, information has been received, which renders it probable that the portion of a jaw, referred to in the text, was imported from Africa. This part of a jaw and other fragments of an enormous bone were given to the writer, and placed in his private museum, by a gentleman, who is still of opinion that some of these skeleton remains belong to the Province. Much doubt must, however, remain on this subject, unless the matter is decided by future discoveries. Every anatomist will readily admit the difficulty of determining upon the character of an animal, from the examination of a few small and mutilated pieces of its bones; and if any error has arisen in the present instance, it is justly to be ascribed to these circumstances.

ERRATUM.

Page 23—10th line from the top, for "were found," read, were said to have been found.

APPENDIX B.

Saint John, N. B., 28th November, 1840.

Sir,—

In reply to your enquiries respecting the borings at the Salmon River Coal Mines, I beg to state, that I have great pleasure in furnishing you with a copy of the return, from the reports made to me by the Superintendant at the Mines.

The boring commenced on the 25th day of May, 1837, and ended on the 28th day of May, 1839. During that period, the work was carried on without intermission, except some occasional delays arising from accidents; and during the last six months the boring went on night and day, two gangs of men being employed. The depth attained, as you will notice by the return, was four hundred and three feet six inches; the cost of examining which exceeded Two Thousand Pounds.

While the boring was going on, mining operations were also proceeding, and a large quantity of Coal was raised from the upper seam, which is from eighteen to twenty-one feet below the surface. These Coals, when first raised, are very hard; but, on being exposed to wet and the action of the atmosphere, yield thereto and fall to pieces. They are highly bituminous, possessing the fat, caking qualities of the best Newcastle Coal.

Since May, 1839, the works have not been in operation, but arrangements are now making to commence again next Spring. The raising of Coal from the upper seam pays very fairly; and as the Company have erected a great number of expensive buildings, for their machinery and the accommodation of their miners, the business may be carried on upon an extensive scale.

I have the honour to be,
Your very obedient servant,

M. H. PERLEY,

Secretary Salmon River Coal Company.

A. Gesner, Esquire, F. G. S.
Provincial Geologist, &c. &c. &c.

RETURN OF BORINGS

FROM THE SALMON RIVER COAL MINES.

(Commencing at the Surface.)

	Feet.	Ins.
Vegetable Soil,	1	0
Sand and Gravel,	6	2
Broken Shale and Clay,	4	7
Shale, (with impressions of Ferns, &c.)	9	5
Bituminous Coal,	1	10
Marly Clay,	1	0
Ditto and Shale,	2	0
Shale,	7	0
Shaly Sandstone,	1	0
Sandstone, (blue grit,)	32	0
Conglomerate,	3	8
Shale, (*with a little Coal,*)	4	6
Sandstone and Conglomerate,	0	8
Conglomerate,	8	0
Shale, *with thin seams of Coal*,	3	8
Sandstone and Shale,	2	6
Conglomerate and Sandstone,	1	0
Sandstone and Shale,	1	0
Conglomerate,	13	0
Sandstone, (blue grit,)	2	0
Grey Sandstone,	5	0
Sandstone and Shale,	2	0
Same—interstratified,	2	0
Sandstone, (blue grit,)	6	0
Sandstone, Shale and Fire Clay,	1	0
Same—and Red Marl,	1	0
Slate Clay and Sandstone,	2	0
Shaly Sandstone and Marl,	1	0
Red and Blue Shaly Marl,	6	0
Marly Shale and Sandstone,	1	0
Sandstone, (blue grit,)	9	0
Sandstone, *with an inch of Coal*,	1	0
Conglomerate,	1	0
Sandstone and Shale,	1	0
Conglomerate,	4	0
Shale and Conglomerate,	1	0
Conglomerate, *with a little Coal*,	2	0
Ditto and Sandstone,	1	0
Shale,	2	0
Red Marly and Blue Shale,	1	0
Red Marly Shale,	5	0
Red and Blue Sandstone,	1	0
Sandstone, (blue grit,)	39	0
Clay Ironstone,	2	0
Quartz and Pyrites,	3	0
Carried forward,	206	0

	Feet.	Ins.
Brought forward,	206	0
Clay Ironstone,	1	0
Conglomerate,	1	0
Shale and Quartz,	1	0
Conglomerate,	1	0
Clay Ironstone,	3	0
Shale and Quartz,	1	0
Clay Ironstone,	4	0
Shale,	1	0
Limestone,	3	0
Conglomerate,	2	0
Clay Ironstone,	3	0
Quartz and Slate,	4	0
Clay Ironstone,	13	0
Slate and Quartz,	1	0
Clay Ironstone,	4	0
Argillo-ferruginous Limestone,	1	0
Shale, with vegetable impressions,	2	0
Bituminous Shale and Coal,	8	0
Quartz, Slate, Ironstone and Fire Clay,	1	0
Clay Ironstone,	3	0
Ditto, with Slate and Quartz,	1	0
Slate, Shale *and Coal*,	1	0
Slate, Quartz and Shale,	4	0
Slate, Shale and Ironstone,	1	0
Clay Ironstone,	5	0
Ditto, (very red colour,)	1	0
Ditto, *with Coal*,	1	0
Ditto,	4	0
Sandy Shale and Slate Clay,	1	0
Clay Ironstone,	1	0
Whinstone,	1	0
Sandstone *and Coal*,	1	0
Coarse Sandstone,	10	0
Sandstone, Shale *and Coal*,	1	0
Clay Ironstone,	3	3
Coarse Sandstone,	1	0
Bituminous Shale,	1	0
Coarse Sandstone, with Quartz,	2	0
Shale and Quartz,	4	0
Shale *and Coal*,	1	0
Hard Blue Shale,	1	0
Sandy Shale and Klingel,	2	0
Coarse Sandstone,	6	0
Soft Blue Shale,	2	0
Carried forward,	320	0

	Feet.	Ins.
Brought forward,	320	0
Clay Ironstone and Sandstone,	1	0
Coarse Sandstone,	6	0
Soft Shale,	1	0
Coarse Sandstone,	6	6
Soft Blue Shale,	1	5
Coarse Sandstone,	1	2
Soft Shale,	9	11
Sandstone,	0	6
Soft Shale,	2	0
Coarse Sandstone,	2	1
Mundick, (Pyrites,)	0	9
Limestone,	0	6
Shale and Freestone Balls,	6	4
Fine Sandstone,	2	3
Carried forward,	361	5

	Feet.	Ins.
Brought forward,	361	5
Coarse Sandstone,	1	8
Sandstone, (blue grit,)	15	0
Limestone,	3	1
Shale,	1	3
Sandstone,	2	6
Ironstone,	4	11
Shale,	0	8
Ironstone,	1	0
Shale,	0	5
Ironstone,	2	6
Shale,	2	3
Ironstone,	5	7
Grey Slate,	1	3
Total,	403	6

GLOSSARY

OF GEOLOGICAL AND OTHER SCIENTIFIC TERMS USED IN THIS REPORT.

(FROM LYELL'S PRINCIPLES OF GEOLOGY.)

ALGÆ. An order or division of the cryptogamic class of plants. The whole of the sea-weeds are comprehended under this division, and the application of the term in this work is to marine plants. *Etym.*, *alga*, sea-weed.

ALLUVIAL. The adjective of alluvium, which see.

ALLUVIUM. Earth, sand, gravel, stones, and other transported matter, which has been washed away and thrown down by rivers, floods or other causes, upon land not *permanently* submerged beneath the waters of lakes or seas. *Etym.*, *alluo*, to wash upon.

AMMONITE. An extinct and very numerous genus of the order of mollusccous animals called Cephalopoda, allied to the modern genus Nautilus, which inhabited a chambered shell, curved like a coiled snake. Species of it are found in all geological periods of the secondary strata; but they have not been seen in the tertiary beds. They are named from their resemblance to the horns on the statues of Jupiter Ammon.

AMORPHOUS. Bodies devoid of regular form.

AMYGDALOID. One of the forms of the Trap rocks, in which agates and simple minerals appear to be scattered like almonds in a cake.

ANTHRACITE. A shining substance, like black lead; a species of mineral charcoal.

ANTICLINAL AXIS. If a range of hills, or a valley, be composed of strata, which on the two sides dip in opposite directions, the imaginary line that lies between them, towards which the strata on each side rise, is called the anti-clinal axis. In a row of houses, with steep roofs, facing the south, the slates represent inclined strata, dipping north and south, and the ridge is an east and west anticlinal axis.

ARENACEOUS. Sandy. *Etym.*, *arena*, sand.

ARGILLACEOUS. Clayey, composed of clay. *Etym.*, *argilla*, clay.

AUGITE. A simple mineral, of a dark green, or black colour, which forms a constituent part of many varieties of volcanic rocks.

BASALT. One of the most common varietics of the Trap rocks. It is a dark green or black stone, composed of augite and felspar, very compact in texture, and of considerable hardness, often found in regular pillars of three or more sides, called basaltic columns. Remarkable examples of this kind are seen at the Giant's Causeway, in Ireland, and at Fingal's Cave, in Staffa, one of the Hebrides. The term is used by Pliny, and is said to come from *basal*, an Æthiopian word signifying iron. The rock often contains much iron.

BITUMEN. Mineral pitch, of which the tar-like substance which is often seen to ooze out of the Newcastle coal when on the fire, and which makes it cake, is a good example. *Etym.*, *bitumen*, pitch.

BITUMINOUS SHALE. An argillaceous shale, much impregnated with bitumen, which is very common in the coal measures.

BOULDERS. A provincial term for large rounded blocks of stone lying on the surface of the ground, or sometimes imbedded in loose soil, different in composition from the rocks in their vicinity, and which have, therefore, been transported from a distance.

BRECCIA. A rock composed of angular fragments, connected together by lime or other mineral substance. An Italian term.

CALCAREOUS ROCK. Limestone. *Etym.*, *calx*, lime.

CALCAREOUS SPAR. Crystallized carbonate of lime.

CALCEDONY. A siliceous, simple mineral, unerystallized. Agates are partly composed of calcedony.

CARBONATE OF LIME. Lime combines, with great avidity, with carbonic acid, a gaseous acid, only obtained fluid when united with water,—and all combinations of it with other substances are called *Carbonates*. All limestones are carbonates of lime, and quick lime is obtained by driving off the carbonic acid by heat.

CARBONIFEROUS. A term usually applied, in a technical sense, to an ancient group of secondary strata; but any bed containing coal may be said to be carboniferous. *Etym.*, *carbo*, coal, and *fero*, to bear.

CHERT. A silicious mineral, nearly allied to calcedony and flint, but less homogeneous and simple in texture. A gradual passage from chert to limestone is not uncommon.

CLINKSTONE, called also phonolite, a felspathic rock of the Trap family, usually fissile. It is sonorous when struck with a hammer, whence its name.

COAL FORMATION. This term is generally understood to mean the same as the Coal Measures. There are, however, "coal formations" in all the geological periods, wherever any of the varieties of coal forms a principal constituent part of a group of strata.

CONFORMABLE. When the planes of one set of strata are generally parallel to those of another set which are in contact, they are said to be conformable.

CONGLOMERATE, OR PUDDINGSTONE. Rounded water-worn fragments of rock or pebbles, cemented together by another mineral substance, which may be of a siliceous, calcareous, or argillaceous nature. *Etym.*, *con*, together, *glomero*, to heap.

CONIFERÆ. An order of plants which, like the fir and pine, bear cones or tops in which the seeds are contained. *Etym.*, *conus*, cone, and *fero*, to bear.

CRATER. The circular cavity at the summit of a volcano, from which the volcanic matter is ejected. *Etym.*, *crater*, a great cup or bowl.

CROP OUT. A miner's or mineral surveyor's term, to express the rising up or exposure at the surface of a stratum or series of strata.

CRUSTACEA. Animals having a shelly coating or crust which they cast periodically. Crabs, shrimps and lobsters, are examples.

CRYSTALLIZED. A mineral which is found in regular forms or crystals is said to be crystallized.

CRYSTALLINE. The internal texture which regular crystals exhibit when broken, or a confused assemblage of ill-defined crystals. Loaf-sugar and statuary-marble have a *crystalline* texture. Sugar-candy and calcareous spar are crystallized.

DEBRIS. A term applied to the fragments or remains of disintegrated rocks.

DETRITUS. See "Debris."

DELTA. When a great river, before it enters the sea, divides into separate streams, they often diverge and form two sides of a triangle, the sea being the base. The land included by the three lines, and which is invariably alluvial, was first called, in the case of the Nile, a delta, from its resemblance to the letter of the Greek alphabet which goes by that name. Geologists apply the term to alluvial land formed by a river at its mouth, without reference to its precise shape.

DENUDATION. The carrying away, by the action of running water, of a portion of the solid materials of the land, by which inferior rocks are laid bare. *Etym.*, *denudo*, to lay bare.

DIKES. When a mass of the unstratified or igneous rocks, such as granite, trap and lava, appears as if injected into a great rent in the stratified rocks, cutting across the strata, it forms a dike; and as they are sometimes seen running along the ground, and projecting, like a wall, from the softer strata on both sides of them having wasted away, they are called, in the north of England and in Scotland, *dikes*, the provincial name for wall. It is not easy to draw the line between dikes and veins. The former are generally of larger dimensions, and have their sides parallel for considerable distances; while veins have generally many ramifications, and these often thin away into slender threads.

DILUVIUM. Those accumulations of gravel and loose materials which, by some geologists, are said to have been produced by the action of a diluvian wave or deluge sweeping over the surface of the earth. *Etym.*, *diluvium*, deluge.

DIP. When a stratum does not lie horizontally, but is inclined, it is said to dip towards some point of the compass, and the angle it makes with the horizon is called the angle of dip or inclination.

EARTH'S CRUST. Such superficial parts of our planet as are accessible to human observation.

ESCARPMENT. The abrupt face of a ridge of highland. *Etym.*, *escarper*, French, to cut steep.

ESTUARIES. Inlets of the land, which are entered both by rivers and the tides of the sea. Thus we have the estuaries of the Thames, Severn, Tay, &c. *Etym.*, *æstus*, the tide.

FAULT, in the language of miners, is the sudden interruption of the continuity of strata in the same plane, accompanied by a crack or fissure varying in width from a mere line to several feet, which is generally filled with broken stone, clay, &c.

FELSPAR. A simple mineral, which, next to quartz, constitutes the chief material of rocks. The white angular portions in granite are felspar. This mineral always contains some alkali in its composition. In *common felspar* the alkali is potash; in another variety, called Albite or Cleavlandite, it is soda. Glassy felspar is a term applied when the crystals have a considerable degree of transparency. *Compact* felspar is a name of more vague signification. The substance so called appears to contain both potash and soda.

FELSPATHIC. Of or belonging to felspar.

FERRUGINOUS. Any thing containing iron. *Etym.*, *ferrum*, iron.

FLOETZ ROCKS. A German term, applied to the secondary strata by the geologists of that country, because these rocks were supposed to occur most frequently in flat horizontal beds. *Etym.*, *flotz*, a layer or stratum.

FLUVIATILE. Belonging to a river. *Etym.*, *fluvius*, a river.

FORMATION. A group, whether of alluvial deposits, sedimentary strata, or igneous rocks, referred to a common origin or period.

FOSSIL. All minerals were once called fossils, but geologists now use the word only to express the remains of animals and plants found buried in the earth.—*Etym.*, *fossilis*, any thing that may be dug out of the earth.

FOSSILIFEROUS. Containing organic remains.

GALENA. A metallic ore, a compound of lead and sulphur. It has often the appearance of highly polished lead. *Etym.*, *galeo*, to shine.

GARNET. A simple mineral, generally of a deep red colour, crystallized; most commonly met with in mica slate, but also in granite and other igneous rocks.

GEOLOGY, GEOGNOSY. Both mean the same thing; but with an unnecessary degree of refinement in terms, it has been proposed to call our description of the structure of the earth *geognosy*, (*Etym.*, *gea*, earth, and *ginosco*, to know,) and our theoretical speculations as to its formation *geology*, (*Etym.*, *logos*, a discourse.)

GNEISS. A stratified primary rock, composed of the same materials as granite, but having usually a larger proportion of mica and a laminated texture. The word is a German miner's term.

GRANITE. An unstratified or igneous rock, generally found inferior to or associated with the oldest of the stratified rocks, and sometimes penetrating them in the form of dikes and veins. It is usually composed of three simple minerals, felspar, quartz, and mica, and derives its name from having a coarse *granular* structure: *granum*, Latin for grain. Westminster, Waterloo, and London bridges, and the paving-stones in the carriage-way of the London streets, afford good examples of the most common varieties of granite.

GREENSTONE. A variety of trap composed of hornblende and felspar.

GREYWACKE. *Grauwacke*, a German name, generally adopted by Geologists for the lowest members of the secondary strata. The rock is very often of a grey colour, hence the name *grau*, being German for grey, and *wacke*, being a Provincial miner's term.

GYPSUM. A mineral composed of lime and sulphuric acid, hence called also *sulphate of lime*. Plaster and stucco are obtained by exposing gypsum to a strong heat. It is found so abundantly near Paris, that plaster of Paris is a common term in this country for the white powder of which casts are made. The term is used by Pliny for a stone used for the same purposes by the ancients. The derivation is unknown.

HORNBLENDE. A simple mineral of a dark green or black colour, which enters largely into the composition of several varieties of the trap rocks.

HORNSTONE. A siliceous mineral substance, sometimes approaching nearly to flint or common quartz. It has a conchoidal fracture, and is infusible, which distinguishes it from the common felspar.

LACUSTRINE. Belonging to a lake. *Etym.*, *lacus*, a lake.

LAMINÆ. Latin for plates; used in geology for the smaller layers of which a stratum is frequently composed.

LANDSLIP. A portion of land that has slid down in consequence of disturbance by an earthquake, or from being undermined by water washing away the lower beds which supported it.

LAVA. The stone which flows in a melted state from a volcano.

LIAS. A provincial name, adopted in scientific language, for a particular kind of limestone, which, being characterized together with its associated beds, by peculiar fossils, forms a particular group of the secondary strata.

LIGNITE. Wood converted into a kind of coal. *Etym.*, *lignum*, wood.

LOAM. A mixture of sand and clay.

MAMMOTH. An extinct species of the elephant (*E. primigenius,*) of which the fossil bones are frequently met with in various countries. The name is of Tartar origin, and is used in Siberia for animals that burrow under ground.

MARL. A mixture of clay and lime; usually soft, but sometimes hard, in which case it is called indurated marl.

MICA. A simple mineral, having a shining silvery surface, and capable of being split into very thin elastic leaves or scales. It is often called *talc*, in common life, but mineralogists apply the term talc to a different mineral. The brilliant scales in granite are mica. *Etym. mico*, to shine.

MOUNTAIN LIMESTONE. A series of limestone strata, of which the geological position is immediately below the coal measures, and with which they also sometimes alternate.

NEW RED SANDSTONE. A series of sandy, argillaceous, and often calcareous strata, the predominant colour of which is brick-red, but containing portions which are of a greenish grey. These occur often in spots and stripes, so that the series has sometimes been called the variegated sandstone. The European formation so called lies in a geological position immediately above the coal measures.

OLD RED SANDSTONE. A stratified rock belonging to the carboniferous Group.

ORGANIC REMAINS. The remains of animals and plants (*organized* bodies) found in a fossil state.

OXIDE. The combination of metal with oxygen; rust is oxide of iron.

OXYGEN. One of the constituent parts of the air of the atmosphere; that part which supports life. For a further explanation of the word, consult elementary works on chemistry.

PALEONTOLOGY. The science which treats of fossil remains, both animal and vegetable. *Etym.*, *pelaios*, ancient, *onta*, beings, and *logos*, a discourse.

PORPHYRY. An unstratified or igneous rock. The term is as old as the time of Pliny, and was applied to a red rock with small, angular, white bodies diffused through it, which are crystallized felspar, brought from Egypt. The term is hence applied to every species of unstratified rock in which detached crystals of felspar or some other mineral are diffused through a base of other mineral composition.—*Etym.*, *porphyra*, purple.

PLASTIC CLAY. One of the beds of the Eocene tertiary period, so called because it is used for making pottery. The formation to which this name is applied is a series of beds chiefly sands, with which the clay is associated. *Etym.*, *plasso*, to form or fashion.

PUMICE. A light spongy lava, of a white colour, produced by gases, or watery vapour getting access to the particular kind of glassy lava called obsidian, when in a state of fusion—it may be called the froth of melted volcanic glass. The word comes from the Latin name of the stone, *pumex*.

PYRITES (Iron). A compound of sulphur and iron, found usually in yellow shining crystals like brass, and in almost every rock, stratified and unstratified. The shining metallic bodies, so often seen in common roofing slate, are a familiar example of the mineral. It is derived from a Greek word, meaning *fire*, because, under particular circumstances, the stone produces spontaneous heat, and even inflammation.

QUARTZ. A German provincial term, universally adopted in scientific language for a simple mineral composed of pure silex, or earth of flints; rock crystal is an example.

RED MARL. A term often applied to the New Red Sandstone, which is the principal member of the Red Sandstone Group.

SAND STONE. Any stone which is composed of an agglutination of grains of sand, whether calcareous, siliceous, or of any other mineral nature.

SAURIAN. Any animal belonging to the lizard tribe. *Etym.*, *saura*, a lizard.

SCHIST is often used as synonimous with slate; but it may be very useful to distinguish between a schistose and a slaty structure. The granitic or primary *schists*, as they are termed, such as gneiss, mica-schist, and others, cannot be split into an indefinite number of parallel laminæ, like rocks which have a true slaty cleavage. The uneven schistose layers of mica-schist and gneiss are probably layers of deposition which have assumed a crystalline texture.

SCHISTOSE ROCKS. See "Schist."

SEAMS. Thin layers which separate two strata of greater magnitude.

SECONDARY STRATA. An extensive series of the stratified rocks which compose the crust of the globe, with certain characters in common, which distinguish them from another series below them called *primary*, and from a third above them called *tertiary*.

SEDIMENTARY ROCKS, are those which have been formed by their materials having been thrown down from a state of suspension or solution in water.

SERPENTINE. A rock usually containing much magnesian earth, for the most part unstratified, but sometimes appearing to be an altered or metamorphic stratified rock. Its name is derived from frequently presenting contrasts of colour, like the skin of some serpents.

SHALE. A provincial term, adopted by geologists, to express an indurated slaty clay. *Etym.*, German *schalen*, to peel, to split.

SHINGLE. The loose and completely water-worn gravel on the sea-shore.

SILEX. The name of one of the pure earths, being the Latin word for *flint*, which is wholly composed of that earth. French geologists have applied it as a generic name for all minerals composed entirely of that earth, of which there are many of different external forms.

SILICA. One of the pure earths. *Etym.*, *silex*, flint, because found in that mineral.

SILICEOUS. Of or belonging to the earth of flint. *Etym.*, *silex*, which see. A siliceous rock is one mainly composed of silex.

STRATIFIED. Rocks arranged in the form of *strata*, which see.

STRATIFICATION. An arrangement of rocks in *strata*, which see.

STRATA, STRATUM. The term stratum, derived from the Latin verb *struo*, to straw or lay out, means a bed or mass of matter spread out over a certain surface by the action of water, or in some cases by wind. The deposition of successive layers of sand or gravel in the bed of a river, or in a canal, affords a perfect illustration both of the form and origin of stratification. A large portion of the masses constituting the earth's crust are thus stratified, the successive strata of a given rock preserving a general parallelism to each other; but the planes of stratification not being perfectly parallel, throughout a great extent, like the planes of cleavage.

SYENITE. A kind of granite, so called because it was brought from Syene in Egypt.

TALUS. When fragments are broken off by the action of the weather from the face of a steep rock, as they accumulate at its foot, they form a sloping heap, called a talus. The term is borrowed from the language of fortification, where *talus* means the outside of a wall of which the thickness is diminished by degrees, as it rises in height, to make it the firmer.

TERTIARY STRATA. A series of sedimentary rocks, with characters which distinguish them from two other great series of strata—the secondary and primary, which lie *beneath* them.

TESTACEA. Molluscous animals, having a shelly covering. *Etym.*, *testa*, a shell, such as snails, whelks, oysters, &c.

THERMAL. Hot. *Etym.*, *thermos*, hot.

TRAP and TRAPPEAN ROCKS. Volcanic rocks composed of felspar, augite, and hornblende. The various proportions and state of aggregation of these simple minerals, and difference in external forms, give rise to varieties which have received distinct appellations, such as basalt, amygdaloid, dolorite, greenstone, and others. The term is derived from *trappa*, a Swedish word for stair, because the rocks of this class sometimes occur in large tabular masses, rising one above another, like steps.

TUFA, CALCAREOUS. A porous rock deposited by calcareous waters on their exposure to the air, and usually containing portions of plants and other organic substances incrusted with carbonate of lime. The more solid form of the same deposit is called "travertin," into which it passes.

TUFF or TUFA, VOLCANIC. An Italian name for a variety of volcanic rock of an earthy texture, seldom very compact, and composed of an agglutination of fragments of scoriæ and loose matter ejected from a volcano.

UNCONFORMABLE. See "Conformable."

VEINS, MINERAL. Cracks in rocks filled up by substances different from the rock, which may be either earthy or metallic. Veins are sometimes many yards wide; and they ramify or branch off into innumerable smaller parts, often as slender as threads, like the veins in an animal, hence their name.

VERTEBRATED ANIMALS. A great division of the animal kingdom, including all those which are furnished with a back-bone, as the mammalia, birds, reptiles and fishes. The separate joints of the back bone are called *vertebræ*, from the Latin verb *verto*, to turn.

VESICLE. A small, circular, enclosed space, like a little bladder. *Etym.*, diminutive of *vesica*, Latin for a bladder.

ZEOLITE. A family of simple minerals, including stilbite, mesotype, analcime, and some others usually found in the trap or volcanic rocks. Some of the most common varieties swell or boil up when exposed to the blow-pipe, and hence the name of *zeo*, to boil, and *lithos*, stone.

ZOOPHYTES. Corals, sponges, and other aquatic animals allied to them; so called because, while they are the habitation of animals, they are fixed to the ground, and have the forms of plants. *Etym.*, *zoon*, animal, and *phyton*, plant.