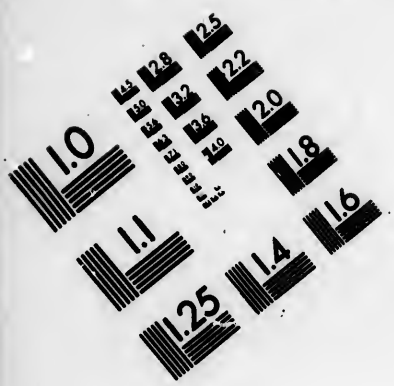


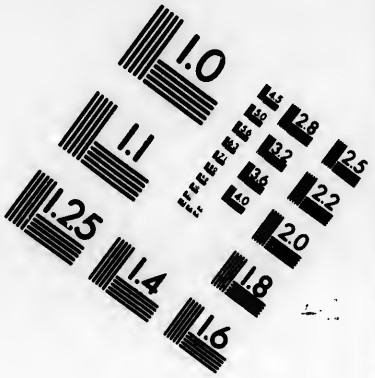
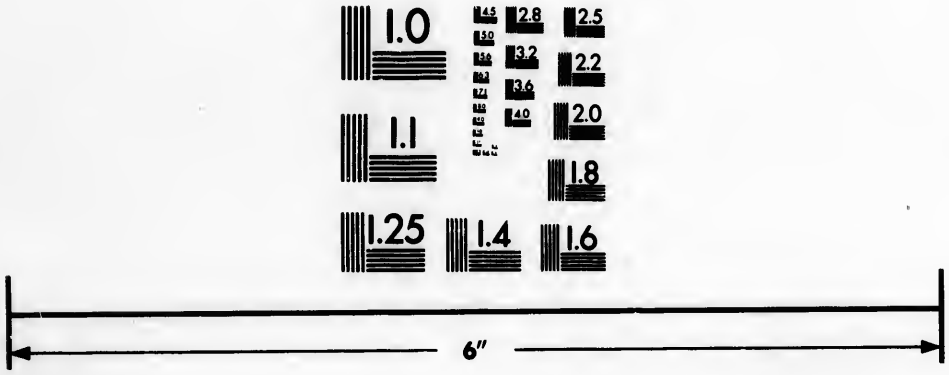
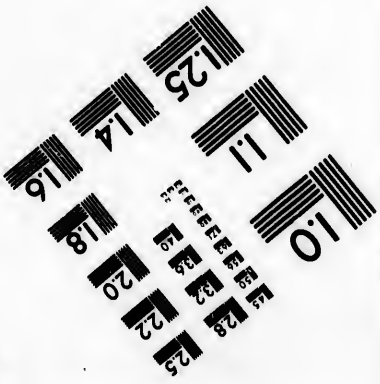


IMAGE EVALUATION TEST TARGET (MT-3)





Photographic Sciences Corporation

23 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

Technical and Bibliographic Notes/Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

- ☐ Coloured covers/ Couverture de couleur
- ☐ Covers damaged/ Couverture endommagée
- ☐ Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- ☐ Cover title missing/ Le titre de couverture manque
- ☐ Coloured maps/ Cartes géographiques en couleur
- ☐ Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- ☐ Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- ☑ Bound with other material/ Relié avec d'autres documents
- ☐ Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distortion le long de la marge intérieure
- ☐ Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- ☐ Additional comments:/ Commentaires supplémentaires:

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- ☐ Coloured pages/ Pages de couleur
- ☐ Pages damaged/ Pages endommagées
- ☐ Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- ☑ Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- ☐ Pages detached/ Pages détachées
- ☑ Showthrough/ Transparence
- ☐ Quality of print varies/ Qualité inégale de l'impression
- ☐ Includes supplementary material/ Comprend du matériel supplémentaire
- ☐ Only edition available/ Seule édition disponible
- ☐ Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image/ Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.

This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.

10X	12X	14X	16X	18X	20X	22X	24X	26X	28X	30X	32X
					✓						

The copy filmed here has been reproduced thanks to the generosity of:

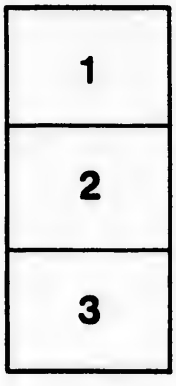
New Brunswick Museum
Saint John

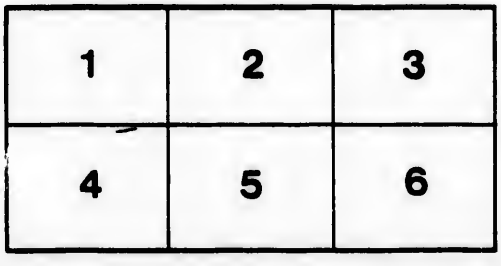
The images appearing here are the best quality possible considering the condition and legibility of the original copy and in keeping with the filming contract specifications.

Original copies in printed paper covers are filmed beginning with the front cover and ending on the last page with a printed or illustrated impression, or the back cover when appropriate. All other original copies are filmed beginning on the first page with a printed or illustrated impression, and ending on the last page with a printed or illustrated impression.

The last recorded frame on each microfiche shall contain the symbol ⟶ (meaning "CONTINUED"), or the symbol ▽ (meaning "END"), whichever applies.

Maps, plates, charts, etc., may be filmed at different reduction ratios. Those too large to be entirely included in one exposure are filmed beginning in the upper left hand corner, left to right and top to bottom, as many frames as required. The following diagrams illustrate the method:





L'exemplaire filmé fut reproduit grâce à la générosité de:

New Brunswick Museum
Saint John

Les images suivantes ont été reproduites avec le plus grand soin, compte tenu de la condition et de la netteté de l'exemplaire filmé, et en conformité avec les conditions du contrat de filmage.

Les exemplaires originaux dont la couverture en papier est imprimée sont filmés en commençant par le premier plat et en terminant soit par la dernière page qui comporte une empreinte d'impression ou d'illustration, soit par le second plat, selon le cas. Tous les autres exemplaires originaux sont filmés en commençant par la première page qui comporte une empreinte d'impression ou d'illustration et en terminant par la dernière page qui comporte une telle empreinte.

Un des symboles suivants apparaîtra sur la dernière image de chaque microfiche, selon le cas: le symbole ⟶ signifie "A SUIVRE", le symbole ▽ signifie "FIN".

Les cartes, planches, tableaux, etc., peuvent être filmés à des taux de réduction différents. Lorsque le document est trop grand pour être reproduit en un seul cliché, il est filmé à partir de l'angle supérieur gauche, de gauche à droite, et de haut en bas, en prenant le nombre d'images nécessaire. Les diagrammes suivants illustrent la méthode.

SECOND REPORT

ON THE

GEOLOGICAL SURVEY

OF THE

PROVINCE

OF

NEW-BRUNSWICK.

BY

ABRAHAM GESNER,

PROVINCIAL GEOLOGIST, &c.

SAINT JOHN:

PRINTED BY HENRY CHUBB, MARKET-SQUARE.

1840.

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,

A Geological Survey may be considered to have a three-fold object. The first of these embraces the discovery of rocks as they are placed in the order of superposition, the causes by which such rocks were formed, and others similar in their nature are now accumulating, and the uses to which their materials may be applied, either in the arts, architecture or agriculture. It also views all the physical operations going forward upon the surface of the country submitted to examination, the relations they bear to the former history of the earth, and the effects they continue to produce upon the occupations and prosperity of its inhabitants.

The second relates to the discovery, examination, and application of all the mineral substances contained in the earth, whether they are ores yielding metals, the bituminous and carbonaceous compounds affording fuel, the chemical substances employed in the different arts and manufactures, or those peculiar kinds of matter that promote the growth of plants, and are therefore of inestimable value to agriculture.

Thirdly it comprises the analysis of the different soils, and by comparing the less productive kinds with those of

known fertility, the elements necessary for their productiveness are discovered, and the sources whence they can be supplied are made known.

On the European continent, mining has long enjoyed the fostering care of different Governments, Colleges have been founded and cherished, for the sole purpose of qualifying the geologist, mineralogist and miner for their important duties. Libraries and museums have been collected, laws have been made to protect and encourage mining, and the ablest men have been employed in those departments of science which were found to be intimately connected with national safety and prosperity.

Great-Britain, with her vast mineral wealth, had observed the advantages gained by neighbouring countries from their attention to natural resources, and viewed with jealousy the importation of iron from Sweden and Germany; but individual enterprise was left unaided, and her miners were for a long period left to grope their way in darkness, without the light of science to guide them in their uncertain path. But no sooner was the attention of the British Government directed to this subject, and its inadequate support to the most enduring branch of natural industry rendered obvious, than public surveys were ordered, the studies of geology and mineralogy were immediately introduced into English and Scotch colleges, and an impetus was given to these enquiries which has been unparalleled in its beneficial results.

The mineral wealth of Great-Britain remained for a long period unnoticed and disregarded, and many individuals were ruined by speculations which have since proved extremely profitable, and of great national importance. Numerous are the instances where vast sums of money had been unsuccessfully expended, in enterprises which, since the diffusion of knowledge adapted to them, and the encouragement offered by legislative acts, have been resumed, and rendered the sources of public and private wealth.

It is to her great mineral deposits Great-Britain chiefly owes her elevated character. They have imparted an extraordinary impulse to mechanical genius—have aroused her inhabitants to most unceasing exertion, and have produced those extraordinary revolutions in agriculture, manufacture and navigation, which render her an object of admiration to all the world. These improvements have not arisen altogether from any peculiar advantages enjoyed by the Mother Country, or the unaided capabilities of her people. They are the

results of legislation by comprehensive minds, and the dissemination of sound principles of science, which have been directed to the public mind and to the legitimate objects of labor. And thus the gradual advancement and application of the arts to the most useful and desirable objects, have closely followed the adoption of measures by the Government for carrying into effect a more perfect developement of those materials, upon which the industry of the people yields the greatest amount of profit.

The annual amount of the raw mineral produce of Great-Britain is no less than twenty millions sterling. When the increase of this by the multifarious operations of manufacture, and the charges of shipping for transportation of vast supplies of wrought material abroad, are computed, the aggregate is almost incalculable.

More than forty years ago, the Ordnance Geological Survey of England was commenced, by Mr. De La Beche, whose labors proved of the greatest utility to the mining and agricultural interests of the country. Both before, and since the above period, large sums had been expended from private funds in order to make new discoveries, and a number of persons from the love of science, were actively engaged, and whose labors have opened a new era in the history of the prosperity of the kingdom.

The Ordnance Geological Survey is now advancing, and the reports of the Geology of Cornwall and Devon, by Mr. H. T. De La Beche are of great interest and importance.

The United States with great alacrity and enterprise have completed geological explorations of many extensive districts; others are in progress, and the time is rapidly advancing, when each section of their territory will have been submitted to careful examination. Nor have the advantages derived from those enquiries in America been less successful than those of Europe, for both agricultural and mining industry have become far more extended and successful than they were prior to the commencement of these enquiries.

Of the British North American Colonies, New-Brunswick is one of the first to undertake an exploration of her mineral wealth, and a gradual interest in the great natural resources of the country is increasing daily, under Your Excellency's paternal care. Since the commencement of the geological survey of New-Brunswick, a similar one has been instituted in Newfoundland, and the work is now advancing. Nova-Scotia would have been upon the list long ago, had

not her mines and minerals been so disposed of that her inhabitants can scarcely participate in the benefits that would arise from having them generally worked.

The navigation of the Atlantic by steam, and the increased demand for iron and coal from this circumstance, and the extension of rail roads, render New-Brunswick a most important colony. For as this Province, as well as Nova-Scotia, contains an abundance of those most necessary minerals, the advantage of possessing sufficient supplies on both sides of the ocean that separates this country from Great-Britain are inestimable, and render New-Brunswick one of the most valuable appendages of the British Empire, independent of her fertile soil and vast supplies of timber. Her importance is also obvious, without any reference to those facts from her proximity to the United States, where bituminous coal evidently does not exist in sufficient quantities and in such situations as render it useful along the Northern Atlantic coast.

The progress of mining in new countries is always slow, a circumstance arising from the lack of capital, which is always employed upon objects of trade procured with the least expense, and afford the most readily a return for their value. But by opening the channels of enterprise to other resources more permanently valuable, encouragement is offered for the introduction of foreign capital, and the prosperity of the country will become equal in some degree to its natural advantages.

AGRICULTURE.

Soils are most frequently composed of the following earths, mixed in different proportions—silica, (flint,) alumina, (clay,) lime, magnesia, and the oxides and salts derived from the decomposition of metallic and other mineral matter. To these are added the different parts of vegetables in their several stages of decay. The presence of some of these substances is absolutely necessary to vegetation, others exert an influence hostile to the growth of plants, when they exist in any considerable quantity, and the predominance of either of the earths withholds from vegetables that kind of nourishment they require for their perfect growth. It has been ascertained that the most productive soil in all countries, and under the different climates, is one composed of different proportions of siliceous (flinty,) calcareous (marly,) aluminous (clayey,) earth

in a finely divided state, and containing a greater or less quantity of vegetable and animal matter returning to a mineral condition. It would be impossible to point out the exact proportions of these substances which should be present, under all circumstances, for general productiveness. These proportions must be regulated by climate, temperature, and more especially by the peculiar nature of the plant it is called upon to nourish. But this general fact is so far applicable every where, that when the soil is found to be composed almost altogether of one or two of those earths, to the exclusion of almost every other kind of matter, it may, from a knowledge of the circumstances, be greatly improved and its fertility increased four-fold.

By pursuing this enquiry into its minutest ramifications, the quantity of each earth may be so adjusted to all the conditions of climate, situation, and the laws affecting the distribution of plants, that the greatest possible harvest may be reaped from lands which in their natural and depraved condition were barren and unfruitful. This constitutes the science of Agriculture, that ennobling branch of industry which nature never fails to reward when her bounties are sought with care, skill, and diligence.

The power of some earths to absorb and retain moisture is much greater than others, and as water performs an important office in vegetation, those soils which are placed upon declivities, and are therefore quickly drained, require a larger quantity of retentive clay than such as are placed in lower situations—where, perhaps, the open sand allows the accumulated rain to escape with greater facility, both by evaporation and absorption. The composition of the subsoil must also be considered. Should it be impervious clay, the water cannot descend even through a thin stratum. Again, if it repose upon beds of sand, it escapes by infiltration with great facility.

Almost all the upland soils have been derived from the disintegration of the rocks beneath, and frequently at no great distance from them. Even the alluviums can be traced to their birth places, whence they have been driven by currents still active in their transportation. The greater fertility of these alluviums has resulted from the continued action of the causes to which they owe their origin. Those mighty operations that spread a covering over the rocks, whereby the earth was rendered a fit abode for man and his associate animals, are now almost inactive on a large portion of the globe. They have not, however, altogether discontinued their

useful labour, nor ceased to clothe the lower grounds with an annual deposit of finely divided matter, and thus to increase the food of plants for the growing population of each continent and island, according to the demands they make upon the vegetable kingdom for food. Geology, therefore, by following causes to their effects, and by watching over the constant changes of matter, both in regard to chemical and mechanical operations, supplies the history of minerals under whatever circumstances they appear on the bosom of the earth.

Agriculture, to be attended with success, must be conducted upon scientific principles. Some knowledge of the plants belonging to the climate and exotics, and the soil capable of producing them most abundantly, must be obtained before the husbandman can receive an adequate reward for his pains or rejoice over the fruits of his labour. It is here also geology lends its aid, and by a careful analysis of the soils, a basis is laid upon which the farmer can by his own experience create a system admitting of more certain success.

In all the different arts a knowledge of the materials operated upon is considered indispensably necessary for those whose employment is in them, and it is surprising that the agriculturist, who requires more of this kind of knowledge than the common artizan, should have been so much neglected and left to discover, by the experience of a whole life, what he might have known from a single lesson. Innumerable are the instances where the seed has been scattered in the sand and in the clay, and because no crop followed, both were condemned as being barren and worthless; but had those two different substances been mixed in proper proportions, a plentiful harvest would have followed, and the disappointed tiller of the ground would have smiled over the bounties received from Nature's cornucopia.

Manures are of three kinds, namely—animal, vegetable, and mineral. It would seem that the Chinese had arrived at a more perfect knowledge of these substances in the support of vegetation than any other people. So essential do they consider manure to be to the production of crops, that night-soil mixed with fat marl and formed into cakes, is an article of commerce throughout the Empire. Geology, as applied to agriculture, takes cognizance of the different conditions of mineral matter adapted to the nourishment of plants, the composition of soils, whether in a natural or artificial state, and the means capable of rendering them fertile. Soil may be unproductive from the absence of certain mineral or vegetable ingredients, or from the presence of some noxious

principle. These conditions can be overcome by the addition of the matter required in the first case, and by producing such a chemical decomposition in the latter, as shall render the poisonous matter inert. These are objects to be gained only by the sciences of geology and mineralogy.

The soil of New-Brunswick is extremely variable in its composition, having been produced by a variety of causes, and from many different kinds of rocks; therefore it is more necessary that it should be cultivated with an extensive view of all the facts connected with its former and present conditions. To this inductive knowledge experiments should be added to afford those practical illustrations which unite in the mind philosophical reasoning with absolute demonstration.

Peat is abundant in this Province, and most of its varieties will afford manure; but it sometimes happens that the low situations where it is accumulated have been exposed to the earth containing much iron, and where the salts of that metal render it unfit for that purpose. Such peat may be known by its ochrey appearance, and the presence of "*bog*" and "*shot*" ore.

Sir Humphrey Davy seems to have been the first who endeavoured to discover, by the aid of chemistry, the manner in which manures act upon the soil, and the influence they hold over its productions; and although his labours have rendered an important advantage to agriculture, there is a wide field unexplored in this department of physical science. Oxygen, hydrogen, and carbon are the principal simple elements entering into the composition of vegetables. Nitrogen, potash, lime, sulphur, and magnesia are sometimes procured from the sap and solid parts of plants. The peculiar process by which these kinds of matter are drawn from the earth seems to be placed beyond the reach of human observation. There are, however, some reasons for believing that heat, light, and electricity are the principal but silent agents by which the earth produces both the lofty oak and the blushing rose, and is covered with a green mantle, affording life and nourishment to innumerable creatures upon its surface. All the elements of vegetables have been found in the soil beneath them. It is by adding manure that a more abundant supply of those elements is afforded, and consequently a more luxuriant growth is the result of their application.

The different kinds of manure, many of which are abundant in the Province, might be applied with the greatest possible advantage to the soils of every county; but of all these

the excrementitious matter of stables forms almost the only kind used in the country.*

Some of the foregoing substances will be noticed in this Report, but as it cannot embrace a particular description of the varieties, application, and uses of manures in general, it is intended to give such an account adapted to the Province as early as possible, and one that shall be founded on a course of analytical and experimental examinations.

The subject of agriculture has already engaged the attention of Your Excellency, and the different branches of the Legislature; and the Counties of Northumberland and Charlotte, by their Agricultural Societies, have sustained under circumstances of discouragement those enlightened views, which, by being more extended, will prove of vast advantage to the rural industry of the Province.

An enquiry will naturally arise, what advantages have already accrued from the geological exploration of New-Brunswick? In this early period of the survey it will not be expected that every useful discovery, or the confidence of the public in the success of mining should be such as to have any great influence over the resources of the country. The recent difficulties in monetary affairs in the United States and the British Provinces, have much retarded the progress of successful enterprise, and English capitalists hesitate to apply their funds for any object in New-Brunswick, until the disputed line between this Province and the United States shall be adjusted, for it is evident that the Colony would suffer a great loss were the Americans allowed to extend their eastern boundary upon her soil. But, notwithstanding these obstacles to the immediate extension of foreign and domestic capital, the beneficial results of the labour of a single season, are such as indicate a certainty of the final utility of the en-

---

* The different kinds of manure may be classed as follows:—

MINERAL— Limestone, Marl, Marly clay, Alluvium of the sea, (marsh mud,) Alluvium of rivers, (mould.)

VEGETABLE— Sea-weeds, Peat, Ashes, Soot.

ANIMAL— Excrementitious matter, Fish, Shells, Bones.

terprise. The application of marl and lime to the soil has already commenced. The excellent quarries of granite on the Saint John have been opened by Messrs. WETMORE, and from the cheapness, superior quality, and beauty of the rock, it will evidently be extensively used. Hitherto the granite employed in the Province has been imported from Nova-Scotia and the United States at a great expense.*

During the last year the coal and iron of Queen's County have been applied for; also, leases for coal and other minerals in the County of Westmorland. Petitions have also been laid before the Provincial Government for coal and other minerals discovered during the past season. Independent of the survey, the Gloucester Mining Association, from the exertions of WILLIAM STEPHENS, Esquire, has been successful in exploring for copper ore in the County of Gloucester, and a bed of manganese is worked at Quaco, where it had been discovered many years ago.

The discovery of the Westmorland Coal Field, and the explorations of its boundaries, and the out-cropping of the coal itself along an extensive tract of country, as detailed in this Report, scarcely require a remark. It may, nevertheless, be affirmed, that few examinations in any part of the world have produced more important results under similar circumstances.

A more general spirit of enquiry has become manifest throughout the Province; and we have devoted much time, patience, and labour in examining a variety of specimens from different quarters. Only a few of these have been found to be worthy of notice. Many individuals have suffered much disappointment when informed that the objects of their search were of no practical value, and made acquainted with the fact, "that all is not gold that glitters." Even in this case it is hoped some good has been performed by correcting erroneous opinions, and by directing the attention of individuals to objects of real value.

The "mineral or divining rod," invented by the Druids to awe their superstitious followers, has been introduced into the British Provinces from the Eastern American States, and has found its votaries even among persons otherwise intelligent. The power of divination contained in two small phials and fixed on pieces of whalebone, and borne along by the

---

*Since the above was in the press we have been informed that two gentlemen from the United States have leased these quarries to obtain materials to rebuild the wharves and buildings consumed in the late conflagration at Saint John.

seventh son of the seventh son, has been considered infallible in the discovery of concealed money and all kinds of minerals. Indeed there are instances of ruinous sacrifices of time and money having been made by persons who have bowed down to this shrine of superstition and folly.

A number of communications have been received from scientific societies and distinguished individuals in Great-Britain and America. In almost all these a degree of interest in the Geological exploration of New-Brunswick is expressed in terms highly commendatory of the Provincial Government, and gratifying to the person to whom the charge of the Geological survey has been committed.

Specimens of the different rocks, minerals, and fossils have been carefully preserved: a collection of the minerals will be laid before Your Excellency with this Report.

The Geological Map of the Province has been commenced, and is advancing towards completion.

It was intended to devote a part of the present Report to Economic and Agricultural Geology; but, upon consideration, it was deemed most proper to treat of those parts of the subject at the close of the survey.

The discovery, by Captain RUEL,* of bones of a large fossil Elephant, which had been mistaken for wood, and sold in the market for fuel, gives a new and most interesting feature to the Geology of New-Brunswick. These bones are now in my possession, and such information has been obtained as will probably lead to the recovery of the skeletons of these gigantic animals, which have long since ceased to exist upon the earth.

The following details will exhibit more fully the discoveries of the past season, and the vast importance of the Geological exploration, as one of those wise and judicious acts which have ever characterised Your Excellency's administration.

---

* The writer begs to express his thanks to this Gentleman for the relics referred to; and also to Dr. LAWRENCE VAN BUSKIRK, for his aid in exploring the coast. The wood cuts are by the talented Mr. TOLER.

GENERAL REMARKS.

In the first Report of the Geological Survey of New-Brunswick, it was stated that there is a moderately elevated range of mountains, extending from Shepody Bay, in the County of Westmorland, to the County of Charlotte, on the American boundary line. The base of this range is at an average distance of fifteen miles from the Bay of Fundy, and its course is north-east and south-west. But this line is not perfect and direct, for having reached the entrance of Belleisle Bay, it diverges to the southward, crosses the peninsula of Kingston, and then resumes its former course.

This chain of mountains and hills may be said to terminate at Shepody, in the County of Westmorland, unless it be admitted that a mountainous district extending from Cape Chignecto along the Cobiquid mountains, to the District of Pictou, Nova-Scotia, belongs to the same chain, an opinion we have adopted from the general agreement in the characters of the rocks entering into its composition.

It is true that an interruption to the continuity of this elevated tract occurs at Chignecto Bay, where the chain is broken, and its parts separated to the distance of thirty miles; but this is by no means an uncommon circumstance, and admits of an explanation by a reference to the volcanic character of the country where this broken tract is situated. We have now completed the examination of this mountainous and broken district, from the State of Maine along the Bay of Fundy side of New-Brunswick, and directly across Nova-Scotia, to the Straits of Northumberland, (a distance of two hundred and twenty miles,) and have had every evidence to establish the belief, that the rocks forming each lofty peak and mural cliff were produced by similar causes throughout; and although those causes have long since ceased to act, the testimony of their former existence remains uneffaced.

The rocks constituting this range of high lands, are such as are believed by almost every geologist, to be of volcanic origin; a doubt on this subject cannot remain in the mind of the unprejudiced, after their characters are fully examined, and the general appearance of the country where they are situated, is compared with the theatre of volcanoes still in operation.

Referring only to New-Brunswick, an extensive granitic ridge is seen extending from the Chiputnecticook River, and Lakes, to the River Saint John, opposite the entrance of Belleisle Bay. It becomes narrower as it proceeds to the eastward, and the perfect granite composed of mica, feldspar, and quartz, is discontinued at the above place. In the County of Charlotte this granite is met on its south side, by an extensive tract occupied by syenite. The two rocks are associated in a most irregular manner, and frequently pass into each other by such gradations as prove their intimate relation with each other, and the identity of the forces exerted to produce their eruption. All of these rocks are penetrated, and apparently have been broken through by enormous masses of trap, which form veins and dikes, from half an inch to a hundred fathoms in thickness, or occupy overlieing sheets several miles in circumference.

The syenite proceeds onwards in an easterly direction, and forms a remarkable belt across the peninsula of Kingston, between the Belleisle and Kennebeckasis Rivers. It then forms the broken tract of country in the neighbourhood of Loch Lomond and on the old Shepody Road, until it reaches Shepody Mountain, where it is terminated or met by rocks of a sedimentary character. In this part of the country it will not average more than twelve miles in breadth, and frequently approaches the coast within a distance of four miles.

The physical features of this syenitic district, are peculiarly characteristic of the volcanic origin of its rocks. In the bold outline, and precipitous mountain—the narrow ravine, walled in by steep cliffs, venting the torrents of the hills from cataract to cataract, we see those distinguishing marks of former terrestrial disturbance, which time itself has refused to remove.

The next class of rocks in regard to geological situation, and relative age, comprises the limestone described in our first Report, and extended across the entrance of the St. John, eastward, to Hammond River, where they meet the syenite, and disappear so far as our knowledge extends; for the limestones appearing still farther eastward and in different parts of the country submitted to the examination of the present

year, are of secondary formation, and are different from the compact crystalline rocks in the vicinity of Saint John. In the order of succession, the slate, greywacke, and greywacke slate occupying a considerable portion of the County of Charlotte, and crossing the harbour and entrance of the River St. John, appear on the east side of the harbour and are terminated in an easterly direction near Loch Lomond. They reach northward to the Kennebeckasis, and southward as far as Emerson's Creek. Both the schistose rock, and the limestone dip towards the south east, and the syenite forms an anticlinal ridge against which they rest.

Since we have discovered the remains of moluscous animals, fossil trees, and anthracite among these slates, their comparative geological age is more readily determined, and they may therefore be classed in the silurian group of Mr. MURCHISON. We do not, however, see any propriety in applying a local term to a class of strata abundant in every quarter of the globe. We have the same right to our Nerepis, Mispeck, and Quaco rocks, as our contemporaries across the Atlantic have to their Ludlow, Wenlock, and Carodic rocks. It is high time a better nomenclature was introduced into the science.

The greywacke, and slates of this group, also appear on the coast of the Bay of Fundy, between Great Salmon River and Salisbury Cove. They are here accompanied with a soft argillaceous limestone, and serpentine, but wherever they have been found in this part of the Province they are injected with dikes of trappean rocks, and have suffered much from causes already briefly mentioned.

We now come to take a cursory view of the Coal Districts in that division of the Province to which the labours of the present season were devoted. The first of these was observed to embrace the whole of Capes Meranquin and Enrage; but these are small portions of the Cumberland coal field in Nova-Scotia, and at present require no further consideration.

Commencing at Shediac, the coal field of the County of Westmorland extends along the eastern shore as far as Tedish River, then running along an irregular line southward it approaches the fertile villages of Sackville, and meets the new red sandstone near Dorchester Island. A line drawn from Shediac to the Petitcodiac, about ten miles below "The Bend," will mark its northern side. This tract of country embraces that part of the coal field which is situated on the east side of the Petitcodiac, except a small group of strata, observed near the road leading from Bay Verte to Sackville. The coal field then becomes more narrow, and, crossing the

River, maintains an average breadth of ten miles westward, until it reaches Sussex Vale; here its extremity is forked: one branch is curved towards the north-west, until it meets the source of Studholm's Mill-stream, the other becomes very narrow and disappears beneath the conglomerate, a few miles westward and southward of Sussex Church. About eight miles north of Shepody the coal strata meet the syenite. In this neighbourhood they cross the sources of Turtle Creek, and Coverdale River. At the head of Pollet river they are overlaid by the new red sandstone, and conglomerate. These rocks also meet and conceal the bituminous strata along the whole line of their northern side.

The whole length of this coal field is upwards of seventy miles, its average breadth, estimating the area on each side of the Petticodiac, is about seventeen miles. The out-cropping of the coal has been discovered at a number of places within its borders, and the examinations which have been made, and the facts disclosed by them, will not only prove of great importance to the county of Westmorland, but to the Province in general.

The remaining part of the country explored, is composed chiefly of new red sandstone, and conglomerate, containing numerous deposits of gypsum, limestone, and rock salt, with mineral springs.

The boundaries of each of these formations have been laid down as accurately as circumstances would admit, on a map of the Province, and a geological map is advancing towards completion which will, at the close of the geological survey, represent each of the formations belonging to the country, and their geographical situations.

The geological map, however, cannot be made perfect in the present state of the country, for at this time there is no correct geographical survey of the Province extant. The density of the forests in the interior, is unfavorable to trigonometrical operations, and frequently it is impossible to ascertain distances, without incurring an expense not warranted by our instructions.

A description of the physical and agricultural features of the country explored, has been deferred until each formation is brought under particular consideration, and local details have been given of each peculiar district. The division of the Province under consideration, and comprising the field of geological exploration during the past year, is situated eastward of the St. John. A line drawn from Shediac to he entrance of Belleisle River will mark its northern

side. Its eastern limits are fixed at Cape Tormentine, and its southern side lies along the shore of the Bay of Fundy and the Nova-Scotia boundary, or isthmus between the Cumberland Basin and the Gulph of St. Lawrence. The length of this tract is about one hundred and thirty miles, and its mean breadth forty-five miles. It embraces the counties of St. John, King's, and Westmorland. The whole of this division has been as carefully explored as the circumstances would admit of, except the peninsula of Kingston, which we were unable to visit until the season was too far advanced. An extensive tract along the line of the out-cropping of the coal also remains to be submitted to a more accurate and minute survey than was allowed by our time after that line was discovered; and we hope during a part of next summer to devote that time and labor to its valuable deposits their importance invites. The discovery of fossil trees, accompanied with anthracite coal, in the greywacke system near St. John, also opens another wide field of enquiry; but the cold storms and frost of the autumn compelled us to retreat when we had scarcely entered upon the threshold of this interesting part of the country. The descriptions will be given first of the coast beginning at St. John, and proceeding to the eastward. The eastern coast of Bay Verte and Shediac will then be noticed, and lastly the interior.

It was proposed to give a description of each of the formations referred to in the present Report by itself; but this plan would render the descriptions less useful to persons who reside in the immediate vicinity of useful minerals, and who are aided in their researches, by details of places with which they are familiar.

General observations on each class of rocks will be given with a view of the agricultural and physical features of the country.

SAINT JOHN.

The belts of limestone described in the first Report, cross the river and extend along the broken and hilly tract situated between the city, and the entrance of the Kennebeck-asis. The first of these belts has been broken through by the river at its narrow outlet, directly opposite the Mills of Messrs. Everitt, and those of the St. John Mills and Canal Company, and forms the overhanging cliffs above the Falls. It is about a furlong wide, and reaches to Marble Cove, a place of security for large rafts of timber, floated down the river, and secured here until a favourable opportunity offers to give them a passage through the Falls to the numerous lumber-yards at the extremity of the harbour.

Proceeding in a north-east by north direction, it then passes beneath the new Church at Portland, and may be seen in the uneven land northward of the estate of Henry Gilbert, Esquire, and along the road leading to Hammond River. Another remarkable ridge of this rock rises abruptly at Portland, and forms the site of Fort Howe, occupied by a small part of the garrison.

The limestone of this hill contains several veins of graphite, or plumbago, one of which is on the north side of the main street, and is upwards of four feet in thickness. This graphite is too impure for the manufacture of lead pencils. It is occasionally used for varnishing stoves, and lessening friction, and may at some future period afford an article of limited export.

Interstratified with these two belts of limestone, there are strata of greywacke, and very frequently masses of trap rock, containing the sulphuret of iron in very small grains. This mineral, wherever it is exposed to the weather, is decomposed. The oxygen of the atmosphere unites with the iron, and forms the peroxide (common rust) of the metal, which is sometimes several inches in thickness. It has been said by some persons that these ferruginous masses would afford good iron ore, but both the iron pyrites and the peroxide are unfit

for the manufacture of iron. Other strata (layers) extend from the main river nearly parallel to the Kennebeckasis, and frequently contain thick beds of calcarious breccia. Of this breccia, large masses may be seen along the shores, and over the country southward, where they have been transported by causes to be noticed hereafter. Very frequently strata of this calcarious formation have a peculiar curled or waved appearance, and the lamina forming even the most compact parts of the rock, are folded over each other in such a manner, that when the rock is polished it has the appearance of curled maple, and a beautiful clouded marble might be quarried in situations where the frost and other meteoric agents have not destroyed the solidity of the rock. The breccia is also very beautiful, and after it has received a polish resembles mosaic pavement.

The limestone is met on its south-east side by slate, and greywacke; these rocks are exposed on the side of the river, at the lumber and ship-yards, and at the powerful steam mills of MACKAY, BROTHERS & Co. The whole shore here is lined with the productions of the forest, which are seen either in the framework of some lofty ship, the squared trunk of the pine, or in tottering piles of deals prepared for the English market.

Between Portland and the City there is a narrow and deep fosse, extending from the harbour to the creek, and separating on the surface, the limestone from the rocks situated farther south. In the bottom of this fosse, there are beds of clay, containing the remains of the *Mya*, *Pecten*, *Mytilus*, and other marine shells, like those still inhabiting the coast. These shells are now elevated about eighteen feet above the level of the sea, which at some former period surrounded the site of the town and rendered its present rocky peninsula an Island. At the same period when the sea had a free access between the present sites of the Iron Foundries, it probably flowed into the low ground now occupied by the pond connected with the powerful Saw Mills of MACKAY, BROTHERS & Co., at Spar Cove, similar shells having been found in the clay at the bottom of the pond, previous to its being overflowed with water.

Saint John is built upon greywacke, and greywacke slate; the strata run north-east, and south-west nearly, and dip towards the south-east, at an angle varying from 70° to 80°. In some instances they nearly approach the vertical line. These rocks contain veins of white quartz, iron pyrites, and sometimes small quantities of the protoxide of iron.

A shallow estuary eastward of the City is terminated by a creek and a tract of marsh, four miles long, and upon an average half a mile in breadth. This marsh is composed of alluvium brought in by the sea; and the trunks of trees of the present growth, buried deeply beneath the soil, show that its formation is comparatively recent. This alluvium is of an inferior quality, and the growth of peat upon many parts of its surface renders it almost barren in a natural state. It is only by the skill and industry of its proprietors that it has been rescued from the sea, and rendered fertile.

The broken land between the Marsh and the Kennebeckasis is composed of limestone, trap and syenite of several varieties. The peculiar features of this tract have evidently arisen from the irruption of the intrusive trappean rocks from beneath, and thus the broken and elevated position of the limestone and the slate sometimes associated with it, will admit of a satisfactory explanation.

On the north side of the ravine not far from the pottery, and directly opposite Jeffrey's Hill, there is a bed of chert extending some distance in an east and west direction; a few strata of slate meet the chert, and in them we found the remains of shells. They are all terebratula, (see Fig. 1.) and being among the oldest relics preserved in the rocks, are not to be seen without a close examination. These shells were afterwards found in the limestone, and therefore the relative age of these rocks is fully determined.

Fig. 1.

A Terebratulite. Slate of St. John.

The trap rock will be seen in the naked hills northward and in the excavations made in opening the road to Indian Town. At the latter place it contains veins of quartz, and is composed chiefly of hornblende.

At several situations along the high ground, running parallel to the mouth of the Kennebeckasis, and at an average distance of two and a half miles from the City, marble of a good quality, and equal in beauty to any imported varieties may be quarried, and a part of the machinery employed in sawing deals, might be usefully and profitably devoted to sawing and polishing the native rock, now remaining valueless in the bosom of the hills. At Lily Lake the marble is highly crystalline and of a pure white, and although it is much broken wherever it is exposed to the frost, it is evident large slabs might be procured by opening the rock to the depth of a few feet. White and green talc appear in the limestone near the Lake. They are only found within the limits of the

influence of the heat, that accompanied the elevation of the trap dikes. This part of the limestone formation supplies the City, and large quantities are annually exported for agricultural and other purposes. The extensive beds of clay belonging to the tertiary deposit already mentioned, also afford bricks, of which there were seven hundred and twenty thousand manufactured during the past season. It also supplies a small pottery, at the foot of Jeffrey's Hill.

It is only in the valleys, and on a few of the slopes that the soil is sufficiently deep for cultivation, and even in those places the covering of the rock is frequently composed of peat and other decayed vegetables instead of earthy soil.

On the north side of the hill at Coburg street, where the sand and gravel have been removed, diluvial grooves and scratches, produced by the moving of loose stones over the rocks, subsequent to the fixed position of the strata, and prior to the collections of loose matter above them, are still to be seen. Some of these are dotted by the vibrations of heavy masses as they passed along; an effect common to heavy bodies when they are propelled over solids by the force of water. Similar grooves are often seen in these rocks, affording another proof of the former submersion of the country and the powerful currents that have passed over its surface.

The River St. John having taken its rise about two hundred miles in the interior of the country, and collected the waters of numerous lakes, and streams, opening into its channel, has all its forces collected at Indian Town, and is poured into the sea, at the extremity of the harbour two miles and a half from the city, with an irresistible fury.

The entrance of this majestic stream is only about two hundred yards wide, and is situated between perpendicular and overhanging walls of limestone. The river, having passed through this narrow gorge, turns immediately to the eastward and mingles with the waters of the sea.

The ordinary tide of the harbour rises twenty-six feet, while above the Falls it only rises about eighteen inches; therefore the height of the Falls might be estimated at twenty-four feet and a half. But this estimate will not be received as correct, when it is considered that the entrance of the river at the Falls is too narrow to allow the sea to flow in freely; and therefore there is a fall inwards at high water, and a fall outwards at low water, and the time of passing for vessels is fixed at three quarters of an hour each tide, and when the sea and river have assumed the same level. The fall outwards we have estimated at twenty feet, and at high tides the

fall inwards at high water is fifteen feet, making the whole height of this double fall thirty-five feet.

The accumulated waters of this extensive and deep river, with all its lakes and tributary branches, is here dashed through a narrow gorge and over a rudely inclined plane into the sea. Interrupted by small islands above, and compelled to pass over huge masses of rocks obstructing the narrow passage, the river foaming and spouting with tremendous fury, assumes, at making its exit, a most tragical character, threatening with instant death any who may venture upon its troubled bosom. But on the flood tide the scene is changed: the ocean spreads its mantle over the thundering cataract, and, flowing inwards through the narrow chasm, stills the noisy rapid—the tide-lock of the Falls is shut, and apparently to oblige the inhabitants, allows them to pass in safety even with large ships.

Perhaps there is not a river in America of the same extent, which has so narrow an outlet as the Saint John. From the Falls to Grand Bay, a distance of four miles, this majestic stream passes through a tortuous channel, at many places not more than two hundred and fifty feet wide, while in the interior of the country it will average from one to three miles in breadth. The rocky shores of its outlet have not been worn down and scooped out, as is common on the shores of all rivers giving exit to immense quantities of ice. On the other hand, they appear to have been separated from each other at a period comparatively recent, and the gorge through which the stream now passes appears like a deep fissure, opened by some sudden movement in the earth. It was at one time hoped that the ancient entrance of this river would be discovered, but we have been unsuccessful in the search. It is, however, most probable that the mouth of the Saint John formerly had two branches, one opening from the Kennebeckasis down the present site of the Marsh, and the other opening from Grand Bay through to Manawagonish. But the same causes that opened the new channel, have evidently obliterated the old one. That the whole line of coast westward has been elevated from eighteen to twenty-six feet, and upwards, we have sufficient evidence in the marine shells found in the clay and marl. The conditions of the Magaguadavic are similar to those of the Saint John, whose bed has been raised, and a stream that was in all probability once very rapid, has become like a lake, from the narrowness of its outlet and the geological causes which have elevated its former bed. But we defer entering widely upon

the interesting facts connected with this noble river until it has been explored throughout its whole extent.*

The slates and greywacke on the east side of the creek, and extending along the shore to Cape Mispeck, on the east side of the Harbour of Saint John, are different in many particulars from those rocks as they appear on the peninsula of the City, and from the direction of the strata, they extend into the bay, and do not reach across this arm of the sea. The strata all dip towards the south-east, at a high angle, and from the anticlinal line formed northward by granitic and syenitic rocks. These slaty strata differ much in their external characters and mineral composition. At some places they are argillaceous, (clayey,) and at others arenaceous, (sandy.) The clay slate frequently contains a considerable quantity of mica in a finely divided state, or mixed with a small quantity of lime. From a hard and brittle, it passes into a soft and finely laminated rock, containing carbon, and yielding readily to meteoric influence. Again it becomes chloritic, and often contains hornblende. A slaty conglomerate also appears interstratified with each of these varieties. From these circumstances and others which might be noticed, it is evident that these rocks were not produced by causes equal and uniform in their operations, and a great length of time must have elapsed, and many changes must have occurred in the physical geography of the country, during the accumulation of such a variety of sedimentary matter.

At Horse Race Point a dike of trap containing veins of quartz and chlorite is seen occupying a place between the strata; but instead of having its lines of separation well defined, it is mixed with the hornblende and chlorite slate, into which it passes insensibly. These facts were observed at many other places along the coast, and they can only be explained by admitting that these dikes were elevated by volcanic influence, while the schistose (slaty) rocks were in a soft state, and therefore became mingled with them before the one had cooled, and the other had passed from sand and mud into compact rock; or, the heat which accompanied these eruptions might have been such as melted the superimposed slate, and changed, by combination, its mineral character altogether.

---

* Some excellent remarks on the Harbour of Saint John, and the causes effecting changes in its channel, heve been recently made by Lauchlan Donaldson, Esquire, and published by order of the Commissioners of the Harbour.

It is evident that these slaty rocks once existed in the form of mud, sand, and silt, and it is equally evident that the trap rock owes its origin to heat, and therefore it is necessary to refer to the conditions under which each rock is known to exist, to explain the phenomena.

At a small creek, near the new Penitentiary, there is a soft fine-grained clay slate, divided in layers from half an inch, to four inches in thickness. In these strata I discovered two small veins of anthracite coal, and it is probable that a workable quantity is not very far distant from this spot. If the coal exist here, it could not be expected to appear in the cliffs of the shore, as the strata associated with it, are readily decomposed, and, when exposed to the air, crumble down, and are either washed away by the brook passing along the site, or are covered with clay and *debris*. The existence of coal here is rendered more probable, from the occurrence of the remains of large vegetables embedded in the rock. Several of these vegetable relics were discovered in the slate and greywacke, which agree in their general characters with the sandstone and shale of the upper coal series.

On the north side of Little River, on land owned by JOHN R. PARTELOW, Esquire, and near the Bridge, a quarry had been opened in a compact greywacke to supply stone for the new Penitentiary. The workmen had removed the rock to the distance of a few yards, and exposed the trunks of two large fossil trees, and several of small dimensions. These trees were embedded between the strata, and lay inclined to the south-west. The largest was two and a half feet in diameter, and ten feet of its trunk was exposed. The other was sixteen inches in diameter, and nine feet long; both were nearly cylindrical. These original trunks of trees are now composed of sandstone, anthracite, and sulphuret of iron. The vegetable fibre of the plants still remains distinct, and is now represented by these minerals. The trees belong to the *conifera* (fir tribe.) Other smaller plants and the impressions of leaves, were also found. Among them is a species of *phytolithus*, and a calamite. How long these fossils will remain in their present situation is doubtful, as they are exposed to the violence of numerous visitors from the City. According to the latest geological discoveries, these plants belong to the first classes of vegetables that ever flourished on the earth. They are different from any now growing upon its surface, and are evidently far more ancient than those which now afford bituminous coal. They are relics whose history cannot be traced, and

remind the geologist of the changes each kingdom of organic nature has sustained, since they were first established upon this planet. The remains of a *cactus* have since been found, near the residence of His Worship the Mayor, in the City, where the rocks had been opened to level a street.

We do not stop here to discuss the question, whether anthracite and bituminous coal, are contemporaneous deposits, but briefly remark that the rocks containing these fossils, are different in many particulars, and evidently much older in their formation, than those containing the bituminous coal of the county of Westmorland to be noticed hereafter. The indications of anthracite coal were not observed until the season of exploration had passed, and the inclemency of the weather urged a retreat from the field of labour. The task will be again resumed early in the ensuing spring. The greywacke and slate had been examined several miles in the direction of Little River, where their general characters appear unchanged. About three miles eastward of the harbour this stream passes three falls, or successive steps; each fall will average thirty feet, so that the river in the distance of four hundred yards, falls perpendicularly ninety feet, and rushes through a narrow gorge overhung with the bending birch, and a wild growth of spruce, and fir.

The power afforded by these falls has been profitably employed by Messrs. Owens & Duncan, who have erected an excellent set of flour and saw mills, directly at their base, to which the river from below is navigable for large boats.

This group of rocks extends as far eastward as Loch Lomond, and northward to the Kennebeckasis. They are here met by the syenite already mentioned. It also occurs as far eastward on the coast as Emerson's Creek, where the new red sandstone covers its strata, forming a curve to the north east. The tertiary deposits on this tract consists of collections of loose boulders, beds of clay, sand, and gravel. The soil is at many places extremely scanty; this is more especially the condition of the insulated patches, occupied by dikes of trap. The surface is covered with groves of spruce, except such tracts as are depressed, where peat forms almost the only vegetable production.

BLACK RIVER.

The settlement at Black River reposes upon an extensive bed of diluvial sand and gravel, which is situated in a

broad, but shallow depression in the rocks just described. A part of this bed has been worn away by the sea, and a perfect section of the deposit may be seen in the high embankment still meeting the waves thrown upon the shore. This bed of sand and gravel, like almost every other of the kind, along this part of the coast, is very perfectly stratified. These strata consist of layers of fine and coarse sand, pebbles, and sometimes thin argillaceous deposits, placed upon each other, and varying in thickness from an inch to two feet. Viewed at a short distance, these layers of sand and gravel appear like the sandstones and conglomerates of many parts of the new red sandstone group. That they were collected, and their materials produced by similar causes is evident; the former being unequivocal evidence of a recent, and the latter of a more remote submersion of the areas they now occupy.

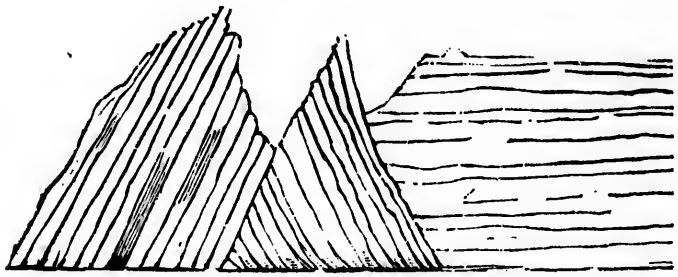
The river runs through a narrow and deep opening in the slate, and can be seen but a short distance from the Bay. The rapidity with which a coast is dilapidated by the violence of the sea, depends much upon the position of its strata. Where layers of rock dip towards and consequently beneath the ocean, the waves fall upon a comparatively smooth surface, and the rock yields but slowly before them, but when the strata dip from the sea, their edges, or bassets, are exposed to its violence, and from the wearing away of the softer parts of the rock, they are undermined, broken up, and scattered in the forms of sand and shingle along the shore. These facts are very manifest on this coast, where large coves have been formed, and are still becoming deeper from these causes, and the ready transportation of sandy and gravelly beds.

At Emerson's Creek the new red sandstone commences, and, with some interruptions, extends to Quaco. Its strata rest unconformably upon the slates just mentioned, and their dip, in general, is in an opposite direction. The shore here has not any considerable elevation. It may however be called bold, and its indentations afford shelter for small vessels in stormy weather.

The strata at Gardner's Creek and several other places, are singularly contorted and displaced; they frequently appear in waving lines or form salient angles, having evidently been forced from their original horizontal position by powerful forces applied from beneath; and the proximity of these dislocations to rocks of known volcanic characters, offers an explanation not to be misunderstood. The following is a

representation of the strata as they are seen at a small headland half a mile westward of "Roger's Pond," (see Fig. 2.) where a small lake has been formed by a "sea wall" composed of drift timber and round pebbles.

Fig. 2.



The strata on the left, dip in opposite directions, while those on the right hand are horizontal.

QUACO.

At Quaco Head the new red sandstone is seen resting unconformably upon a grey sandstone, containing lignite and the remains of plants allied to those still growing in tropical climates. Among these are found two species of the *stigmaria ficoides* (Brong) and one calamite. The trunks of several small trees were also observed near the junction of the sandstone and trap at the "Head." The grey sandstone extends along the shore about three furlongs, and dips to the northward at an angle of 40°.

Between two strata of this rock, there is a layer of soft slate clay three feet in thickness. In this slate clay there is a vein of sulphurous lignite, from two to three inches wide, passing down the front of a high and steep cliff exposed to the sea. It had been supposed by Messrs. ALEXANDER and RANDAL, two gentlemen from the United States, that this was a vein of coal, and a lease for two years had been granted them by the Provincial Government to open and explore this mine, or any other they might discover in the Parish of Saint Martins; but after a small sum of money had been expended the work was found to be unprofitable, and at the time of our examinations at Quaco it was abandoned.

The sandstone strata containing this lignite, dip in opposite directions, being met by the new red sandstone on one side and trap on the other. They have also been much fractured from the upheaving of the contiguous rock, and appear in a situation very unfavorable to the existence of true coal. Between three and four miles farther northward, and at this distance from the shore, the sandstones and shales of the coal measures crop out to a limited extent, and are seen dipping beneath the red sandstone already mentioned. The indications of coal here are much more favorable than at any other locality on this part of the coast.

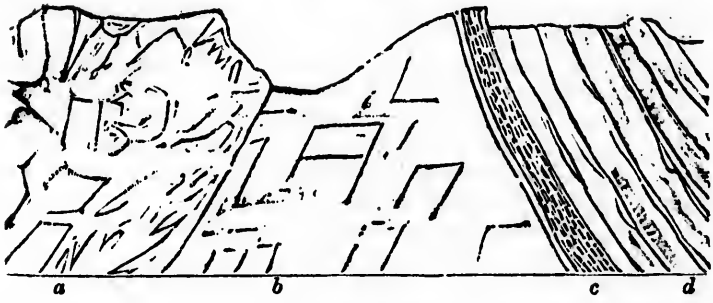
At three different situations near the "Head," the arenaceous (sandy) rock contains a considerable quantity of the sulphate of lime. This mineral covers the rocks with beautiful and regular crystals, often of a thickness of two inches. Large groups of these crystals were removed from the cliff by the hand alone. They are interesting specimens, being daily formed by nature, and by a process unknown in the arts.

The trap forming "Roger's Head" presents a cliff two hundred feet high, rising perpendicular from the sea. This cliff has been rent asunder from the top to the bottom, and the lines of fracture are seen passing obliquely up the precipice. The rock is an extremely compact greenstone, that sometimes passes into a light red trap, from the predominance of feldspar and the oxide of iron. Both of these varieties are associated with amygdaloid, having its cavities filled with green chlorite.

These rocks extend a mile eastward of "Roger's Head," where they are met by secondary limestone. Immediately upon the limestone the new red sandstone appears again, reposing in unconformable strata upon the calcareous rock beneath, and dipping to the northward at an angle of 40°. The limestone apparently dips to the southward, but it has been too much disturbed to ascertain its true inclination.

Between the limestone and the sandstone, there is a thick stratum of calcareous breccia, composed of nodules of the former rock, cemented together by the latter. The following wood cut (see Fig. 3.) represents the cliff where these rocks meet; the disturbance produced by the uplifting of the trap is manifest.

Fig. 3.



a. Trap. *b.* Limestone. *c.* Conglomerate. *d.* New Red Sandstone.

Now it is evident that after the limestone was formed, pieces were detached from its strata, rounded by attrition in water, and deposited over its surface; afterwards the sediment of which the sandstone is composed covered these pebbles, and the breccia was produced. Then the strata of sandstone were laid on beneath the water, and finally the upheaving of the trap forced each of these beds from their original horizontal position into the situations they now hold. It is seldom these different geological effects are seen more clearly portrayed than they appear in the cliffs of Quaco.

Two isolated masses of trap, called "Adam and Eve," stand in advance of the precipice, where large cavities and archways have been scooped out by the violence of the waves, and where the sound of the voice is echoed back from the projecting masses of rock overhung with a low underbrush and the wild flowers of the forest. The trap rock may be seen again, forming an extensive and elevated ridge passing through the western part of the settlement, and at the point near the Light-house, where it is again met by the limestone and covered with the red marly strata of the upper group.

The Light-house is situated upon a low reef of new red sandstone that defends the harbour during certain winds. Between it and Roger's Point the rocks are covered partially with a thick bed of diluvial sand and gravel, remarkable for being regularly stratified with alternate layers of coarse and fine sand.

The new red sandstone and sometimes the *detritus* covering it in this neighbourhood contain the black oxide of Manganese. The most extensive deposit of this ore, so far as it has been discovered, is situated near the Light-house

and in a bed about twenty feet above the tide. The ore is mixed with the red rock to the thickness of six feet, and was formerly collected in considerable quantities on the beach, having fallen from the cliffs above. Messrs. RANDAL and ALEXANDER have opened this bed of ore, by making a deep excavation from the surface above, and at the time of our visit to the spot, a hundred barrels of the Manganese had been shipped by them to the United States, while a number of men were employed in raising fresh supplies.

The above gentlemen were also exploring for ore on the farm of Mr. BROWN, where a deep excavation had been made in the side of a hill, covered with *debris* containing loose pieces of the oxide. It may be presumed that this excavation is made too near the trap rock to be attended with success, and the detached pieces mixed with the soil are only indications of the existence of the ore farther northward.

It also occurs on the farm of Captain M'LEAN, and elsewhere. Quantities of this ore have been shipped from Quaco during the last thirty years, but its use in the arts is too limited to offer a demand for any great supply. This ore is the peroxide of Manganese: every eighty-eight parts, when exposed to a red heat, give eight parts oxygen, and eighty of the deutoxide remain. It is well adapted for the preparation of oxygen gas, and other purposes in the arts.

Quaco Bay terminates in a large brook called the Creek, which passes through a tract of marsh of inferior quality. This settlement was first made by officers and soldiers of the King's Orange Rangers, who, at the close of the American revolutionary war, sought a home here. Of these, Mr. SPRINGSTEAD and Mr. WELCH are the only survivors. The harbour is almost surrounded by a flourishing settlement and a number of fine farms. The soil in general is sandy, and might be rendered very fertile by the employment of lime and marsh mud, for manure.

At Big Creek and East Creek the sandstone, of a bright red colour, is immediately succeeded by a conglomerate composed of globular masses of quartz, trap, and syenite, varying from the size of a musket ball to the largest cannon shot. This rock is very perfectly stratified, and lies conformable to the substrata of new red sandstone, being strongly contrasted with it by its colour and the coarse quality of its materials. Its position proves that it was formed before the level of the sandstone was changed, and the cause that gave origin to these strata of cemented pebbles might have been a change in the force, or direction of the current of water beneath

which both rocks were deposited from drift and sedimentary matter.

Were the loose beds of stratified sand and gravel, now covering the surface in broad belts, consolidated, they would with difficulty be distinguished from the conglomerate beneath, and the identity of the operations that collected their several mineral ingredients is evident.

But these beds of stratified sand and gravel, commonly called *detritus*, are placed in a horizontal position, and occupy a high mound between the creeks, and also a number of elevations in this district, while the solid strata beneath, dip from the horizon at an angle of 25°. Thus it is evident, that a change in the level of the country was effected, previous to the collection of the superficial sandy layers; while at the same time, the sources whence the materials of each bed were derived, continued unchanged.

This settlement has been surveyed by persons who placed implicit confidence in the virtues of the "mineral rod," and there are many pits opened in the earth where money was superstitiously believed to have been concealed.

These deposits of new red sandstone and conglomerate, are met about nine miles north of Quaco, by the syenite, and eastward by the older slates, and limestone. The beds of brooks afforded us the only opportunity of examining the rocks *in situ*. A number of the principal streams were followed several miles, but between them, strata may hereafter be found unlike those now hanging over the deep vaults, and piled in majestic grandeur along the tortuous channels of the descending rivulets. Even in these remote places, new settlements are springing up, and the lumbermen having found their way into the back woods, supply yearly the timber for many fine ships. But the narrow trail of the axeman, and the hardy ox amidst the wild groves, is seldom deeper than the snow that covers the earth in winter, or the green moss, supplying with moisture, and covering the roots of the trees in summer.

In this district the conglomerate, and red sandstone, are frequently interstratified, and the firm, silicious, (sandy,) and argillaceous (clayey) beds are laid upon each other in succession. At Tooley's Point the former is both underlaid and overlaid by the red strata, dipping north at an angle of 40°. Although these beds do not succeed each other in regular order, it may nevertheless be stated that the conglomerate most frequently forms the lower portions of the deposit, and the upper strata of red sandstone contain beds of limestone,

gypsum, and rock salt. It is evident that these two rocks were formed by similar causes, and during the same geological era. The beds of conglomerate, were produced by currents of water, and before the pebbles entering into their composition were reduced to sand, or those currents had in some degree subsided, they found a resting-place. The materials of the sandstone on the other hand, were longer exposed to the action of water, and were therefore reduced to fine sediment; and the interstratification would arise from any change in the configuration of the surface, or direction and force of the current. Facts explanatory of these former conditions of the rocks, may be observed at the mouths of large rivers and estuaries, washed with violent tides.

East Quaco Head is a steep cliff one hundred and fifty feet high. There are here a number of strata of soft slaty clay, alternately laid with the beds of red rock. They contain the remains of marine plants similar to those observed at St. Andrews.

At Fuller's Creek two miles further eastward, the new red sandstone terminates, and the older slates and limestone, broken through and changed by enormous masses of trap rock, and serpentine, occupy almost the whole of the shore eastward to Salisbury Cove, near Cape Enrage.

The sandy strata of Quaco and other places, where the group extends, will afford good freestones, the rock is moderately compact, admits of being cut, and hardens when exposed to the rays of the sun. It is, however, inferior in beauty to the sandstones of the coal measures, to be noticed hereafter.

The slate at the creek is argillaceous (clayey), and its colors vary from a light blue to a dark red. The planes of cleavage are often remarkably crooked and uneven, the rock having the appearance of being submitted to sudden movements before it was consolidated. It frequently contains graphite and cubic crystals of iron pyrites. This rock is associated with a slaty limestone, in which argilite (clayslate) and the lime are mixed in indefinite proportions. Narrow veins of calcareous spar (carbonate of lime) intersect these strata in all directions, and frequently the rhombic crystals of this mineral cover the sides of the fissures with beautiful incrustations. The rocks disintegrate very rapidly before the waves, ever dashing against the leaning precipices, and the broken masses piled in wild confusion along their front. With these there also appears a fine talcose slate, of a light green color, and readily separated into thin leaves not thick-

er than common wrapping paper. Chlorite slate in small quantities was also observed at several localities.

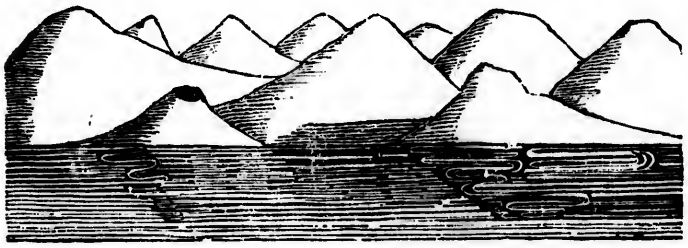
All of these schistose rocks have been forced from beneath, by whole mountains of trap and serpentine; of this there can be no doubt, as the slates are seen shelving from the sides of each eruptive mass, and remarkably fractured at the lines of contact.

The serpentine is of a dark green color, and contains a large quantity of magnesia. Frequently, also, it is magnetic. Surveyors therefore should not be surprised if their compasses are much affected in the neighbourhood of these volcanic productions. Farther eastward this rock contains schorl, amianthus, and asbestus. Numerous and large veins of quartz, coated with bright green chlorite, penetrate the slate and trap. Several narrow veins of the specular oxide of iron were also observed, but none of them are sufficiently thick to admit of being worked with advantage.

The features of the country where these rocks are situated, are very different from those of the new red sandstone. The lofty and abrupt hills are separated by deep and narrow ravines, and the parallel ridges of slate may be distinguished at a distance, from the rows of cones, composed of serpentine and trap, and which are truly characteristic of the volcanic character of the country, at the period when they were raised.

These facts are well illustrated by nature near Great Salmon River, the site of a superior set of mills, owned by Messrs. G. D. Robinson & Co. The following wood cut (see Fig. 4.) represents a number of these cone-shaped mountains, as they appear near the shore.

Fig. 4.



Half a mile eastward of this river, a detached portion of the sandstone formation may be seen at the foot of a high hill. Its strata have been elevated on one side, and depres-

sed on the other; and the characters of their mineral ingredients changed, by their proximity to masses of igneous origin.

The deep chasms and open fissures, the results of former volcanic disturbances, are now partially filled, and the precipitous sides of the cliffs, are skirted with thick beds of diluvial *debris* collected beneath water after the mountains had been formed and the violent agents concerned in their erection had ceased to act. These are frequently seen intersected on the shore, and are very common in the interior of this district. They are evidences of design and wisdom, manifested in the recent changes the earth has been submitted to, in order to render it a fit abode for man, and the inferior animals: for had not the dark and almost unfathomable pits, produced by volcanic convulsions been afterwards filled with loose stones, gravel, and sand, by the force of a mighty current of water, the surface would have been incapable of cultivation, and hazardous to the lives of the human race.

Martin's Head is a cliff of serpentine and trap rock, connected with the main land by a bar of sand. It contains numerous veins of quartz and calcareous spar, with small crystals of the sulphurets of iron and copper. *Asbestus*, (commonly called by the inhabitants rock cotton) and chlorite, occur here in the quartzose veins.

The detached portions of the red sandstone formation along this coast, appear to be remaining parts of a group that formerly had possession of a tract now covered by the waters of the Bay. Its ready disintegration from atmospheric causes, the action of the sea, and violence of the tides, have been sufficiently powerful during past centuries to remove large tracts of this rock, and that which still remains is fast wearing away, and contributing to the filling up of the Bay of Fundy where the sea is rendered turbid by the sediment several miles from the shore.

The slates and limestone already mentioned situated in the Parish of St. Martin, and accompanied with dikes and overlieing masses of trap and serpentine, extend from Fuller's Creek, near Great Salmon River, to Salisbury Cove, meeting the Bay on their south, and the syenite on their north sides. They may be seen on the old Shepody road, forming a very uneven line with rock composed of hornblend and feldspar in large crystals.

The country contained within these limits is about forty miles in length and ten miles in breadth. It remains in a wilderness state from geological causes alone, and although

a few inhabitants may be seen at the mouths of the small rivers where saw-mills have been erected, it is only on some bed of sand and gravel, or isolated portion of sandstone, that any attempt has been made to cultivate the soil. The prospects of agriculture are more favorable at Martin's Head than at any other place in this distance. There the red sandstone contains both limestone and gypsum, and a few fine farms might be made at this romantic spot.

HOPEWELL.

At the extremity of Salisbury Cove, in the Parish of Hopewell, the sandstones and shales of coal measures were observed. These rocks form the whole of Cape Enrage, and extend eastward as far as the entrance of New Horton river. The strata run east-south-east from the cove, and dip south-south-west at a high angle. At the Cape they are nearly perpendicular. The same rocks compose Grindstone Island, and Grindstone Point, and also the extremity of Cape Meranguin, where their course and inclination, although not exactly alike, have a general agreement.

These strata of the coal series now seen in the points and headlands on the north-west side of Chignecto Bay, belong to the Cumberland coal field of Nova-Scotia, and are evidently remaining portions of the series which have not been worn away, or covered by the sea entering this deep estuary. The Cumberland coal field extends beneath the Bay into New-Brunswick, embraces the Capes already mentioned, and terminates in a north-west direction at the base of Shepody mountains, and the ridge of syenite connected with them. Its margin may be seen distinctly from any eminence in this quarter, and the tract is known by its low and level appearance. We may then look back to that period when the present site of Chignecto Bay, (which will now average ten miles in breadth, and is thirty-five miles long), was filled with these strata and coal, in continuous lines. But such are the effects of causes still in operation, and more remote geological changes, that the former dry land has been removed and the basset edges of the sandstone, shale and coal, are now buried far beneath the waves of the sea.

A narrow belt of new red sandstone extends from the extremity of Salisbury Cove to New Horton and Shepody, resting upon the basset edges of the strata belonging to the coal measures, and meeting the syenite northward. The

lower sandstones in this part of the coal field, are of a dark red or chocolate color, and might in some instances be mistaken for the newer sandstones above them. These chocolate colored strata are also exposed at Cape Meranguin and Westcock, being associated with the lower rocks of this coal basin, along its northern side to the distance of twenty-four miles. These strata are very compact, fine-grained, and very superior for buildings, as they resist the vicissitudes of the weather, and become very hard by being exposed to the rays of the sun.

The changes of level these rocks have suffered are displayed in a singular manner at Cape Enrage. At a narrow and deep cove westward of the Light-house, the strata are resting upon their edges, and appear to have been separated from each other; their flat surfaces are now placed along the sides of a narrow and deep fosse filled with sand and gravel. At other places a few strata are seen in separate groups which appear like walls built by the mason, on parallel lines. These results were evidently produced in consequence of the strata separating from each other at the time they were uplifted. At the village of New Horton a singular Island has been evidently formed in this manner, and it can scarcely be doubted that these phenomena have resulted from the proximity of these sandstones to the trap, and serpentine, which are known to be of volcanic origin.

NEW HORTON.

New Horton is a thriving settlement on a part of the low lands situated at the foot of Shepody mountains. It contains a tract of excellent marsh, and is covered with a fertile soil derived from the marly and silicious sandstones beneath. At this place the strata of the coal series dip east-south-east 30°. An extensive flat separates the village from Grindstone Point, where the lower sandstones emerge from beneath the red rock, appearing at the bottom of the estuary, where a bar of sand extends outwards connecting the Point with the main land.

Near Cape Enrage, at New Horton, and Grindstone Point, many of the strata will afford excellent building-stone of different shades of blue, red, and chocolate color. Quarries of grindstones have also been opened at the above places, to supply a constant demand from the United States. The grindstone strata are however much harder than those

of the North and South Joggins; consequently the expense of cutting is increased, and the effect of sharpening edged tools is much diminished.

GRINDSTONE ISLAND.

Grindstone Island is an inconsiderable group of strata, situated about two miles eastward of Grindstone Point, and at the entrance of Shepody Bay. The grindstone quarry at the Island had been worked to considerable extent, but in consequence of "running out," as it is called by the workmen, or suddenly passing into a rock of bad quality, all operations at the quarry have been discontinued. On the south side of the Island there are several [illegible] red shale, with narrow seams of coal. The [illegible] of the strata here is west, and the dip south 40°.

A careful examination was [illegible] this and the before mentioned places, and although there are indications of coal at several localities, no out-cropping of any practical value was discovered on the shore.

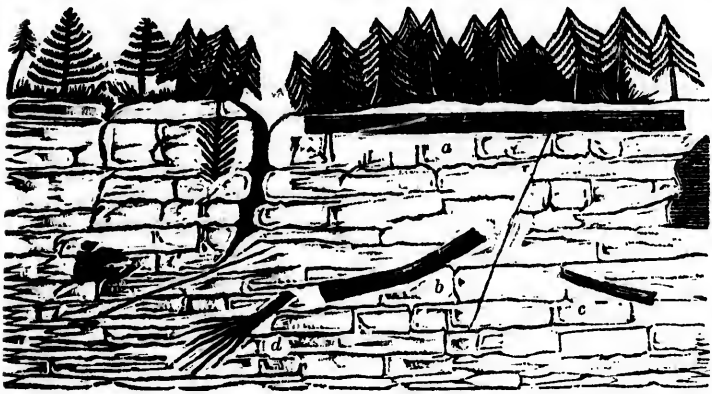
These sandstones abound in the remains and impressions of various kinds of tropical herbage. Some of these are merely casts of the original plants. In other instances those plants have been converted into coal and lignite; again, others are fossilized in part by the surrounding rock, coal, sulphuret of iron, and sometimes sulphate of barytes. Wherever they appear, the rocks contain more than an ordinary portion of iron, in some of its different combinations. Large trees have been thus changed and appear in the cliffs along the shore or scattered in broken masses on the beach.

One of these remarkable relics appears on the north side of Grindstone Island, at the top of a cliff about fifty feet high. As this cliff is inaccessible, this fossil tree could not be measured; it was estimated to be about two feet in diameter at its largest extremity, and about forty feet of its length is now exposed. How far it extends into the rock is uncertain. It is, however, a most majestic fossil plant, but from the constant breaking down of the cliff, it will, before many seasons pass away, roll from its rocky bed, and be dashed upon the solid pavement over which it now holds a precarious situation.

Several branches extend from its smallest extremity into the strata. Some of these had fallen—were removed and have been carefully examined. The tree belongs to the

dicotyledonous order of vegetables, but of a species unlike any to be found in a living state. Several other trunks and branches of less dimensions may be seen at this spot, and the remains of a variety of small plants, and leaves resembling those of the palm, may be collected from almost every rock on this side of the Island. To these we shall advert hereafter. The following wood cut (see Fig. 5.) represents the cliff where the fossils were observed, and the way the largest of them are situated.

Fig. 5.



a. Largest fossil tree. *b*, and *c*. Other fossil trees. *d*. Branches of fossil trees.

SHEPODY.

It has been already stated that there is an extensive ridge of syenite, reaching from the river Saint John in a north-east direction to Hopewell, where it terminates. This ridge at its eastern extremity, where it borders on Shepody Bay, is surmounted by a thick deposit of conglomerate forming Shepody mountain. Following along the base of this mountain, the new red sandstone was found to extend westward to Salisbury Cove.

It had been reported that some kind of ore had been found in this neighbourhood, and upon examination it proved to be the gray oxide of manganese. We first observed this ore in the loose *detritus* on the farms of Mr. Thomas Calhoun, and James Brewster, Esquire, at a part of the village called German Town. A number of large pieces

were picked up in a field of potatoes, where they were mixed in the soil. A large mass had formerly been seen near the road, but it has disappeared either by rolling down the side of the hill into a pond, or by the hands of persons who supposed it contained a large quantity of silver. The ore is of a superior quality, and evidently abundant. The inhabitants of the village having been made acquainted with its uses and value will continue to examine its situation, and explore more widely than we were permitted to do from the lateness of the season at the time of our explorations in that quarter.

Shepody River follows the course of a belt of new red sandstone in the direction of Salisbury Cove, which it nearly approaches, terminating in a beautiful lake, three miles long and half a mile wide. This lake abounds in fine trout, and openings are being made between it and the sea, and through sunken bogs at the head of the marsh, to allow the tide to flow in and cover the sunken tracts with alluvium. The tract of country on the above rock is of moderate height and very uneven, being furrowed with deep ravines and abrupt hills. The soil in general is of a superior quality, and such farms as have become unproductive from long culture, might be cheaply renovated by the use of lime and marsh mud for manures.

It was observed that most of the higher grounds were covered with a sandy soil, and there is a general deficiency of clay and alkaline matter. The application of alluvium from the marshes, and lime are therefore especially required, to render such lands productive, and such as will fairly try the experiment may be assured of their success.

Limestone was observed jutting out from beneath the soil on land belonging to S. G. Morse, Esquire, where it is probable a large quantity might be procured.

There are no less than five thousand acres of marsh on the Shepody River. Many acres of this fine alluvial tract remain unreclaimed from the sea. Such portions of it as have been diked are of a good quality, affording the best kind of hay and crops of wheat.

It is a remark applicable to all the marshes of this country, that after they are diked and drained they have a tendency to settle and become lower than the banks of the rivers, where the alluvium is rising and becoming more and more compact. The marsh adjoining the upland we found in several instances to be six feet lower than the banks of rivers daily receiving alluvial matter from the tides. From this circumstance the inner margin of the marsh is overflown with fresh water during a considerable part of the season, and is thereby ren-

dered worthless. The best remedy for this effect would be to allow the sea to flow in again over certain tracts for a few seasons. This would raise and renovate the sunken ground, and entirely destroy the poisonous plants now covering many of the lots. This plan might be effected by throwing up dikes from the upland to the present barrier against the tides, and thus tract after tract might be redeemed. The muddy water of the Bay being introduced and undisturbed by currents, would deposit its sediment equally according to its depth; and as the lower tracts would be covered deeper than the higher ones, they would receive the greatest share of alluvium, and be raised to the common level.

Few Parishes in the Province appear to be in a more thriving condition than Hopewell. The broad marsh on each side of the Shepody River is skirted with fine farms, and a large and rapidly increasing population are clearing higher up the slopes, the bases of which are closely occupied by the older inhabitants and their senior descendants.

Sheltered from the bleak northern blast by the highlands in the rear, and possessing a rich soil, this extensive settlement, with its new villages, presents a wide rural plain. Its marshes are protected from the fury of the waves by Grindstone Island and Point, and the coming tide that drives the herds of swine from the creeks, does not disturb the droves of cattle and sheep feeding securely within the dikes. Such as are fond of fine scenery will find a view from the mountain extremely interesting, as it commands a sight of a wide range of the eastern district of New-Brunswick, a part of Nova-Scotia, and, of a clear day, Prince Edward Island, with numerous bays, rivers, and villages of the most picturesque and pleasing varieties.

There are many traditionary stories of money having been buried at the foot of the mountain, by Pirates and French Acadians, the latter having been the first inhabitants of Shepody; and a number of pits have been opened by visitors from other parts of the country, to recover concealed treasures. It is to be regretted that there are persons in the Province who still believe that there are virtues in the "mineral rod," even in those used in the United States, and thus seek for money that has never been lost.

With the assistance of S. G. Morse, Esquire, we made an excursion from Shepody to the head of Turtle Creek Mr. Ezra Styles, and Mr. George Rogers having kindly volunteered for guides. The trap and syenite in the neighbourhood of Hammond River, and composing the broken

lands northward of Saint Martins, were found to extend to the Parish of Hopewell, where they are discontinued. At this place those rocks form a chain of high hills and a broken tract of country ten miles wide. This chain is terminated by Shepody mountain, which is about ten miles in circumference at its base, and is the highest land in any of the eastern counties of the Province. This mountain is composed chiefly of conglomerate, which appears to have been elevated by the uplifting force that accompanied the formation of the volcanic rocks in its neighbourhood. Our instruments for taking heights had been injured by an accident, and therefore the altitude of the mountain could not be determined. It will be ascertained at a future period.

Along the elevated ridge of trap and syenite there are some excellent tracts of table land, thickly covered with a heavy growth of beech, birch, and maple. The soil in general is scanty, but of good quality, a circumstance which may be attributed to the potash contained in the feldspar of the rocks beneath. The lofty trees of the forest were observed to have their tops and largest branches much broken and decayed. This effect was produced by a gale of wind, that swept over the mountains in the winter of 1835, at a time when the trees were loaded with the solid ice, accumulated from a freezing mist.

CAPE MERANGUIN.

The new red sandstone of Sackville extends to within six miles of the extreme point of Cape Meranguin, and, crossing the peninsula, reaches along the shore of Shepody Bay, to Point Gilbert. Its strata repose directly upon those of the coal measures to which it is unconformable. In general the rock is of a bright red color, and is composed of fine siliceous particles mixed with mica, and firmly cemented with the oxides of iron; occasionally it passes into a dark chocolate colored rock, and in a few places it is purple. Numerous quarries of excellent building stone might be opened along these shores; for the sandstone resists all atmospheric changes, and the frost. It should nevertheless be taken from situations above the tide, as the salt water hastens its decomposition. An excellent quarry of the chocolate colored variety has been opened at Grindstone Point, by Mr. ANDREWS, and a quantity of superior freestone is annually shipped to the United States from that place.

At Point Gilbert a quantity of limestone was observed scattered in large masses on the shore. It is derived from a bed of that rock situated in the sandstone, and jutting out at the cliffs, rising perpendicularly above high-water mark. How far it is continued eastward is unknown.

"Grand Tasse" is a considerable Bay southward of the Point. There is here an extensive deposit of gypsum, situated immediately upon the shore. Plaster has been shipped from this locality to the United States, and notwithstanding the trade in that article is at present very limited from this quarter, this deposit of gypsum is a valuable part of the mineral wealth of the county of Westmorland. This sulphate of lime frequently contains large and transparent crystals of selenite, and near its junction with the subjacent sandstone, specimens of phosphate of lime were procured. A quantity of superior flag-stones was shipped to New-York from a quarry near the gypsum, during the present season. The general course of the strata is west-north-west, with a dip of 28° north-north-east: both the course and inclination deviate at different situations.

The Cape, to the distance of six miles on each of its sides, is composed of sandstones and shales, belonging to the coal measures of Cumberland. The shale (slate clay) is most frequently of the red and blue varieties, and often contains clay iron stone balls. The course of these strata is east 10° south, and the dip is south 10° west, at an angle of 42°; from these facts it is evident these strata belong to that coal basin, the principal area of which is situated on the east side of Cumberland Bay, where the rocks have a similar dip, and follow nearly the same course. The strata on each side of the Bay are also identical in their chemical components, and general characters.

There are no less than nineteen strata of coal at the South Joggins of Cumberland, and it was inferred at the time of our explorations in Nova-Scotia, that some of these might be found on New-Brunswick side; but, upon a close examination, their original situations were found to be occupied by the Bay itself, and the outcroppings which were at a former period continuous from one side to the other, have been removed, and now have their remaining portions buried beneath the waves of the sea. Upon the causes that have contributed to destroy so large a tract of country, as that now forming the site of Chignecto Bay, we do not at present stop to speculate. There cannot, however, be any doubt, that the sea, which has made such vast inroads into this coal basin,

has, in its turn, been driven back by the collections of alluvium on the Tantamar and other adjacent streams, and the sites of the great tracts of marsh, the lakes and extensive peat bogs reaching twenty-four miles into the interior, were once washed by the saline waters of the Bay of Fundy.

We have on another occasion observed that there is a coal district of great magnitude, extending from Cape Breton, across a part of Nova-Scotia, into New-Brunswick; and the examinations of every season, illustrate more clearly this interesting and important fact. But it must not be understood, that the coal strata themselves follow a direct course, and are perfectly continuous throughout this vast area. This coal field embraces within its limits, a number of separate and distinct basins, which contain coal to a greater or less amount.

Coal appears on both sides of the Memramcook River, Peticodiac River, and ten miles north of Shepody; but the strata show by their contrary inclination and different courses, that they form no part of the Cumberland series, and therefore they should be considered apart from them.

It is evident that the western margin of the Cumberland coal basin is fixed at Cape Enrage, New Horton, and Shepody, having within its limits Cape Meranguin, Grindstone Island, and Grindstone Point.

The east side of Cape Meranguin is called the North Joggin, in contradistinction to the South Joggin, on the opposite side of the Bay. It is indented with a number of notches or "jogs" as they are called by the inhabitants; from this, the term Joggin (jog-in) has probably been derived.

At Slack's Cove, and Desk's Cove, a number of strata of sandstone afford excellent grindstones. They are like those of the opposite shore, in Nova-Scotia, and supply the best stones for cutting and polishing the metals ever found in America. The rock is of a gray color, and is composed of fine angular grains of quartz and feldspar, with a few shining spangles of mica, and an argillaceous cement.

The reefs are broken at low water, and masses of rock are secured to large boats; at high water they are brought to the shore, where they are cut by the workmen with great facility, into grindstones from four to eight feet in diameter, and from six inches to a foot in thickness. These are called "water stone," and are extensively used in the United States, for grinding down and polishing all kinds of cutlery. Other grindstones of less dimensions, are made from the rocks situated above the tide. These are used for more common

purposes. The price of each stone delivered on the shore, is from two to three shillings.* They are sold in the United States from six shillings and three pence, to nine shillings per stone. The trade is, therefore, profitable. We were unable to ascertain the exact number of grindstones shipped from this part of the Province; but from the most correct information received, it will exceed fifteen thousand per annum. The same strata also afford the best materials for architectural purposes, the rock above the sea being durable, and capable of bearing the designs of the sculptor. They are therefore valuable for the supply of the Province and its foreign trade,

---

* A stone by measurement is two feet in diameter, and four inches thick.

FOSSILS

OF

CHIGNECTO BAY COAL FORMATION.

We have already briefly adverted to the fossil plants found at Grindstone Island, and other localities along the shores of Chignecto Bay. Such as have been found on the east side of this Bay, in Nova-Scotia, have been noticed in a work devoted to the geology of that Province, published in 1836; and in a communication prepared for the Geological Society of London. The object of this report will not admit of a full description of these vegetable relics, and therefore they will be but briefly considered at present.

The same fossils which occur at Cape Enrage, New Horton, Grindstone Point, and Grindstone Island, were also discovered at Cape Meranguin. Among these are trees, frequently of large dimensions, which have been considered most nearly allied to the *conifera*, (fir tribe) of the warmer latitudes. The trunks and branches of these trees are lieing in all directions in the rocks. They are seen at low water extending directly downwards, and often penetrating the strata at right angles. Again, they appear situated obliquely along the sides of the cliffs; and in other instances, between the strata of shale and sandstone, to the inclination of which they sometimes conform.

Some of these relics of ancient vegetation, are two feet in diameter, after the bark (now changed into coal,) has been removed. From their dimensions as still seen, they were lofty trees, and far surpassed in beauty and grandeur, any now flourishing on the soil that covers their graves. Their woody parts have been converted into coal, lignite, sulphate of barytes, and iron pyrites. These minerals are so collect-

ed, that the original vegetable fibre of the plant remains distinct, and the annular rings of one species are still as well defined as they are in the living oak.

These monuments of the herbage of a remote era, appear like the decayed stumps of a forest overrun with fire. In particular situations, the sandstones and shale abound in the remains of smaller plants, and leaves, which have been scattered abroad, and are now sealed up in the solid rock; of the latter, one variety belonging to the fern tribe was only discovered at one locality. (See Fig. 6.)

Fig. 7.

Fig. 6.

Four species of the *syrengodendron* were procured at different situations along this shore. They were plants of considerable size, and differ from the *calamitæ* in having no joints, and the greater distance between the flutings. None of the *cactæ*, and but one species of the *phytolithus* (steinhauer) were discovered at Cape Meranguin: this circumstance is somewhat remarkable, as they are abundant on the opposite shore. *Calamites* are numerous. These fossils are distinguished by their jointed and striated stems. One of these was procured, which before it was removed from the rock, had the remains of its leaves still adhering to its surface; (see Fig. 7.) The figure is a correct representation of the plant, as it appeared in the broken cliff. The *calamite* was supposed by BRONGNIART to have been allied to the *equisetaceæ* (horse-tail tribe,) plants still living in cold climates; but even those now growing between the tropics are very inferior in size to these of the coal period, being seldom more than an inch in diameter. We have one in our possession, in a fos-

sil state, from Chignecto Bay, no less than four inches and a half inches in thickness. This shows how favorable the climate and soil were at former periods in the history of this earth, to the production of these vegetables.

Besides these we have two species of *Sigillaria*, (Brongniart), which, if not altogether different from any described by fossil botanists, are very rare. (See Figs. 8 and 9.)

Fig. 8.

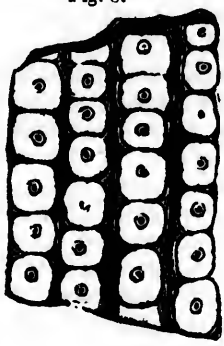
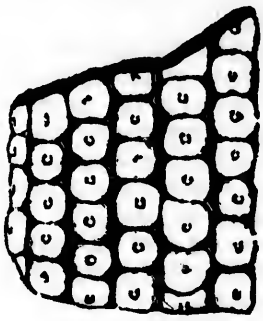


Fig. 9.



The trunks of these plants are from one to three feet in diameter, and must have been from forty to sixty feet high. The scars on the stems are in parallel rows on the flutings, and the sections of the vessels leading to the leaves, are still visible. There can be but little doubt, that these vegetables were arborescent ferns, but they have no successors on the earth in its present state, that can vie with them in grandeur and beauty.

Cactæ, and other plants common to coal formations may be collected at many places along these shores, but we forbear entering upon a minute description of them, as it would exceed the limits intended for this report.

The fact that coal is of vegetable origin, is now established and believed by every geologist who has impartially examined its relation to the ancient vegetation of the earth. And its situation in separate troughs or basins, offers an explanation of the manner in which the vegetables it was derived from were accumulated. Near Cape Enrage, there are two strata of black, shaly limestone, containing the remains of fresh water muscles. At the South Joggin, on the Nova-Scotia side of the Bay, there are three strata exactly similar in their characters and organic remains. These strata are

placed one above another at a distance of several hundred feet, and at the latter place, two strata of coal of considerable thickness, are interposed between them. Thus it appears evident, that this coal basin had successive deposits of mineral and vegetable matter spread over its surface, and that there were periods when moluscous animals were permitted to occupy its whole area, without being disturbed by those violent causes by which other succeeding strata were formed; and it also appears evident that this basin was a lake, and not open to the sea, as all its fossil shells belong to fresh water species.

The characters of the fossil animals, and more especially the flora of the carboniferous period, lead us to infer, that the waters of the ocean and lakes, and also the climate were much warmer, and less variable than that of the latitudes where coal strata are abundant. The existence of large tree-ferns, which may be called the descendants of those now found in a fossil state, still growing in hot and humid climates, confirm the opinion that the temperature of the atmosphere and ocean, have been reduced in northern latitudes. If it should be observed that most of the plants of which the coal was evidently formed, have become extinct, and therefore should not be referred to, in supporting this argument, yet the whole of their characters, when viewed generally, are such as prove the warmth of the climate when and where they flourished.

Under all these circumstances it is exceedingly difficult to avoid looking backward into time, and taking a view of the condition of the earth at that period when the materials for fuel were produced, and laid up in nature's vast store-house, to supply the wants of man, who appears to be among the latest occupants of this planet.

When the present growth of vegetables, covering the dry land of this district, is compared with the fossil flora of the rocks beneath, a contrast the most remarkable and peculiar, cannot fail to strike the mind of the observer. The remains of large tropical trees not only appear in the cliffs of the shore, but their colossal trunks, broken by the fury of the waves, are scattered in fragments along the beach, or appear like massive columns whose summits are scarcely uncovered by the greatest retreat of the tide; and thus the terrestrial changes to which they have been exposed, have buried them beneath the water of the bay, or lifted them to the tops of the cliffs, where they are ready to fall from their sepultures, and disappear before the never-ceasing attrition

of the sea. In the steep embankment lie buried the lofty palm, and *auracarian* pine, that flourished in a moist and heated atmosphere; while on the surface, the hemlock and the hardy spruce of humbler growth, seem to mock the grandeur of their predecessors, over the graves of which they bid defiance to the winter's snow and frigid vapours.

At Cape Meranguin, and near New Horton, the cliffs at some places are covered with the sulphate of iron, produced by the decomposition of the sulphuret of that metal, and the quantity is sufficient for the manufacture of copperas upon a large scale. In one instance the sulphate of lime in small crystals was observed by the Hon. Judge PARKER, with whom we had the pleasure of making our last visit to this interesting locality.

ACTION OF THE SEA ON THE COAST.

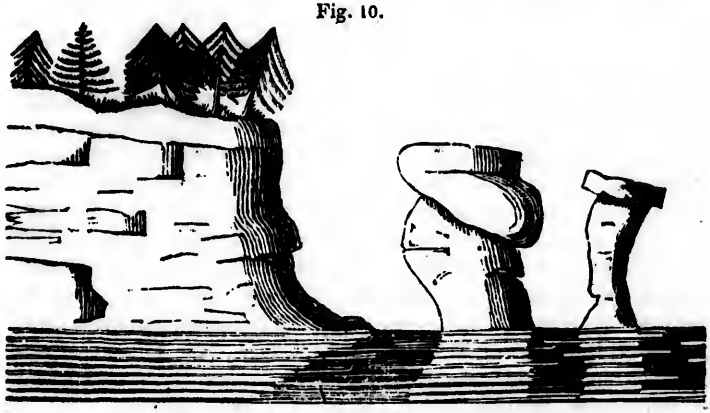
About ninety miles of coast besides estuaries, and indentations, are, in the district under consideration, exposed to the action of the sea; and an opportunity is thereby afforded for observing the influence of the tides and waves upon the rocks of the shore. From Cape Mispeck to Cape Enrage the ordinary rapidity of the tide is from three to four miles an hour. At Shepody Bay and Cumberland Basin, its velocity is much increased; and in the mouths of the Peticodiac, Memramcook, and Tantamarre, it runs at the rate of ten miles an hour. But notwithstanding this constant current along the line of coast, its effects in abrading the rocks are limited to those of a soft and yielding nature, and the range of strong eddies, where the water is urged upon the naked strata with violence.

The configuration of any coast depends upon the hardness of the rocks exposed to the sea, which wears out the most yielding parts into harbours, bays, and coves, while the more compact masses are left, forming capes and headlands. At every situation in the above distance, these observations will apply, due allowance being made for the variable power of the waves, and the entrance of rivers. It might be supposed that low sandy shores would suffer most from the action of the sea, but such is not the fact; in those instances the waves throw up a barrier of sand and shingle, upon which their force is broken, and the dry land is thus defended from encroachments.

Along the shore under consideration, the Bay is bordered in general by steep cliffs, these by being undermined by the waves fall down, and the rubbish forms a slope, defending the precipice until it is washed away, when the same process is repeated. The falling of the cliffs is far more common in the spring, when the rocks which have been rent asunder by the expansion of the water freezing in winter, are loosened when the ice dissolves, and they therefore fall headlong in enormous masses to the beach below. It is to the formidable action of the breakers, however, that the great

delapidation of the shore may be chiefly ascribed. Even in calm weather, the ground swell, as it is commonly called, falls heavily upon the beach, or against the rocks, breaking the largest stones into pebbles, and grinding the pebbles into sand. During gales this action is greatly increased, and the dissolving rocks render the water turbid several miles from the land. This effect is also produced by landslips, where large collections of rock, gravel and soil, covered perhaps with trees, become loosened by the escaping frost, or the breaking out of a spring, and are launched downward to the beach, or into the water of the bay. From these combined causes, and others which might be mentioned, the shore at many places is rapidly wasting away, and the sea is making annual encroachments upon the land. In other instances, the united powers of the tide and waves wear out rude caverns, and with uncouth sculpture, form isolated blocks, which at a distance resemble the work of art. The following wood cut represents two of these outliers, as they appear at Cape Muzzle at the entrance of the Petitcodiac. (See Fig. 10.)

Fig. 10.



The sediment produced by these operations on the sea coast is transported by the tides to the banks and mouths of the rivers issuing from the low grounds, and thus the extensive marshes of Westmorland and Cumberland have been formed, and are daily increasing in magnitude. These are the means by which not only the geographical features of a country are changed, but its agricultural character is improved by these operations of nature, which from the naked sterile rock, produces a fruitful soil, and whole tracts of arable land are deposited along the vallies, to feed 'the cattle of a thousand hills.'

EXPLORATION

OF THE INTERIOR PARTS OF THE DISTRICT.

Having given an account of the different formations, as they appear on the coast of the Bay of Fundy and Chignecto Bay, and the minerals contained in them, we now proceed to the examination of the interior of the district submitted to exploration during the past year, and the description of the various minerals contained in it, with due attention to the soil and the proper mode of its improvement.

The deep fosse that separates the limestone of Saint John from the peninsula of the City, extends eastward about four miles. The calcareous rock pursues its ordinary course in a north-east direction, and is seen on the main road, on both sides, at Robinson's Inn, where, as usual, it is accompanied with trap rock forming naked and steep hills. Near Ferguson's Inn these rocks are met by the granitic and syenitic ridge already described, which, from this place, extends in a north-west direction across the peninsula of Kingston to a mountain, improperly called the "Devil's Back," on the west side of the Saint John: eastward, it occupies the high lands between Hammond River and Quaco. The limestone also appears at several situations between Saint John and Hammond River, where the formation is terminated.

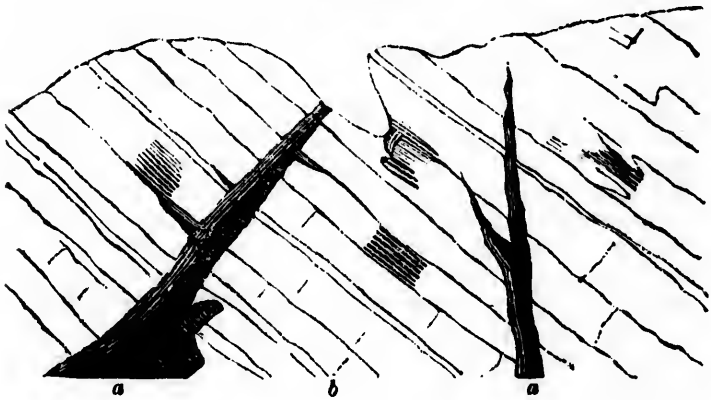
HAMMOND RIVER.

Hammond River, after running in a south direction about three miles, passes through a fine belt of intervale, skirted with some good farms. It is then seen rushing through a narrow gorge in the limestone a mile above the bridge. The syenite is met by new red sandstone a short distance from Gondola Point, on the Kennebeckasis; from

thence the latter formation, accompanied with conglomerate, runs on a course parallel to Hammond River, towards Sussex.

At the farm of Mr. SHERWOOD, one mile south of KETCHUM'S Inn, the limestone forms bold cliffs on each side of the narrow opening where the river passes. On each of its sides there is a belt of syenite. Its strata are nearly perpendicular, and are frequently intersected and separated by dikes of the hornblende rock.—Fig. 11 represents two of these dikes, with veins branching off in different directions.

Fig. 11.



a. Trap Dikes. *b*. Limestone.

An excellent marble might be quarried in the high hill at Mr. SHERWOOD'S farm, and many of the strata where they have not been fractured in the vicinity of the dikes would supply large slabs. The syenite and trap are seen on both sides of the river as far eastward as TITUS' Mills, twelve miles from the bridge, where it meets the new red sandstone and conglomerate of the Parishes of Hampton and Sussex. By examinations made in a northerly direction from this river, the latter rocks were found to occupy a large tract of country, and north-easterly they overlie a part of the coal field of Westmorland.

About four miles farther eastward, at the farm of Mr. WILLIAM GANTER, and on lands owned by ROBERT PAYNE, Esquire, the sandstone contains beds of gypsum and limestone. The gypsum is of an excellent quality, and being

surrounded with a dense forest and at an excellent site for mills, it might be calcined and ground upon the spot. Immediately by the side of the road there is a small pond, having in its centre an isolated mass of gypsum. The water of this pond was discovered to evolve sulphureted hydrogen gas, an effect evidently produced by the decomposition of the sulphate of lime, and perhaps the sulphuret of iron contained in the earth. As this gas is very inflammable, it would not be surprising if the surface of the water at certain seasons of the year would be covered with a flame, if heat were applied to it. The above deposit of sulphate of lime reaches a mile farther eastward, where it again appears above the common level of the tract. Its situation may be always known by the presence of deep pits commonly called "Kettle Holes," which give a peculiar aspect to all plaster districts. These deep cavities are formed by the decomposition of the gypsum in the earth, and hollow caverns are formed beneath, while the soil remains unbroken. In these instances they frequently break in and inhume animals, and sometimes man himself. We have found pits of this kind a hundred feet deep, and not more than ten feet in diameter. Lofty trees sometimes slide from their foothold into them and disappear, or only have their tops left above ground. In general, however, where the country is uncleared, they are choked with rubbish.

The limestone is a dark brown slaty rock, reposing upon a bed of conglomerate, and containing the remains of two species of marine shells. It is covered at many places with a fine black marl, derived from the rock beneath. This will be found a cheap and excellent manure, and, with the limestone, offers great advantages to the settlement in its neighbourhood.

The river pursues its course in a north-east direction, passing through a narrow tract of intervale of excellent quality, which is spread along the bottom of a deep valley, walled in by lofty hills of the most imposing aspect. Although the lands on each side of this stream are elevated, the mountains of syenite and trap, diverging away towards the coast, may be readily distinguished at a distance from the more oval and undulating hills of conglomerate and sandstones seen stretching away towards Sussex Vale.

The whole surface of the country here, is broken and uneven. In the inhabited portions of it, luxuriant fields are frequently seen at the base of some perpendicular cliff, and almost overshadowed by the lofty trees clinging to the neighbouring slopes. The inhabitants seem to have

sought concealment between the hills which send back the echo of their voices, as they pass the friendly salute across the river.

The soil, wherever it is derived from the conglomerate, is stony and gravelly. The sandstone yields a red loam, and both are highly productive when they are properly cultivated. The *debris* covering the syenite, is more scanty, notwithstanding there are some tracts of good land situated upon its surface in this quarter. Excellent freestones may be quarried from the red rock. Southward of Mr. GANTER's farm, and at several other places in this district, there is a fine white sandstone, composed of siliceous particles strongly cemented together, and capable of bearing the violence of the weather. This rock has been mistaken for granite, and is used for millstones, buildings composed of it would be white, and resemble those built of some varieties of marble. Neither the limestone nor the marl have ever been used for manure. And many farmers suppose their lands do not require the application of any foreign substance; but they may be assured that by a judicious management of the limestone, marl, and sometimes peat, to be found in their neighbourhood, their crops might be greatly increased.

Following the Hammond River still farther eastward, the soil becomes more sandy and meagre. At a new village called the Irish Settlement, sixty miles from Saint John, on the old Shepody Road, the syenitic rock would be distinguished from any other by the appearance of the inhabitants living upon its surface, as their labours to procure a crop far exceed those of settlers upon the more fertile sandstone and conglomerate.

We visited three Salt Springs in the Parish of Hampton, and others are said to have been found in the forest bordering on the river. In every instance they issue from the new red sandstone, and evidently from deposits of mineral salt contained in that rock. The water by evaporation yields a very pure chlorate of soda, (common salt,) but as none of these Springs differ in any important particular from those of Sussex Vale and other parts occupied by the same formations, it is unnecessary to give particular details of them, those Springs being described more perfectly.

Almost all the high hills in this neighbourhood are composed of conglomerate, large boulders of which are scattered over every part of the country. From the top of every cliff enormous masses have been broken off and rolled downwards into the valleys. There are certainly no causes now in ope-

ration that would separate these huge blocks from the parent rock. It is only to the former influence of powerful currents that these phenomena can be attributed, and the evidences of these currents still remain engraved on the hills. Excursions were made into the wild forest on each side of the Hammond River, and the facts observed were only such as coincide with the statements laid down.

The line of junction between the schistose rocks appearing at Saint John and along the coast eastward to Emerson's Creek, and the syenite, was found between Hammond River and Loch Lomond, and other lakes in that quarter. The marking of this line upon the geological map, now in progress, is rather an arbitrary act, as it is exceedingly difficult to determine where it should be drawn, from the interruption of vast masses of trap rock which have obliterated the true line, and produced a confusion in each formation by distorting their borders. In such situations a considerable tract has a most broken and uneven character, being occupied with steep precipices, sharp naked hills, and deep oval cavities of various dimensions. Such of these cavities as become dry in the summer season, appear to have been produced by the falling in of the rocks, while the hills on the other hand were evidently raised by protrusion.

Several inconsiderable collections of quartz rock were observed in this quarter. Some of these cross the road between Saint John and Quaco, with colors of the purest white deepened to a bright red. In this rock we found numerous indications of copper: the sulphuret and carbonate of that metal were found in small veins in situations adjacent to the trap: a specimen of the latter ore yielded sixty-five per cent. of pure metal. It is by no means improbable that after this range becomes cleared of its timber and the rubbish on its surface, a profitable vein of copper ore will be discovered.

The irregular depressions at the bases of the sharp conical hills are frequently the sites of lakes. The largest of these is Loch Lomond, which is surrounded by high hills and naked cliffs affording some bold and romantic scenery.

Large and rounded masses of rock are scattered over the surface, and the soil is composed chiefly of sand and gravel. Wherever there are any considerable collections of detritus, their surfaces are level and they are covered with a growth of hardwood. In the neighbourhood of Loch Lomond there are several fine farms on these beds of *debris*, while in situations where they are absent, spruce and cedar are the prevailing trees, and peat bogs are numerous.

HAMPTON.

Near the Hammond River Bridge the new red sandstone commences and continues eastward. It is here, as usual, interstratified with and frequently overlaid by the conglomerate belonging to the formation. Its general dip in this quarter is north-west 50°, and the course is north-east. At a few places it will supply good freestones, but in general it is too coarse or slaty for that purpose. It should be observed here that the syenite southward forms an anticlinal ridge, the strata of Hampton dipping in one direction, and those on its southern side, dipping in an opposite one from the chain of high lands already noticed. Whether the sandstones and conglomerates were formed after the elevation of this chain, or had their strata uplifted by the disruption of the syenite, is a question not to be answered without deep research; the facts, however, as they have been observed rather lead to the conclusion that the latter is the more correct view of the case.

The sandstone and conglomerate appear frequently at the surface, forming broad shelving masses. The soil is sometimes scanty, but in general very productive. On the opposite side of the Kennebeckasis, there is a peculiar bold and undulating chain of high hills composed of trap rocks. This chain of hills appears like a majestic wall thrown upon the margin of the river which separates these two classes of rocks.—Viewed from any of the higher grounds of Hampton, the imposing hills of Kingston with their steep cliffs and deep ravines, and skirted with a continued line of fine farms stretched along the side of the river, afford a most interesting and pleasing prospect.

The whole tract of country extending from Hampton and Norton, on the south-east side of the Kennebeckasis, and reaching to Sussex, is composed of the red sandstone and conglomerate. The former rock agrees in its general characters with the same formations in other quarters, and yields, when exposed to meteoric changes, a most fertile soil. The conglomerate is composed of pebbles and occasionally large boulders of trap, quartz, and other rocks firmly cemented. It resists disintegration with great obstinacy, and supplies a soil less productive than other strata associated with it. At the Mill Stream both limestone and gypsum are deposited in connexion with these rocks, and might be employed with advantage in the agriculture of the new settlements springing up in this part of the country.

SUSSEX.

The great eastern road of the Province follows the direction of the Kennebeckasis until it reaches the head of the Petitcodiac, which it crosses near its source, and then runs along the north side of the latter stream to the "Bend," a distance of a hundred miles from St. John. The low grounds through which these rivers pass are like a deep channel opened among the hills. At the branching off of the lesser streams of the Kennebeckasis, the new red sandstone forms an extensive level area called Sussex Vale, a tract not rivalled in the Province in beauty and fertility. Near Roach's Inn, at the entrance of the valley, the limestone may be seen forming the side of a steep hill, and possessing characters like that of Hammond River.

The calcareous rock appears again a quarter of a mile eastward of the church, cropping out in a shelving ridge on the farm of Mr. Corey. Its structure is slaty, and the only organic remains found in its strata were a few small tubipores. The outcropping rests directly upon a coarse conglomerate belonging to the new red sandstone group. It may therefore be considered equivalent to the lias limestone of Europe, as it is placed in the same geological position. The conglomerate situated beneath this rock extends in an easterly direction on the north side of the stream which passes through the Dutch Village, where it forms an almost perpendicular cliff three hundred and fifty feet high called the "Bluff."

From the summit of this cliff the attention is immediately directed to the beautiful villages and luxuriant intervales beneath, where the rocks of the red marly group, true to their geological characters, have, from the natural observation of the inhabitants, directed them to cultivate its surface which is covered over with rich meadows and fertile cultivated fields. The Bluff is the extremity of a chain of high hills running from it eastward. Piccadilla, four and a half miles from the church, is of still greater altitude.

The basset of the limestone is fixed some distance within the outer margin of the conglomerate, a result that would have followed the uplifting of the rocks by a force applied from beneath.

It is however more probable in the present instance, that the features of this district have been greatly modified by currents of water which have washed the tops of the highest hills, and were capable of producing similar features. Each of these formations at this place, runs south-east, and dips north-

east, at an angle of 24°. The "Bluff" has been a favorite resort for operators with the "mineral rod," and strange sounds and apparitions are reported to have been seen and heard at the cliffs. Those who hope to find a gold mine here by the aid of divination may depend on certain disappointment, and little will be heard during the summer months, more terrifying than the notes of the beautiful songsters of the inland forest. Limestone occurs at several other situations in this neighbourhood, and may be calcined at a cheap rate. In a low meadow but a few hundred yards from the limestone, some beautiful crystals had been accidentally found. Upon examination, they proved to be the sulphate of lime, and a number of large and perfect specimens of that mineral, were removed from the sand where they were formed. We are indebted to Mr. HALLETT for a single group of these crystals, which weighs upwards of a hundred pounds.

This crystalized sulphate appears most frequently in the decomposed vegetable matter of the surface, and in a fine sand immediately beneath it. It is somewhat singular, that these crystals are now in the act of forming, and the calcareous mineral is daily collecting on the roots of trees, and other vegetable productions in the bog. It is curious to observe compact mineral matter, collecting on plants that have not ceased to live. Almost all the crystals contain fine sand, and this shews how powerful the force is, whether electrical or otherwise, which embraces the siliceous particles, and brings them into an union with the lime, with which they are only mechanically associated. The decayed roots of the pine, fir, and hemlock, are daily becoming encrusted and clothed with crystals of the most perfect geometrical figures. The mineral itself is evidently derived from a deposit of gypsum, situated at the margin of the meadow.

In many of the bogs and swamps of Sussex Vale, there are extensive deposits of bog iron ore. On the farm of Mr. JOHN JEFFRIES, and other lands adjoining, there are accumulations of this ore of great thickness. The oxide of iron contained in the sand, and derived from the decomposition of pyritous iron, is washed from the uplands, and during the summer months appears in a brown and yellow coating upon the stagnant waters and moist cavities, where the only drainage is that afforded by the evaporating power of the sun's rays. These oxides of iron finally become consolidated, and from their annual increase, they are in many places ten feet in thickness.

The changes produced by the operations of nature, are truly remarkable. First, the iron mixed with sulphur through the agency of volcanic heat, is converted into iron pyrites. This from being exposed to the oxygen of the air and water, produces the oxides of the metal, which by time and pressure, become consolidated. There can be no doubt that many of the compact ores, of the older rocks have been formed in this manner. Finally the art of man is exerted to restore the metal to a pure state, and he throws charcoal into the furnace to absorb the oxygen: the sulphur having already entered into new combinations, and the inert matter having passed through many changes, is at last placed along the railroad—forms the piston of some mighty engine, or forsooth, the polished blade that glitters in the sunbeam, amidst the pomp and pride of war.

The iron of Sussex might be worked with advantage, being of a good quality, and situated where wood for fuel is abundant. Also its proximity to a part of the coal field, to be noticed hereafter, offers another inducement to any who may engage in its manufacture. The bogs also abound in the brown, yellow, and red oxides of iron, which will afford ochres for pigments.

A large quantity of gypsum appears, forming a long ridge, reaching from the base of the Bluff in a northerly direction, and meeting the limestone on one of its sides. But the localities of these minerals are too numerous in this quarter to require particular description.

Three miles eastward of the church, two salt springs rise from the new red sandstone at the foot of a gentle declivity, near the great road. The quantity of water supplied by each spring, is about fifty gallons per minute. Every hundred gallons yield by evaporation a bushel of salt, which is very pure and free from earthy matter. A small quantity of the sulphate of magnesia was discovered in the analysis of this water, but it is of no practical importance, and too scanty to produce any sensible effects on the production of the springs. Salt has been manufactured here on a small scale, the process is evaporation by boiling in iron vessels, and fifteen bushels have been the average produce per day. But the establishment seems to be neglected, and the buildings are falling into decay, circumstances arising from the low price of foreign salt.

There can be no doubt that the beds of salt communicating their properties to these springs, might be found by judicious boring, and should the wants of the country ever

require it, an inexhaustible supply of this necessary mineral might be procured.

Sussex Vale, at its eastern extremity, is divided into two branches; one going in the direction of Salmon River, and the other following the course of Smith's Creek. At the bifurcation, a steep mountain of conglomerate, called Mount Pisgah, separates one part of the valley from the other. The scenery of this district is extremely beautiful. The great Valley, with its fertile fields and meadows, shaded by stately elms, and bordered by the thickset alder; its pastures sloping down the sides of the hills, surrounded by several bold elevations, intersected by deep ravines and rapid brooks, afford a most pleasing landscape.

The rocks of the lower ground are chiefly concealed beneath beds of diluvial sand and gravel, having very frequently a fine alluvial covering. The soil is a fine dark red loam, frequently mixed with sand, and sometimes with marly clay. The rains washing the beds of limestone, gypsum, and other rocks, bring down an annual deposit of mineral manure, which is spread by the freshets of spring over all the low lands. The earth thus renovated, produces fine crops of wheat, and all the vegetables of the climate. Even in this fertile part of the country, there are but few farms that would not be much improved by the use of lime for manure. The soil, at a number of places where it is washed by the rain descending from the gypsum and limestone, is already sufficiently mixed with the calcareous mineral; but the unyielding clay and light sand, require its application. The indications of coal in this quarter will be noticed when the coal district of Westmorland is considered.

PETITCODIAC RIVER.

The new red sandstone and conglomerates of Sussex, meet the sandstones of the coal district on the old road across the portage; and the latter rocks were found to extend northward, to the sources of Studholm's Millstream. The different quality of the soil on the carboniferous rock is very remarkable. The rocks of the red marly group are covered with a fertile loam, producing groves of hard wood, while the grey sandstone possesses a meagre covering, and is occupied with red pine, fir, and spruce. After crossing the portage, the high lands skirting the valley diverge northward on the one side and southward on the other, and the country is low and level.

From these facts it will be observed that the great valley of the Kennebeckasis extends in a north-east direction until it meets the valley of the Petitcodiac, and thus a long belt of low land is extended across this part of the country, where it is evident the sea had access at some former period in the history of the earth.

The new red sandstone possessing the characters of that rock, as they have been already described, occupies the whole tract of country from the Portage to the Bend, and to a distance of ten miles southward from the river where it is associated with the conglomerate, and reposes upon the rocks of the coal measures. In this tract it was not found to contain any limestone or gypsum. Northward, the same rock extends to a ridge of conglomerate, reaching eastward to Moncton, and these formations were found to continue in a north-east direction to Shediac, being again met by coal measures in that quarter.

After leaving the Portage the western extremity of the Petitcodiac passes through a tract of fine intervale enclosed between high embankments that appear to have been washed by the river at some former period. The stream is now confined to more narrow limits, and its former bed is almost filled with alluvium. The same observations were made in other parts of the district under consideration, where the alluvial mud brought downwards by the rivers or inwards by the sea, forms extensive marshes and intervales.

In the deepest parts of these intervales and marshes, the trunks and branches of large trees still remain undecayed. At the upper part of the Petitcodiac large oaks have been dug up and found fit for use, having only parted with their outer portions, called the sap. These trees had been evidently buried during a number of past centuries, and have been preserved by some unknown principle in the alluvium.

This river is navigable for vessels of a hundred tons, thirty-three miles from its entrance, and the tide flows inland thirty-six miles. At the Bend, the stream having entered from the southward, turns suddenly to the westward at a distance of twenty miles from its mouth. At this place the tide flows in and ebbs off in six hours, running at the rate of seven miles per hour. The flood tide is accompanied by a tidal wave called the *bore*, which at high tides is five and sometimes six feet high. The rushing of this overwhelming wave produces a noise like that of a number of steam-boats in operation, and is one of the most interesting spectacles the country affords. The salmon and shad, urged forward

by the sweeping current, to avoid the force of the stream, seek the shallow water near the shores, where they are discovered by their wake, chased by wading sportsmen, and fairly caught.

At low water extensive flats are laid bare; these are composed of fine shingle and quicksands, which, with the *bore* and rapid tide, have been the cause of several shipwrecks. The danger to vessels arises from venturing too early on the flood and too late on the ebb tide. In the first instance they overrun the tide, and are stranded in the quicksands; in the second, the tide leaves them before they arrive in deep water. When thus situated, if they resist the fury of the *bore*, the water washes the sand away from the leeward side—they roll over before the current—breaking their masts, and finally, filling with shingle, they are buried in a sandy grave. The *bore* is much higher and more violent in some parts of the river than in others,—a circumstance probably arising from the configuration of the shore and the bottom of the river.

At the Bend there is a considerable village. The soil is chiefly of two kinds, the sandy and the clayey. Lime, if judiciously applied, would greatly improve both varieties, and the admixture of marsh mud would increase the fertility of fields where the clay is absent. There are large tracts of marsh on each side of the Petitcodiac, of which a portion has been diked and is under cultivation.

The northern side of the coal district in this quarter was observed about ten miles from the entrance of the Petitcodiac. The rocks of the new red sandstone group, again cover a part of the coal field at Belleveaux village, on the east side of the stream, and occupy a large tract in the township of Hopewell, having the conglomerate of Shepody Mountain on the southward, and the syenite westward. At the latter place, and near the farm of JOHN EDGETT, Esquire, the new red sandstone contains thick deposits of gypsum and limestone, which extend in a westerly direction several miles. The gypsum is a very pure white sulphate of lime, and is situated so as to admit of transportation from the river. The limestone is of the same variety seen at Sussex Vale.

At the Cape, a high cliff four miles above the entrance of the river, a grey sandstone of this group reposes upon strata of soft marly clay. This rock is worked by the French inhabitants for grindstones, the only instance seen in the Province of strata belonging to the newer sandstone being used for that purpose. Its dip is south by west 10°, and is almost

directly opposite to that of strata belonging to the coal measures beneath, and those of the eastern side of the Petitcodiac. A fine magnetic iron sand is washed from the strata of the cliff, and may be collected on the beach below. It is an excellent blotting sand.

Near the out-cropping of the coal-bearing strata, and at the Belleveaux village, there are two mineral springs, the waters of which are so similar in their characters that they do not require a separate analysis. There is also a spring of mineral water on the farm of Mr. Stephen Smith, within sixty yards of the line separating Hopewell from Hillsboro.' In the water from each of these springs sulphureted hydrogen, and carbonate of magnesia have been detected; but we have been unable to obtain it sufficiently pure, and before it had undergone decomposition, to decide correctly upon its properties.

There are also large tracts of marsh on this part of the river, and the uplands in general are of a superior quality. Wherever the gypsum and limestone are present the features of the country are uneven, and its fine scenery is greatly improved in districts where the calcareous compounds seem to have been collected after the strata of the sandstone had been laid beneath the ancient sea.

SHEDIAC.

Our labours were next directed to the exploration of the country eastward of the Petitcodiac, and the coast between Shediac and Cape Tormentine. The new red sandstone forms a large tract reaching northward and eastward from the Bend. This rock meets the coal series on an irregular line from where it crosses the Petitcodiac, and runs in a north-east direction to the south side of Shediac Harbour. The country on its surface is very low and level, not averaging more than twenty-five feet above the level of the water of the Straits of Northumberland. Its strata are nearly horizontal, and have not suffered from the volcanic forces which have evidently been powerfully exerted in other parts of the Province. The rock is covered at many places with thin beds of sand and clay, and boulders of sandstone are common. Among these are rounded blocks of granite often of considerable dimensions. It is known that the current of water which transported these detached masses from their native situations flowed from the north towards the south, and it is therefore some-

what difficult to explain how these boulders of granite have been brought to their present situations, as no granitic rocks are found nearer than those of the District of Gaspe, which is separated from this part of the Province by the Bay Chaleur, and a distance of one hundred and fifty miles. But boulders are found under similar circumstances in other parts of the world, and there can be little doubt of their origin, however far they may have been driven from their birth places. The soil of this part of Westmorland varies from a stiff clay to a light gravel and sand, containing a large quantity of mica. Under proper cultivation it will be found highly productive; but hitherto the attention of the inhabitants has been directed to the timber, formerly abundant, and they have not availed themselves of the substantial advantages arising from agriculture.

We were unable to discover any limestone contiguous to Shediac, and it appears to be absent in every part of this level district. Oysters are abundant on this shore and their shells are used for manure. Small quantities of marine plants are also applied to the soil. Besides these, excellent manure might be procured from the small creeks and ponds filled with sediment from the influx of the sea.

It has been proposed to open a Canal between this place and the Petitcodiac, and the importance of uniting the waters of Northumberland Straits and the Bay of Fundy has claimed the attention of those who are interested in the prosperity of the British North American Colonies; and indeed the distance, (which will not exceed fifteen miles,) the nature of the rock to be excavated, elevation of the country above the sea, and every circumstance connected with the enterprise are most favorable to the success of the undertaking; and an abundant supply of fresh water to fill the Canal can be obtained from the streams along its site, should it be required.

The tide at Shediac rises, upon an average, only four feet, and the time of full sea is extremely variable, it being influenced by the winds in the Gulph of Saint Lawrence, which frequently produce a high water of four days' duration along the coast, and a low water of an equal length of time. A question has arisen in regard to the currents which would be produced in a Canal where the tide would rise fifty feet at one of its extremities and only four at the other. By observation we found that when it is half tide in the Petitcodiac the water is very nearly on a level with the water in Shediac Harbour, and therefore in a Canal opened between these two places there would be a current from the river towards the harbour at high water, and at low water there would be a current in the oppo-

site direction, provided there were no high grounds or locks to oppose such currents.*

The Harbour of Shediac is safe and convenient for ships of large size. It is, however, a fact which should not be overlooked, that the numerous beds of oysters along the coasts are constantly lessening the depth of the sea and slowly filling up the bays. There are in the settlement upwards of two hundred families of French Acadians. The front of the harbour is occupied by English inhabitants, and the whole appear in a very thriving condition.

At the entrance of the Harbour there are two beautiful Islands composed of sandstone. On the smallest of these, there are the remains of a fortification and breastwork, which were thrown up by the French immediately after the taking of Quebec by General Wolfe. Several pieces of large fossil trees were observed on the shore. They had been brought to the Island from the coal field southward, by the ice. We are much indebted to Dr. THEAL and other respectable inhabitants, for aid during the explorations in this quarter. The indications of coal at Shediac will be noticed in the account of the Westmorland coal field.

EASTERN COAST OF WESTMORLAND.

Kouchibouguas is a small river about seven miles eastward of Shediac. The sandstones of the coal measures appear along the banks of this stream, and crop out from beneath their red marly covering at numerous localities on the surface. Proceeding along the coast the soil becomes more light and sandy. It is, nevertheless, very fertile under proper cultivation. Lime prepared from oyster shells is used for manure and with great advantage; the quantity, however, derived from this source is insufficient for the land under cultivation, and the marsh mud, abundant on the sides of the small creeks and rivers, might be cheaply and profitably applied to all the sandy soils. On the shore there are walls of blown sand and gravel thrown up by the sea. The winds and waves,

*The tides rise in the Petitcodiac as follows: At the "Bend"—common tides 22 feet 8 inches; highest tides, 28 feet 8 inches. At Dorchester Island: common tides, 36 feet; highest tides, 42 feet.—It is three hours flood before the tide reaches the Bend, and from rushing along the river to the distance of twenty miles it rises higher here above the lowest level of the sea at Grindstone Island, than it does at Dorchester Island. The difference of the level between Grindstone Island and the Bend may be estimated as follows—common tides, 45 feet 4 inches; highest tides, 57 feet 4 inches.

two powerful agents, have combined their efforts to defend from the encroachments of the sea considerable tracts of low ground, which are ultimately converted into marsh by the falling down of sedimentary matter. These facts were observed at many other places along the coast where the uplands are scarcely elevated above the level of the ocean. The marsh lands produced by these means are inferior in quality to those formed by the rapid tides of the Bay of Fundy, and the disintegration of the sandstone submitted to their more powerful operations.

The sandstones of the coal measures extend to Aboushagen and as far eastward as the entrance of the Tedish River, being covered occasionally with red loam, beds of sand, clay, and sometimes loose boulders. At the above places there are extensive settlements of French Acadians, who, like their countrymen throughout the Province, are remarkable for their loyalty to the British Government, orderly behaviour, hospitality and industry.

From Tedish River to Little Shemogue, Great Shemogue, and Cape Tormentine, and the whole peninsula of Botsford Parish, the new red sandstone is predominant, and the soil in general is of a superior quality. This rock will supply excellent freestones and support a superior agricultural character, but does not contain any minerals of importance.

BAY VERTE.

At the head of the Bay Verte there is a considerable tract of marsh, but it is not sufficiently drained to render it productive of the finer grasses. This circumstance arises in some measure from its low situation, and the small degree of tidal recession along the coast. Almost all the pine and spruce timber has been removed from this part of Westmorland. The higher grounds, however, are still covered with fine groves of beech, birch and maple, and new settlements are becoming extended some distance from the shore. Limestone here is a desideratum, but after a careful search in every situation where any hopes of its discovery were offered, no quantity of any practical importance was found.

Evidences will be brought forward hereafter to prove that almost the whole of this coast has been raised above the level of the ocean as it is now fixed, within a period comparatively recent, according to geological chronology. Prince

Edward Island, which possesses the same general features, has also evidently been elevated by some volcanic struggle that effected great change over a wide area.

From the shallowness of the water along this part of the shore, resulting from the constant accumulations of sand, shingle and shell-fish, it cannot be surprising that new shoals should appear annually, and the time is slowly but surely approaching when a whole line of coast will become unnavigable.

The small rivers and creeks emptying into the Bay become entirely dry during the summer months. Both the Gaspereau and Tignish were found dry in the month of August. These and other rivers have singular embankments thrown up on their sides by the force of the ice in the spring season. They are several feet high, and resemble the breastwork of a fortification, or what are commonly known by the name of "running dikes." Common tides at the Bay Verte rise seven feet. The harbour is very shallow and much exposed to easterly winds.

The new red sandstone extends from Bay Verte to Cumberland Basin, and forms the narrow peninsula connecting the Province of New-Brunswick with Nova-Scotia. It has been proposed to cut a Canal across this peninsula, and thereby open a communication between the Bay of Fundy and Gulph of Saint Lawrence; and so far as the materials to be removed are concerned in this important enterprise, the situation is most favourable—but the shallowness of the Bay and the deficiency of water along the line, are circumstances which should be duly considered when this site is compared with that offered between the Bend of Petitcodiac and the Harbour of Shediac, the distance at both places being alike.

The rocks of this isthmus are covered with a red sandy loam, and consequently a fertile soil. At Joli Cœur settlement the rocks of the coal series appear, but over a wide area to the eastward they are covered with the red marly strata and detritus.

SACKVILLE.

The greater part of the cultivated portion of this Parish is composed of new red sandstone, which meets and overlies a part of the coal field to the northward. This rock is here peculiarly undulated on the surface, and the numerous oval mounds, with gentle slopes, add much to the natural beauty

of this fertile and closely populated part of the county. New settlements are yearly springing up in the interior, and the whole face of the country proclaims the success of agriculture, and the comfort of its inhabitants. It should, however, be remarked, that many farmers seem tardy in improving their natural advantages, and their farms do not possess that neatness which is indicative of taste and well-directed industry. The residence of the Hon. Judge BOTSFORD, at Westcock, is almost unrivalled for beauty of scenery. At this delightful spot, industry, directed by good taste, has been applied, and the earth pours forth her bounties to its hospitable and benevolent proprietor.

The most abundant soil at Sackville is a light red sandy loam, sometimes mixed with clay or alluvium. It contains less mica than the soil farther eastward, and is highly productive. A great improvement in agriculture appears to be advancing in this quarter, from the practical experiments of the Hon. WILLIAM CRANE, who has introduced peat for manure, and the use of composts.*

The best growth of wheat and potatoes we observed in the County was the second crop from land manured with this compost. It is therefore obvious how much the productions of the earth may be improved both in quantity and quality by a proper management of the soil; but we must defer entering upon this part of the subject until the Agricultural Geology of the Province shall be considered.

The Tantamar Marsh is situated on both sides of a river of that name. It is about thirteen miles long, and, upon an average, four miles wide, being one of the most extensive collections of fertile alluvium in America. This vast collection of alluvial matter has been produced by causes still active in this part of the Province. Large tracts have been rescued from the sea by dikes thrown up on the margin of the river, and produce excellent crops of wheat and hay. But the quantity of these productions would be increased, and their

---

* The compost made by this gentleman consists of alternate layers of peat, barn manure, straw, &c. thrown up in oblong heaps about ten feet wide and four feet high, in the barn yards, in the following order:

Peat,	9 inches.
Barn manure,	9 inches.
Peat, rushes, flags,	9 inches.
Barn manure,	9 inches.
Lime,	4 inches.
Saturated soil of the barn yards,	9 inches, for a covering.

The peat is taken from a bog near the barns. It is composed of sphagneous plants and flags.

quality improved, by draining the land where they grow—an object that has been much neglected hitherto, from the great quantity of marsh owned by each proprietor, and the low price of hay. A number of Islands, formerly surrounded by the sea, are now enclosed by the alluvium. Of these, Cole's Island is a peculiar instance. The inlets and indentations of the sea have been filled with sediment, and it is only at high tides the ocean attempts to regain its former boundaries.

From the rapid falling of the alluvial matter from the water, the banks of the rivers and creeks are higher than parts more remote, and adjoining the upland, which are frequently in a boggy and sunken state. An ingenious and highly commendable plan has been successfully employed to reclaim these morasses. It consists in opening a free communication for the sea to enter through the running dikes along the banks, and overflow the low tracts. The water, loaded with fine sediment, is admitted at high tides, and periodical layers of new alluvium are thus collected. The sphagneous and fresh-water plants are destroyed by the saline water of the sea, and the "dismal swamp" is converted into a luxuriant meadow. These same channels also give exit to the fresh water when the tides are low. The Hon. WILLIAM CRANE and Judge BOTSFORD are now opening new canals for the purpose of renovating the swamps in their neighbourhood. THOMAS ROBSON, Esquire, and other Commissioners of Sewers are also engaged in opening a canal on the Tantamar to Tolar's canal, which, by being extended in branches, will drain a chain of lakes and allow the alluvium to flow in.

At the head of the Tantamar Marsh there is a tract of peat bog, floating bog, and small lakes, not less than eight miles long, and, upon an average, three miles wide. The whole site of this extensive area was once open to the sea; but from the vast quantities of alluvial matter formed from the decomposing rocks along the coasts of Chignecto Bay, and brought inward by the tides, the mouth of the estuary now occupied by the great marsh has been filled up, and the small streams have contributed to the production of lakes which now occupy the lower parts of the country. Mineral matter, in a finely divided state, is swept up the river by the rushing tide, but before it is transported beyond a certain distance it falls, and the tide, having reached its highest elevation, retires: hence it may be perceived why marshes accumulate at the entrance of rivers, (where the violence of the tides and waves is not such as will prevent the collection of alluvial matter altogether,) and why parts more remote from

the places where alluvium is formed are not covered with such deposits. From the rising of the marsh in parts near the entrance of the river, and the natural barrier thus thrown up, these lakes and bogs have been formed, and their surfaces are sometimes ten feet lower than the alluvium fronting the sea. The same fact may be observed, but on a smaller scale, at the Aulac and Amherst rivers. All these bogs and lakes might be reclaimed by the means already mentioned. Fortunately the Tantamar has not been obstructed by "Arbiteaux," like some of the fine rivers of Nova-Scotia, where all opportunity of redeeming some of the low lands is lost, and the navigation of many fine streams has been thrown away.

Large trees of different kinds, collections of shells, and bones of fish, are found buried at different depths in the marsh. The vegetable productions have evidently been drifted, and marine animals have been covered in this recent deposit. The rapidity with which the alluvium collects is proved by the discovery of pieces of cord wood of peculiar dimensions, and which are known to have been cut by the French in the early settlement of the country. An Indian harpoon, and other relics of the untutored aborigines, were found at a depth of ten feet below the surface.

It has been remarked, by persons of observation, that the tides in the Bay of Fundy are gradually rising, and according to our own enquiries into this subject, during the last twenty years, they have attained a greater annual elevation in the Basin of Mines, and other parts of Nova-Scotia, during that period. In the great marsh of Westmorland, there are layers of stumps standing in their natural positions, and situated above each other in the alluvium in a manner that proves the fact of their having been buried from time to time, and suceeeded by new races. These circumstances can only be observed near the margin of the upland, where the vegetables of the soil, above the tide, appear to have been driven back by the advancement of the sea.

DORCHESTER.

Leaving Sackville and proceeding towards Dorchester, the new red sandstone is met by the rocks of the coal measures about three miles westward of the church. It is difficult to determine the limits of these two classes of rocks in this quarter, on account of the great quantity of loose detritus spread over the surface.

In the principal village of Dorchester, the gray sandstones interstratified with conglomerate appear at the surface, and form long parallel ridges. The strata run North 68° East, with a dip of 35° South West. There are indications of coal here, over a considerable area, and the remains of plants were found at several localities. At Robb's Mill, new red sandstone and indurated clay repose on the conglomerate, in unconformable strata. The soil in general is sandy, and requires the application of lime. The sandstones have been used in erecting some of the fine buildings of the village, and when carefully selected, will be found to resist the changes of the weather. There are several thousand acres of marsh on the Memramcook, which have been formed in the manner already described, and the fine farms sloping towards the river, and rugged scenery at its entrance, form a beautiful and very pleasing landscape.

WESTMORLAND COAL FIELD.

Having now given an account of the different formations of the district submitted to exploration during the season, and the minerals contained in them, without particular reference to the eastern coal district of the Province, we proceed to the details of such facts as have been obtained relative to this important bituminous deposit. It has been deemed necessary to enter upon this part of the subject apart from any other, from the peculiarity of the formation, and its vast value to the country.

The great extent of this district, the short space of time which could only be devoted to its survey last season, the wilderness state of the principal part of the surface, and the limited means afforded, have not allowed us to complete the examination of this coal field, and at least the labor of another year would be required to finish such a survey as its great importance demands. Such facts, however, as have been discovered, are faithfully recorded, and it is presumed that they are of such a nature, as will lead to the full developement of this valuable bituminous deposit, by an accomplishment of the survey and the employment of the valuable mineral matter it has already exposed, and by which a competition has arisen among the inhabitants of the Province for the profits attending its exportation.

Coal as it is found in the earth appears in beds, interstratified with sandstone, shale, limestone, and sometimes clay iron stone. Beneath these strata there frequently occur a coarse sandstone and conglomerate, called the Millstone grit, and a peculiar calcareous rock, called the carboniferous or Mountain Limestone. All the different members of this group are found deposited in basins, troughs, or other depressions in the earth, where frequently they have been broken by volcanic and other causes of terrestrial disturbance. Of the whole mass of these rocks, coal, even where it is abundant,

forms but a small proportion. For example, in the north of England, the coal-bearing strata have been estimated to be 3000 feet thick, but the strata of coal varying from twenty to thirty in number, when taken together are not more than sixty feet in thickness.

By a reference to our first Report, it will be seen that the coal measures of Sunbury and Queen's Counties, repose upon the mountain limestone, the mountain limestone upon the old red sandstone, the old red sandstone upon the slate, and the slate upon granite, according to the regular order of superposition; but in the Westmorland coal field, all the rocks from the Millstone grit downwards to the granite, so far as the coal field has been explored, appear to be absent, and along the southern side of its range, the carboniferous strata rest upon syenite. Facts of a similar nature have been observed in England and other countries. There is great difficulty in fixing the bounds of the coal field of Westmorland, on account of a part of its surface being covered with new red sandstone and other deposits of more recent formation, the strata of which thin off in such a manner as to leave the line of demarcation obscure. We have endeavoured nevertheless to define the boundaries of this coal district as accurately as possible, and trust they will be found sufficiently correct for all practicable purposes.

It has been stated that, beginning at the Harbour of Shediac, the Westmorland Coal Field reaches along the shore eastward to Tedish River. It then extends along an irregular line, southward, until it approaches the village of Sackville, and proceeding in a westerly direction, it meets the new red sandstone near Dorchester Island. A line drawn from Shediac to the Petitcodiac, about ten miles below the Bend, will mark its northern side. As it has been already remarked, this tract of country embraces that part of the coal district which is situated on the east side of the Petitcodiac, except a small group of strata observed near the road leading from Bay Verte to Sackville. The coal field then becomes more narrow, and, crossing the river, maintains an average breadth of ten miles, as it proceeds in a westerly direction until it reaches Sussex Vale: here its extremity is forked: one branch is curved towards the northwest, until it meets the source of Studholm's Millstream; the other becomes very narrow and disappears beneath the conglomerate a few miles southward and westward of Sussex Church.—We have here preferred a repetition to making a reference to what has been already stated.

The longest diameter of this coal field is upwards of seventy miles, and it will average seventeen miles in breadth. It is by no means certain that coal is contained in every part of the area included within these limits, but as the outcropping of the bituminous strata has been discovered at a number of situations, it is evident that it embraces vast quantities of coal, and is of the highest importance to the Province.

In giving details of the carbonaceous deposit we commence at its western extremity, and proceed along its surface toward its eastern termination on the Straits of Northumberland. It will not be expected from the limited time devoted to the exploration of this coal field that a full and perfect account of its extent, contents, and value can be given, at present. The labors of a single individual, whose assistants could perform little beyond the aid of being guides, and discharging only a mechanical duty, require an application during a much longer time than has been employed in the survey of this district where even the beds of rivers and creeks are frequently so much obstructed as greatly to retard his progress and increase the fatigue of exploring a tract but partially inhabited. We nevertheless proceed to give such facts as have been discovered in confidence of receiving that support these pursuits so much require.

The rocks belonging to the Westmorland Coal Field were first observed between the upper settlements of Hammond River and the Kennebeckasis, where it enters Sussex Vale. Here they dip beneath the more recent formations of new red sandstone and conglomerate already described, and which rest upon them uncomformably, and the detritus common to the surface.

After passing round a considerable area the lines indicating the boundaries of this formation proceed in an easterly direction towards the Parish of Salisbury. On the road leading southward, and immediately after ascending the higher lands of Sussex, the sandstones and shales appear and are intersected by the small streams passing downwards to the river. These rocks were examined at the farm of Mr. Allen Sheck and other localities, and their bituminous characters distinguish them from any other in this quarter. At the latter place there is a stratum of impure cannel coal about three feet in thickness, and from the quantities of this kind of coal mingled with the debris of the surface it is evident that it exists in much greater quantities, and of a quality more pure in situations now concealed by beds of sand and

other detrital matter. The carbonaceous stratum burns very freely, and contains a very considerable quantity of bitumen. But the quantity of ashes after combustion is almost equal in bulk to the quantity of the coal used, notwithstanding its specific gravity is much diminished. The ashes contain much carbonate of lime and will be found excellent for manure. This stratum is overlaid by a fine micaceous sandstone and reposes on argillo-calcareous shale. Both the sandstone and shale were observed to contain numerous remains, and impressions of the plants belonging to the coal period. Large *cacti* and *calamitæ* with the relics of leaves of other plants are widely disseminated through the rocks, which also contain carbonaceous and bituminous matter throughout a wide range. The strata apparently dip to the north-east and from the anticlinal ridge already mentioned, but from the rubbish on the surface, which still remains uncleared of its timber it is impossible to give an accurate account of their position without incurring a greater expense than our instructions would warrant.

The same kinds of sandstone and bituminous shale were followed in a north-easterly direction to the extremity of the Dutch Village where they appear in the sides of deep ravines and brooks and also in large pieces mixed with the soil.— From the agreement in their mineralogical characters, and inclination of these rocks, so far as it has been ascertained, it is evident that they belong to one and the same deposit.— The sandstones and shales have one peculiarity, which is indeed common to the whole coal field, namely, that of containing a larger quantity of calcareous matter than is usual.— The outcropping of the coal may therefore be considered as having been ascertained extending in a north-east direction from the starting point and along a distance of six miles.— And although the largest and most important beds of coal remain undiscovered from circumstances already noticed, yet an advancement is made towards their developement.

The rocks of the carbonaceous series continue their course eastwardly, and, at the sources of the Kennebeckasis and Petitcodiac, form an elevated ridge branching off to the north-west, and meeting the conglomerates in that direction. They may be seen on the old road called the Portage, and are crossed by the new road at the base of the hills. Few indications of the coal itself were observed in this part of the coal field, for the dense forest, decayed vegetable matter, and diluvial detritus conceal the strata beneath; detached pieces of sandstone and shale are however scattered over the surface

and frequently bear the impressions or relics of vegetables belonging to the coal period.

The new red sandstone was found reposing unconformably upon the carbonaceous rocks on the farm of Mr. Colpitts, ten miles southward from where the Pollet River empties itself into the Petitcodiac. Fifteen miles from the mouth of the former stream small seams of coal appear in its bed. The strata here dip northward at a small angle. Coal also is found two miles farther southward and mixed with the gravel and sand, having evidently been transported from the outcropping of some vein in this vicinity, and by the same causes that produced the detritus where it is buried. At this place the shale and sandstone are interstratified with layers of limestone, and the whole series is succeeded by a coarse conglomerate forming the more elevated and broken land farther southward. The coal appearing in small quantities on the surface at the head of Pollet River is of the bituminous and common variety, and that it is abundant in the concealed strata beneath appears very evident, but the almost horizontal position of the rocks, and the wilderness condition of the country render its discovery very difficult without resorting to boring.

Here also the sandstones contain the relics of plants belonging to the bituminous rocks, and the casts of leaves, trunks, and branches still remain in the solid materials of the earth. This river is also walled in by alluvium, bearing in its natural state majestic elms and an abundance of "bush cranberries," and wild currants. Cultivation has scarcely been extended to this remote part of the county, and the rapid stream rushing from the lakes of the mountains still abounds in fine salmon.

These remarks are also applicable to Coverdale River and Turtle Creek. These streams terminate in this part of the coal field, and are crossed by its strata about ten miles southward of the Petitcodiac, and the same indications of coal exist eastward to the main River. It was not without considerable labor that the boundary of the coal field in this quarter was ascertained. A few inhabitants are scattered along the intervales, but the higher ground remains covered with an unbroken forest.

Our next effort was to intersect the coal field from the southward, and to ascertain as far as possible its extent in that direction. Having explored the outcropping as it appears at Sussex and the indications offered at the Dutch Village, Pollet River, and Coverdale River, it was hoped that

on the same line as it proceeds towards the Memramcook, discoveries of greater importance might be made; nor were we disappointed in the result. From the examinations entered into it appears that the general course of the coal on its line of outcropping is about north-east from SHECK's farm, near Sussex Vale, notwithstanding there is considerable variation in the direction of the strata at different places.

At the head of Turtle Creek and about ten miles north-north-west of Shepody the coal again appears at the surface, and may be followed along this wilderness tract of country several miles. On lot No. 3, belonging to Mr. WLLLIAM STEPHENS, and about a mile from a new road and path connecting Hopewell with Hillsboro', a quantity of cannel coal was found in the bottom of a small ravine. Upon closer examination a stratum about ten feet in thickness was seen where the rocks have been uncovered by the water of a brook. But the surface is too thickly covered with detritus, the forest, and decayed trees, to allow of any accurate measurement; nor can the dip be ascertained without the application of considerable time and labor. From the drift coal found in the small brooks and in the soil it is certain that there are other beds a little farther southward. Coal strata also appear on the adjoining lot occupied by Mr. WM. BAIZLEY, and upon ungranted lands farther eastward. That there is an abundance of coal in this district cannot admit of any doubt, and before many years have elapsed it will be applied to the numerous objects it is calculated to support.

Besides being abundant, the coal here is much superior in quality to any found along the whole line of outcropping. Nor should it be supposed that it is altogether of that variety called cannel coal, for it has been found in England and other countries, that at different parts of the same coal basin, different kinds of coal exist and pass into each other almost insensibly.

The bituminous mineral also when taken from the surface where it is exposed to the decomposing influence of atmospheric agents is always much inferior to that taken from mines.

This coal kindles quickly and burns with a splendid white flame, affording much heat and light. Pieces taken at the distance of three feet below the surface are found to possess the fat caking qualities, as they are called. The proportion of carbon, hydrogen, and azote differ in different specimens. It affords a greater quantity of carburetted hydrogen gas than any of the imported varieties, and is therefore admirably

adapted for lighting buildings and streets. The earthy matter varies in quantity from twelve to twenty-five per cent. and the ashes contain carbonate of lime. A particular analysis of these bituminous strata has been deferred until they have been opened to a greater depth.

The outcropping at the above locality is within five hundred yards of the trap rock and the syenite already described, and which form a high and steep declivity along its southern side to the distance of about ten miles. A highly bituminous shale that burns with a beautiful flame is placed beneath, and also reposes upon the coal. It was the discovery of this shale by persons employed in making maple sugar, who by accident found that these rocks became ignited when exposed to heat, that we were led to the spot where almost all the detached fragments of the surface are capable of combustion.

The limits of this side of the coal field and its outcropping were discovered late in the season, when, on account of the heavy rains, the exploration could not be prosecuted with advantage. It was therefore deemed advisable to defer farther operations until another season should arrive. In the mean time many of the inhabitants are becoming acquainted with the subject, and are extending their observations to the natural resources of the Province. Almost the whole line of country where the carbonaceous rocks rise to the surface is uncleared. This circumstance renders its examination more difficult and expensive. It must however be a pleasing reflection to all who have an interest in the welfare of the Province to know that besides its agricultural advantages it possesses invaluable mines whereby its commerce and manufactories can be supported.

Still proceeding in a north-easterly direction, the sandstones and shales of the coal measures cross the Petitcodiac from ten to fifteen miles below the Bend, and near the farm of Mr. John Edgett again offer indications of coal. Near the river they are concealed beneath the new red sandstone and beds of gypsum and limestone. Crossing this stream they form almost the whole of the peninsula between the Petitcodiac and the Memramcook rivers. On the road leading from the bridge and on the west side of the latter stream and in the higher grounds of the peninsula the rocks of the coal field are partially uncovered.

Nearly opposite the village of Dorchester, four miles from the main road, and on the farm of Mr. George Taylor, cannel coal was discovered last autumn. This part of

the coal field we had described in letters addressed to Your Excellency, by permission, in 1837. Coal, shale, sandstone, and clay iron stone appear on the side of the river, where they form a low cliff, directly above high water mark. The first stratum of coal is near a small brook, and is twenty inches thick. The second is about eighty yards farther south, and is twenty-two inches in thickness. This stratum is immediately succeeded by argillo-calcareous shale, capable of combustion. Forty yards still farther south, there is another stratum, four feet in thickness, and superior in quality to any other at present discovered here. Another small seam is partially covered by the mud near the margin of the marsh. The course of these strata is east by south, and the dip is south by west 35°. The rocks belonging to this carbonaceous deposit, are succeeded by a thin formation of limestone, forming a ridge running parallel to the sandstones westward.

This coal has the hardness of anthracite, but possesses most of the common properties of the bituminous mineral. It ignites readily, and burns with a white lambent flame.—When it is first taken from the earth, it is very hard, and slightly sonorous, but by being exposed to the weather for any considerable time, it decomposes, and crumbles down in thin scales. It is of a dark brown color, and the best kind is streaked with solid bituminous matter, yielding an odor when rubbed, like that of carburetted hydrogen. It retains the heat a long time after the flame has subsided; but the quantity of ashes produced is very great, and contains a considerable quantity of the carbonate of lime. The ashes of the most impure kinds will afford excellent manure, and the rock contains enough bitumen for calcination. A pound of the best coal from this place yields four cubic feet of carburetted hydrogen gas; it is therefore like that north of Shepody admirably adapted for lighting cities.

The calcareous nature of the shale and coal are somewhat peculiar, but they merely show, that during the time of the drift and deposit of the detrital matter now forming these beds, that lime was abundant then at situations from which the clayey shales of the coal basin were derived. Also the bituminous and carbonaceous matter widely mixed in these strata, are but proofs of the dissemination of the vegetable productions whence the coal itself has had its origin. All of these rocks are characterised by the presence of vegetable remains, sometimes scattered, and at others collected into layers, sufficiently thick now to afford coal. The admixture of

argillaceous and calcareous matter with the coal, is only the result of more active operations at this place, than in situations where the materials of the coal were more quietly laid down, and consequently were less exposed to become mixed with drift and sedimentary matter.

The alteration in the character of these beds, which in their early periods of formation were evidently fine sediment, produced chiefly by the action of water, and vegetables, brought downwards from the sites where they flourished by the same active agent, may either have been the result of gradual changes in the order of geological events, or sudden catastrophes that affected the condition of a wide area, common both to the original materials of the coal, and the impurities now mixed with it. If we consider the various facts connected with the carbonaceous strata as they appear in this quarter, we are irresistibly led to reflect upon the causes by which they have been produced. And it is only by refering to operations still going forward upon the earth, that we can explain the phenomena, however weak these operations may appear, when compared with the results of those which have so much added to the comfort and happiness of mankind.

The coal, with its accompanying strata, may also be found on the opposite side of the Memramcook. It was observed here, by taking the course of the strata, and may be seen on the farm of Mr. TAYLOR, a short distance northward of the Court-house, at Dorchester, where the shale has been excavated in the repair of the turnpike. The same indications also appear at several places in the woods between CHARTERS' Inn and Shediac, where the rocks are often beautifully decorated with the fossil flora of the carboniferous period.

A small quantity of coal had been discovered about four miles from the mouth of the Shadouac river, and upon examination, the Westmorland coal field was found to extend to the south side of the harbour of Shediac. The dip of the strata at this place is north 25° east, 7°. An unsuccessful attempt was made to find the outcropping of the coal which is evidently deposited in this part of the district, but from the small angle of the dip, the coal will not probably be found without boring through the upper strata. Besides this circumstance, the rocks are frequently concealed beneath a thin deposit of new red sandstone, and the common detritus of the surface. It is evident that by boring in a situation judiciously chosen, the coal strata might be found; and which, from their proximity to the harbour, would prove most advantage-

ons to this portion of the Province. From this source, Quebec, Montreal, and the steam navigation of the Gulph of St. Lawrence, might receive their supplies of fuel, and another important motive be offered for opening a canal between two of the most extensive and valuable bays of the North American continent.

The various shales, sandstones, and calcareous beds composing what is generally termed the coal formation have been most frequently preceded by thick deposits of other detrital rocks interposed between these and the still more ancient accumulations of solid matter which surround the globe, and very generally the mountain limestone and old red sandstone are seen cropping out beneath the coal series at some places along its margin, but the latter rocks have not been discovered in any part of the district under consideration, so far as it has been explored. It is probable that where they exist, they are buried beneath the new red sandstone and conglomerate that evidently overlies large tracts of the coal field. Another peculiarity is manifest in the junction of the carbonaceous strata with the syenite and trap north of Shepody. Upon a line explored to the distance of ten miles where these rocks meet, they appear to be in immediate contact. But whether the trap and syenite have been elevated by volcanic efforts since the rocks of the coal series were laid, or existed prior to the deposits now resting upon them, are circumstances upon which we cannot decide in the present state of our knowledge. If, however, the volcanic rocks possess the greatest antiquity, those causes which produced intermediate strata at other situations, have not been in operation here, or those rocks might have been worn away during a period that elapsed between the uplifting of one and the deposit of the other.

Of the importance of the examination made during the past season, in reference to coal only, it is almost unnecessary to make a remark. In a new country, where the progress of improvement is often retarded from the want of sufficient means to bring natural resources into operation, and where more or less timidity will exist, when a large capital is required for the accomplishment, even of objects known to be of the highest importance; the discovery of such natural resources may not always be viewed in their true light. But when coal is considered in reference to its value, and the services it is capable of performing by the agency of steam, and as being the prime mover in the arts and manufactures, the indications of its existence in any country will be hailed with pleasure by

its inhabitants. That there is an abundance of this useful mineral in New-Brunswick, is now no longer problematical; for it may be seen in thick strata exposed to the light of day, and only requires a moderate degree of enterprise to bring it to bear upon the demands of the country, and the support of those national energies it is capable of sustaining. As an instance, it may be mentioned, that from the knowledge of the existence of deposits of coal, capable of yielding gas in large quantities, a proposition has already been made to light the city of St. John from this source; nor can the time be far distant when other and more important objects will be gained from the mineral wealth of the Province. But we defer entering widely upon this subject until we come to treat of the Agriculture and Æconomic Geology of New-Brunswick, a work which is advancing as rapidly as our present duties will allow.

The physical features of the country occupied by this coal field are very different from those of other formations, and its agricultural character being established by the mineral composition of the subjacent rocks, may be distinguished from any other, and should receive the attentive consideration of those who fix their residences upon its surface. Instead of the red marly loam belonging to and daily forming from the decomposition of the more recent deposit, the rocks of the coal series, are frequently covered with a thin soil, chiefly composed of silicious particles, and beds of blue stiff clay, which in their natural state are very unproductive. There are, however, large tracts which have received their covering from the drift matter of the new red sandstone, and are thereby rendered more fertile.

The general course of the strata of the new red sandstone and conglomerate, is from the south-west towards the north-east, and the country occupied by those rocks appears furrowed, or thrown up into ridges, extending in those directions. It is true that each mountain and hill is intersected by deep ravines, which have apparently been produced by causes not regular in their effects; but in general, the ranges of the hills and vallies along their sides, are parallel to the course of each formation, having been established by uniform geological laws. In all countries, the courses pursued by rivers are much affected by the direction of the strata over which they pass. But seldom will the hydraulic channels transmitting the fresh water from the mountains towards the sea be found more obedient to this law, as they proceed lengthwise the outcroppings of the rocks.

No sooner does the Saint John itself descend into the primary and trappean rocks of Greenwich and Kingston, than its course is changed. Its branches, Salmon River, Washademoak, Bellisle, Kennebeckasis, and Hammond River, flow in from the north-east, and parallel to the strata of the formations over which they pass. The same observations will apply to the Miramichi, Richibucto, and the lesser streams of the Straits of Northumberland. But in the county of Charlotte, where the rocks are generally of the unstratified varieties, the rivers run at right angles with the coast, and flow along the depressed tracts between the mountains, produced by volcanic agency. These are facts of much importance in the study of geology, and a knowledge of them, derived from geography, is often an important guide; and from them it may be seen how much the navigation of any country depends upon its rocky structure. From these and similar facts it is also rendered perfectly obvious, how wisely the operations of nature are balanced and adjusted by the Great Artificer of the Universe.

I have the honor to be,

Your Excellency's most obedient

And very humble servant,

ABRAHAM GESNER,

PROVINCIAL GEOLOGIST.

Saint John, N. B., January 20, 1840.

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.

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 varieties 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 been therefore 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, uncrystallized. 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 statum or series of strata.

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

DEBRITUS. 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 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 high land. *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.

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.

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.

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 *ginoeso*, to know,) and our theoretical speculations as to its formation *geology*, (*Etym.*, *logos*, a discourse.)

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.

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 compact felspar.

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

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.

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 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 a metal with oxygen; rust is oxide of iron.

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.

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.

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 cleav-

age. 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 arrrangement of rocks in *strata*, which see.

STRATA, STRATUM. The term stratum, derived from the Latin verb *struo*, to strew 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 and 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.

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.

TUFA, VOLCANIC. See "Tuff."

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.

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.