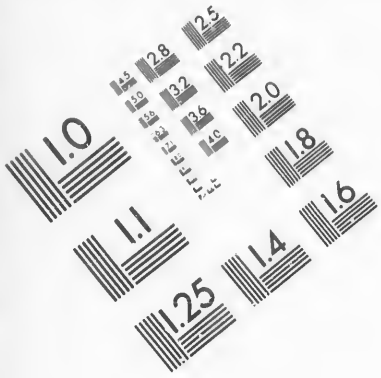

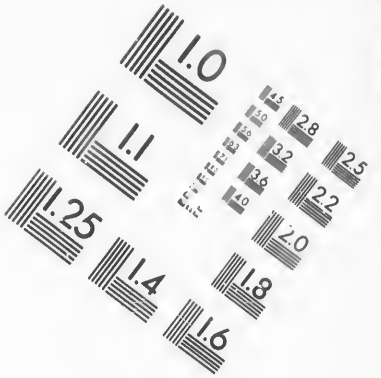

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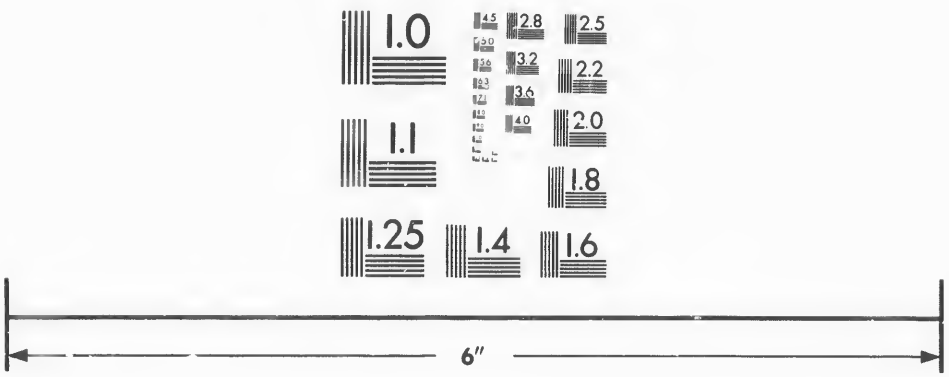

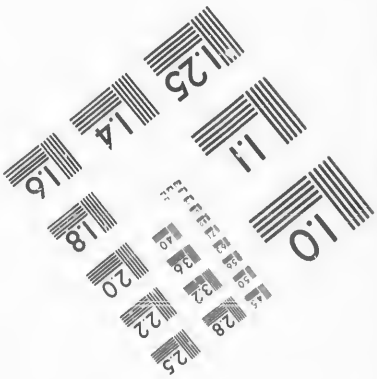

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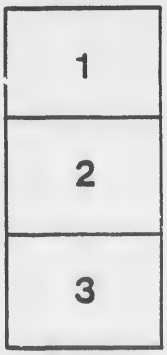

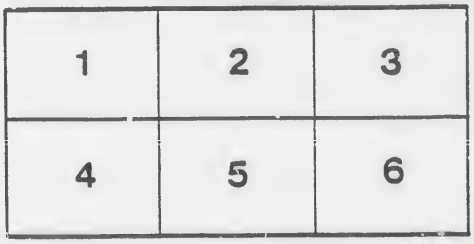

SOILS OF NEWFOUNDLAND.

THE ORIGIN, DERIVATION & COMPOSITION

OF SOILS,

CONSIDERED FROM A GEOLOGICAL POINT OF VIEW

WITH PARTICULAR REFERENCE TO

THE SOILS OF NEWFOUNDLAND.

(BY JAMES P. HOWLEY, Esq., F.G.S).

Printed at the Daily Colonist Office, St. John's, N.F.

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NEWFOUNDLAND SOILS

The Origin, Derivation and Composition of Soils, considered from a Geological point of View, with particular reference to the Soils of Newfoundland

[By James P. Howley, Esq., F.G.S.]

St. John's, June 11th, 1889.

P. R. Bowlbs, Esq.,

Dear Sir,—The paper on the subject of soils, which I handed you the other day, was written two years ago. It was my intention to have read it before the Agricultural Section of the H.I.E.S.; but circumstances prevented the carrying out of that intention. I was requested lately to have it published. The present would seem an opportune time for doing so; now, especially, when we are about to enter upon railway extension northward, and so much discussion has recently taken place relative to our resources, agricultural lands, &c. One of the chief objects of the paper was to endeavour to remove the false impression as to the character of our soils—to show that they could not greatly differ from those of other countries, being composed of the same mineral constituents, &c. I reasoned purely upon geological grounds, and from personal observation all over the island. As a proof of the correctness of my conclusions, I would draw especial attention to the analysis at the end of the paper, of the average soil in the St. George's Bay district.

It was only last autumn, more than a year after I had written the paper, that I was kindly favoured with a copy of this analysis by Mr. Wm. W. Bonnyn, C.E., &c., of the Telegraph Land Co., who has also recently given me permission to make use of the same. It is a complete confirmation of what I had previously written about the soils of that district, and being such a reliable, independent testimony, founded upon actual ascertained fact (analysis), which there can be no gainsaying, should, I think, forever settle the question of the character of the soil in that section of the country, at least.

Yours sincerely,

JAMES P. HOWLEY.

Introduction.

The cultivation of the soil is one of the most noble occupations of our race. In every age, and in every country, it has justly occupied the foremost place amongst the civilized industries of mankind. No country without agriculture, at least where such is possible, can claim to be thoroughly civilized. It marks the line between civilization and barbarism. Prehistoric man was, in most cases, a wild, nomadic hunter, eeking out a precarious existence from the product of the chase—at times wallowing in abundance, but just as frequently pinched by gaunt hunger and starvation. He required immense tracts of territory over which to extend his hunting avocations in order to supply his needs. The ancient Swiss lake-dwellers seem to have been the earliest European people who attained to any marked success in agricultural development. They had undoubtedly arrived at the culture of cereals by a process of selection from wild stocks which entitles them to our greatest respect. The Celtic race, also, early attained to a considerable progress in agriculture and domestic pursuits. When we turn to Asia and America we again find the Chinese and Japanese of the former, the Peruvians and Mexicans, or Toltec and Aztec races, of the latter, all far advanced in this noble science and, consequently, in civilization, while the more barbarous hordes of both hemispheres were still in the hunter state of existence and utter savages. In fact, agriculture and civilization were so closely allied that the one was the natural outcome of the other. Today it is agriculture which marks the onward march of progress, before which the less stable pursuits of the savage have retreated step by step, and the savage himself disappeared from the face of the earth. What was once the home of the buffalo and wild red man of America, is now converted by this giant industry, into the smiling, golden-eared wheat fields, of the "world's greatest granary."

Here in our own Terra Nova alone, of all the civilized countries of the globe, has agriculture been proscribed. It is true we have improved the original red man off the face of the earth long ago; but, unlike our neighbors, we have not occupied his place. Another dusky denizen of the forest—the Micmac hunter of Nova Scotia and Cape Breton, driven out from his ancient home, has come into the inheritance of the Beothuc, and still roams over our vast interior

forests and plains in pursuit of the fur-bearing animals of the country. It is a reproach to our civilization, a reproach to the British nation, that this one spot of all her dominions, boastfully termed her oldest colony, is still so far behind in the onward march of progress, and the condition of her people so analagous to that of the hunter state of existence. It is nothing new, it is simply the history of all countries which have neglected or ignored agricultural pursuits, at least where such pursuits are possible. If we believe them possible here, and I, for one, have no doubt on my mind about the matter, we should then make every effort in our power to carry out without delay such measures as would be most likely to conduce towards so desirable an end. But as my main object is to enquire into what are really the chief characteristics of our soils, and what they may be capable of producing, I will proceed at once to the consideration of this important question.

ORIGIN AND COMPOSITION OF SOILS.

The term soil is applied to all those loose materials which cover the surface of the globe, such as sand, gravel, clay, mud, peat, &c. Soils vary exceedingly, according to the preponderance or otherwise of any one of the above materials. In fact, there is a regular gradation from pure sand or clay, exclusively mineral soils, to peat bog, which is almost entirely composed of vegetable matter. A thorough knowledge of their various characters, and the manner of treating them, appears to me essentially necessary to the successful raising of crops. Different soils require entirely different treatment, and there can be no doubt that skilled and scientific cultivation enables the farmer to obtain the best possible results from good soils, and even greatly to enhance the productiveness of those of a comparatively poor nature. But, before going more deeply into this part of the subject, I must ask you to follow me, while I make a few general observations relative to the derivation and composition of soils. The doing so necessarily involves some rather dry geological details, which will, I trust, not be altogether without interest to you.

STRUCTURE OF THE EARTH.

Although the greatest diameter of our globe measured at the equator is 7,926 miles, it is estimated from various well-authenticated sources, that the solid portion, or crust as it is termed, is not more than 50 miles in thickness. Without entering into all the theories upon which this conclusion is based, I shall just mention a few of the more prominent. The presence of active volcanoes and hot springs on various parts of the earth's surface, from which frequent ejections of molten matter and boiling water take place, point beyond doubt to an internal source of heat. The seismic movements, or earthquake throes, which have convulsed the earth from time to time, and are still of not infrequent occurrence—for we have read of many fearful shocks experienced within the last few years—are another proof. They are caused from expansion by heat of some vicious, gaseous, or fluid matter, contained in the bowels of the earth. When we add to these the well-ascertained facts that the temperature is found to increase rapidly as we penetrate into the earth's surface, so that a point must be reached where the heat would be so great that all known rock or mineral substances must be converted into fluid or semi-fluid matter. The question of the character of the great internal body of the earth can no longer be one of mere speculation. Allowing an average rise of temperature of 1° Far. for every 90 feet vertical depth, this point would be reached at about 50 miles below the surface.

SOLID CRUST.

It will be apparent, then, that the solid crust of the earth is in reality a mere shell, as it were, and in proportion to the size of the globe represents about the thickness of an orange peel to the size of the fruit itself. Such is the well-founded theory of the structure of the globe we inhabit. At present, however, we are more particularly concerned in the character and constituents of the crust only, as it is from this our soils are principally derived and obtain their distinctive characteristics. Nevertheless, some of the richest known soils appertain to purely volcanic regions, as on the sides and slopes of active volcanoes—such as Vesuvius and Etna. These soils may be considered as direct products from the deep-seated internal fires themselves. Their fertility is proverbial, and, notwithstanding the danger attending their cultivation, the Neopolitan and Sicilian peasants will brave all in order to reap the rich harvest of grapes which these vine-clad natural hot-beds so luxuriantly yield. But by far the greater portion of the loose materials covering the earth's surface are derived directly from the solid rock crust upon which they rest. This fundamental pavement or floor, extends alike around the globe—beneath the waters of the great seas and oceans, as well as the dry lands. Broken, shattered, contorted or twisted into a series of great folds and flexures, often abruptly lifted up into huge elevated masses or depressed into profound abysses, it gives rise to all those natural features of towering mountain ranges, rolling ridges, widespreading prairies, plains, valleys, ravines, gulches, submarine banks, plateaux, or profound and fathomless ocean depths

ATMOSPHERIC ACTION.

The interminable action of the atmosphere both chemical and mechanical, in breaking up or wearing down this rock crust, pulverizing and disseminating its particles broadcast over the surface, and depositing the same on all the lower depressions, are the chief agencies through which our earths and soils have been accumulated. At one period of the earth's history immense ice sheets and gigantic glaciers, or

moving masses of ice, such as still exist in the Polar regions of the globe, seem to have extended at least over all the Temperate Zones. The powerful influence of these cyclopean plowshares in tearing away and grinding down the rock surfaces over which they passed, is attested everywhere today, not only by the smooth, worn and often polished surfaces of the rocks themselves, but in the immense accumulations of gravel, sand and boulders, met with on all sides. Other less potent agencies, even plants and animals, have contributed in no small degree to the formation of those surface deposits, notably the growth and decomposition of plants, such as mosses, grasses, scrubs, etc., which constitute the bulk of the peat bogs so prevalent, especially in these northern regions; and even the small insignificant earthworm lends his aid towards pulverizing the earth. In fact, the whole history of the globe has been one succession of demolition and reconstruction. What were the clays, sands and sands of one age, became the rocks from whence clays and earths of succeeding periods were derived.

SIMILARITY OF MINERAL CONSTITUENTS.

It follows, then, that notwithstanding the almost infinite variety of rocks which go to constitute the crust of the earth, the substances of which they are chiefly composed are in reality similar. But to be more explicit, in regard to their actual composition, mineralogists have ascertained that most of the rocks of the globe are really composed of but thirteen of the sixty-six elementary substances known to science. These are the gases, oxygen, hydrogen, nitrogen, chlorine, the non-metallic elements, carbon, sulphur, silicon; the metals calcium, sodium, potassium, magnesium, aluminium and iron. The combination of these various elements really reduces the actual materials constituting the rocks, as they are most commonly known, at least, to some half-dozen ordinary substances. Chief amongst these are silex or quartz, which is almost pure silica; feldspar, which is a combination of silica, alumina, potash, lime, soda and water; some varieties contain a little iron manganese, magnesia and acids. Carbonate and sulphate of lime, which are combinations of carbonic acid and calcium or lime, that is, simply ordinary limestone, and sulphuric acid and calcium which is gypsum or plaster. Steatite or soapstone is a combination of silica, magnesia, protoxyd of iron, carbonic acid, water, etc. These, then, with occasional admixtures of other and rarer minerals, are the chief constituents of all rocks, and consequently of all soils derived from them.

ORDINARY ROCKS.

The most common rocks, and those found in almost all countries, are granites, orgranitoids, sandstones, slates, limestones, and trap or igneous rocks. These are all simply different combinations of the foregoing minerals; for instance, true granite is a crystalline rock composed of quartz, feldspar and mica. The absence of any one of these ingredients, or its substitution by another mineral, simply results in another variety of granite. A sandstone, again, may be composed of the self-same minerals, but in a finer state of aggregation; quartz or feldspar being almost always present in both. Slates are only the same ingredients in a still more minute state of combination, where the particles have been ground into an almost impalpable powder. Just in proportion, then, as one of these minerals may preponderate over the others, do the rocks vary in character. An excess of silex makes a sandstone hard and gritty; a slate silicious or flinty. An excess of alumina or clay, renders both softer. The presence of lime in any rocks has a still more softening influence upon them, and where an excess of lime, or rather carbonate of lime occurs, we have the well known limestone. Most limestones contain impurities, such as silex alumina, magnesia, etc., the finest forms being white marble and calcspar.

OTHER CHARACTERISTICS OF ROCKS.

Of course all these varieties of rock vary exceedingly in hardness, color, and degrees of consistency, while the presence of some foreign mineral not unusually gives a distinctive character to each; for instance, sandstones are said to be quartzose or silicious, argillacious or clayey, calcarious containing lime, micacious containing fine scales of mica, fine-grained, gritty, conglomerate, etc.; also, porous and friable, *i.e.*, capable of absorbing much moisture and easily crumbled. Slates, again, are silicious, or cherty, arrenaceous or sandy, calcarious, shaly, when they split into thin leaf-like pieces, micaceous, carbonaceous, phmbaginous, talcose, aluminous, bituminous, etc. But I fear many of you will begin to weary of all this geological dissertation on rocks, and to ask yourselves what has all this to do with soils and their cultivation. Well, I shall endeavour to explain the intimate connection of the two subjects. The aluminous minerals mentioned as constituting so large a portion of the earth's crust, give to the soils their clay proper, when this clay is unmixed with the other ingredients, especially with sand, it is in the form known as plastic clay, or potters' clay—a tough impervious material, unfit for the support of vegetation, from the fact that the roots of plants are unable to penetrate it. Here is a dried specimen of pure clay only fit for coarse pottery or earthenware.* It is from the Exploit's Valley. A similar clay is frequently found under our peat bogs in this neighborhood, and I believe the fact of its being so dense as to prevent the surface waters penetrating downward, has been the chief cause of the collection of those swampy accumulations of vegetable matter. The silex in the rocks gives to the soils the sand which is

*A specimen of purely aluminous clay such as frequently occurs in this country, was to be exhibited and explained here.

so necessary an ingredient. A due admixture of this sand with the clay renders the latter sufficiently porous to admit moisture, and absorb manures. Thus, while sand renders the soil light and porous, clay gives it body and consistency. But just as too much clay makes a poor soil, too much sand, by its non retentive character, is equally unproductive, and where clay is altogether absent the sand is so light and dry, as to be utterly useless for agricultural purposes in its natural state. Besides, the above properties of those two chief constituents of soils, both furnish to plant life, and even to animal life; through the plants, certain aliments without which they could not exist. Silex in a soluble form, hydrous silicate, enters into the stalks and stems of plants and bones of animals. It is the material which gives rigidity to all trees, grasses, etc. The soda and magnesia, contained in the clays are all necessary to plant life.

VALUE OF LIME.

Lime is an exceedingly important. I might say absolutely necessary ingredient in all soils, so much so, that no soils destitute of it can possibly produce good crops, and their fertility or otherwise greatly depends upon their containing the necessary proportion of this valuable commodity. Its presence exerts, perhaps, more marked influence on the growth of vegetables, than any other constituent of the soil. This influence is manifold. It blends the qualities of clay and sand, occupying, as it were, a place between the two. Its extraordinary affinity for carbonic acid, which it absorbs with avidity from the atmosphere, and from manures, is one of its chief recommendations. This acid, which is a most important factor in the nourishment of plant life, is held in reserve in the soil by the presence of lime. In its caustic state (that is when burnt so as to expel the moisture naturally contained in the rock), it becomes most efficacious as a manure, not so much from its inherent qualities, as from its influence on other manures. In this state it is a powerful promoter of putrefaction, or decomposition of animal and vegetable matter. It fixes the carbonic acid in the soil, generated by the fermentation of the manures, which would otherwise escape into the atmosphere, and in great part be lost. Together with the moisture which it so eagerly absorbs, it readily imparts those nourishing properties to plants. The latter having separated the carbon contained in the acid and appropriated the same, give back the oxygen again to the air.

PLANT RESPIRATION.

In this manner the leaves and roots of plants, by absorbing and decomposing carbonic acid gas, perform in the economy of vegetable life, just the same functions as the lungs do in the animal economy, while an all-wise Creator has so ordained that just those substances in the atmosphere, most conducive to vegetation, are those most detrimental to animals. If it were not that the vegetable world so eagerly appropriated these deleterious substances, the air would, in a short time, become so vitiated, as to render animal existence an impossibility. Besides the above-named absolutely necessary ingredients, there are often present in soils small quantities of phosphoric and sulphuric acids, nitrates, vegetable matters, etc., all of which greatly enhance their productiveness, and when not naturally present, some at least, especially the phosphates, have to be supplied by means of manures. All manures contain these in greater or lesser degree. Fish manures, guano, bone dust being especially rich in phosphoric acid, no grain crops or leguminous plants, such as peas, beans or vetches can come to perfection without this latter ingredient, and soils destitute of it, or not supplied artificially, are only capable of supporting but scanty vegetation. In fact, silex in its soluble state, lime, carbonic acid, and phosphoric acid, are the principle food of the vegetable kingdom, and just in proportion to the presence or absence of the necessary quantities of these substances will the crops mature or otherwise. The presence of considerable quantities of decomposed vegetable matter in soils necessarily implies a certain amount of carbonic and phosphoric acid. Most peats for instance, contain these substances, besides small quantities of lime, magnesia, potash, silex, oxide of iron, alumina and water. Hence the application of peat to soils of a dry, sandy nature, is very beneficial. I am perfectly aware that all our farmers recognise this, and are in the habit of composting large quantities of peat with fish offal for manure.

APPLICATION OF PEAT.

But, if I may offer a suggestion, I think peat might be applied to much greater advantage than it is at present. I don't think I am far astray when I say most of the peat now used is simply spread out on our meadow lands, where it dries up, or is broken into fine powder by bush-harrowing, and afterwards, what has not been blown away is raked off. No doubt a certain amount of it becomes incorporated with the soil; but in my humble opinion where this peat carted out to the fallow land, allowed to dry and become pulverized, and then ploughed in with the more silicious substances, so as to give body and consistency to the latter, much benefit would result; even very dry sandy soils could thus be rendered fairly good and retentive of moisture. While by reversing the process, peaty soils, when first properly drained, can by the application and incorporation of considerable quantities of sand, gravel and lime be converted into probably the very best hay-growing lands. These, and such like experiments have been carried out in England, Scotland and the United States, with marked success,

Many extensive tracts of land utterly useless in their natural state have been thus brought into a high state of productiveness. From all the foregoing observations which I hope I have made sufficiently explicit, it may readily be deduced that primarily the bulk of all soils is derived directly from the rock crust of the earth. That, consequently, it partakes of the characters of the various rocks from which it is so derived. That where these rocks contain but few of the mineral substances requisite, or are otherwise in such a highly crystalline condition as to render them less liable to crumble under the influence of the atmosphere, the resulting soils will be poor, and where on the contrary, many such substances are present in a form more easily disintegrated, the soils are apt to be rich and deep. Where again, these soils are still further enriched by vegetable decomposition, and the presence of phosphates, etc., their natural fertility will reach its maximum. With a view to ascertaining the exact character of any soil it would be well could the cultivator institute analysis of each variety found upon his farm, thereby ascertaining exactly just what is present or absent, and in the latter case supplying the deficiency. Of course this is done in countries where the science of agriculture is brought to its highest development, and perhaps there is no nobler occupation in the world than skilled scientific farming, whereby the soils are studied in such a manner that there exact capabilities are known. On the other hand unskilled and unscientific farming frequently entail double the actual labor required with a mere modicum of the returns. In every country, and in almost every district of country, soils of different degrees of richness will be found. They will vary just in proportion as the rocks from which they are derived vary. All this must be well understood in order to obtain good results from their cultivation. In some cases they are naturally so rich as to require little or no manure at all, but the great majority of soils, all the world over, do require some fertilizer in addition, if only to prevent exhaustion. It only remains to state that when a district of country is occupied by hard, silicious and crystaline rocks, such as granitic regions, or those underlaid by what is termed the Laurentine formation, the soils are usually thin, stony and poor. The next succeeding formation Huronian being also chiefly composed of very intractible silicious slates, sand-stones or quartzites, and conglomerates or pudding-stones, yeilds but a slightly better class of soils. Both these are equally destitute of limestone in this country at least, and consequently the soils are destitute of that important ingredient. The Cambro silurian formation, next in order of succession, being composed of a greater variety of rocks, with a considerable amount of slaty and shaly strata, and several large bands of limestone is invariably found to support a much better quality of soil. Next in order of succession, is the great silurian formation, which is divided into lower, middle and upper. The rocks of this great geogical epoch are of infinite variety. Some portions of the formation are particularly rich in limestones, shales, slates, and fine-grained sandstone, and, of course, yield a superior class of soils, while another portion, owing to the preponderance of magnesian minerals, which, when in excess, are deleterious to vegetation, do not afford such. As we ascend higher in the geological scale, that is, come upon newer and less altered rock formations, we invariably meet with deeper and richer soils.

THE LOWER CARBONIFEROUS,

which, in this country, is the most recent rock formation known to exist is composed of substances eminently calculated to yield a superior quality of soil. These are limestones, gypsums, soft sandstones, shales, marls, bituminous and carbonaceous slates, coaly matter and a variety of other substances, the combination of which in the soil cannot fail to produce fertility, and such is invariably the case wherever such formation occurs, unless indeed it should be so greatly disturbed and the rocks so much altered by igneous intrusions as to entirely change their character. I think, however, I am pretty safe in stating that the silurian and carboniferous formations, when not so greatly altered, yield on the whole about the strongest and best soils. In Great Britain, Canada, and the United States at all events, especially in the two latter countries, the silurian and carboniferous are proverbial in this respect. Prince Edward's Island is underlaid by a still higher and more recent formation, the triassic, hence its well-known character for fertility, yet I doubt whether its soils can be superior to those of the lower carboniferous, as they are more sandy, and limestone and gypsum are absent from the rocks. It must appear, then, that there is an intimate connection between geology and agriculture. The geological structure of a country or district being known, and the mineral character ascertained, we can almost to a certainty determine the quality of its soils, and their adaptability to agricultural pursuits. Let us now apply all these facts to our own island with a view to ascertaining what should be the character of its soils.

GEOLOGICALLY,

then, it includes all the formations from the laurentian the oldest, to carboniferous, viz.: laurentian, huronian, cambro silurian, lower, middle and upper silurian, devonian and cerboniferous. A glance at the geological map upon which each formation is distinguished by a different colour will give an insight into the probable character of the soils appertaining to the various districts of country.* For instance, the pink shade on this map represents the laurentian

* Here the map would be referred to and the various formations, indicated by different colours, pointed out.

formation. It will be seen to occupy a very large area, including all the Southern Shore of the Island, from Fortune Bay to Cape Ray, to extend thence far into the interior north-easterly, and from Cape Ray through the whole length of the Island, almost to its northern extreme. This is termed the long range of mountains, and is in reality the back-bone, as it were, of the whole of the Island. Owing to the crystalline character of these laurentian rocks, and their consequent durability, or power of resisting atmospheric influences they form today nearly all the higher elevations of the island, and there is seldom any soil worth cultivating over their surfaces, except, indeed, where alluvial deposits, washed together from the ruins of many rocks may occur. Nevertheless, much of this country, where not too elevated, is fit for grazing, especially for sheep, as many considerable tracts sustain nutritious wild grasses. Generally speaking, however, it may be considered as unfit for agricultural purposes. The Huronian formation, which is colored pale blue, will be seen to occupy nearly the entire Peninsula of Avalon, and the country surrounding Conception, Placentia, Trinity, Fortune and Bonavista Bays. The character of the soils here is several degrees better than those of the Laurentian areas; but they are not by any means to be classed as really good soils. They are usually thin and rocky, underlaid by coarse gravel, and destitute, if not altogether, at least in great part, of the requisite amount of lime. Now, as this is the formation underlying the whole country round about St. John's and the nearer settlements: and moreover, as the soil resulting from its disintegration, is that which, unfortunately, up to the present time, has engaged the attention and energies of all our best agriculturists, I will dwell more at length upon its actual composition. The rocks of this formation, samples of which I have here by me are sufficient in themselves to give a fair idea of what the soil must be like. They consist of very hard siliceous slates, at times approaching flint, hard crystalline, sandstones or grit-rock, the well-known Signal-hill sandstone and the coarse conglomerates, composed principally of quartz, jasper, and other exceedingly hard pebbles. There are no soft rocks in the formation, no shales, no limestone bands, very few calcarious veins even, and altogether no rock or rocks likely to yield any of those more fertile descriptions of soils. I have said it is unfortunate that the only systematic attempts at farming by persons who understand the business, should have been confined to such districts as these, because their productive capabilities are persistently put forward as a criterion of those of all other parts of the island. Yet, on the other hand, seeing what industry, perseverance and skill can produce from such an unpromising source, I believed in the end, when the better classes of soils become known and availed of, the results of this experience will not be without value to the agricultural interests of the country. Poor as the soils are here, I believe they are capable of being greatly improved by studying them a little closer. I think were a few analysis instituted, they would tend much to enlighten us as to the best mode of treatment, with the view of obtaining the best possible results from them.

THE ALMOST TOTAL ABSENCE OF LIME

seems to indicate that the application of this material in considerable quantity, to the extent of a hundred bushels to the acre, that is, incorporated with the soils, would have a most beneficial effect. Peat also applied in the manner I have before indicated, or sand and gravel to the more peaty portions, would undoubtedly be attended with good results. In fact, what Nature has failed to do in combining these various materials, art must effect, and there are few farms hereabout, upon which sand, gravel and peat do not occur in close proximity to each other. I presume all here present have heard of the superior quality and fertility of the islands of Conception bay, the shore near Kelligrews, the Salmonier Valley, Branch Valley, in St. Mary's Bay, St. Brides and other places in Placentia Bay, South Shore of Trinity Bay towards its head, portion of Random Island and Smith's Sound on the west side of that bay, and Goose Bay and Clode Sound, in Bonavista bay. This is simply from the fact that the above localities are underlaid by a newer less crystaline formation, the Cambro Silurian, colored dark blue. The rocks consist of sandstones, slates, shales and great beds of limestone, they are all of a softer nature than the Huronian. Slates and shales preponderate, but I take it that the presence of the limestones have most to do with their fertility. At St. Brides, in Placentia Bay, a red earthy limestone occupies the country, the soil overlaying it being of the same colour is exceedingly rich. As a consequence the people are very well to do, keep a large number of cattle and sheep, and have no difficulty in raising sufficient food for their maintenance. This applies almost equally to every locality where settlement has taken place on this same rock formation. As we proceed north and west, we lose entirely the older huronian and cambrian rocks, they do not exist at all north of Bonavista, or west of Fortune bays.

THE VALLEYS OF THE GANDER

and Exploits Rivers of which you have all heard, but few, I presume, have seen, are represented as containing large area of fine land. Need you be surprised at this when I inform you that both valleys are underlaid by the great silurian formation, coloured yellow on the map, the rocks of which consists for the most part of slates, sandstones, limestones, magnesian rocks, carbonaceous and plumbiginous shales, and a host of others too numerous to mention.* Being all of more recent date, than any of those in this neighbourhood, they are less crystalline, yield much more rapidly to atmospheric influence, the great rivers have been for ages carrying down the finer particles and depositing them along their valleys. A dense forest, which covers the entire country,

*It is the same series of formations which underlies the St. Lawrence Valley from Quebec westward to St. Georgian Bay. The soils of which district are probably the best in Eastern Canada.

has added and is continuously adding its decomposed wood, leaves, etc., to the surface. Great fires have from time to time completely demolished these forests, only to be replaced by others. It is known that about 188 years since the entire valley of the Exploits for over 100 miles up the river on either side, was entirely swept by a great conflagration, vestiges of which are still visible in the numerous charred pine trunks still standing, and the piles of partially decomposed wood strewn everywhere over the surface. All of which tend materially to enrich the soil. A dense undergrowth of ferns, ground hemlock, and other like shrubs, are also constantly adding to the soils in these regions. When we take into consideration the advantages these latter tracts of country possess in point of climate, and situation, being so far inland and removed from the baneful effects of the fogs and cold sea airs of the outer coast-line, together with their undoubted superiority of soil, there can be hardly a question of the future agricultural development, which must some day take place in these splendid regions. Had it only been the will of the Almighty to reverse this island, and place those magnificent valleys within easy reach of the wealth and intelligence of St John's, Newfoundland would have a different story to tell today. And now for a few words upon the carboniferous areas of

ST. GEORGE'S BAY AND THE HUMBER RIVER.

Here we have decidedly the richest soils in the island. Soils which can certainly compare favourably with any in the eastern provinces of Canada and the New England States, beyond that I will not venture, because I have only seen these latter to form a comparison with, and I think they are quite sufficient for the purpose. Furthermore being so near us and so nearly similar in climatic and other ways, I think there need be no necessity of going beyond these provinces to institute comparisons. What they are capable of in an agricultural point of view I fully believe Newfoundland is in proportion to its size, due to return to the carboniferous areas. The soils here are the result of the disintegration of limestones, gypsum, sandstones, marls, clays, shales, coaly matter, combined with shell beds, decomposed grasses, weeds, ferns, wood and all the concomitants of the very best qualities of soils. There is no need to dilate further upon their origin, suffice it to say that where tested, as in the valleys of the Codroy rivers, and along the shores of St. George's Bay, they give every evidence of their superiority. In some places they are naturally so fertile as to need no manure. I have seen piles of stable manure thrown into the rivers because, as I was informed, were it applied to the potato crop, the latter would all run to stalk. I saw uplands under hay, which had been over 20 years yielding good crops, without ever receiving a shovel full of manure, and, indeed, without ever having been properly cleared or cultivated at all. These may have been exceptionally rich spots; but so far as my observation enabled me to judge, many square miles of country here partook of the same character. I believe the land to be richer than that of Prince Edward's Island, because it is less sandy and from the character of the underlying rocks it ought to contain a greater variety of fertilizing ingredients. Such, then, is the ground upon which I base my theory respecting the soils of this country. Like those of all other countries they are principally made up of the ruins of the underlying rock formations; where these latter are poor in fertilizing ingredients, the soils, as a necessary consequence, are also poor, and vice versa. Hitherto our principal attempts at agriculture have been confined to the poorer districts, and it is a remarkable fact that where the worst soils exist there also the very worst climate prevails. Both soil and climate seem to form part of each other to such a degree that undoubtedly the best climate in the island will be found in those districts containing the best soils. This has been my experience after twenty-one years of exploration in all parts of the Island. That the climate varies very much over the country is not to be wondered at, when we consider its situation and great extent. The southern and eastern seaboards are only too frequently enveloped in dense fogs, rendering the atmosphere cold, moist and uncongenial to a great degree. But the northern and western sides, and the great interior, are as comparatively free from their influence in summer as, perhaps, any part of the Maritime Provinces. In fact, these latter districts might well be considered as an entirely different country altogether.

And, now, comes the question as to what crops our soils are best adapted to, and what particular direction agriculture in this country should take.

It has been frequently asserted that grain crops, especially wheat, barley and oats, cannot be successfully raised in the country. It does appear to me very strange, that while there is really no negative evidence beyond mere supposition for this assertion, there is, nevertheless, abundant positive evidence to the contrary. As a matter of fact, all these crops are raised every year in some part or other of the country.

AS TO WHEAT GROWING.

In the first place, has any systematic attempt ever been made to obtain the most suitable grain, or to acclimatize it; and, secondly, to grow it on those soils more particularly adapted to this cereal? I think not. I have seen wheat grown and ripened in the Codroy valley, in St. George's Bay, and last summer at the mouth of the Exploit's river. The grain was fine, large, and pronounced by those competent to judge, of excellent quality. A Canadian gentleman, last year, expressed his surprise at the quality of wheat raised at the latter place. While the people of Codroy, who had experimented for several years, assured me they had no doubt whatever of being able to raise a sufficient quantity to supply themselves with flour, had they only the means to grind it. Yet none of this wheat was, I believe, raised from seed specially selected to suit the climate, and certainly was not grown on exactly those soils I would be inclined to select for the experiment. It must not, however, be understood that I am at all an advocate for wheat growing in Newfoundland, beyond, indeed, a sufficiency for local consumption in a few favored districts. I believe that owing to the immense areas in Canada and the Western States devoted to this branch of agriculture, and producing such an excess of grain over and above the demand, that it would be folly for us, even under the most favorable circumstances, to attempt competing with such countries in the grain markets of the world. I believe our lands can be turned to much more profitable account, and so far as our own supply of flour is concerned, we could not possibly produce it at a cheaper rate than we now import it from America. Oats, barley, flax, hemp, hay of all kinds, peas, vetches, and all ordinary root crops, can be raised in any quantity. But why need I inform you of this; you all know it as well as I.

It is in the direction of

SHEEP AND CATTLE RAISING

I believe our future agricultural development should tend. We must convert the produce of

our soils into beef, mutton, wool and horseflesh. These would all find markets amongst the ever increasing populations of Europe. While we are certainly situated geographically to reap all the advantages of a short sea voyage, which should place us first in the market. All this, however, is an old, almost threadbare, theme, which has been frequently dealt with by far abler pens than mine. That there is no extravagant stretch of imagination in the matter, I am convinced from actual personal observations. This country is peculiarly a grass growing one. Wild grasses (for there are several varieties), of sweet nutritious character, spring up spontaneously wherever the woods have been burnt or otherwise removed, and in the neighborhood of St. John's this fact is availed of every year by persons having cattle who turn them out to graze over our barrens. The condition of these cattle in the fall is ample testimony as to the nature of the food. In my humble opinion, by far the greater portion of the poor, thin soils on the Peninsula of Avalon, would be best converted to grazing purposes. There is seldom more than a few inches of the very surface really capable of producing crops, and instead of disturbing this, or worse still, burying it beneath the poor, hungry, gravelly subsoil, as is most frequently done in cultivating it, I believe, were the wood first removed, leaving the stumps to decay, and all the rubbish burnt, by simply then scattering hay seed over the freshly burned surface, we would soon have extensive grazing ground, which would be enhanced in productiveness every year by the droppings of the cattle. Were the Peninsula of Avalon, in particular, treated in this way, and the dog nuisance got rid of, I see no reason why thousands of sheep might not be raised here instead of the few hundreds now kept. Our wild grasses are infinitely more nutritious and keep green longer than in Canada and the New England States, owing to the moisture of the climate and absence of those parching heats in summer. Everyone knows that we can raise better hay. It appears to me, also, that this same coldness of climate should greatly enhance the quality of the sheep's wool grown in the country. In the direction, then, of sheep and cattle raising, I believe, lies our future hope in agricultural development. Raising grain or vegetables, beyond a sufficiency for home consumption, would be preposterous, as all our near neighbors supply their own wants in this respect, and are able to monopolize the markets. No doubt manufactures might be instituted that would turn some of the produce to account.

FLAX CULTURE.

If we can grow flax to advantage, I don't see why, at least the coarser kinds of linen, may not be manufactured; and in a maritime country like this, where the fisheries will always occupy the attention of a large portion of the population, there should ever be a demand for canvas, cordage, hemp etc., sufficient to create a home consumption of these articles which should render the production of the raw material and the manufacture profitable; for the same reason the fisheries will ever create a demand for farm produce, all of which the country is quite capable of supplying, but which, at present, drains an immense amount of capital from it each year. When we come to consider the whole matter properly, how really few countries are there where different sections of a population would find a home market, superior to any foreign market, for their produce. Let us suppose we have 100 000 fishermen, or persons entirely dependent on the fisheries, and 100,000 agriculturists, the former could well absorb all the surplus produce of the latter, while the latter would furnish the very best market for at least 100,000 qtls of fish, annually, the produce of the former. If we cannot become agriculturists ourselves, let us offer every facility to outsiders who are such, to come here and engage in that business. If we admit that the country is capable of raising all the farm produce required, and I think very few doubt that now, why should it not reap the benefit of the large annual outlay for farm produce which now goes to enrich our neighbors. Were the facilities for developing our lands and then reaching our markets equalized with those they now enjoy, I have reason to think many Prince Edward Islanders, Cape Bretoners and Nova Scotians, would avail of them, and for my own part I would prefer to see an immigration of farmers from these Provinces than from the Old Countries. I believe they would be better adapted to cope with the difficulties of clearing and cultivating our lands, coming, as they would, from an almost similar climate and character of country.

Since writing the above paper, I was quite unexpectedly favoured with the copy of an analysis of the average soil of St. George's Bay district, made by a thoroughly competent and reliable person, who was sent out by the Newfoundland Land Company to examine and report upon the nature of the soil, &c.

It is a very great satisfaction to me to learn by this analysis, that what I had reasoned out upon purely geological grounds, should so soon, and so thoroughly, be borne out, from such a reliable and entirely independant source. Here is the copy in question:—

[COPY].

Approximate Analysis of the average Soils between Fisher's River, Crabb's River, from one to six miles inland from the Sea-board,

Moisture		214 60
Organic matter containing nitrogen equal to 23 ammonia		111.60
SALINE MATTER.		
Phosphate	3.80	
Carbonate of Lime	15 60	
Carbonate of Magnasia	51.20	
Alkaline Salts	14.46	
Oxide of iron	30,87	
		115.93
SILICIOUS MATTER.		
Sand and Silica	485.02	
Alumina	72.85	
		537.88
		100,000

The above soils are very rich in organic matter and contain the full amount of the saline fertilizing matters found in all soils of GOOD bearing QUALITY. On such land, properly cleared and ploughed, root crops in small patches round the fishermen's habitations, show the startling profusion with which they are raised, viz.: Potatoes average 220 bushels, per acre; turnips, beets and other root crops, 285 to 300 bushels per acre. Tomatoes ripen in the open air, &c., &c.

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