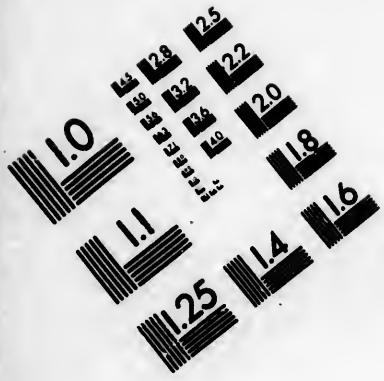

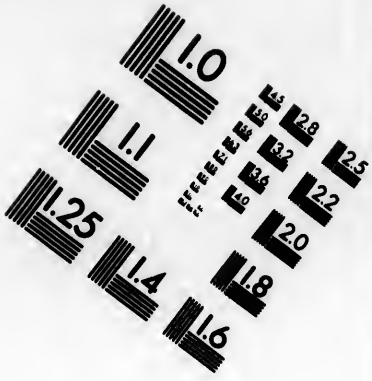

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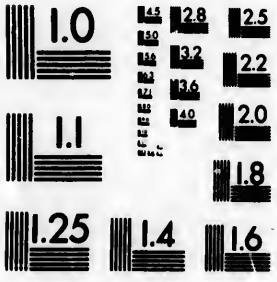

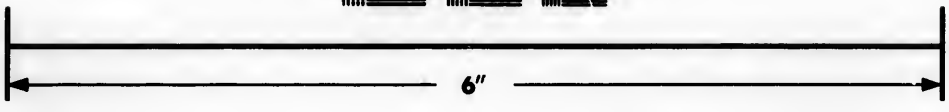

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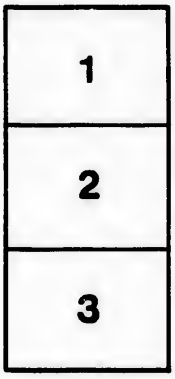

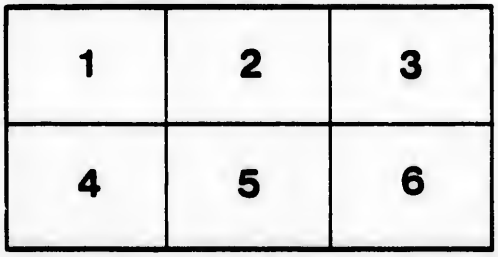

FIRST REPORT

OF THE

GEOLOGICAL SURVEY

OF THE

PROVINCE

OF

NEW-BRUNSWICK.

BY

ABRAHAM GESNER,

PROVINCIAL GEOLOGIST, &c.

SAINT JOHN:

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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,—

In compliance with the appointment I had the honour to receive from Your Excellency, and instructions dated at Government House on the 17th day of April, 1838, to commence a Geological Survey of the Province of New Brunswick, I beg leave to submit the following Report.

Knowing the object for which the Geological and Mineralogical exploration of the Province was authorised, namely, that of developing the resources of the country, and supplying the elements of lawful enterprize and industry, I have devoted my labours to the discovery and application of such substances as have been found most important to the interest and support of commerce, agriculture, and manufacture. And although an attempt has been made in some instances to give some details of circumstances connected with the science of Geology, and the situation of curious minerals, it has been done with a view to shew that New-Brunswick not only possesses vast mineral wealth, but also contributes largely to that collection of facts upon which a true theory of the earth can only be founded.

As this subject will be new to those who have not hitherto devoted their attention to such enquiries, I trust I will be

pardoned in introducing a few hints relative to the importance of these examinations, and the benefits flowing from the mineral kingdom,—the greatest source of national wealth.

When the condition of Great Britain is compared with that of other nations, less favoured with coal and the metals, it will be perceived how much mankind have been improved in their moral and secular state by the use of substances found only in the earth. And, when the present happiness of civilized countries is contrasted with the condition of those barbarous nations, whose axe and arrow are made of stone, some idea even at a single glance may be formed of the power and wealth which have been drawn from the bosom of this planet. Should an enquiry be made into the cause of the exalted state of the mother country, and the sources from which her commerce has been derived, and is now supported, it will be found that the vast and various productions of her mines are the chief support of her manufacturing industry, and the great centre of supply for almost every nation upon the earth.

The uses of Iron are so well known they scarcely require any mention. This metal enters into all the multifarious operations of civilized life, and the purposes to which it is applied in every kind of labour are almost too numerous to be comprehended. It forms the plough of the farmer, the hook of the fisherman, the safeguard of the mariner, and all those terrific engines of war used for assault and defence. Its use distinguishes a civilized people from those who are but little elevated above the brute creation, except in their human form.

Next in importance to iron, is Coal. When Coal is viewed in all its relations to mankind, the mind is filled with astonishment at its effects. To Coal, the generator of steam, the multiplied operations in manufactories, the great improvements in all kinds of machinery, the vast saving of animal strength, the diminution of human pain and labour, and the majestic strides of civilization, owe their origin.

Coal possesses the power of transmuting ships and land carriages into animals, capable of performing the greatest feats of strength without relaxation or repose. Through its influence directed to the production of steam, vessels now ply between Great Britain and America in a shorter space of time than had been ever before anticipated, and the inhabitants of countries far remote from each other are now brought into frequent and neighbourly intercourse. Were the bituminous treasures of England exhausted, her manufactories would fail, her trade cease to exist, and the nation would gradually retrograde into a state of ancient barbarity.

Referring to the effects of steam Dr. Buckland remarks "When we consider that a large proportion of this power is "upplied to move machinery, and that the amount of work "now done by machinery in England has been supposed to "be equivalent to that of between three and four hundred "millions of men by direct labour, we are almost astounded "at the influence of coal, and iron, and steam, upon the fate "and fortunes of the human race." "It is on the rivers," says Mr. Webster, "and the boatman may repose on his "oars; it is on the highway, and begins to extend itself along "the courses of land conveyances; it is at the bottom of mines "a thousand (he might have said eighteen hundred) feet be-"low the earth's surface; it is in the mill and in the work-"shops of the trades; it rows, it pumps, it excavates, it car-"ries, it draws, it lifts, it hammers, it spins, it weaves, it "prints." Should the advancement of this power be as rapid during the next ten years as it has been during a brief space that is gone by, it seems as if man would be indulged with a long holiday, having nothing to do but to gaze upon his own inventions.

Besides these copper, tin, lead, zinc and manganese should claim some attention, and although but small quantities of the precious metals have been found in North America, several of the most beautiful gems have been obtained in Nova-Scotia and New-Brunswick.

The oxides and other chemical combinations of the metals are extensively used in medicine, chemistry, bleaching, dyeing and other important arts, and the beautiful colours used by painters are only so many different forms of mineral matter.

Again, for the purposes of architecture, granite, porphyry, marble, freestone, lime and slate are indispensable, and the discovery of any of those rocks iucreases the value of the country where they exist. Salt, clay, mineral and thermal springs also form a part of national wealth. Nor is Agriculture less indebted to geology, and mineralogy, than other arts; for this, lime, marl, gypsum and other substances of a mineral nature are required to increase the fertility of the earth, while those sciences investigate the nature of the soil that yields our daily bread.

In the mineral kingdom lie the hidden properties of magnetism, and electricity, with all those chemical phenomena now so well known, but whose true causes are but imperfectly understood. The former guides the wandering mariner over the pathless ocean, and the latter delights us by its extraordinary effects. A combination of these two properties is now

directed so as to be made obedient to the human will, and from a knowledge of their laws a power has been obtained similar to that produced by steam. In all these the design, wisdom, and beneficence of an intelligent architect are displayed in a manner so nicely adapted to human comprehension, that none who enquire into them can forbear to acknowledge the power and goodness of their Creator.

If it, then, must be acknowledged that the prosperity and happiness of the inhabitants of any country depend upon their facilities for obtaining the necessaries and perhaps in some instances the luxuries of life, just in proportion to the natural advantages possessed by any Province or district (provided those advantages are improved) so will the power and wealth of its inhabitants be increased. Affluence does not so much depend upon labour, as upon the objects upon which that labour is bestowed, and that it is necessary the industry and skill of man should be directed into proper channels, or into those which will yield the greatest and surest rewards, is obvious. One of the best sources of national wealth is found in the earth, and wherever this great fountain of profit is open, it should claim a due share of attention from those whose influence stamps the character of society.

From the importance and profit of mining operations, every portion of the United Kingdom has been explored by the aid of Government, and private funds, in order to discover the riches concealed among its rocky strata, and although the sums expended for such purposes have been enormous, they have been repaid an hundred fold by the discoveries made and the knowledge purchased.

It may be said that the fate of France was decided by her mines: when her foreign supplies were cut off by her powerful foes, her legislators offered the highest rewards for the discovery of useful minerals, and the success of her men of science delivered the nation from impending danger.

The people of the United States, ever ready to learn by the experience of others, have commenced geological surveys, at a great expence, of every State in the Union. Some of these are completed and others are in progress. The advantages which have followed these surveys are incalculable; neither talent, nor money, nor time have been spared; and although bituminous Coal has not been found in any considerable quantity in any of the eastern States, the developement of other mineral treasures has returned an ample reward. In districts where neither coal nor the metals were deposited, quarries of slate, granite and marble have been opened, and

large tracts of country have been fertilized by the discovery and use of marl.

The geological and mineralogical exploration of New-Brunswick was commenced under circumstances truly embarrassing; but, from the results already produced, it cannot fail to mark a new era in the history of the Province. It will be seen in the body of this report, how important this enquiry is to the prosperity of the country, and so great are the discoveries already made, even in the commencement of the undertaking, that the names of those who have supported the object will be remembered with gratitude by succeeding generations.

Hitherto the energies of the Province have been directed to the exportation of timber in its different forms, and the commerce of the Colony has been greatly enlarged from the fine forests which formerly occupied the interior of the country. But timber is gradually becoming more scarce, the expense of procuring it is annually increasing, and the time will come when other objects for exportation must be sought for. It is then certainly desirable that other resources of the country should be opened, and while the agricultural districts are encouraged and protected, the riches contained in the bosom of the earth should not be overlooked.

Almost all the Coal used in this Province is imported from England, and Nova-Scotia, and it is a singular fact that the steam boats plying on the river between Saint John and the Capital are propelled by imported fuel, while during each of their trips they pass directly over a coal field now known to contain vast quantities of that important combustible.

It is impossible that this state of things can remain for a much longer period, and only by calling such resources into action, can the enterprise and capital of New-Brunswick and other countries be brought into successful operation, and the Province continue to flourish.

It is justly remarked by Henry Bliss, Esquire, a talented writer on the trade and resources of the North American Colonies, that "the mineral resources of the Northern Colonies have by no means been explored. Whatever, indeed, is known, has been less the result of enquiry than of the voluntary and almost obtrusive disclosures of nature herself, who has scattered indications of these her gifts on the very surface of the land, and even on the shores of the sea, so that if the eye did not heed them, man's foot would stumble where they lie. Enough, however, has been ascertained to make it unquestionable that the mines of these Pro-

vinces are destined to become an immense and inexhaustible source of wealth and power."

It would be in vain to attempt an enumeration of all the different mineral substances which have proved useful to mankind; their uses are as wide as the field from whence they are taken, and the welfare of any country must in a great measure depend upon the native riches contained in its rocks, and success can only attend that industry which is devoted to the legitimate objects of national wealth and independence.

Now it should be remarked that all the Iron, Copper, Lead, Tin, Zinc, and Manganese and other metals also used by the inhabitants, are imported directly from Great-Britain or some foreign port; most of those metals exist in the country, and might be manufactured at a cheaper rate than they can be purchased at, and conveyed from any other place.

The large quantities of timber shipped annually from the Province are insufficient to meet the amount of imports, and the country sends abroad an article which other countries have not, to purchase articles which she possesses. The result of such an economy must be readily perceived, and if not remedied by calling forth our own mineral supplies, must terminate greatly to the disadvantage of the Colony.

Were the Coal raised, and the Iron and Copper manufactured in the Province, in a sufficient quantity to supply its own wants, then the amount of these necessary articles would be saved to the country—the reward to honest industry would be certain, and emigration could be encouraged. But the more immediate means of support, namely, Timber and Deals, are now required to balance with the importations, and when these means fail, (and fail they will in time,) and great loss has been sustained, will every object capable of producing relief be resorted to; whereas, had they been used at an earlier day, the general prosperity would have been as steady as it now may be made great.

The histories of ancient and modern nations shew how much the civilization and happiness of mankind rest upon natural resources, and the fate of empires depends upon those stores of mineral matter laid up in the earth's vast warehouse: these stores show their intended use, and the care and foresight of a superintending power, which has abundantly provided for all the wants of the human family.

Were it to be admitted that the opening of mines in the Colonies, and the establishment of manufactories abroad, would diminish the trade of the Mother Country, it should

be remarked that Great-Britain will long remain in advance of her Provinces, and, as she always has done, will still continue to supply by latent advantages, any seeming want in a demand for her productions. And although among the subjects of our most gracious Queen, none are more loyal than those of New-Brunswick, it would be a silly patriotism for them to sacrifice the natural advantages they possess, to the supposed benefit of England.

Like Nova-Scotia, New-Brunswick possesses the greatest riches of the mineral kingdom; but while all the best resources of the former are held in durance by an association whose interest is best supported by a partial and limited developement of her mines, the latter is free from that embarrassment, and her inhabitants can participate in the benefits to be derived from them. While the mines and minerals of Nova-Scotia are placed beyond the reach of Provincial legislation, those of New-Brunswick can be rendered profitable to the revenue, and to the people.

The object of a geological survey is to examine each rocky formation, and to discover, as far as possible, all the minerals they contain, with the view of making them subservient to the demands of the country. It also embraces the analysis of the different soils, mineral springs, &c. and freely exposes them by a report of their nature, uses, and importance. How far these objects have been obtained will be judged by the following details, which, although they are confined only to a small portion of the Province, cannot fail to shew the advantageous results that may be expected to follow.

Specimens of all the useful minerals collected during the survey will be laid with this report before Your Excellency. A geological map of the Province has been commenced upon the plan of the actual survey received from the Honorable Thomas Baillie, Commissioner of Crown Lands, to whom I am much indebted for geographical information. Among my notes, which were almost always taken when the objects described were before me, there appears some topographical matter,—of this, some is inserted in the report, it having been supposed that it would be useful to those who are engaged in other pursuits.

For such as are not conversant with geological terms, a short glossary has been appended, and the whole has been prepared with the greatest care and accuracy the time allowed would admit of.

In concluding these remarks previous to entering upon the general subject, I cannot but beg leave to express my

sincere gratification at the result of a single season's labour, in a part of the Province which at first seemed to offer so few inducements for exploration; and that gratification is much increased when I reflect upon the pleasure Your Excellency will receive in beholding the prosperity, and advancement of New-Brunswick.

Perhaps among the reasons why the Province should be explored in search of its hidden resources, not the least of them is offered by the imperfect knowledge possessed by distinguished individuals in England, and even by Parliament, of the value of the Colonies to Great Britain. Should an attempt ever be made by foreign powers to possess the North American Provinces, and seize upon their advantages, one of the principal motives will arise from the value of their mines. And, if there were any cause for the British Government to apprehend that the Coal of England would become exhausted, and to institute an enquiry into the quantity still remaining, which was done but a few years ago; it is certainly necessary it should preserve, if possible, those Colonies which possess an inexhaustible supply of that fossil fuel.

It is pleasing to observe the interest taken in England in the objects of natural history collected in this country. I have already transmitted to Europe several collections of minerals, and geological specimens of Nova-Scotia, and New-Brunswick, and they have not only excited curiosity, but also much surprise, as they shew how numerous, and important many of those objects are to the welfare and prosperity of these British Possessions.

GENERAL REMARKS.

The rocks composing the crust of this earth may be properly divided into two great classes. One of these classes has had its members formed by heat, which, having acted under a great variety of circumstances, has produced results in some degree dissimilar to each other; but as it has always fixed the most important features of certain rocks, the geologist is able to recognize each member of the class with some degree of facility. Granite, syenite, greenstone, and pophyry, belong to this division, and are intimately connected with the more recent productions of basalt, and trap, which agree in their texture and composition with the lava poured forth by volcanoes now in operation. These compact and crystalline masses of mineral matter, have from time to time burst from beneath and overspread extensive portions of the earth.

The other great class of rocks has been derived from the disintegration, and decomposition of older formations, and by the action of water has been spread out in many different layers at the bottom of ancient oceans, seas, and lakes. In this way stratum after stratum has been collected, until they were elevated to form dry land. The members of this division are readily distinguished from rocks of an igneous origin, by being separated into strata piled one upon another, and like the different masses of stone placed by the skill of the architect, they form an edifice exhibiting the most perfect order and regularity. The materials of each stratum have been taken from pre-existing rocks, accumulations of vegetable matter, swept from the surface by floods, and the solid parts of marine, lacustrine,* and terrestrial animals; hence the variation in their ingredients cannot be surprising, as the fluctuations and changes in the causes that produced them were evidently numerous. These different mechanical deposits are separated by geologists into distinct groups or formations, according to the kind of matter they contain, or the races of once

* Lacustrine—belonging to a lake.

living animals, now sealed up in their impenetrable vaults.—It is only by consulting extensive geological treatises, that even a theoretical view of this subject can be obtained, and the order of superposition understood. A practical acquaintance with the science not only requires a knowledge of almost every branch of natural history, chemistry, and mineralogy, but an actual inspection of each mountain mass, and sections of the deepest mines.

Coal, and the most important of the metals are only found under certain circumstances, and associated with certain kinds of rocks, therefore the importance of such knowledge is manifest, for the practical geologist can discover at a distance, by the altitude and configuration of mountains and hills, what rocks they are composed of, and he knows what minerals those rocks are likely to contain.

Having obtained in the summer of 1837, an outline of the geological features of that part of the Province which borders upon the Bay of Fundy, and commenced an examination of a section of the country extending from Magaguadavic to the Gulf of St. Lawrence, I was not unprepared to enter upon a more particular investigation of the district to which my instructions referred, and the labours of the past season have fully confirmed opinions expressed in letters I had the honor to address to your Excellency, previous to my appointment to commence a general survey.

The south-east side of New-Brunswick, or that part which reaches near the coast, extending from Shepody Bay in the County of Westmorland, to the American boundary line in the County of Charlotte, is occupied by an extensive and moderately elevated range of mountains, composed principally of granite, and other primary rocks. This range is situated at an average distance of fifteen miles from the shore of the Bay of Fundy, and includes the highlands eastward of the River Saint John. Westerly, it embraces Bald, Eagle, Douglas, Pleasant, and other mountains. The course of this mountainous district is from the south-west to the north-east, the general direction of all the principal formations in North America.

At the south-eastern base of this elevated region, the slates and limestone of the transition series, and the sandstones and conglomerates of the secondary formations, are placed in their usual order of succession, wherever they have not been broken up, and buried by extensive eruptions of volcanic matter. All these rocks have been penetrated by large and numerous dikes of trap, basalt, and pophyry, and the surface

of the country with all the islands in the Passamaquoddy Bay, exhibit the clearest evidences of having been the theatre of violent earthquakes, and intense volcanic action.

The granite entering into the structure of this mountain chain, is also succeeded on its northern side by slate and greywacke; these have been examined as far westerly as the Meductic Falls. Then follow the rocks of the great coal formation, which extends from the head of the Oromocto river in a north-east direction to Northumberland Straits, a distance of one hundred and twenty geographical miles.—This is one of the diameters of the New-Brunswick coal field, which ranks amongst the greatest ever discovered. Only a limited portion of this coal region has yet been explored, but in future examinations its boundaries will be defined, and its importance to the Province more perfectly explained.

Each of these formations, and the minerals they contain, will be described in the order in which they were examined, this general outline having been given to assist the memory.

The transition and secondary rocks on the north-west side of the primary chain already mentioned, are placed in conformity to the order in which they are observed in England and other countries, and they do not appear to have suffered much by forces acting upon them after the position of each formation had been fixed. Not so with the groups of strata situated along the coast; after these had been laid in their general situation and position as they are found elsewhere, they were displaced, the strata broken up and elevated, and both their chemical and mechanical characters changed by heat, and other agents applied under the most intense energy of subterranean power.

Perhaps to some, such declarations may appear to assume too much, and to have been drawn from theoretical views, rather than practical inferences; but the circumstances justify the most unequivocal mode of expression, and the facts unconnected with any theory have been honestly and faithfully recorded. Whoever beholds the south-eastern side of the Province cannot fail to observe the lofty mountain, the vertical cliff, the foaming cataract, the rude outline, and other sublime features of the district; nor need he hesitate to attribute to the earthquake and the volcano, the contrast between this and the great coal region, where a more tranquil course of changes has marked both the mineral, and agricultural character of the country.

It has been observed by geologists, that the proximity of the sea is a necessary condition of the existence and continu-

ance of volcanoes. If the intense heat of the crater, and its overflowing lava, are the results produced by water coming in contact with the bases of the metals, and a consequent chemical reaction of all their united forces, it is readily explained why both ancient and modern volcanoes are formed upon the margins of oceans and seas. It may be remarked, notwithstanding, that in the great volcanic band of the Andes, some of the craters are placed at a great distance from the ocean, the presence of which, in these cases, does not seem to be necessary to produce the fiery deluge ever rushing from their lofty cones. But a sufficient supply of water may be placed in subterranean reservoirs to feed the hidden laboratory.—The trap rocks of Nova-Scotia and New-Brunswick, although by no means of recent origin, are placed along the shores, and the interior of the country bears not the marks of those violent eruptions which have taken place along the coasts. It is true there are none of those splendid operations now going forward in North America, and the inhabitants rest free from the terrors of the earth's furnace, and the dismay of the sulphureous deluge ; but many rocks bear the clearest evidence that such phenomena have existed even here, and the shocks of earthquakes felt from time to time, loudly proclaim that their causes are not altogether removed.

To ascertain the limits of any of the formations of New-Brunswick is often extremely difficult, on account of the loose beds of *detritus* frequently covering the rocks to considerable depth, and as much of the surface is still in a wilderness state, and rendered at some places almost impassable by decayed trees, and a thick growth of underbrush, much labour is required under these circumstances to collect such facts as are necessary to describe the situation and position of the rocks beneath. If, therefore, any inaccuracies should appear in regard to distance, and the exact situation of particular minerals, they are such as could not be avoided under the circumstances, and they are not such as can materially retard the progress of any practical object.

It will be observed that my instructions directed me to commence the geological *reconnoissance* in that part of the Province which extends southward and westward from the River St. John to the Bay of Fundy, and the American boundary line on the St. Croix, including the British Islands in Passamaquoddy Bay. This tract embraces the County of Charlotte, and parts of other counties that intersect the river. The examinations were commenced on the coast and islands, and thence extended to the interior of the country.

CHARLOTTE COUNTY.

SAINT ANDREWS.

Saint Andrews is situated upon a peninsula on the east side of the mouth of the Scoodiac or St. Croix, which at its entrance is two miles wide. The peninsula is four miles long, and is composed of new red sandstone, covered with beds of clay, gravel, sand, and marl. The sandstone also forms Navy Island at the entrance of the river, and extends in a westerly direction into the American State of Maine. The course of this formation is from the north-east to the south-west; the general dip of the strata is to the south-east, at an angle of 15° from the horizon; but wherever the rocks are intersected by dikes of trap, the angle is often much increased. At several places this sandstone was observed to be underlaid by thin strata of conglomerate, which belong to the same formation. The upper strata of the rock is variegated in its colours. Some of them are soft, marly, or slaty, resembling red shale; others are more compact, and will afford good freestones for building. These circumstances of themselves distinguish the rock from the old red sandstone, which is of an uniform dull brick red colour, and more coarse and granular in its texture. In an easterly direction this red marly group extends five miles from the town, and is met by rocks of an igneous character. The sandstones of this formation are composed of small particles of quartz mixed with mica, cemented generally with the oxides of iron. The streaks of different colours led the celebrated Werner to denominate the formation "*Bunter Sandstein*," variegated sandstone. Wherever the mica is abundant, the rock becomes slaty, as the scaly particles of that mineral are always placed with their laminæ parallel to the lines of stratification. This circumstance is also evidence that the rock was formed by water, which, by its currents, always throws down substances of every kind upon their broadest surfaces.

It has been remarked that the red marl group of England contains no organic remains, except the magnesian limestone which is associated with it. The members of this group appearing at Saint Andrews contain numerous relics of marine plants. Among them one was found resembling the *Laminaria Saccharina*, or common kelp, still growing abundantly along the coast. Scarcely an atom of the original plants can be said to remain, but the situations which they occupied after the materials of the rock had been deposited, have been filled up, and perfect casts of the originals still mark the places where they ceased to live.

Among the lower members of this group, the sandstones approach in their character those of coal formations, and the charred remains of land plants were discovered among them. From this and other circumstances, it was hoped that some sure indications of coal would appear, especially as they would be matter of great importance in a part of the country where every circumstance connected with the transportation of that mineral is very favourable.

In order to ascertain this point, it cost me much time and labour to determine if these rocks were connected with the great coal field of the Province; but since my last visit to Saint Andrews, I have discovered that they are separated from the great coal district of the country by a distance of many miles, and the mountainous chain already described. It may, however, be probable that coal exists near Saint Andrews, but the difficulty of ascertaining its situation, is great under all the circumstances, and much capital might be lost before the facts necessary to successful mining could be known.

The conglomerate is made up of rounded masses of older rocks, firmly consolidated by calcareous and silicious particles. The strata resemble mortar, in which pebbles from the size of a walnut to that of an orange have been mixed. Each of these rocks have had their strata intersected by numerous and extensive masses of trap rock, which frequently extend in parallel ridges to the distance of several miles, and may be followed to the highlands situated northwardly, from which they branch off in all directions, decreasing in their altitude according to the distance they depart from their parent mountain.

At "Joe's Point," and near the ferry from Saint Andrews to Robbinstown, there are two dikes of trap, each about fifty yards wide, and the elevation they have produced is distinctly marked upon the surface to a considerable dis-

tance. They are separated about a furlong by a coarse conglomerate, which is overlaid by one of them in a remarkable manner. It appears the matter forming the dike having filled the cavity it now occupies, overflowed the opening, and now covers the rock through which it passed, to a distance of several hundred yards. This fact reminded me of having seen the liquid lava pouring over the sides of the volcano at St. Lucia.

The trap rocks of the "Point" contain narrow veins of calcareous spar; in one of these veins, a small quantity of the green carbonate of copper was found, but during an accurate examination of every rock near the place, no further indications of that mineral were observed. Wherever the sandstone is found in contact with the trap rock, it is filled with small empty cavities, and resembles the cinders of an iron foundry. But when these cavities are found in situations where the air has not had free access, they are filled with the carbonate of lime, and semiopal, and the rock becomes amygdaloidal. The empty cells are produced by the ready decomposition of the minerals contained in them, and wherever the volcanic rock meets the sandstone, amygdaloid is generally formed—a fact also observed in Nova-Scotia, and in England. It appears that the cellular structure of lava, and scoria, arises from the presence of air, when those volcanic productions are in a liquid state, and not from small collections of gases, as some have supposed. These openings have evidently been filled by mineral infiltration, after the ejected matter had become consolidated.

Four miles northward and eastward of Saint Andrews, the Chamcook mountain rises near the entrance of a river, and the exit of a lake, bearing the same name. The most prominent part of this mountain is 580 feet, trigonometrical measurement, above the level of the sea. It is composed altogether of trap rock, and marks the boundary of the sandstone which lies along its base, forming a wide, level, and fertile plain, with a harbour on each side, and a beautiful town at its extremity. From its summit, this pretty view, Moose, Deer, and several other Islands, scattered in Passamaquoddy Bay, Robbinstown, and other villages of Maine, Saint Stephens, and the winding Saint Croix, afford a wide, varied, and pleasing landscape. In a northerly direction, the volcanic rocks are piled in naked mural precipices, which appear to have burst through the red marly group, and carried its broken strata even to the pinnacles of the highest cliffs.

The soil in the neighbourhood of Saint Andrews is very fertile, wherever it has been derived from the decomposition of the sandstone; the beds of clay and gravel are less productive, and would be much improved by the application of marl or lime. The former substance having been found here, will be particularly described when the tertiary deposits are brought under consideration. But it would not be just to proceed farther before noticing the existence and usefulness of a Geological Society, formed in the town. This society embraces a number of the most respectable and scientific gentlemen of the county. Already a considerable number of specimens have been collected, and some of the members are making rapid advances in geological science. To them I am much indebted for assistance and information, and it is ardently hoped their labours may be as gratifying to themselves, as they must ultimately prove useful to that portion of the the Province.

Advancing up the Scoodiac, the conglomerate with thin strata of sandstone were observed to occupy the shore, to the distance of five miles. Both of these rocks are perforated at many points by the dikes of trap or hornblende rock, which by the heat evolved during their ascent, have rendered the former remarkably compact and flinty, and changed the latter into an imperfect kind of jasper. The trap then predominates, and finally passes into syenite.

At Johnston's Cove, four miles from St. Andrews, there is a valuable deposit of marl, similar to that previously discovered at Simpson's Cove, and afterwards at a number of places in the County, and on the American side of the line. At the former situation, it appears on the north side of the creek, and occupies a considerable tract. The bank where it may be most readily procured and transported, is about thirty feet above high water mark, and presents the following sections:

No.		Feet.
1.	Vegetable soil,	1
2.	Sand and gravel,	8
3.	Fine blue argillaceous marl, containing decomposed shells and marine plants,	9
4.	Lead coloured ditto, containing ditto,	9

The upper stratum of this marl may be considered of the best quality, as it contains a greater quantity of the carbonate of lime than the stratum beneath.

At Sand Point a thick bed of diluvial *debris* covers the rocks, and forms a sloping bank on the side of the river, fifty feet high. A large quantity of the yellow oxide of iron is mixed with the sand, and at one spot is sufficient in quantity to be worked for ochre. Several pieces of pitchy iron ore were dug out from among the oxide from which they had been formed;—the sand and pebbles are often cemented together by this mineral, and a perfect conglomerate is the result.

Between this place and the mouth of the Warwig river, the trap becomes syenitic. In some instances the hornblende predominates, in others the feldspar is most abundant, and often these two minerals are so united as to form a beautiful material for building purposes. Similar rocks appear on the American side of the river, and from being coated with the red oxide of iron, have been mistaken for red standstone. Their decomposition is extremely slow, but from the potash contained in them some of the valleys are rendered very fertile.

Notwithstanding these two varieties of what might be considered the same rock, insensibly pass into each other, and partake of characters common to both, their line of junction seems to be distinctly marked by a narrow valley placed between them, and which may be seen extending into the hills eight miles above the mouth of the river.

The whole face of the country here is covered with cone shaped hills, many of which are entirely bald and barren; some are partially covered with a scanty growth of birch, and pines killed by the fires that destroyed the forest many years ago. The scenery is peculiar, and wherever the soil is deep enough for the plough, or on beds of sand, clay, and gravel, there are good farms.

The river to this distance will average a mile and a quarter in width, and although the tide rises thirty feet, the current is not so rapid as in many parts of the Bay of Fundy. It was at the mouth of the Warwig River that I first discovered the marl deposited at the head of a small indentation called Simpson's Cove, which has been formed in consequence of the marl being more readily washed away than the syenitic rock on each of its sides. This deposit of marl reaches across a small point, and extends twelve feet above high water mark, where it is covered by a thin bed of diluvium. It contains the remains of shells and plants like those already noticed.

It will be unnecessary in this Report to give a particular description of every situation where the marl is found,

but I shall endeavour to supply such details of its characters and properties as may be sufficient to guide those who are desirous to obtain the benefits of its fertilizing qualities. At the before-mentioned situations it is seen under its most common circumstances, and therefore a particular account of it, as it appears at either of those places, will be sufficient for any practicable object. The tertiary deposit containing the marl was also observed at the head of Oak Bay, and at St. Stephens, where it is often perforated in digging wells, and in general may be known by the shells it contains. These shells are, however, often mixed in the clay stratum, and therefore the test of acids is required to distinguish one from the other.—On the peninsula of Saint Andrews the marly stratum also appears on the farm of Mr. WALTON; the upper layer is exposed, and although it is rather above its ordinary level, by opening the deposit to the depth of ten feet, the best kind may be procured. It was observed in the interior of the country, and at some future day will be found very useful when cultivation is extended farther into the wilderness.

I also had the pleasure of discovering this valuable substance in the State of Maine. At the Lubec Plaster Mills it has been intersected by a deep canal, and from this single circumstance a knowledge has been gained, which has resulted in the discovery of other deposits in that neighbourhood, and along the American side of the Scoodiac. Subsequently, the formation has been followed eastwardly to Saint John, but a perfect account of its whole range cannot be given until farther examinations are made.

The great difficulty some have found to account for what they supposed to be a change of level in the country is now removed, for as two of the species of shells found in the marl are extinct in these latitudes, it is evident the formation belongs to an era remote, and very different from the present. Indeed the occurrence of the beds of diluvial detritus covering the clay, marl, shells, &c. and evidently thrown upon them by a current of water which has overspread the whole country, is ample testimony that those shells do not belong to any recent period.

The appearance of clam, muscle, and scollop shells, like those now found upon our shores, in situations remote from the sea, and elevated far above the reach of the highest tides, must produce astonishment in the mind of the tyro in geology. But such phenomena are connected with a series of events that have effected the crust of the earth, and can in some measure be explained by changes still going forward on its surface.

It may be laid down as a general rule, that marl is useful as a manure, in proportion to the quantity of lime and potash it contains; and therefore the farmer, by applying acids as a test, can discover the richest kinds without the aid of experience. But it should be observed, that, although the lime and potash may be present, the mixture may contain other ingredients deleterious to vegetation, or such as will neutralize the good effects of the alkali upon the soil.

The most common chemical compounds found in marl, destructive to the growth of plants, are sulphate of iron (copperas) and the sulphates of alumine and potash (alum). These from their astringent properties often render soil, otherwise fertile, perfectly barren; therefore in employing this kind of manure, that variety must always be avoided which contains these salts, unless their effects can be prevented by other agents.

The earth is not rendered fruitful by any single substance; it is by the admixture of different chemical agents the growth of plants is best promoted. Even on a small farm several varieties of soil will be found; one of these may require a greater, and another a lesser quantity of lime, while a third would be improved by a dressing of sand. It is only by pursuing the science of Agriculture, and by careful observation that the agriculturist can arrive at such a knowledge as will enable him to turn the torpid barren plain into a fertile field, and the sullen bog into a luxuriant meadow.

At several places in the County of Charlotte, the marl is much injured by the copperas and alum it contains. For an instance, at Johnson's Cove the stratum is covered by a thin bed of sand containing the oxides of iron. These oxides have descended by filtration into the upper portion of the marl beneath, where they may be seen filling narrow seams and often occupying the places and impressions of the fossil shells, now decomposed and removed. This part of the stratum would be injurious to the soil, unless its astringent properties were overcome. When the sulphate of iron, and alum are present, they will be known by a white, or yellowish white efflorescence coating the marl, and by a sweetish and highly astringent taste.

Again, the upper marl stratum contains a considerable quantity of fine green sand, which renders it more applicable to stiff clay, than the lower stratum, which is better adapted to sandy tracts. These remarks will apply to that substance, wherever it may be found; and it is to be hoped that farmers will direct their enquiries to this subject, and

rather than use the astringent variety, and consequently injure the character of the whole formation, they will apply the best kinds, and reap the advantage it is capable of giving to their lands. The quantity to be applied to each acre, must ever be regulated by its strength, and the nature of the soil, for it is impossible to give definite rules where circumstances are so various.

Many experiments have been made to correct the noxious effects of spurious marl, and some of them have been extremely successful. By exposing a quantity spread in flat heaps to the air, rains, and winter of one year, the copperas and alum will be dissolved and carried off, while the calcareous and silicious particles will remain, and thus the mass will become purified. In England, composts are made, by which the astringent principle is neutralized. Professor Rogers, of Pennsylvania, has recommended the application of a small quantity of *freshly burned lime*, which is capable of decomposing the sulphate of iron and alumine, and producing the sulphate of lime, (gypsum,) a very useful manure. This method is well worthy a fair trial, but may not be necessary in the County of Charlotte, where pure marl can be obtained.

The following are the results of an analysis of marl taken from the upper sandy stratum at Johnson's Cove:

Silicia.....	47.	40
Protoxide of Iron...	20.	10
Lime.....	6.	45
Alumina, *(clay)*.....	12.	40
Potash	8.	20
Water.....	4.	.
	98.	55 in 100 parts.

The lower stratum yielded a greater quantity of alumina, and lime, and a lesser amount of sand. The fertilizing effects of these deposits depend upon the proportions of lime and potash contained in them; for it must be observed that the latter is a most useful substance in the soil, when it is uncombined with sulphur.

It is necessary to distinguish these deposits from beds of clay associated with them. The remains of shells and decayed plants frequently appear in the argillaceous stratum which yields the odour of marsh mud, in consequence of the decomposition of the vegetable matter it contains.

The objects of this report would not be promoted by taking a wider range in this part of the subject, nor is it necessary, if the inhabitants will take the pains to apply to their lands those stores of manure which have hitherto been passed by unheeded. In Great-Britain, France, and Germany, marl is considered of vast importance, and its lasting and beneficial effects upon agriculture have been fairly tested. In the United States, land which formerly sold for two dollars and a half per acre, has increased in value to thirty-seven dollars per acre, from the discovery and application of marl. In the County of Charlotte, its discovery must be hailed with satisfaction, and time alone can shew the greatness of the prize obtained. It cannot fail to be an object of much importance to this part of the Province, for it will supply the place of lime, which has not been found nearer than L'Etang.

I proceeded along the east side of Oak Bay, occasionally making an excursion into the interior a short distance. Granite, syenite, and trap, are the prevailing rocks. These often pass imperceptibly into each other, and have their component parts so mixed, that it is frequently impossible to draw a line of distinction between them. Near the mouth of the Warwig, and belonging to the mountainous chain already noticed, the granite appears; and although in general most of its varieties are too coarse to be used in architecture, on the property of JOHN WILSON, Esquire, I discovered a beautiful kind, and if the quantity should be found sufficient, an excellent quarry might be opened, which, from its proximity to the sea and river, would afford every facility required for the ready transportation of its contents. This rock, instead of mica, contains hornblende, united with feldspar, and quartz, which are very pure, and white, and equally disseminated in small crystals. The quarry will be opened next spring, and considerable advantage may be expected to arise from its discovery, as heretofore the granite used at Saint Andrews, has been imported from the United States, at a great expense; while it is now known that a more beautiful variety of that rock is placed but a short distance from the town.

At Connick's mills, three miles up the Warwig, greywacke and greywacke slate were found, meeting the granite. The schistose rocks contain much sulphuret of iron, which, by being exposed to the atmosphere, decomposes, and covers them with the brown oxide. Near the mill, there is a considerable vein of iron pyrites; this, from its peculiar metallic lustre, had been mistaken for gold. It is scarcely necessary

to add, that it contains none of that valuable metal, and is of no practical importance. A large granitic slab, placed at the door of Mr. Connick, contains large crystals of feldspar, schorl, and garnet. The same minerals were seen in a large boulder, by the side of the turnpike. At Bartlett's Pond, there is a considerable formation of reddish silicious rock, containing transparent crystals of quartz. A chain of small lakes holds a communication between this place and Chamcook, a spot remarkable for its romantic scenery and volcanic character.

More certain proofs cannot be required of a mighty rush of waters having passed over the country from north to south, than is afforded by the *talus* on the southern side of almost every eminence in this part of the Province. This fact is admirably displayed at Sand Point, and a small Island at the head of Oak Bay, where the diluvial *debris* is collected on the side of a mass of rock, upwards of sixty feet high. Circumstances of this kind, I do not recollect to have seen noticed by others, and they will therefore be referred to hereafter. At the extremity of this Bay, and five miles from its mouth, the shore slopes gradually down to the beach. Bricks are here made,—but from the clay being connected with the marl stratum, containing lime, they often crumble down, when exposed to the air and water. Before the clay is used for this purpose, it should be carefully examined, and that kind should be avoided which contains shells, for these, by being burnt, are converted into quicklime—will slake, and destroy the bricks.

On the south side of the Bay, several dikes of hornblende rock were observed, penetrating distorted strata of the greywacke and greywacke slate. These rocks have suffered remarkable changes by the heat applied from beneath during the filling of the dikes, and the sulphur, being sublimed, has united with the iron, and formed the sulphuret of that metal, or iron pyrites. At one place, the greywacke contains a large portion of the decomposable variety of that mineral. This is the hepatic pyrites of Phillips—*(Fer sulfuré epigène.)* The oxygen of the atmosphere unites with the sulphur, and forms sulphuric acid. This combines with the iron, and produces the sulphate of iron, (copperas,) which might be manufactured on the spot, without much expense. At Oak Point, the granite rises to considerable height, and quarries might be opened within a hundred yards of the shore. The rock will supply pieces of large dimensions, but its crystals are too large in general to admit of ornamental work.

SAINT STEPHENS.

At Saint Stephens, on the British side, and at Calais, on the American side of the river, there is a variety of syenite, which at several places was seen alternating with the greywacke, and forming the narrow gorge where the river passes. At Mill Town, there is a considerable vein of the pyrites. It was covered by the freshet at the time of my visit, but a specimen from the vein was examined, and its characters fully recognized. Both of the above rocks contain large quantities of this mineral, which, by the action of the air, is converted into the oxides of iron. At several places, and especially on the farm of Mr. MARKS, the syenite decomposes rapidly, and a great quantity of these oxides are mixed in the soil. Large spongy pieces are seen upon the surface, having received their porous structure from the decomposition of the crystals of hornblende and feldspar. The soil is rendered almost barren, and vegetation is destroyed by the water rising from these natural laboratories. The oxides are carried by the rains upon the lower grounds, and bog iron ore is constantly accumulating. This ore might be collected and worked, if the quantity be sufficient, a fact I had not the means to ascertain.

Upon the farm of Mr. WILLIAM PORTER, four and a half miles northward of Saint Stephens, there is a stratum of graphite, (plumbago,) or black lead, situated between perpendicular strata of the schistose rock. This stratum had been opened, and was supposed to be coal. I was unable to examine its thickness, as the excavation was filled with water. The demand for this mineral is not adequate to its supplies. Besides being employed in the manufacture of crayons and lead pencils, it is very useful in diminishing the friction of wooden machinery, and its powder prevents iron from rust. Not far from the above farm, limestone was supposed to exist; the rock was, however, found to be greywacke, which occasionally contains beautiful crystals of limpid quartz. The sulphuret of molybdena, a rare mineral, was found here, embraced by a mass gneiss.

Although the tertiary deposits in the neighbourhood of Saint Stephens are much like those before mentioned, the marly strata were not found, notwithstanding they may be discovered by the examinations of the inhabitants. Instead of the argillaceous marl, beds of blue clay, containing the remains of the mya, mytilus, and pecten, are spread over considerable tracts, and are frequently covered with thin beds of

alluvial sand. The clay exhales the odour of marshes, newly formed by the sea. The soil is of two kinds—the sandy, and the stiff clay: both would be improved by using lime, or marl, for manure.

Saint Stephens possesses a mineral spring of no ordinary medicinal powers. Near the church, and on the property of Mr. PORTER, a small stream issues from the earth, and contributes to the supply of a brook, crossing the street. The water is very clear—has a weak fetid smell, and unpleasant taste, when first taken into the mouth. I could not have an opportunity to examine this water, until several weeks after it had been taken from the spring, and therefore the following analysis may not be correct, as new combinations may have taken place during that time. The analysis was repeated three times with nearly the same results.

In each wine pint—

Sulphuretted hydrogen.....	4. 5	cub. in.
Sulphate of Soda.....	5. 4	grains.
Lime.....	2. 5	—
Muriate of Soda.....	6. ..	—
Oxide of Iron.....	.. 4	—

The sulphuretted hydrogen reddens the infusion of litmus, and precipitates the nitrate of silver black. The sulphate of lime was detected by evaporating a pint of the water down to four ounces, a precipate of the sulphate of lime formed, which was soluble in four hundred parts of water; and the solution afforded a precipitate with oxalic acid, carbonate magnesia and alcohol.

The aperient effects of this spring are very manifest, and they evidently arise from the sulphate and muriate of soda contained in the water. From the above, it will therefore appear that it is not inferior in its medicinal powers to many of those in England and France. Admitting that the good effects of watering places are in part produced by a change of air, amusement, and scenery, Saint Stephens is pleasantly situated, with a fine surrounding country, and will evidently hereafter become a place of considerable notoriety.

There is also another mineral spring at Oak Bay. Its properties appear to be similar to that first noticed, but in consequence of my engagements at the time when the water from it was received, I am unable to give its analysis in the present report.

THE ISLANDS IN PASSAMAQUODDY BAY.

Having procured a boat and good pilots, I proceeded to make an examination of the numerous islands in the Passamaquoddy Bay. It will be seen by reference to a map of the Province, that Deer Island is stretched across the Bay of Saint Andrews in a north-east and south-west direction. The Scoodiac empties between the south-west part of the island and the American shore, while the waters of the Digdeguash and Magaguadavic are discharged into the sea through two openings between its north-east point and the main land of New-Brunswick. The largest of these passages is called "Big La Tete," and the lesser "Little La Tete." The island obstructs the ready exit of the waters from the rivers, and the tide rushes through these passages with great rapidity, occasioning eddies which frequently perplex the best pilots.

On each side of "Little La Tete," a coarse red syenitic trap, occasionally covered with detached portions of conglomerate and sandstone were observed. The small islands and rocks situated in and near these passages are composed of the same rocks, into which numerous dikes of the trap have been introduced. L'Etang, or Frye's Island, is valuable on account of being placed within the range of the limestone formation that extends in a north-east direction from the County of Charlotte to St. John. The limestone is continuous from one of its sides to the other, and is advantageously situated for being calcined and exported. A quarry has been opened, and a kiln erected by Dr. Frye, of St. Andrews.—Fuel is abundant, and excellent lime might be supplied, and readily shipped upon a large scale. The same remark will apply to the quarries on the west side of L'Etang harbour, owned by Mr. Califf, who is employed in the business, and supplies the settlements along the coast. An excellent quality of marble was seen on the western part of the island, but the rock appears to have been too much fractured to supply large slabs. It is highly crystalline, and will bear a fine polish.

The limestone has been deposited between strata of greywacke, and greywacke slate, but the introduction of trappean matter from beneath has effected great changes in the composition and position of each formation, and so altered the situation of the strata that it is impossible to ascertain their true inclination. A few small veins of serpentine were observed, and there are numerous veins of quartz intermixed with nodular masses of dark green chlorite, extending through the

rocks in all directions. The limestone contains a vein of milky quartz two feet thick; the sulphuret of iron is common, and appears under circumstances like those already mentioned.

In order to avoid uninteresting details respecting the geographical situation of, and the peculiar circumstances connected with dikes and ridges of trap rock, a particular notice of them is deferred until they can be embraced in one general view, for they are too numerous to receive particular description, unless they should appear to be connected with facts of some practical importance.

A number of small islands at the entrance of L'Etang Harbour were next examined. Many of them still remain without being distinguished by names. They offer but little variety in their structure, having been fixed in their present situations and composed of the same materials as other high lands to which I shall often have occasion to refer. Conglomerate and detached pieces of new red sandstone, interlaced with dikes, is the prevailing character of these isolated rocks, which were not found to possess any minerals of importance.

The White Horse is a rude mass of trap, situated about four miles from L'Etang harbour; it rises abruptly from the sea to the height of one hundred and fifty feet, and is so perpendicular that the largest ships in calm weather might lie at its sides as at a wharf. This rock has been rent asunder by some sudden force. A deep chasm, called "Styx," and the depressions on the surface, where caves have fallen in, point out how much it has suffered by powerful causes. Not a tree has ever taken root here, notwithstanding the Island is covered with peat, and other decayed vegetable matter, to the depth of four feet. The table land on its summit contains about four acres. This is yearly covered with a fine growth of wild grass, which is mowed and carried away by the people of the inhabited islands. The sea-pigeon and other wild ducks breed here, but their eggs are procured with difficulty and danger, as they always seek seclusion in the sides of the steepest cliffs. During a gale, the little island presents a sublime spectacle. The sea, instead of breaking upon the ordinary inclined plane of the shore, is thrown headlong against the vertical rock, and, trembling under the furious lash, the island is almost buried beneath the spray.

The Wolves, six islands of inconsiderable magnitude, are situated at a distance of about ten miles from the coast. These are well known to the mariner, for having been the scene of many shipwrecks. They are composed of trap and conglomerate—situated very unfavorably for the navigation

of the coast, and are under the dominion of a poor but hospitable fisherman and his family.

White, Spruce, Green, Cherry, and Casco Bay Islands, and Pope's Folly, are formed of coarse conglomerate. Sandy Island has a beautiful beach of fine sand, whence its name. Indian Island is a beautiful spot, and consists principally of altered slate. Jouett's Island contains about four acres of soil, resting on conglomerate. Its comfortable mansion is the residence of Captain Moses, now an officer of Her Majesty's Customs. I have been thus brief in the description of these places, as they were not found to possess any minerals, or quarries of any practical value.

DEER ISLAND.

Deer Island is not less than twelve miles long, and will average about three in breadth. Its south side presents a chain of low hills, composed of trap rock and broken slate. These hills are scattered over an inclined plane, extending to the shore, which is singularly indented, and occasionally occupied by beds of sand and gravel. Sometimes projecting masses of rock extend into the sea, affording fine harbours for boats and other small craft. This side of the island is also sheltered by a great number of smaller islands, scattered along the shore. Many of the hills are naked; others, and the valleys, are covered with a light growth of birch and spruce. Not a few inducements are offered for the inhabitants to cultivate the soil, and a number of fine farms have been cleared; but as fishing is supposed to be the most profitable employment, they have been much neglected. I had hoped to meet the limestone formation somewhere along this shore, but was unsuccessful. The distance to L'Etang, however, is not great, and lime may be readily procured to fertilize the soil, now requiring its application. At a number of places, deep grooves appear to have been cut through the rocks, and extend from one side of the island to the other. As these places are worn down smooth, and marked with diluvial scratches, there can be but little doubt that those grooves were produced by a current of water, that has rushed over the surface. Near the "Little La Tete," there are two remarkable eminences, which add much to the natural beauty of the surrounding landscape. The north-west side of the island is abrupt. The rocks at several places contain narrow veins of magnetic iron ore, but none of suf-

ficient thickness to afford a profitable supply of that mineral. The precipitous character of its northern side, has arisen from the greater elevation always attained by the "intrusive rocks" than those which owe their existence to more tranquil causes; and although the slate, conglomerate, and sandstone cover the tops of the highest hills in some instances, their altitude can always be accounted for by the fact, that they have been uplifted by forces applied from beneath. Vast masses of greenstone may be seen supporting the strata rent asunder and sloping down their sides. At a few places, toadstone and amygdaloid were noticed, occupying lower situations. The latter often contains in its vesicles calcareous spar, and more seldom zeolite. These are thinly covered with light green chlorite; veins of white quartz, and a kind of hornstone or chert appear very frequently.

CAMPO BELLO.

Campo Bello is upwards of eight miles long, and will average two miles in breadth. Its longest diameter is from north to south, and whether considered on account of its fine harbours, fisheries, or timber, is extremely valuable. The rocks, from Harbour De Lute to Old Friar's Head, are slates, through which large masses of trap are protruded, and elevated to form a number of conical hills or angular prominences, seen scattered over the surface. The changes effected in the slate, where the trap has been forced through, are very remarkable, and the rocks are so much fractured and thrown out of place, that no satisfactory account could be taken of their dip. At those places where the trap and slate are in immediate contact, the changes produced by heat on the latter, are singular and interesting, and sufficient opportunities are afforded to observe those changes from the highest to the lowest of their several degrees. Wherever they are found in juxta-position, and the trap has any considerable dimensions, the slate is converted into novaculite, whetslate, or Turkey stone. Just as a departure is made from a dike, so the effects of the heat which attended its eruption are seen to decrease, until the slate assumes its true argillaceous character. When the dike is narrow, or such as might be called a mere vein, these effects are scarcely discernable, as the accompanying heat of only a small portion of the once melted matter, was insufficient to produce the changes effected by greater eruptions.

The novaculite readily breaks into small rhomboidal fragments: larger pieces can, however, be procured by removing the exposed part of the rocks, and will be found equal in quality to any of the imported oilstones. At Friar's Bay, and in the bank immediately below the village of Welchpool, there are several narrow veins of lead ore. This ore, which is called galena, or the sulphuret of lead, is contained and mixed in veins of quartz and calcareous spar. The largest vein, forming the matrix of the ore, is twenty inches wide, and has two veins of smaller dimensions. By ascending the bank, which is about twenty-five feet above high water mark, I discovered that the quantity of ore was much increased, but instead of the galena, the whole width of the vein is occupied by the sulphuret of iron. As the beach is covered with loose sand and broken masses of rock, I could not ascertain at what rate the lead ore increased in its descent, and I regret that I had not the means of ascertaining, by a deeper examination, what hopes this spot offers for opening a mine. There is another vein of the galena at the head of Harbour De Lute. It occurs here, unaccompanied by the quartz, and carbonate of lime. It is only four inches wide, but of an excellent quality.

There can be no doubt that this ore is connected with several veins, discovered but a few years ago, on the east side of South Bay, and within eight miles of Lubec. I had previously visited that place, at the request of one of the proprietors, and am of the opinion that, by a judicious exploration, the ore might be found in sufficient quantities to repay the expense of mining. A small sum of money, properly applied in seeking the lead ore at Campo Bello, might be amply repaid by new discoveries.

These veins of the sulphuret of lead were evidently produced by the heat attending the elevation of the trap rocks, with which, there can be no doubt, they are contemporaneous. The same remark will apply to the sulphuret of iron, always found most abundantly near a dike. The lead and iron must have existed previously in the slate, where they were combined with other minerals; but when they were submitted to intense heat, they united with the sulphur, which aided their fusion and fluidity. If it be remarked that these ores are found filling veins in the trap, which is of later origin than the slate, the fact is by no means weakened, for veins and dikes of that rock, often found crossing and entering into each other, shew that it is of different ages, and was thrown upwards at separate periods. An empty fissure in

the pre-existing trap, would be as readily injected with metaliferous matter, as one left open in the slate.

From Harbour De Lute to Head Harbour, the hornblende rock is most abundant. At the harbour, and near the light-house, the altered slate appears again. It is filled with the sulphuret of iron, which, from its decomposition, covers the rocks with the sulphate of that metal, and thus an excellent opportunity is afforded for the manufacture of alum and copperas. The slate on the east side of the island exhibits the same character, and has been distorted by the same causes referred to in describing the west side. The honeslate is abundant; but, besides these, I discovered four enormous dikes of porphyry, cutting through the slate at right angles in some instances, and passing between the strata in others. One of these dikes will be seen on each side of Schooner Cove, and another appears at Liberty Point; but the most remarkable of the four is at West Quoddy, and almost opposite the lighthouse, on the American side of the line. Here the porphyry cuts the slate at right angles, while near it there is a high cliff of trap, which interrupts the slate again. A drawing was taken of this remarkable spot, but I have been unable to have it engraved for the present report.

The whole of the eastern shore is bold and lofty.—Frightful needle-shaped cliffs, and shelving masses of slate, descend into the sea so perpendicularly, that, in foggy weather, vessels might be thrown by the waves against the cliffs, before any danger would be apprehended. Instead of the overhanging precipice, the west side of Campo Bello has a gentle slope towards the shore, where the inhabitants have made a considerable progress in agriculture. Friar's Head is a considerable cliff on the south side of the harbour at Welchpool. It has a detached mass of trap placed at its front, named the "Old Friar;" but the imagination must be very active to recognise any resemblance between this conical rock and any monastic functionary. The island is owned by Captain Owen, R. N., who resides at Welchpool.

West Quoddy light, on the American shore, stands on a low cliff. Between Lubec and Campo Bello, the tide runs with great rapidity; and as the channel, at low tide, has scarcely two feet of water, and contains a number of dangerous rocks, the navigation is almost impracticable, except at high water.

At all the islands, peat is abundant, and frequently covers the rocks, even at places where it is exposed to the waves. There are also large collections of clam shells in the harbours

and creeks, where they are often covered by the soil. They are always found at the ancient haunts of the Indians, who, before the discovery of the country by the whites, made the "clam" a principal article of diet in times of scarcity.

It is impossible to conceive a more interesting sight than is presented in the Bay during the summer season. Boats and vessels becalmed, and carried away by the tide, are at one instant hidden by the blackened rock, or the green foliage of some little island. At another, they glide from behind the curtain, and appear struggling with the overwhelming current. Often several hundreds of boats huddled together, and practicing a deadly deception on the haddock and cod, from a signal given by the tide, draw up their anchors, and hasten to the shore. The silence of evening is broken by the sound of the Indian's gun, levelled with deadly aim at the rising porpoise. The hollow sound of the "loon's" note is discordant with the scream of the gull. Here the glassy surface of the water is broken by a shoal of herring; yonder the spouting grampus is blowing up the spray in preparation for another dive. Perched on a rock, and armed with a pin hook, baited with a shrimp, the fisherman's boy can fill a larger bag with herring than half a score of scientific anglers could replenish with trout during a whole season. The sea is alive with fish, its surface with human beings, and the air with feathered tribes.

GRAND MANAN.

Grand Manan is a large and beautiful island, situated about twelve miles south from Campo Bello, and West Quoddy Head. It is twenty-five miles long, and upon an average five miles in breadth; its longest diameter being from north-east to south-west. The north-west side of the island lies almost upon a straight line, notwithstanding several high headlands that advance into the sea. It is uninhabited on this side, which presents a bold front of overhanging cliffs and lofty mural precipices of majestic grandeur and beauty. Occasionally collections of *debris*, or broken rocks, have fallen from the cliffs, forming steep slopes. Upon these slopes, wherever they are not too steep for the soil to repose, the birch, alder, wild gooseberry, and currant, are planted, and thrive amidst the ruins of the dilapidated coast. Between the main land and the island there is a very powerful current, both on the flood and ebb tide. When the wind is

opposed to the current, a heavy sea is soon produced, which by its violence is constantly undermining the rocks, and promoting their downfall. Deep caverns are worn out of the solid base of the lofty wall, which tumbles headlong into the sea beneath. Along the straight coast on this side of Grand Manan, there is a lofty ridge of trap rising most frequently in a perpendicular direction from the sea. The breadth of this ridge is about two and a half miles.—The mountain thus skirting the shore is furrowed lengthwise, and is occupied by several small lakes, that fill the deep circular impressions along its summit. It can scarcely be doubted that these basins, now filled with water, were once the craters whence the trap flowed in a liquid state. The molten masses that rushed down the sides of the mountain may still be seen marking the limits of each fiery deluge, and the points where they became too cool to flow over the burning wave that had preceded them. There is a wide difference between the trap rock and the schistose formations unlieing the southern side of the mountain. The latter have deep ravines extending from north to south, and those distinguishing grooves and scratches, that point out the course of a current of waters once sweeping over them. The diluvial grooves common in the Province are parallel to the ravines worn out of the slate.

The mountainous district is covered with a fine growth of beech, birch, and maple. The southern side of the island is low, and quite level. The different kinds of slate and quartz rock, into which numerous dikes of trap have been injected, compose its base. These slates also have been more or less changed in their characters by the heat attending the filling of the dikes, and the strata are much disordered from causes already noticed. It is to be remarked that this island, and almost all those in the Passamaquoddy Bay, have their longest diameters in the direction of the course followed by the stratified formations of the Province, and there can be no doubt that the direction of strata in all countries has greatly modified the courses of mountains formed by intrusive rocks, independent of a magnetic influence which is supposed to have had an effect of a similar nature.

It is probable that an opening in the earth for the transmission of accumulated matter under the forms of lava and gas, would be much more liable to occur in the direction of the strata, and between their layers than at right angles with their natural joints; and it would be an important enquiry that would discover how far volcanic vents are influenced by

the rocks through which they pass. Wherever the trap exists unassociated with the stratified rocks in the British Provinces, it is found to attain a much greater elevation than when it appears under any other circumstances. This may be accounted for by the resistance the strata have made wherever volcanic violence has not been sufficiently powerful to remove them altogether, or to open such a passage for the lava as would allow it to flow freely from beneath.

Formerly the lower lands produced an immense growth of pine and spruce, but the large timber has been consumed by fire, the great destroyer of American forests. The hard wood upon the mountain was protected by its less inflamable foliage, and the thick growth of green plants covering the hills.

My examinations were commenced on the north side of the main island, but the turbulence of the sea prevented me from completing them in that quarter, and a vessel of sufficient size could not be procured during the fishing season to buffet the waves and afford a retreat on an uninhabited coast, where travelling on foot is rendered impracticable from the lofty cliffs whose bases are washed by the sea to the depth of many fathoms. Indeed, it is by no means a comfortable employment to be creeping beneath the precipices from two to three hundred feet high, whose overhanging rocks are suspended above, and are constantly falling upon the shattered fragments spread along the shore, or dropping into the ocean to be no more seen. I was able, however, to determine the character of each formation, and procure the beautiful and interesting minerals contained in them.

The northern side of the island will average from three to four hundred feet in height. Its lofty mural cliffs stand like rude imitations of masonry, and rival in grandeur those of the celebrated Cape Blomidon in Nova-Scotia. The rock at many places is perfectly basaltic, and appears like large pieces of squared timber placed upright side by side, with a perfection and beauty equal to the basaltic columns of Staffa. These are met by enormous blocks of rhomboidal and amorphous trap, which from their architectural arrangement appear to have been laid by the skill and ingenuity of man.

The amorphous trap is frequently alternated with amygdaloid, which by decomposing more rapidly than the compact variety, hastens the undermining and consequent breaking down of the headlong steep. Whole facades of columns have been broken off and carried away by the sea. The ends of the columns have been polished by the attrition of the

waves, constantly moving the sand, and the lofty colonnades stand based upon a natural tessalated pavement.

About nine miles from Northern Head westward, there is a singular indentation in the cliff called Dark Harbour.—At the entrance of this opening the sea has forced up a barrier of sand, pebbles, and drift timber, and completely closed the mouth of a safe and very convenient harbour for small vessels. During the flood tide, and at high water the sea infiltrates through the bar, and there is a regular ebbing and flowing in the basin thus produced, and partially filled by a small stream descending from the mountain above. It may not be improper to remark here, that only a small sum of money would be required to open this singular harbour, which might be entered at all seasons of the year, and allow the inhabitants to have communication with the main land during the winter months.

The minerals between Northern Head, and Dark Harbour, are amethyst, agate, jasper, hornstone, Thompsonite, stilbite, heulandite, calcareous spar, zeolite, and apophylite. These are similar to those found in the trap rocks of Nova-Scotia, and although they may not prove to be of much practical value, they are very interesting in the science of mineralogy, and the discovery will give a new feature to the Province, which is evidently not surpassed in mineral wealth by any of her sister colonies. Several veins of specular and magnetic iron ore were also discovered along the shore, but none of them are of sufficient thickness, and are placed in such situations as will admit of their being worked with profit. Most of the minerals first mentioned are contained in the amygdaloid, which at many places forms the foundation on which the amorphous and columnar rocks rest. The amygdaloid is extremely vesicular, and has its cavities filled with varieties of zeolite and calcareous spar.

At Northern Head, the green stone trap, and amygdaloid present a lofty and perpendicular cliff of surpassing grandeur and sublimity. The precipice will average two hundred and forty feet in height, and stands majestically fronting the sea, constantly rolling its green waves upon the broken fragments of rocks scattered along its base. At the extreme point, a detached mass of trap stands in advance, and is called the Old Bishop. Whence this name was derived, I could not discover, unless it was given to it in contradistinction to the Old Friar, at Campo Bello, which it strongly resembles. Near the Old Bishop, the rock is basaltic, and beautiful columns stand erect, apparently supporting the pre-

cipice; farther southward, many of these columns have fallen, and a slope has been produced by their downfall, having the ends of the columns with pentagonal and hexagonal faces, inclined outwards towards the sea.

At Eel Brook, the cliff is rendered accessible by a notch, and slope; just above these, there is a small lake, abounding in large eels; and a number of deep pits were observed, where money-diggers had been seeking for treasures, supposed to have been concealed by the unfortunate crew of a French ship, wrecked near the brook in the early settlement of the country.

Whale Cove, at its extremity, exhibits a mural precipice that has attained still greater elevation, and is three hundred feet perpendicular above the level of the sea. This frightful escarpment is composed of alternate layers of amorphous trap and amygdaloid, and resembles a section of the most perfectly stratified rocks. The layers vary from ten to thirty feet in thickness, and dip to the south-east at an angle of 15°. It is remarkable that each alternate layer is composed of amygdaloid, as there can be no doubt that this rock, and the amorphous greenstone interstratified with it, are of volcanic origin. But, perhaps, this kind of stratification may be accounted for by referring to the periods of activity, and repose, common to all volcanoes. Why a compact trap should be ejected from a crater at one time, and cellular lava at another, is not readily explained, unless one be admitted to be the product of submarine action, and the other to have been cooled by exposure to the air. The amygdaloid abounds in oval cavities, filled with calcareous spar, zeolite, semi-opal, and heulandite. Nodules of these minerals often constitute the greatest portion of the rock. Along the base of the cliff, I collected fine specimens of calcareous spar, heulandite, stilbite, laumonite, and semi-opal, equal in beauty, and like those found in the trap rocks of Nova-Scotia. They had fallen from the cliff, or had been exposed by the constant undermining operations of the sea. Near the farm of Mr. Thomas, and about a mile southward of Eel Brook, the basalt appears again in perpendicular pillars. On the south side of the cove, there is a vein of quartz, containing the sulphuret of iron.

At Fish Head, and about two miles south of the brook, the quartz contains dark green chlorite in considerable quantities. This mineral is much used by the Indians, who pay an annual visit to the spot, to procure a quantity of the chlorite to make their pipes. Before they were made ac-

quainted with iron, it was also used by them for pots and other vessels, therefore the mineral has been called *pipestone*, *potstone*, &c. Also the American fishermen transport considerable quantities to the United States, where it is sold for specimens, and other purposes.

Near a small cove, called the Swallow's Tail, there is a dike of porphyry, about twenty feet wide, supported on each side by walls of greenstone. The porphyry is of the red feldspar variety. Leaving the lofty cliffs of trap rock at Whale Cove, the slates begin to appear, near the Swallow's Tail, and crop out at Long and Duck Islands. Following along the coast from Mr. JOHN M'INTOSH's store to the estate of WILFORD FISHER, Esquire, there are beds of sand and clay, collected between the sharp ridges of slate, and dikes of greenstone trap. Near Ragged Point, there is a narrow ridge of quartz rock, which has been mistaken for marble. This rock is interstratified with greywacke, talcose and hornblende slates, often forming in the schistone rocks veins of large dimensions. Some of these slates are composed of talc and hornblende, others of talc, chlorite, and quartz, The same rocks compose Nantucket Island, Gull Rock, and the reefs connected with them.

Along the south side of the main Island, there are a number of small Islands. Some of these are connected with each other by reefs of rocks, and bars of sand, which are covered by the sea at high water. The small Islands afford shelter for vessels at all times. A number of ledges appear only at low water,—others are always covered by the sea: to avoid them, the greatest care and experience are necessary on the part of the pilot. The largest of these small Islands are inhabited, and although the soil is scanty, fine crops of grain and potatoes are generally produced. It is from the excellent fisheries, the inhabitants derive their chief support, and, therefore, a soil capable of successful cultivation, is neglected. The season is short, and the frost appears early in the autumn; but vegetation is rapid, and fine fields of ripe wheat may be seen in the month of August.

The number of American vessels fishing at Grand Manan at the time of my visit, was estimated at six hundred, while the number of British bottoms would not exceed one hundred. In fine weather, the surface of the water around the Island is covered with these craft, and a more singular and lively scene can scarcely be presented than the panorama of Northern Head. This fishery is of incalculable value to New-Brunswick, and Nova-Scotia, whose inhabitants will

discover, perhaps when it is too late, that they should have been better protected from foreign aggression.

At Priest's Cove, and Creek, and at the Thoroughfare, the slate and quartz rocks are seen passing into each other. Near the house of Mr. Ross, at Ross's Island, the latter contains crystals of fine limpid quartz. Chaney, or Blue Island is composed of the same rocks, with here and there a distorted mass of greywacke. At White Head Island, a quantity of chlorite was observed, near a dike, forced through the clay slate. The quartz rock is abundant, and composes a bold cliff, called White Head, where beautiful crystals, like the above, may be collected. This Island abounds in gulls, and other sea birds. The young broods are so numerous in July, that thousands may be taken by the hand, and the swamps are shadowed by the grey and white gulls floating in the air.

I next visited Kent's Island, where, besides the greywacke, there is a deposit of highly crystaline limestone, situated between masses of greenstone. This limestone is about fifty yards thick, and extends through the Island a distance of about a furlong. The rock is white, with yellow and blue veins, and will afford a good marble. The inhabitants will find their lands to be much improved by the application of this lime, which may be cheaply quarried, and calcined, in their immediate neighbourhood.

At Red Head, near Seal Cove, a peculiar kind of sand had been procured several years ago, and I was informed that considerable quantities had been shipped to the United States, for the purpose of filling hour glasses, &c. Upon examination, it was found to be magnetic iron sand similar to that constantly driven up by the sea at the Isle of Sable. Merchants will find this an excellent blotting sand. All the slates placed beneath the main, and smaller Islands, have been broken up by a great number of trappean dikes, similar to those already described.

Ganet Rock, a lighthouse station, is composed of trap rock, and chert; and all the dangerous reefs and ledges along the south-western side of the Grand Manan, seem to be the remains of submarine volcanoes.

Between these rocks and those forming the south side of the Bay of Fundy, on the coast of Nova-Scotia, there is a great similarity, and it is well known by pilots that a long reef of rocks extends across this part of the Bay to Brier Island, a distance of fifty miles. Fortunately the reef is placed so deep beneath the sea, that ships may pass over it

in safety, although it alarms the stranger by the breaking of the water over its submarine precipices and "dark unfathomed caves."

But the most remarkable circumstance connected with the geology of Grand Manan, is the fact, that the whole south side of the main, and all the small Islands in that direction, have, within a recent period, been submersed to the depth of about eighteen feet. At the time this submersion took place, the Island was not inhabited, but several persons are still alive who can remember the tradition, that there once existed between the main, the three Duck, Nantucket, and other Islands, a kind of marsh, which occupied several thousand acres, and was only covered by the sea at high tides. This kind of marsh had also been seen at Grand Harbour, the Thoroughfare, and other places along the shore. It produced a peculiar kind of grass, which was used for fodder. All these marshes have now disappeared, and it was only at a few places where any parts of them could be found, and wherever any remnant still remains, it is situated eighteen feet below the mark of the highest tide, and is covered during every influx of the sea. Upon examination, I found that not only this marsh, but large bogs of peat, have been buried beneath the ocean, until its waves, and the rapid motion of the tides, have almost removed them, and left their beds to be overflown twice in every twenty-four hours.

The stumps of a great number of trees—the pine, hemlock, and cedar—still remain firmly secured in the sunken earth, by their roots, and at the very spots where they flourished. This buried forest, with its logs, branches, and leaves, is now covered by each succeeding tide, and the peat taken from the remaining bog, when dry, will burn more rapidly than that taken from the upland. It was by this submersion, that the small Islands became isolated from the main, for the marshes and peat bogs formerly uniting them, were soon removed, when they became exposed to the violence of the sea, and its currents. It is certain, and the fact is confirmed by twenty-five years of careful observation, that the tides in the Bay of Fundy are slowly but gradually rising every season. This circumstance does not, however, by any means account for the change of level in the south side of Grand Manan, where vessels now anchor at places formerly dry at low water, and where their tackle is often entangled among roots and stumps of trees, that formerly stood above the level of the ocean.

I could not discover that the northern side of the Island had changed its level, and it appears that the land has rolled to the southward, and thus altered its former position.

We have now taken a brief view of the principal Islands in Passamaquoddy Bay, so far as it is connected with their most important geological features. A few other Islands, situated along the coast, extending towards Saint John, will be noticed in the survey of the shore, to which, in their structure, they are nearly related. The stratified rocks of all these insulated portions of the transition, and secondary formations, agree, in their characters, with those occupying the main land, and their present elevation above the water can be justly ascribed to forces formerly applied to them from beneath, and at the time when the dikes of trap now contained in them, were thrown upwards. Wherever these forces have not been exerted, the slates, limestones, conglomerates, and sandstones, dip beneath the sea, emerging only as they approach the protruded greenstone, basalt, and trap.

The White Horse and other detached masses of rock are composed altogether of igneous matter, and their origin is similar to that of Islands formed within a recent period, in volcanic districts. There have been also instances, within the present era, of whole continents being elevated by subterranean causes. While the coral insect of the Pacific Ocean, is raising his mound beneath the sea, to become, at last, the residence of man;—while the Ganges is sweeping up the sand, and building islands, the volcanoes of Iceland are lifting the lava above the water, and the "earth's safety valves" are performing the double office of venting internal heat, and erecting continents. However remote may be the time when the Islands in the Passamaquoddy Bay were raised up, there can no doubt, that they owe their existence to causes to be explained by referring to operations still in continuance upon the earth,—and a violence that once shook the strata to their lowest foundations.

SURVEY OF THE COAST

BETWEEN

SAINT ANDREWS AND SAINT JOHN.

Having completed the examination of the Islands, I proceeded to explore the coast, advancing in an easterly direction from Saint Andrews, and following the numerous and deep indentations of the shore.

On the east side of Chamcook Harbour, the sandstone becomes gray, and having been worn away by the sea, a broad pavement is left uncovered at low water. This natural pavement is divided by numerous parallel fissures, running east and west, and the dip of the rock is south 10°. At Chamcook Head, the sandstone is met by a bold cliff of reddish porphyritic trap. At its eastern point, detached strata of sandstone appear to have been uplifted, and have their dip much increased. A red colored trap and greenstone occupy the shore almost exclusively, from this place to the north side of the entrance of the Magaguadavic. It also extends in a northerly direction, until met by the syenite, and granite before mentioned. Rising into mountains, and sharp pyramidal hills, this rock again affords its peculiar scenery. The resistance it offers to decomposition, prevents a soil from forming, and the naked steep is often surmounted by the barren slope, equally destitute of the may-flower and the pine. Chamcook, Hardwood, and Little Hardwood Islands, consist of sandstone and conglomerate; the general dip of the strata is south-east 15°. The abrupt and conical hills forming an unbroken chain along the coast, are remarkably distinguished by characters only to be ascribed to the influence of heat applied under different circumstances. The trap

often passes into syenite, and its red colour is derived from the great quantity of red feldspar entering into its composition: sometimes the rock is composed of this mineral altogether; in other instances the hornblende is most abundant, and a greenstone is the result. Here, again, these ancient volcanic productions have been in contact with clay slate, which they have converted into an extremely hard novaculite, or flinty slate, and excellent hones, and oilstones, may be procured abundantly. The new red sandstone has also been submitted to heat, wherever it has been found under similar circumstances, and a coarse jasper has been formed. At several situations, it appears that the variegated sandstone has thus been converted into striped jasper, not unfit for the purposes of the lapidary. These facts are well displayed at Hog Island, at the mouth of the Digdeguash. A great part of the Island is composed of this mineral, and for its rude name, Jasper Island should be substituted. Large veins and dikes of that mineral were often observed, and are too common to require particular description.

On the west side of the entrance of the river, there is a singular conglomerate, composed of silex and lime, containing globular masses of calcareous spar. Frequently these masses are a foot in diameter, and, when broken, large, perfect and rhomboidal crystals may be collected. They are, however, opaque, and contain small fragments of rocks. That these solid crystalline bodies have been rolled from a distance, there can be no doubt; but under what circumstances they became crystalized, and sealed together in the solid rock, it is by no means easy to determine.

At a small cove near the house of Mr. Robert Glass, the slate is again found changed into a hard clinkstone, and containing the remains of marine plants, somewhat similar to those previously found in Nova-Scotia. The situations formerly occupied by these plants, are now filled with the oxides of iron, and the most delicate of their branches and leaves are as beautifully pictured on the rocks as they could have been by the hand of art. They are all corallines, and do not seem to differ materially from those growing on the coast. Being concealed in the slate, they are among the oldest classes of fossils, and evidently flourished when the first dawning of animal life began to appear. It has been doubted by some, whether corallines, from their great delicacy, could in any way resist the changes and effects of time; but they may be assured that the remains of this plant may still be seen with all the beauty possessed by its original.

Sometimes, where the once heated slate has been thrown up, and left resting upon the trap, it decomposes rapidly—its colour becomes a light red, and it adheres to the tongue like cachalong. It also has a splintery fracture, and is highly sonorous when struck with a hammer. Indeed the changes effected through the medium of this powerful agency, on most of these formations, are truly astonishing, but they nevertheless afford the best explanation of phenomena, which were formerly considered inexplicable.

The greenstone contains veins of quartz, and carbonate of lime, and, more rarely, narrow seams of chalcedony.

Few places will afford more delightful and romantic views than the entrance of the Digdeguash. The mouth of the river is filled, but not choaked, with small islands, closely covered with evergreens. Among them the light skiff and sail-boat seem to dance, before the breeze, while the more lofty ship slowly finds her way, with canvass spread, amidst the forest.

At the valuable estate of the Hon. James Allanshaw, the scenery is bold and picturesque. On each bank, the lofty hills, rising in successive steps, mark the horizon with salient angles; towards the east, the overhanging cliff offers resistance to the waves, ever foaming at its base; the bald summits of the mountains bear the characters engraved by time: the rapid river, having escaped from fall to fall, passes beneath the busy wheel of the saw-mill, where, having performed its last act of usefulness, it rolls onward towards the sea. Even the diving seal seems pleased with all around him, and, rolling his head upon its oily hinges, breathes with delight the elastic air.

About a mile eastward of the Jasper Island, there is a cliff of conglomerate, fifty feet high; it stands unconnected with any other rocks of the class, and its summit is well cleared, and cultivated. The feldspathic rock, of a deep brick-red colour, then occupies the shore to the entrance of the Magaguadavic. A small uninhabited island, at the entrance of this river, composed of hornblende trap, is beautifully basaltic. The pillars are of an equal size throughout its whole extent, and are formed under five, six, seven, and nine sides, and lean towards the south, at an angle of 15°. On the east end of this island a large block of trap tufa still remains, the representative of a much larger rock, which has been carried away by the tidal currents sweeping along the shore. At its western extremity, a group of isolated pillars shews the line whence the columns have retreated from

the sea. The reddish trap tufa is also seen at "Jour's Cove," and other places on the northern side of the river's mouth, where it might be mistaken for new red sandstone, or conglomerate, if viewed at a distance.

COPPER ORE.

On the main land, and immediately opposite the little basaltic Island, the feldspathic rock is of a bright red colour, and its amorphous masses are occasionally striped with narrow veins of greenstone, in which the hornblende is more abundant. In this rock I discovered three veins of copper ore. Two of them are each three inches, and one two inches wide, and extend from beneath the sea up the side of a low cliff. While examining these veins, I found that the ore occasionally contains pieces of pure native copper. Not unfrequently the native mineral is associated with its sulphate, green, and blue carbonates, affording specimens of much interest. The ore is, however, principally the sulphuret, and copper pyrites, which at one place is mixed in the rock to the distance of two feet on the side of the largest vein. The veins of ore are more readily decomposed than the hard rock wherein they are situated, therefore they are removed by the operations of the water and air, and deep fissures are left at the places they have occupied. The expense of exploring them even superficially, is thus increased, and it was with some difficulty I could procure even a hundred weight of the ore without blasting the rocks with gunpowder. The following is the result of an analysis of a specimen of the sulphuret.

Copper,	76. 5
Sulphur,	19
Iron,	4
	99. 5

It is therefore a rich ore of copper. The veins increase in thickness as they descend, and there can be little doubt that those already discovered are connected with a far greater deposit situated beneath the surface. At Cornwall in England, I have seen seams of copper ore of dimensions no greater than those just mentioned, worked at the depth of eighteen hundred feet below the surface. Were the veins at Magaguadavic explored to one half of that depth, they doubtless would be found of far greater thickness.

I next proceeded to examine the high cliffs and rocks northward of this place, and at several situations found indications of the copper. The difficulties of making an accurate examination are extremely great, as the valleys between the hills are covered with windfalls, rotten wood, and moss.—From the naked cliffs we were driven several times by the great heat of the sun in the month of August, and at this busy season of the year not a miner could be procured. It was therefore deemed proper to defer a more expensive exploration of the spot, until a better opportunity and more ample means were afforded.—It will claim my earliest attention in the spring.

During the examination of this part of the country, my son, who accompanied me, discovered several small veins of lead ore, at about a furlong eastward of the copper. They are not sufficiently wide to promise a reward for the expense of exploring them, but they nevertheless offer indications that might lead to some beneficial result.

The red trap and feldspar rock already mentioned, are highly metaliferous, and from the discoveries already made open a wide field for particular search. Should future and more extensive enquiries on this shore be rewarded by the discovery of a richer copper vein, the advantage arising from its discovery would be great. And should no disposition be manifested to smelt the ore upon the spot, ships laden with timber for Great Britain, might carry their ballast of ore, instead of worthless rock. That the necessary quantity of ore does exist there can be no doubt, and I feel the fullest confidence in its final developement.

At the "Mascarine Head", the trap is seen cutting through the new red sandstone and conglomerate; these two rocks are placed in alternate layers, and compose a cliff of considerable magnitude. The latter contains angular fragments of trap, a circumstance that proves the previous existence of that rock. But the outbreaking of the igneous matter has taken place at separate and far distant periods, and the formation containing that kind of matter, in pebbles or fragments, may also be penetrated by a production of a similar character. The Mascarine shore is composed of the sandstone and conglomerate, broken up and dislocated by numerous dikes similar to those already noticed.

The rocks on each side of the Magaguadavic were next examined as far as the falls, five miles from its entrance: they are chiefly clay slate, and contain as usual numerous walls of the hornblende trap. It had been supposed that

good roofing slate would be found near the river, but it is too much broken and contains sulphuret of iron, and therefore is unfit for any useful purpose.

MAGAGUADAVIC.

Few places in the Province afford a more singular and beautiful spectacle than the Magaguadavic Falls. And, whether they are considered in reference to their sublime scenery, or the geological catastrophe they exhibit, they cannot fail to be interesting to the visitor, and will reward the traveller for making a close examination of their peculiarities. The river after having descended from the mountains northward, passes through a level and wide plain of intervale, and when it reaches the village is about one hundred feet above the bed of the river below. This intervale appears to have been a large lake. Between this lake and the sea, or river below the falls, there was a strong barrier of trap rock, now seen cutting through the slate. This barrier has been forced and rent asunder by an earthquake, and the river now passes through a narrow gorge into the sea. The same catastrophe that opened a passage for the stream so fractured the rocks on the west side of the falls, that several deep fissures were opened, into which the water has been directed by a rolling dam above, and passing through those deep chasms beside the main fall, now turns the machinery of a number of saw-mills with a swiftness almost incredible. Here as on the main stream, a part of the water is diverted into sluices, secured to the sides of the cliff, to carry off the lumber and rubbish produced by the mills.

At the main fall the water descends by five successive steps, in the distance of five hundred yards, through a chasm averaging about thirty feet wide and a hundred feet deep.—Through this narrow gorge the whole contents of the river is poured out with a fury that defies description. The industry and ingenuity of man have considerably modified the appearance of this remarkable spot. It still however remains a most extraordinary hydraulic spectacle, and affords a power for turning machinery beyond computation. Having swept slowly along the valley above, the water is accummulated at the bridge over the top of the falls; it is then thrown by its own weight into the deep and narrow opening below, where spouting from cliff to cliff and twisting its foaming column to correspond with the rude windings of the passage, it falls in a

torrent of froth into the tide below, or passing beneath the mills its fury seems abated as it mingles with the dense spray floating above.

There are six saw-mills huddled together at this spot, and they appear like eagles nests clinging to the rocks on each side. A large sum of money has been expended in their erection, and they are now in full operation. The deep cavities in the rocks are overhung with the alder, and creeping evergreens, which seem to be placed here for the purpose of decorating one of nature's wild performances. The low roofs of the mills are strongly contrasted with the massive rocks they occupy, and where they hold a precarious situation,—the shelving piles of deals seem to mock the violence of the boiling pool beneath. Such is the power of habit the sawyer careless of danger, crosses the plank placed across the gorge, and ventures where his life depends upon an inch of space.

L'ETANG.

L'Etang is an excellent harbour, formed by a neck of the main land, extending outwards towards Deer Island. On the east side of the harbour and on a narrow peninsula, there is an inexhaustible supply of limestone belonging to the formation, extending towards St. John, and previously noticed. Its colours are black, blue, brown, and white, and wherever the strata are not too much fractured, a good marble might be procured. The course of the strata is north east and south-west, the dip is north-west at an angle of 80′ —sometimes the layers are perpendicular. This limestone is under and overlaid by clay, and chlorite slates. It is penetrated by numerous dikes and veins of greenstone, from a few feet to four inches in thickness. These dikes do not cut across the strata, but rise between them, having produced considerable alteration in the appearance, and solidity of the rock;—they have rendered the limestone crystalline, and sometimes filled it with cubic crystals of iron pyrites. Every facility is afforded at this place for burning the lime. It can be cheaply conveyed from the quarry to the kiln, and from the kiln on board of vessels. The property has been purchased by gentlemen from the United States, who are making preparations to calcine the limestone upon a large and excellent plan. I followed this formation across the peninsula to a deep cove, and some distance in an easterly direction. There is

an abundance of fuel on the tract, and suitable slates for erecting the kilns.

The new red sandstone and conglomerates, are the prevailing rocks at Dead Man's Head, and the islands adjacent.

BEAVER HARBOUR.

At Beaver Harbour there are considerable deposits of clay and *detritus*. In one instance, and near the house of Mr. YOUNG, a bed of stiff blue clay was found belonging to the tertiary deposit, and containing the remains of shells like those in the marl of the Scoodiac. The clay is succeeded by a collection of sand and gravel, containing much oxide of iron, and sometimes the black oxide of manganese. It has arrested these minerals in their descent, and the pebpebbles are sealed together, forming a perfect conglomerate. The oxide of iron is finally converted into bog ore, shot ore, and the specular oxide. The oxides of iron produced by decomposition are frequently washed by rains into shallow basins on the surface, where they become consolidated into globular masses, especially when clay is present. These masses when broken often exhibit incurved lines having a metallic lustre. In this way may the clay iron stone of the coal fields have been produced. The above fact was observed by the celebrated Dr. Buckland; and at Beaver Harbour and other places, I have observed iron pyrites gradually passing into a soluble state, thence collected by drainings from the soil, and finally through different stages of solidity, back to a hard compact ore. Such are the changes to which even solid and inorganic matter is liable.

The oxide of manganese is used in glass-making, pottery, and chemistry, and may be useful when manufactories are introduced into the country.

Both sides of Beaver Harbour are composed of clay, and chlorite slates, sometimes there are narrow deposits of hornblende slate; all of them contain nodules of green chlorite, which is used by the Indians for making pipes. On the east side of the harbour, the chloritic rock contains a vein of pure white carbonate of lime, about two feet wide, and embraces a small quantity of lead and copper ores. At the eastern head of the harbour the rocks are singularly striped from the tops of the high cliffs, down to the sea. Some of these nearly perpendicular stripes are composed of hornblende almost pure, and of a deep green colour. Sometimes the rock resembles

hornblende slate, but it separates into rhomboids when broken, and the planes of cleavage differ from what might be called the lines of stratification. The hornblende divisions are alternated with the reddish trap, which passes into a hard and compact jasper, also rhomboidal in its structure. In one instance a vein of this kind of jasper appears forty feet wide, and extends to the top of the precipice, which is upwards of one hundred feet high, and almost perpendicular. It appears that the hornblende and feldspar refused to unite during the time of their fusion. Similar facts appear along the coast towards the Poclogan. The changes effected by the heat, which must have accompanied the eruption of trappean matter from the lower parts of the earth, are so numerous and varied that it is difficult to place under proper classes, the rocks thus produced and acted upon. The clay slate is seen passing into hornblende, and the greywacke becomes solid quartz; sandstone is converted into jasper, and limestone imperfectly indurated, is changed into crystalline marble.* The rocks from Beaver Harbour for a number of miles eastward along the coast, exhibit similar characters. Trap, hornblende slate, feldspar rock, and red jasper, are sometimes mingled with each other; again they are separated, and mark the shore with a variety of colours, and lance-shaped figures, represented on the front of lofty and perpendicular cliffs. Sometimes talcose slate may be seen, and when placed in contact with a dike, is changed into a hard clinkstone. That rock forms a considerable hill half a mile northward of Seely's Cove. The trap contains large veins of quartz and calcareous spar. A number of small veins of magnetic iron ore were also observed, but none of them are sufficiently wide to afford a proper quantity for working. The sulphuret of iron in cubic crystals, and irregular pieces, is common: but none of the zeolites were observed.

This part of the coast has a very gloomy and forbidding appearance; lofty precipices—shelving and overhanging cliffs rise abruptly from the sea, and being inaccessible at almost every point, offer no way of escape for the unfortunate traveller who might be landed beneath them. There are also deep caves, and wide chasms, where but a few rays of

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* "Hornblende Schist," says Dr. M'Culloch, "may at first have been mere clay; for clay or shale is found altered by trap into Lydian stone, a substance differing from hornblende schist almost solely in compactness and uniformity of texture. In Shetland argillaceous schist, (or clay slate) when in contact with granite, is sometimes converted into hornblende schist, becoming first silicious, and ultimately at the contact hornblende-schist."—*Syst. of Geol. vol.* 1, *p.* 211.

light ever enter, and no sound can be heard but the murmurings of the sea, ever washing their deepest vaults. That these frightful openings were formed by earthquakes, there can be no doubt, as the walls on either side clearly shew that they were once united. The examination of such places is not free from danger, on account of the violence of the waves, and the detached pieces of rocks constantly falling from the cliffs above.

Red Head is a lofty cliff rising perpendicular from the side of the Bay. It is composed of the red feldspar trap, which gradually passes into a compact red jasper, capable of receiving a fine polish. The jasper may not only be procured in sufficient quantities to meet its use for ornamental purposes, but also supply an abundance of material to erect whole buildings. Had the ancient Greeks and Romans possessed a much less quantity of this mineral than is found at Red Head, they doubtless would have employed it in their magnificent works of art.—The great limestone formation, previously mentioned, was seen north of Seely's Cove, and it continues beneath the forest, following its course in a north-easterly direction.

POCLOGAN AND LE PROE.

The shore from the Poclogan to New River, is composed of argillaceous slate, talcose, and hornblende slates, frequently interrupted by enormous dikes, and changed in their composition and position by causes already referred to. The talcose slate is most abundant, and embraces large veins of quartz, and occasionally narrow seams of the micaceous oxide of iron. Its dip is towards the south-east, angle 40°. At the entrance of the Le Proe, the conglomerate and new red sandstone appear again, and compose two small and beautiful islands, situated about a mile from the shore. The river is navigable for small craft only three miles from its mouth, where there is a beautiful waterfall, employed in driving saw-mills. The sandstone at this place is intermediate between the new red, and that forming the upper series of coal measures. Its general dip is north-west 45°. Following the river some distance northward of the bridge, the new red sandstone becomes decided in its characters, and occupies a tract of low level country, well distinguished in its appearance and agricultural character, from the naked crests of hills whose origin is to be ascribed only to operations in

which heat was the principal agent. Excellent freestones may be quarried in this neighbourhood: they will not be found too hard, and will resist the weather.

On the south side of the entrance of the Le Proe, the sandstones of the coal measures appear; their dip is north-west 75°. This sandstone extends along the shore of Maee's Bay to the entrance of the Basin, a distance of two miles, where it is covered by a coarse conglomerate, and finally by the red sandstone. Near the entrance of the Basin, the conglomerate presents a bold cliff: the same rock continues southward where it is again overlaid by the new red sandstone at Point Le Proe.

The discovery of this coal formation was unexpected, as the general features of the country near it are unfavorable to its existence. A complete section has been made on its western side by the encroachments of the sea, and by a difficult exploration made of the creeks and ravines in its neighbourhood, it was found not to exceed three miles in its longest diameter. Some hope might have been entertained that coal could be found, but upon examination the strata were ascertained to dip north-west at an angle of 75°, and therefore it is most probable that if they contained that mineral, it would have been exposed among the layers now placed almost upon their edges. It is true that the outcropping of the coal might be covered with other rocks, beds of sand, clay, &c., but the section above mentioned, made across one of the diameters of the coal basin, and the strata, would have exposed the coal if it existed in any considerable quantity.

The sandstones composing the rocks of this coal basin, contain numerous remains of plants, now unknown in this climate, or at any higher latitude: but although a long period of time has evidently elapsed since they were buried in the earth, they still exhibit much of their original beauty, and even the vegetable fibre of their woody trunks. The most abundant of these plants now converted into fosssils (or petrifactions as they were formerly called) approach nearest in their characters, to the fir tribe. Some of this class were observed, having parts of their trunks extending outwards from the solid sandstone, and measuring twenty inches in diameter. The ferns which often appear in coal fields are more rare, and but few fossil specimens of that plant, were procured at this place. Several branches of the stigmaria, like that described in Dr. Buckland's Geology, were discovered, and are beautifully marked on their surfaces with curious figures, that distinguish their class from every

other either of the former or present growth. Many of these once living vegetables have their bark converted into coal or lignite. Some whole trees have been thus changed, and as those substances are more readily removed, than the solid rock where they have been buried, their situations are represented by deep holes in the side of the cliffs. It would be irrelevant to the object of this report to enter deeply into a description of these singular relics; but none who behold them can refrain from reflecting upon the remarkable revolutions this planet has suffered. The effects so often mentioned, as having produced great alterations upon other rocks, and referred to the application of volcanic agency, are also very manifest in the strata of this coal formation, and are equally interesting. Doubtless by that agency the whole series of layers belonging to this group, has been thrown from its former almost level situation, and while one side of the coal basin has been elevated, the other has been depressed to a great depth from the surface. Its rocks have been hardened, and crystals of feldspar are formed among the consolidated particles of sand. The small quantity of coal and lignite still remaining, have been changed into a kind of anthracite, and the once flourishing fir is transmuted into a stone that rings under the blow of the hammer.

The strata of conglomerate extending from Mace's Bay to Point Le Proe, are thick and composed of pebbles of trap, porphyry, and occasionally serpentine, united by a calcareous cement. They contain numerous veins of calcareous spar and quartz, and also afford evidence of the disturbing force communicated to all the formations along the coast.—The extreme point where the lighthouse stands is new red sandstone, in which several narrow veins of asbestus have appeared from time to time, as the sea gradually removes the yielding rock. The same formations compose the shores of Dipper Harbour. It is somewhat singular that when the conglomerate rises to the surface, the soil is immediately improved and covered with a large growth of hard-wood, while other rocks are accompanied with the spruce and cedar. About a mile northward of the Harbour, the great limestone formation was again observed, with enormous masses of serpentine that occasionally reach the coast. Leaving this place and proceeding towards Saint John, the attention will be arrested by a number of deep chasms and hollows often separated from each other by large grotesque columns, formed by the hand of nature, in the solid materials of the earth. The rocks being of unequal hardness, yield to the

sea at one point, and resist it at others; hence the rudest figures, and most unsightly pinnacles are placed according to the taste of the most disordered imagination. Still farther eastward the trap appears again, having forced its way through talcose slate, and the dangerous reef and frowning precipice have resulted from causes now inactive.

Little Dipper Harbour is a small cove, affording shelter only to vessels of moderate size. On its west side several veins of sulphate of barytes were discovered in a compact greenstone. The barytes is associated with crystals of quartz, and in a few instances with a beautiful amethyst of a deep violet colour. The above rock is continuous to Chance Harbour, where it forms lofty and leaning cliffs of much grandeur and beauty. On the east side of the harbour, trap, argillaceous, and talcose slates, form a cliff two hundred feet above the level of the sea. The slates are much fractured, and embrace numerous veins of quartz. Sometimes the quartz is connected with crystalized carbonate of lime, of a deep red colour, and a beautiful green chlorite which appears to have been rendered fluid, and disseminated throughout every crevice in the strata. The soil in this neighbourhood is extremely scanty, and the summits of the hills are unoccupied by a shrub of any kind. It is only in the valleys where collections of sand, gravel, and clay sometimes appear, that any encouragement is offered for the honest employment of the farmer. But what nature has denied on one hand she has supplied on the other and the coast abounds in excellent fish of several varieties.

MUSQUASH.

From the above place to Musquash Harbour, the red and jaspery trap is most abundant, there are however numerous intrusions of the hornblende variety, and the shore appears to be interstratified with several kinds of sedimentary and volcanic matter. The sea washes against the mural cliffs, and sharp fragments of rock stand up like needles to pierce the rushing waves. The clefts and fissures, before noticed are common here, and more than once was my boat nearly filled with water, by being urged by the waves into their narrow openings. The Gooseberry Islands at the entrance of the harbour, do not require particular mention, as they were found not to possess any minerals of importance.

Musquash Harbour is a mile and a half wide and two miles long, it can be approached safely, and affords a shelter from all winds. Its eastern side at the entrance is composed of alum and copperas slates, with strata containing plumbago and the sulphuret of iron. The decomposition of the iron pyrites often covers the rocks with a thick coating of the brown and red oxides. At one situation the front of the cliff is covered with small crystals of the sulphate of iron grouped together, and sometimes covering the rock to the thickness of an inch. Thus an abundance of copperas is produced by natural operations, for the decomposable variety of the sulphuret of iron from being exposed to the atmosphere and moisture, undergoes a chemical change, and is converted into copperas. The same rock also contains the sulphate of alumine which by the addition of a small quantity of the sulphate of potash will yield alum. The above minerals are so abundant that any quantity of alum and copperas might be manufactured at a small expense, while they are now imported from England and the United States, where few such opportunities are afforded for their manufacture as can be seen at Musquash. These slates are met by the limestone formation, which near their junction is very impure and often ferruginous; a short distance north of Mrs. SHANNON's house it is penetrated by a dike of deep green serpentine. The serpentine having been mixed with the limestone has formed a beautiful marble of the "verde antico" variety, but it is to be feared that the rock has been too much fractured to supply any large slabs. Beautiful pieces of green marble were also procured here, and as it sometimes contains crystals of iron pyrites, it affords a rich variety for ornamental purposes. Fine specimens of satin spar were discovered at this spot, and a singular variety of brecciated marble has been produced by the intrusion of the dikes.

The limestone was examined some distance from the shore, where it appears to be cavernous. On the side of a hill there is a narrow opening, that probably communicates with a cave, but the passage is narrow and crossed by a small brook which descends among the rocks and finally re-appears breaking out at the beach some distance below. I made an attempt to descend into this dark chasm, but as it appeared to open directly downwards, and the men I had employed were unwilling to volunteer their aid, its exploration was deferred. The same formation also appears at French Creek, so named from a French armed brig having escaped from an English man of war, by entering the inlet concealed from the harbour.

It also appears at a number of places on both sides of the river. On the west side of the harbour it forms a ridge of considerable extent. This is not only an excellent situation for making lime, but a good marble quarry might be opened and its productions shipped with little previous labour and expense. The marble is white with blue veins. It bears a fine polish, and if opened to a proper depth will afford blocks of a large size. Crystals of limpid quartz are common in the altered slates. They are called diamonds by the inhabitants, from possessing the property of cutting glass. The alum and copperas slates were also found on the west side of the harbour.

Few places can afford a better situation for calcining lime, quarrying marble, and manufacturing alum and copperas, and it is to be hoped that some enterprising individual will soon bring those materials into use, and render them of public utility.

In many instances it is remarkable how these slates have been twisted in their structure. They often appear like sheets of paper crumpled up, or doubled into folds. The lines of these folds are distinct from those of the strata, although there are instances where the strata themselves have apparently been wrapped together. It is most probable that this disturbance was effected when the mass was in a soft state, and is not the result of its original mechanical situation. Here again each formation is accompanied by frequent volcanic intrusion, and the same changes of level, and in the chemical characters of the rocks are exhibited, which have been already so often referred to.

Eastward of Musquash, the rocks are of the trap kind, interwoven with the altered slates. At a number of places, the former contains narrow veins of the micaceous oxides of iron, quartz, chlorite, and carbonate of lime. Sometimes beautiful crystals of quartz are found lining cavities or geodes. The cliffs will average from one to two hundred and fifty feet in height, and frequently rise so perpendicularly from the sea, that a landing cannot be effected among them.—Large tabular masses of the slates are yearly falling, and the shore is covered with the ruins of the broken strata. I made attempts to land at a number of places, but could not proceed any distance on foot. Even in calm weather, the undulations of the sea are constantly rolling into deep gorges, and cavernous openings, where the rocks are rendered slippery by a luxuriant growth of marine plants.

At Negro Head the trap becomes more amorphous, and presents lofty cliffs of much grandeur. There are great

quantities of coarse red jasper, coated with red oxide of iron. The talcose slate has become flinty, and resembles chert or hornstone.

At Manawagonis there are deep beds of gravel, sand, and clay, which, being exposed to the sea, are constantly washed away, and the Bay is rendered wider and more shallow, yearly. The Islands in Manawagonis Bay, and Partridge Island at the entrance of Saint John Harbour, are composed of rocks similar to those just described. The trap forms the eminences where the tower and block-house are built at Carleton, while the slates will be found to occupy the lower grounds.

It is an extremely difficult task to arrange in separate classes the different kinds of igneous rocks, or such as have had their origin in heat: for, besides being mixed with each other, almost indefinitely, they frequently partake of the characters of the strata they have penetrated and disturbed; and although many of their varieties have been distinguished by mineralogists under different names, they frequently pass into each other by different gradations, so that it is impossible to draw a line of distinction between them.

These remarks also apply to the trap rocks so often mentioned, and the granite and syenite, evidently of much greater antiquity. Again, the changes produced by the eruption of the trap dikes, and other collections of volcanic matter, on the slates, limestones, conglomerates, and sandstones already mentioned, are not only numerous, but appear to have been governed by circumstances which were not uniform, and therefore a particular description of them might render this report more voluminous than useful.*

That the volcanic rocks situated along the coast of the Bay of Fundy, have been produced at different periods, there can be no doubt. The same rock that has been forced through the superincumbent strata, has itself been injected with veins of matter of a similar origin: but frequently different in appearance and mineral composition.

It does not, however, appear that these intrusive masses have in every instance been forced upwards into the rocks above. Sometimes they have been injected into veins, and

*The secondary and tertiary rocks also, when they are intersected by basaltic dikes, have frequently undergone some change,—beds of shale and sandstone are indurated, and reduced to jasper; compact limestone and chalk are converted into crystalline marble, and chalk flints altered to a slate like that resulting from heat in an artificial furnace.—*Buckland's Geology and Mineralogy, vol. 2, page 9.*

fissures pre-existing in the older rocks, and probably in some instances produced during the time of its cooling.

I have observed in a few instances two and even three dikes, or veins of hornblende rocks, intersecting each other in a manner that proves as many volcanic efforts made at different times. Again, it is evident that since these rocks have been produced, they have been broken up and rent asunder by earthquakes, and thus the deep chasms, fissures, and fractured condition even of the trap itself may be explained.

I next proceeded to examine the country extending from St. John to St. Andrews, and situated more remotely from the shore. After leaving the argillaceous and greywacke slates at Carleton, and following the course of the main road, granite appears at the surface as far westward as Lancaster. The limestone formation was seen at a number of places in the forest, where it is sometimes exposed on the sides of ravines and brooks. Its course varies from west-south-west to south east, and it is met on both of its sides by the slates and greywacke already referred to.

LANCASTER.

A large hill on the east side of the Musquash, and about a mile from the village of Ivanhoe, is composed of conglomerate, which has been intensely heated by its proximity to an overlaying mass of trap. Numerous veins of quartz run through the rocks in all directions, and contain beautiful crystals of limpid quartz. The limestone appears on the opposite side of the river, and near Mr. MARSHALL'S farm.—A tract of land was purchased by some Americans for the purpose of quarrying marble from it. Like many other speculations of the kind, it proceeded no further, notwithstanding a good marble might be procured at the spot.

Eastward and westward of the Mills of the Lancaster Mill Company, a coarse syenite forms a chain of hills of considerable elevation. This rock often changes in its character so as to become a greenstone, and by having mica added to its mixture instead of hornblende, sometimes becomes a perfect granite. Each of these rocks contain injected masses of trappean matter. On the side of a hill half a mile northward of the church, some indications of limestone had been observed during the past summer. The situation was explored, and by the assistance of several gentlemen from the neighbourhood, we were successful in discovering a sufficient quantity

of that rock to supply the demands of this flourishing settlement, and means have already been employed to bring it into use as a manure. A reddish argillaceous slate meets the limestone on both of its sides. The slate passes into greywacke, containing at some places a sufficient quantity of brown and red oxides of iron to be manufactured for pigments.

The river communicates with a chain of lakes, extending to the head waters of the Oromocto, so that every facility is offered for transporting the logs from the forest to the village, where there are mills of superior construction to saw them into lumber fit for the English market.*

The granite and syenite penetrated by numerous dikes of trap, continue in a westerly direction to near the Le Proe river, where they are met by the sandstones already mentioned. Those rocks are frequently covered to considerable depth by beds of sand, and clay, containing large blocks or boulders that have been swept from the mountains and hills situated to the north.

The gray sandstones of the coal measures, with occasional tracts of new red sandstone, continue about three miles northward, and a mile westward of Le Proe Bridge; from thence to New River the talcose, argillaceous, and greywacke slates are found in place; but the same interruption they have suffered on the coast, is also manifest throughout their several formations, wherever they are found in this part of the country. The hornblende rocks forming the dikes contain veins of quartz, carbonate of lime, and feldspar.

From New River to the Magaguadavic, a distance of fifteen miles, the trap predominates, and the surface is frequently occupied with boulders of granite, and beds of gravel. The mountains in the neighbourhood of Lake Utopia, and westward to the Digdeguash, are in general trap of the red feldspar variety, which also extends to Chamcook, where it is met by the new red sandstone.

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* The village of Ivanhoe belongs to the Lancaster Mill Company, who have here a very superior and powerful set of mills for the manufacture of all kinds of lumber, and an incalculable amount of unemployed water power. The mills are 200 feet in length, by 60 in breadth; the moving power is an overshot water-wheel 25 feet in diameter, which carries four gangs of saws besides other machinery. The Company own a tract of country containing upwards of 50,000 acres, in connection with these mills, and from which they procure supplies of excellent timber. The establishment appears in a very thriving condition, and every thing about it at the time of my visit had the appearance of busy industry. It is well worthy an attentive examination, especially by those who have not been accustomed to the best kind of machinery.—It is fitted up in a manner so perfect that it reflects a high credit on both the mechanic and architect, and must make the capital advanced a profitable stock.

Extending in a north-east and south-west direction, and on a line parallel with the coast and the granitic range of mountains, the transition slates and limestone, followed by the coal measures appearing at Le Proe River, and the conglomerate and red sandstones, &c. lieing above them, appear once to have succeeded each other in regular order. But all these formations have been broken up, and overlaid by extensive masses of trap rock. The whole of the strata between the granitic chain, and the present sea, have been fractured, changed, and in many instances, buried by ancient lava, and the appearance of the hills indicates how extensively volcanic forces have been applied.

But few minerals were found of any value during the exploration of this wide and almost uninhabited tract of country, where the settlements do not extend far from the road reaching from Carleton to St. Andrews. I was informed that lead ore had been found at Clear Lake, near the head of New River, and I endeavoured to obtain such information as would lead to its development; but the only individual who declared that he had seen the ore, would not reveal the secret for less than five hundred pounds, a sum I was rather unprepared to supply, especially as he would not become my guide through the forest until the money was placed in his hands. Probably, the report circulated concerning this ore, is little better than an idle story.

Along the broken and desolate district extending from the mountains of the Nerepis to the American boundary, the feldspathic, and hornblende trap forms lofty, abrupt, and often inaccessible cliffs, and the sublime appearance of this chain of mountains admirably displays the igneous character of its rocks. The remains of ancient craters, that have outlived the destructive operations of the elements, are still visible, and fill the mind with the highest veneration. This mountain scenery is rendered still more wild by the depth and silence of its valleys, and the succession of pyramid after pyramid, rising as far in the distance as the eye can behold. Their bright tops seen glittering in the mid-day sun, seem like beacons hung over the dark ravines, and winding hollows, mantled with the thickest spruce, and inhabited only by the sulky bear and bounding deer.*

Wherever there is any collection of *diluvial detritus*, or alluvial matter brought from the mountains by descending torrents, derived from rains and the melting snow, there is a fine growth of timber, and the beach and birch, and maple, may be seen in those places where a sufficient foothold has been supplied for their roots.

To those who have not become acquainted with the effects produced upon rocks by igneous causes, and have not studied the history of volcanoes, some of the facts laid down may appear fanciful and extravagant; but if they will look into those causes, and observe the effects resulting from them in other parts of the world, they will find that New-Brunswick is not alone in bearing the most faithful records of ancient terrestrial disturbance.*

It is evident that this part of America, has, within a recent period, been disturbed and convulsed by earthquakes. The numerous dislocations, chasms, and caverns, filled with broken rocks, shew that from this, or similar operations, they have been produced. In New-Brunswick, Nova-Scotia, and Lower Canada, these phenomena are common. Sometimes there are deep fissures in the granite several miles in length, and not more than two feet wide at the surface. Into these dangerous openings many wild animals have fallen and perished.

It has been said that Jacques Cartier, in his first voyage up the St. Lawrence in 1535, met with no obstacle when sailing on the northern side of the river, but on his return in 1540, he fell in with a shore which had been formed during his absence, so that for a time he could not proceed on his voyage.

A manuscript in the Jesuit's College at Quebec, describes a number of tremendous earthquakes that took place in 1663. These opened new channels for rivers, and lakes were formed in the depressions left in the earth. New islands arose, hills were levelled, and showers of volcanic ashes fell upon the surface of the country. These earthquakes also shook New England, Acadia, or Nova-Scotia, and New France. Since that time, shocks of earthquakes have been felt at separate intervals, and volcanoes are said to have been in a state of activity in the neighbourhood of Baffin's Bay, but a few years since. The shock that alarmed many of the inhabitants of Nova-Scotia, but a few years ago, is well remembered. The Indians, also, have a tradition that the Saint John river was formerly a great lake, which burst its barrier at the falls during an earthquake, and emptied its contents into the sea. Whether it was from these earthquakes that the lakes in Canada had their origin, is not certainly known; but it is certain that the waters flowing into them, formerly escaped down the Mississippi into the ocean; and the original bed of the river has been

* See Lyell's Principles of Geology, vol. ii. chap. ix

distinctly traced to a great distance in that direction. Hence it cannot appear improbable that the submersion of Grand Manan, and other phenomena observed in New-Brunswick, had a common cause with those just mentioned, when the whole coast of British America was shook to its deepest foundations.

According to the memoirs of Captain BAYFIELD, the shores of the Gulph and mouth of the River St. Lawrence, have, from time to time, since the year 1550, been submitted to upheavings of the earth. Sometimes their force has been sufficient to throw down chimnies. At St. Paul's Bay, fifty miles north-east from Quebec, the inhabitants say that the country is visited with an earthquake every twenty-five years, and the shocks continue forty days. It is also stated in the history of Canada, that, in 1663, these convulsive upheavings of the earth continued six months, and extended to a distance of a hundred and thirty miles.*

But without calling in the aid of these historical facts, or referring to tradition, it is only necessary to appeal to the rocks themselves, which bear the most indubitable evidence of having been broken up and moved by the earth's internal energies, but at what period of time cannot be exactly known.†

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* See M'Gregor's Travels in America.

† Since the above went to press, accounts have been received from King's County and other parts of this district, that an earthquake has within a few days past greatly alarmed the inhabitants; and a church, in consequence of the injury received during the shocks, was consumed by fire.

ENTRANCE OF THE SAINT JOHN.

CARLETON.

Having given some account of the Falls at the entrance of the Saint John River, in letters previously addressed to Your Excellency, and published in the Province, I defer giving a more particular description of this remarkable spot, until a geological survey is extended to its east side.

At Sand Point, the greenstone may be seen, having forced its way through the greywacke slate, and in immediate contact with its broken strata, which frequently contain veins of quartz, and carbonate of lime. A small vein of jasper was also observed, where the sea had worn away the rock. The trap rock composes the eminences where the tower and blockhouse are built, and the naked conical hills stretching away to the west.

At Negrotown Point there is a bed of clay of a good quality for making bricks: but few of the shells belonging to the tertiary deposits were observed in it, and it is free from the carbonate of lime. This point suffers much from the action of the waves, and rapid currents; many old persons can remember when it extended outwards much farther, and was separated from Partridge Island by a very narrow channel. Large blocks of calcareous breccia are occasionally seen in this part of the county; they have evidently been drifted from the mouth of the Kennebeckasis, situated to the north, where that rock is *in situ*. From the tower, there is a beautiful view of the city, harbour, and falls of Saint John. The slate and trap formations, extending along the coast, are undulated on the surface, while the limestone formation, following a north-east course, has a peculiar uneven and very picturesque appearance. Farther north, the more lofty mountains of the Nerepis are seen rising in successive steps,

and in more lofty grandeur. From the site of the bridge, the greywacke slate is uncovered on both banks of the river, to the lower opening of the falls, a distance of half a mile.

The narrow gorge forming the lower outlet of the falls, is composed of a white and variegated limestone. The river here passes through an opening not more than one hundred and fifty yards wide. The cliffs on each side are about one hundred feet high, and perpendicular. On the east side, a large block of impure limestone stands in advance, offering a great impediment to the flood tide, and the descent of the water above. The whole length of the "narrows" is perhaps three quarters of a mile. Two small islands are situated on the east side, and create powerful eddies and dangerous whirlpools: but, from being exposed to such rapid currents, they are wearing away, and in time will disappear. Were the cliffs on each side of the falls brought together, they would correspond, and the protuberances on one side would occupy cavities in the other; this is the best evidence of their having been separated by the causes already mentioned. There are lime-kilns on each side of the narrows, and the rock is conveniently situated for being quarried, and shipped after it is calcined.

The rocks on each side of the river at Indian Town, are syenite and trap, which have broken up and replaced the limestone in a remarkable manner. Occasionally, detached portions of the slate and greywacke formations, hold positions unconformable to the crystalline masses beneath them. The limestone crosses the river in separate belts, or what might be called large veins. The first of these is at the lower opening of the falls; the second crosses the river on a line with the lime-kilns on each side; and forms a part of the upper island. The third is seen a short distance above Indian Town; another appears at Robertson's kiln, and also on the west side of the river. This seems to be the most important belt, and affords lime of the most superior quality. Several more may be seen on each side of the "Narrows." These belts or veins will average from a hundred to four hundred yards in thickness. Detached masses of the calcareous rock may also be seen included in the greenstone that is mingled with it in a singular manner. Several of these isolated portions of the transition limestone formation, were observed running in a north-east and south-west direction, on the peninsula between Saint John and the Kennebecknsis. Directly opposite Indian Town, there is a rock composed of hornblende, feldspar, and quartz. It resembles granite, and

and is common on this part of the river, where it is often injected with dikes of greenstone.

The limestone is generally of a light blue colour, and, so far as it has been examined, contains no organic remains. When calcined, it is white, and the lime is well adapted for masonry and agriculture.

A short distance from the shore, and not far from Carleton, a beautiful marble was discovered. The rock is highly crystalized: the marble is of a light pink colour, clouded and shaded with veins of bright green chlorite and serpentine, resembling, very nearly, the "*verde antico*" of the Italians. At the surface, the rocks have been fractured by the frost; blocks of large size may be procured by opening the quarry to the depth of a few feet. Arrangements will certainly be made in the spring, to work this marble, as it is superior in beauty to that imported from the United States, and sold at a high price.

At the "Narrows," there is also a fine white marble, but it appears to be too much broken to afford any large slabs. The greenstone and limestone continue to within three-fourths of a mile of the "Boar's Head," where they are met by a coarse calcareous breccia, or puddingstone, forming the Head and shore, to a considerable distance on the Kennebeckasis. The breccia is composed of angular fragments of limestone of different colours, firmly cemented together. The whole formation resembles the conglomerate of England, sometimes found connected with the old red sandstone; and probably it is of the same relative age. Its course is about east, and the dip north 15°. This rock was only seen at one place on the west side of the river. The limestone occurs at South Bay, whence, westerly, the greenstone is predominant. Along the shore, towards the Nerepis, there are deep beds of clay, sand, and gravel, often covering the rocks to the depth of a hundred feet. There are sixteen lime-kilns on this part of the river, and within a distance of four miles. The quantity of lime burnt in them last season, according to the most accurate computation that could be made, is about five thousand hogsheads, and the price is from eight to ten shillings per hogshead. The amount of lime consumed in the Province, and shipped from these kilns, is therefore upwards of two thousand pounds. There is also a considerable quantity of the rock transported to Nova-Scotia.

Many of the strata have a peculiar waved appearance, and are finely marked with coloured lines, like those of curled

maple; these lines, no doubt, were laid during their original accumulation, and probably the wavings were effected while they were in a soft state. The above quarries are of much importance to the country, and might be made, by the use of proper kilns, to supply a much greater quantity of lime, at less expense.

INTERSECTING LINES.

I next proceeded to explore intersecting lines across this part of the Province, in order to cross the several series of strata between the sea and the great coal formation; and, if possible, to discover how far the coal district extends southward. It will be seen, presently, what success attended this plan of exploration, and the important discoveries that resulted from it. The granitic range of mountains, and the successive formations running parallel to its base, were observed to follow a north-east and south-west direction, and therefore, by exploring a north-west line of country, each stratum was crossed at right angles. The section that was made for this purpose, extends from Carleton to the mouth of the Oromocto, following the direction of the Nerepis road. Another was made along the south and west side of the main river, as far as Fredericton; and the third reaches from the mouth of the Magaguadavic to the Oromocto, and crosses the strata obliquely.

NEREPIS ROAD.

The limestone extends northward on the river and the Nerepis road, to the farm of Mr. John Stevens. From this place, and the kilns at South Bay, Fredericton and the villages along the river receive their supplies of lime. Near Mr. Hatfield's mills, the greywacke may be seen in contact with a large dike, where its fissures are filled with the sulphuret of iron, and beautifully spread upon each broken mass.

From HAMM'S Inn to MATHER'S, the greenstone, interrupted by numerous dikes appears, at the surface, and extends along the sides of the Long Reach and river, often rising in bold cliffs. At the entrance and some distance up the Nerepis, (a small river emptying into the Saint John) there are large collections of sand and gravel, and as the trap rocks gradually disintegrate, a fertile soil is produced, and a fine growth of beech, birch, and maple flourishes upon all the high grounds. The river runs through an extensive tract of marsh and intervale, from which the farms along its banks are well supplied with hay. COFFIN'S Manor and other places in this neighbourhood are delightfully situated, and there is a neatness about the farms not always to be observed in the country. A few crystals of amethyst, quartz, and feldspar, were taken from the rocks near MATHER'S excellent Inn.

The Nerepis River runs in a north-westerly direction, and to the distance of twelve miles passes through a belt of intervale of a superior quality, and affording a fine growth of ash and elm, which in many places from the absence of underbrush, appears like a planted grove. A large portion of this excellent land was owned by the late General COFFIN. The area occupied by the intervale is called COFFIN'S Valley, which passes through a deep gorge in the Nerepis mountains, and affords the only course where the road could be taken without passing over hills almost insurmountable. On each side of the valley the mountains rise in sublime grandeur, and afford some of the most picturesque scenery in the country.—These mountains are composed of varieties of granite, syenite, and greenstone.

At many places the rock is a perfect granitic breccia, being composed of different kinds of granite cemented together. In other instances, pieces of trap, syenite, and granite compose this peculiar conglomorate, whose probable origin is like that of trap tuff.

I visited several places on Douglas mountain, and found the rocks to consist of crystalized feldspar, with large grains of quartz imbedded. The top of the mountain is naked of plants. The decomposition of feldspar leaves the grains of quartz unattached, and they cover the surface of the rock frequently to the depth of a foot; hence travelling over them seems like walking over coarse salt. About two miles northward of Mr. DIBBLEE'S farm on the main road, the crystalline rocks are met by slate and greywacke slate, having the positions so common to the strata wherever they have been exposed to subterranean disturbance. The mountain is about

one thousand feet above the level of the sea. From its summit were seen in a southerly direction the narrows and lands in the neighbourhood of the City of Saint John ; and in the distance the north mountains of Nova-Scotia are distinctly visible. From this site the primary chain of mountains will be seen elevated far above the common level of the country. This Alpine range is strongly contrasted with the lower grounds situated upon the slate, and the coal district placed farther to the north. Eagle Cliffs and other high lands were also visited, but they present but little of interest beyond what has been already noticed.

The slate becomes more argillaceous and continues to the distance of about five miles northward of HARDING's Inn, on the main road leading thence to Fredericton. The width of this formation will not be however more than four and a half miles, if measured directly across its surface, and at right angles with the lines of stratification. The strata are highly inclined, and frequently perpendicular. Among them a number were found capable of affording excellent roofing slate, but as this valuable material may be procured much nearer the main river, and where it can be readily shipped, it is not probable that quarries will be opened very soon in the more retired situations of the district.

Near DARBY GILLON's the slate is succeeded by a coarse conglomerate, and finally by the millstone grit and sandstones of the coal measures, which continue to the mouth of the Oromocto. The old red sandstone and mountain limestone, were also discovered above the slate, but an account of those formations is deferred at present.

SECTION OF THE COUNTRY BETWEEN THE MOUTH OF THE MAGAGUADAVIC AND THE OROMOCTO.

Having thus made a section of the primary and transition rocks lieing between Saint John and the great coal field of the Province, my labours were next devoted to explore a similar line from the Atlantic coast towards the same point, and by which a perfect section across the Province was completed, as the remainder of the line had been explored in the summer of 1837.

The trap rocks at the village of Magaguadavic continue to within a short distance of the "Upper Falls." The red feldspar variety forms most of the precipitous mountains on each side of the valley where the river passes. To the dis-

tance of eight miles from the village the stream runs through a rich tract of intervale, with fine farms on each side. But the high lands in general are barren, and the decomposition of the naked rock is too slow to allow a soil to accumulate to any depth, and the torrents of rain descending with great violence upon the mountains, wash away each particle as soon as it is liberated by other causes.

At the "Upper Mills," the river passes over a considerable fall, and nine saws are kept in motion on the side of a steep cliff, which is one of a series of steps from the sea to the lakes of the more elevated region. The soil at this place is composed of a fine sand, derived from the granite situated to the north: it contains grains of feldspar still undecomposed. Between this place and a new village, fifteen miles farther northward, there is a large tract of low, level land: the country then becomes exceedingly mountainous, and exhibits the characteristic features of a granitic district; and it is remarkable that here the lower land is almost barren, while the higher grounds, although situated on the same rock, are covered with fine forest timber. I travelled some distance along the banks of the Piskehagan, and found the slate mixed with boulders of other rocks, but did not observe it *in situ* as I had anticipated. The season having been dry, this branch of the Magaguadavic, and other river channels, present a singular appearance, and shew to some extent how solid rocks become worn away by running water. Frequently the solid granite has become excavated to the depth of thirty feet, and to a distance on the surface of twenty miles into the wilderness, where each water channel is overhung with the thick foliage of the forest. Deep groves have been cut by the water collected in times of freshet, but at drier seasons of the year, their beds are travelled by the lumberman and his team.

About fifty miles above the entrance of the Magaguadavic, and fifteen from "the last house," as it is called, lofty mountains of granitic and trappean rocks rise side by side.—Among these bold and declivious hills, Mount Pleasant reaches a greater altitude than any other eminence in this part of the country. I regret that I had not the means of ascertaining, correctly, its exact height, for it is impossible, even with the best barometers, to make accurate calculations when they are carried unsteadily over hills and valleys, when the temperature and density of the atmosphere is constantly changing, and often in this climate becomes materially affected during the time required to ascend any considerable tract of country.—According to the best calculations I could make,

it is thirteen hundred feet above the level of the ocean. By climbing a tall spruce on the summit of the mountain, the Bay of Fundy, and the settlements along the shore may be seen distinctly, and the eye having wandered over the uninhabited desert, can discover the smoke of the steamboats on the river of Saint John.

Still farther northward, there is a range of hills composed principally of porphyry. Its base is red feldspar, and contains imbedded crystals of quartz. This rock if cut and polished would be very beautiful.

After leaving these plutonic mountains of eruptive rocks, the slate and inferior rocks of the carboniferous group, were expected to be found in place; but as it is frequently the case, they are absent, and their places seem to be supplied by the porphyry. The old red sandstone was however found on the banks of Skin Creek, a small branch of the Oromocto. The sandstone probably meets the porphyry, but the surface is so deeply covered with vegetable rubbish and stony detritus, that it is impossible to lay down, on the geological map, the exact boundaries of each of these formations. The slate and carboniferous limestone may appear at some future day, when the dense forest is removed, and villages of settlers spring up and occupy the valleys now only visited by the hardy lumberman, and tenanted by herds of deer, still remaining, and by their fleetness escaping the destroying hand of man.

From Skin Creek to Mr. Hartt's mills, the distance is seven miles, and the rocks are the conglomerates and sandstones of the coal measures. From this place to the entrance of the Magaguadavic, the distance is about fifty-six miles, and to the mouth of the Oromocto is twenty miles, making the whole distance, by the route taken, between these two points, seventy-six miles. The remaining part of this section of the Province, as was before observed, was made in 1837. The rocks were examined from the Oromocto, along the Grand Lake and Salmon River, to the Richibucto,—a distance of one hundred miles,—making the whole line of section one hundred and seventy miles.

At Mr. Hartt's mills, much to the credit of the proprietor, the conglomerate has been excavated, to allow the salmon, and alewives to pass up the stream, where they deposit their ova. I here found the trunks and branches of fossil trees imbedded in the solid rock. *Conifera*, or those belonging to the pine and fir tribes, are most abundant, and may be procured in pieces of large dimensions. One species of the *calamitæ* was procured, and of a size far exceeding any

of the present growth. These fossils, or petrifactions, as they were formerly called, are surrounded by a coating of coal, which has resulted from the original bark of the plant. The woody part is converted into carbonaceous matter, calcareous spar, and iron pyrites; but notwithstanding the remarkable changes they have been submitted to, and the conversion of vegetable into mineral substances, the fibrous texture of the plant is still discernable, and under the microscope displays the most perfect regularity and beauty. The inhabitants suppose that all these fossils were formerly birch and maple; but they do not belong to any species of trees now found in the forests of North America.

Similar fossils, and many other varieties, are common throughout the rocks belonging to the great Coal District of the Province.

The banks of the north branch of the Oromocto, are composed altogether of sandstones, shale, and conglomerate, abounding in the remains of plants which flourished upon the earth, previous to the revolutions that changed the climate and all its animal and vegetable productions.

Ten miles up this stream there is an outcropping of coal, the vein is only four inches thick, and appears in the banks of the river between strata of bituminous shale, where fossil remains are abundant. That there are thick beds of coal beneath, there can be no doubt, and the time is rapidly advancing, when the fuel now concealed in the rocky strata of New-Brunswick, will be required to meet a demand that must continue to increase on the whole coast of America.

From the bridge to the mouth of the main stream, all the rocks belong to the coal measures already mentioned.—The river runs along a broad tract of fine intervale. The uplands are light and sandy. Formerly the large area situated at the base of the mountains, was covered with extensive forests of pine timber. These have been destroyed by fire, and the lofty trees now stand leafless, decayed, and ready to fall to the ground. A light and stunted growth of birch and alder is succeeding them. Thus the country has suffered an irreparable loss, and much of its original beauty has faded before the devouring element.

Each portion of the uninhabited districts is carefully searched by the enterprising lumberman, and parties from the settlements along the Saint John now meet those from the shores of the Bay of Fundy, in the wilderness. Almost every rivulet has been cleared to "drive" the logs down to the mills. Sluices were observed in the centre of the forest,

and the expense of procuring lumber for the English market is yearly increasing.

In the rocks between the Magaguadavic and the Saint John, no minerals of any importance were discovered, except the coal, which will be noticed hereafter. Although the porphyry may at some future day be required to ornament the dwellings of the wealthy, its distance from navigation, and the infant state of the country, render it useless in regard to its application to architecture.

Eastward of the head of the Oromocto, the slate appears; and is succeeded, occasionally, by the old red sandstone, and carboniferous limestone, dipping beneath that part of the coal field, which is situated on the south side of the Saint John. These formations do not always appear at the surface, as they are often covered by large tracts of sand and gravel. They were, however, discovered at such a number of distinct points, as enabled me to recognize the boundaries of this part of the great coal district of the country.

IRON ORE.

About six miles north-east of HARDING's Inn, on the Nerepis Road, the slate was again seen, with its strata placed perpendicular, and running east-north-east. Near the church, a specimen had been found which was supposed to be coal; upon examination it proved to be the hydrate of iron, and from being attached to pieces of argillaceous slate, I was led to suppose that larger quantities might be found, by a careful examination of the schistose rock. The first indications of the ore, were observed about half a mile eastward of the church. At Coot Hill, a considerable quantity had been dug from the side of a steep slope, to repair the road: and it was afterwards pursued in an easterly direction, to the distance of two miles. But the superficial deposits sometimes placed above it, and the covering of vegetable matter laid in the trackless forest, were obstacles not to be overcome, without incurring an expense not justifiable under all the circumstances; and, therefore, my object to follow the deposit to the main river was frustrated, although I had the satisfaction afterwards of finding the best indications of its existence, near the Saint John, where its transportation would be attended with but little expense. The ore is situated between the strata of argillaceous slate. It is sometimes rendered magnetic, by the heat which it has evidently received from the

eruption of the trap dikes; and it is curious to observe at such places, how the magnetic needle becomes affected.

I was unable to ascertain the exact width of this bed, on account of the collections of detritus always covering a part of the basset. Its thickness was uncovered at one place to the distance of twenty yards, and at another no less than sixty yards. It doubtless exceeds the largest of ordinary deposits of this kind, and would supply the whole of America with iron for many ages. Being exposed on the surface, it can be quarried like freestone, and its removal and use are rendered easy on account of its slaty structure, which allows it to be broken up with the greatest facility. Three varieties of the ore were found, namely, the hydrate of iron, argillaceous oxide of iron, and hematite; upon an average they will yield forty per cent. of pure iron, a richness seldom possessed by the ores extensively worked in England. Every advantage is afforded for manufacturing the iron of this bed. It runs through a forest of hard wood, that will supply an abundance of charcoal; and limestone was afterwards found, suitable for a flux, within a short distance of its range. But should there be no enterprise to erect furnaces, for the smelting of iron, the time has arrived when it will yield a profit by being shipped to England, and the United States. Its proximity to the navigable Saint John, and the sea, are objects of the highest importance, and many years will not pass away, before it will meet the demand now supplied by other countries. The value of such a discovery, although by no means completed, is too obvious to require a remark.

Four miles northward of the Church, the strata belonging to the coal measures were found overlieing the slate, and they continue thence to Gagetown, a distance of about fourteen miles.

I carefully examined the rocks from Gagetown to Oknabog Lake: they are all sandstones and shales of the coal measures, and contain numerous remains, and impressions of plants that have long since ceased to flourish on the earth; and wherever their nearest types have been found, they are situated beneath a tropical sun. But before I proceed to notice the indications of coal in this district, it will be proper to take a view of the underlieing rocks, as a more general description can be applied to their superincumbent strata.

SECTION OF THE ROCKS

FROM THE COAL MEASURES TO THE GRANITE.

CARBONIFEROUS LIMESTONE.

About a mile southward of the Oknabog Lake, and on the road leading along the west side of the river, I was much gratified to discover, again, the outcropping of the old mountain, or carboniferous limestone. This formation reaches away in a south-west direction, and on the opposite side of the river makes a gentle curve from E. N. E. to N. E. It is not thick where the river intersects its strata, but widens considerably, farther west. Immediately upon this rock, the millstone grit, and the lower members of the coal measures repose. The limestone is crystalline, and will afford marble capable of receiving a high polish. Its colours are white, grayish white, and dark brown; it contains a large quantity of the carbonate of lime—may be calcined by a moderate heat, and therefore its discovery in this part of the country will be extremely useful to its agriculture. This rock abounds in the remains of marine animals; among them are the ammonite, encrinite, and trilobite. The ostrea, mya, and arca, are common. These with several other species of shells, are not only beautifully figured on the rocks, but frequently the solid models of their originals may be procured in the softer parts of the strata. Frequently the places once occupied by the fleshy parts of these animals, are filled with crystals of calcareous spar, which are covered with the original shell, also converted into the carbonate of lime. But it may appear more extraordinary, that among all these shells, not one belongs to species now inhabiting the earth; nor do they agree exactly with races found in the same rocks in Europe. That period in the earth's history when any of these tribes were animated, has passed away, and other species fitted to the present condition and climate of the country, have succeeded them.*

* It has not been considered proper in the present report, to give a minute description of these fossil shells; a more detailed account of them may yet appear in a work not altogether devoted to the mineral resources of the Province.

OLD RED SANDSTONE.

Immediately to the southward, and in contact with the carboniferous limestone, appears the old red sandstone, with its strata dipping northward, beneath the superincumbent calcareous rock. This sandstone is of a dull brick red color,—is composed of course silicious sand, pebbles, with mica and clay slate, firmly cemented together. On the farm of Mr. GILBERT, it has been broken through by a dike, and changes have been effected similar to those noticed in the beginning of this report. The formation extends four miles along the road to Little River, where in its turn it overlies the slate.

Both the limestone and old red sandstone, rise to considerable altitude, and form large oval hills. The soil upon them is very fertile, and they bear the same general character of similar formations in Europe

ARGILLACEOUS SLATE.

At Little River, the strata of this formation dip beneath the sandstone, which conforms to its inclination. From that place it extends to the southward three miles, where it is met by the granite of the primary mountain chain. Its strata in general are argillaceous, except where they approach the granite, and pass into mica slate. Indications of the existence of the iron ore, before mentioned, were found near the river, where a large quantity of the oxide of iron has been washed by rains from the side of a hill.

Excellent roofing slate may be quarried near the road crossing this formation; at several situations it was examined, and the strata were often found admirably adapted for covering buildings. On the surface, the slate has been much broken by the frost, but by removing the fractured crust, to the depth of a few feet, the rock assumes its true character, and is capable of being split into pieces of the ordinary thickness. It is to be hoped that the attention of enterprising individuals will be directed to the use of this domestic slate, which, if carefully explored and properly worked, will equal in value any hitherto imported from Wales.

GRANITE.

Like the several formations already noticed, as they occur on this section, the granite, entering into the primary chain, extends, in a north-east direction, to the very margin

of the main river, where it rises in low naked cliffs, rather above the ordinary level of the country. At FOWLER'S and JONES'S mills, the river passes along directly at the termination of a long granitic ridge, that will average from a mile to a mile and a half in breadth. The granite forming this ridge is of several varieties, and all equally free from any decomposable minerals that would injure their colour or durability. In general it is fine grained, compact, and will admit of the most delicate sculpture, without crumbling before the chisel. To these advantages, it may be added that granite will seldom be seen in any country that can vie with it in beauty. Masses of almost any dimensions may be quarried within two hundred yards of the river, and the facilities for its tranportation are such as are seldom possessed. Millstones have been made here for a number of years past, and one variety of the rock is suitable for that purpose. But it is surprising that these fine quarries should have been so long overlooked, while the granite used at Saint John and Saint Andrews, has been imported from Nova-Scotia, and the United States.—The persons whom I had employed to assist me, probably observed the attention paid to these rocks, and I had spoken of their value to several individuals in the neighbourhood. Since that time, all the quarries have been purchased by Messrs. CALEB and JUSTUS S. WETMORE, who are making preparations to open them in the spring. In future, this Province, Nova Scotia, and the United States, can be abundantly supplied from the River Saint John, where not only the best materials for buildings, but the cheapest mode of transportation are united, and ready to meet the most extensive demands.

On the west side of the Long Reach, are syenite, and slate. These rocks compose a considerable eminence, called the "Devil's Back," and other conical hills in the country adjacent. Bald Mountain is eleven hundred and twenty feet high, and will afford the traveller one of the most picturesque and delightful views in America. Although it requires some industry to march through the forest, and ascend to its summit, the labour is amply repaid, if performed of a fine day. Nothing can exceed the grandeur of this mountain scenery—the river, the great watery turnpike of the Province, appears like a serpentine brook, winding its way through the hills, and the steam-boats and small craft gliding over its surface in the summer season, render the prospect enchanting. Often they seem to be sailing among groves of elms, and stacks of hay, scattered over the intervale, made still more pleasing

by the half-shadowed cottage, and the spire of the village church.

Seldom, in any part of the world, are the several formations found succeeding each other in the great scale of superposition, with that beauty, regularity, and order, that they display on the section just adverted to. The granite is succeeded by the slate, the slate by the old red sandstone, then comes the carboniferous limestone, millstone grit, and the coal series, surmounted by conglomerate, and the new red sandstone appearing on the shores of the Grand Lake.

It must be pleasing to geologists in Europe, to know that the same order of succession, which has been established by experience, and is observed in the strata of Britain, France, and Germany, is also found to exist in North America; and thus the science of geology is supported in its first principles, and rendered of more general application.

COAL MEASURES.

Having thus given some account of the rocks and minerals of that part of the Province, included in my instructions, and situated southward of the coal district; I now proceed to notice this important formation, and without giving particular local details, shall endeavour to define the area in which coal may be expected to occur, so far as my explorations have been extended.

The rocks composing the primary mountain chain, extend in a westerly direction into the American State of Maine. Another series of granite hills and mountains rises in the neighbourhood of Loon Lake, reaching in a north-west direction, embracing the Pokioke, and Meductic Falls, Eel River, and the high lands in that quarter. The slates, greywacke, and other transition rocks, occupy large tracts, situated at the bases of these more elevated regions, following a cuvulinear course, having the Oknabog Lake at one extremity, and the Keswick at the other. The old red sandstone, mountain, or carboniferous limestone, were discovered at several places along this curve, and although they do not always appear, the margin of this portion of the great coal district was distinctly ascertained, so that its boundaries can be laid down upon a geographical map. It therefore appears that the division of the coal field, which is situated southward of the Saint John, is a segment of a large circle, described between the Oknabog and Keswick, and touching at Skin Creek, and the head of the Oromocto.

The discovery of such facts in England, would be considered of national importance; for, as bituminous coal has always been found under circumstances similar to those just described, it only requires the application of capital, and enterprise, to render it subservient to the wants of the country, when such conditions of its existence have been ascertained.

At many places within the limits of this great bituminous coal field, outcroppings of the most superficial coal strata have been found; but the richer and deeper deposits remain unpenetrated, notwithstanding their existence is now rendered certain. I endeavoured, so far as possible, to find where the deeper strata of coal rise to the surface; but the extensive collections of sand, gravel, &c. spread over them, are obstacles not to be overcome by a mere view. In the detritus that has been derived from the edges of the strata, pieces of coal were often observed. Under a consideration of all these circumstances, no doubt, then, can be entertained, that coal may be procured in the country adjacent to Fredericton, Gagetown, and in the circular tract already adverted to.

The season becoming advanced, the inclemency of the weather, frost, and snow, compelled me to retreat from the field of my labours, long before the necessary examinations had been completed. I hope, however, to resume them in the spring, and to complete a work which at its commencement has been so successful.

It is a fact of the first consideration, that the navigable Saint John passes across a part of the great coal field of the Province, and, therefore, its productions could be cheaply transported; and as bituminous coal has not been discovered any where along the eastern coast of the United States, the value of New-Brunswick can scarcely be estimated; and long after her forests of timber have disappeared, and agriculture has ascended even to the mountain's top, will her coal and iron, if properly developed, support her commerce, and maintain her revenue.

DILUVIAL COLLECTIONS.

In every part of the Province, so far as it has been examined, there are numerous boulders, or blocks of rock, scattered over the surface, and buried in all the superficial deposits of sand and gravel. Sometimes these detached

masses are of enormous magnitude, and will weigh some thousands of tons. That many of them have been transported from a distance, there can be no doubt, as their sharp angles have been worn off, and they are scattered at distances of a few yards, to many miles from the formation where they belong, and where they have been conveyed. In every instance, the nearer their parent rock is approached, the larger they become, which is strong evidence of their having been drifted by a current of water, which, by the friction produced, lessened their dimensions, and rendered them globular, according to the distance of transportation.

At the base of the trappean and primary mountains, these blocks are seen piled in the greatest confusion, but still retaining their sharp edges. At a distance of a few miles, they are of much smaller size, and assume a spherical shape. By carefully observing the courses these boulders bear from their original beds, the course of the current that swept them away may be ascertained. Having found minerals contained in these loose masses, I have been able, by the aid of a compass, to pursue these minerals to their native mountain. Admitting that these boulders have been transported by a current of water, that has passed over the country, the course of that current in general must have been from the north, towards the south. But it sometimes happens, that such blocks are found in other directions. This circumstance can be fairly explained, by the fact, that the course of running water is always powerfully influenced by the surface over which it passes; and if the whole country has been submersed, (a fact not admitting of a doubt,) during the subsidence of the water, or the elevation of the land, the current would be liable to many changes, and the effects produced by those changes, would be, as they still are, manifest.

In approaching any of the mountains or hills of New-Brunswick, from the southward, the traveller is made acquainted with their rocks long before he reaches their bases; but advancing from the northward, he receives no information of this kind.

These remarks will also apply to the numerous and extensive beds of pebbles, gravel, and sand. In all cases these collections are found to partake of the characters of rocks, situated northward of them: they are these rocks, more or less comminuted, and acted upon by the new chemical combinations their pulverised state has made them capable of entering into. The granite yields a sand composed of mica, feldspar, and quartz, the conglomerate affords pebbles,

and the sandstone large tracts of fine sand. As the newer rocks have been formed from the materials of those preceding them, so the gravel, sand, &c. now found upon the surface, has resulted from the disintegration of rocks now situated at the outside of the earth's crust.

The same rule will apply to alluvial matter; when this has been conveyed from rocks containing potash, lime, clay, &c. it is fertile, but when it has its origin in silex alone, it is as sterile as the desert. The newer formations are always derived from the older, and in the British Provinces, the qualities of soil may often be discovered by an acquaintance with the rocks beneath, and those that are placed in a northerly direction.

Besides these evidences of a general deluge, there are others not less important. In general, the summits of mountains and hills are uncovered, and frequently destitute of vegetation. The surface of the rocks is smooth, and appears to have been worn down. In the deep valleys, there are numerous collections of broken rocks, sand, and pebbles, that are known to have been derived from higher situations. These collections of large rocks could not have been made through the influence of any other cause than a violent rush of water, which rolled the loose fragments from the mountain's top downwards to the valleys beneath. Again, in the rocks of every part of the country explored, there are grooves and scratches, from one to several inches in depth, extending from the north towards the south. These grooves were evidently cut by heavy masses moved over them, by a powerful force; and are such as would result from a powerful flood. It is true these diluvial marks do not point out the course of the current, by which they were produced; but that fact is established by the testimony already adduced. Sometimes they are seen to cross each other at different angles, and this affords evidence that the course of the current was not always uniform.

There is still one more fact displayed in the Province, which accords with those just stated. It is the *talus* collected on the southern sides of mountains, hills, and islands. Almost all the islands in Passamaquoddy Bay, and along the coast, present to the north, steep or perpendicular cliffs, while on the southern sides, they descend by a gradual slope down to the sea. This circumstance has arisen from the collections of diluvial *debris* formed in the eddies made by these prominences, and is exactly similar to those occurring daily in rivers, upon a much smaller scale.

Under the concurrent testimony of so many facts, it appears impossible that even the most sceptical should disbelieve that a deluge has swept over this continent: but should any doubt an event that has left so many witnesses of its existence, they should receive the advice of Demarest, who when attacked by the Neptunists for his belief in similar facts, replied, "Go and see."

CONCLUDING REMARKS.

By taking a general review of the preceding report, and the results obtained in the commencement of the geological survey, it will be seen of what importance such examinations are to the interests of the Province, and for laying the foundation of its future welfare. It would be unnecessary to advert again to the different mineral substances already discovered, as their situations, characters, and uses, are briefly described in the body of this report. Some of these, such as marl, limestone, marble, granite, &c. will be employed immediately, and public interest will be advanced far beyond the comparative expense incurred in their developement.

There are other minerals of still greater utility, now known to exist in the country, such as iron, coal, copper, lead, &c.; but these, from the nature of their situations, and the expense attending their manufacture, will require more time to bring them into the employment of the several departments they are calculated to supply. If the country be too near an infant state, and its science, industry, and enterprize are too feeble to improve its own natural advantages, and gather wealth from the mineral kingdom; it is also helpless in regard to its agriculture, and every other branch of honest industry. But such remarks are by no means applicable to the inhabitants of New-Brunswick. They only require that knowledge of their resources which offers some encouragement to their labours, when they are ready to engage in any laudable undertaking. But the knowledge of latent resources extends much farther than the sphere of local speculation. It reaches to other and more wealthy countries, whose in-

habitants are ever ready to extend their commerce, and call into action such objects as will promote individual wealth, and national greatness.

Besides the advantages arising from geographical situation, an extensive navigable river, and a supply of excellent timber, New-Brunswick evidently possesses most important mineral resources, which, although less immediately available, will be found more enduring, and capable of elevating her power far above the level of less favoured Colonies.

To Your Excellency, I beg leave to express my sincere thanks, for the assistance at all times most cheerfully given, to enable me to proceed with the work. The number of individuals to whom I am indebted for much aid, hospitality, and kindness, during the survey, is too great to admit of separate consideration. To them, Members of the House of Assembly, Magistrates, and the inhabitants generally, I beg to return my sincere acknowledgements.

I have the honor to be,

Your Excellency's most obedient

And very humble servant,

ABRAHAM GESNER,

PROVINCIAL GEOLOGIST.

Saint John, N. B. January 15, 1839.

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. *Etym.*, *a*, without, and *morphe*, 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. *Etym.*, *amygdala*, an almond.

ANTHRACITE. A shining substance like black-lead; a species of mineral charcoal. *Etym.*, *anthrax* coal.

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 combined 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, *fero*, to bear.

CHERT. A siliceous 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, also called 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.

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

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

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

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

DEBRITUS. See debris.

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

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

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

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

FELSPAR. A simple mineral, which, next to quartz, constitutes the chief material of rocks. This white angular portions in granite are felspar. The 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.*, *flots*, 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.

FOSSILEFEROUS. 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 *ginosco*, 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 common felspar.

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

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

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.

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 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 cleavage. The uneven schistose layers of mica-schist and gneiss are probably layers of deposition which have assumed a crystalline texture.

Schistose Rocks. See "Schist."

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

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

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.

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.

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

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

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

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

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 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.