

VII.—NOTES ON THE GEOLOGY AND BOTANY OF DIGBY NECK.
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Of the more readily accessible portions of Nova Scotia there is probably none less frequently visited, or of which less is known by ordinary travellers, than the peninsula commonly known as Digby Neck. Thus, while hundreds or thousands are, in the course of every summer, whirled along the rails from Yarmouth to Digby, and *vice versa*, or are forced into expressions of admiration as they steam through the wonderful passage of Digby Gut, few ever think it worth while to visit and study the long, curious neck of land whose eastern end forms one of the pillars of that famous gateway, and which, stretching thence to the westward as a narrow and yet almost mountainous ridge, separates the waters of St. Mary's Bay from those of the Bay of Fundy. Even professional naturalists and geologists, usually upon the alert for whatever is new or instructive in the world of nature, would seem in but few instances to have visited Digby Neck, except that portion immediately adjacent to the town of Digby, and observations upon its structure, physical features, mineral contents or floral characteristics, are alike few. And yet it may safely be said that, with the exception of Blomidon, no area of equal extent is to be found in Nova Scotia, and probably not in eastern America, which presents such peculiar features of scenery, geological structure, plant distribution, or mineral associations, as are here met with.

It has hence been thought that the following notes, taken during a sojourn of several weeks upon the Neck, in connection with the work of the geological survey, may be of interest to the members of the Institute, and possibly encourage others to the task of its further exploration.

PHYSICAL FEATURES.

Under the designation of "Digby Neck" will be included, for the purposes of this paper, not only the long narrow ridge properly so called, together with the isthmus by which this is connected with the mainland of Nova Scotia, but also what is clearly but a former extension of this ridge through Long and Briar Islands.

As thus regarded, the area naturally becomes divided physically, as it is also geologically, into two portions, of which the one, comprising the isthmus referred to, is comparatively low, while the other, more by the abruptness of the contrast than by the possession of any considerable altitude, may almost be termed mountainous. This latter is indeed the extension, westward of Digby Gut, of what, eastward of the latter, is commonly known as the North Mountain range.

The total length of this belt of high land, from the Gut to the extremity of Briar Island, is 44 miles; and for much of the distance the breadth varies but little from a mile and three quarters. There are, however, places, as at Sandy Cove, where indentations on opposite sides of the peninsula considerably reduce the actual distance from water to water, while at Petite Passage, and again at Grand Passage, transverse gorges, excavated completely through the peninsula and of great depth, give free movement to those waters as well as to navigation, from side to side. On the other hand, the breadth of the isthmus connecting the mountains with the mainland is, between the one and the other, only about three miles, while between Annapolis Basin and the head of St. Mary's Bay it is about five miles. Near the town of Digby the connecting isthmus includes some rather high and no very low land, but the elevation declines both in the direction of the foot of the higher hills and again towards the head of St. Mary's Bay, where, upon the ebb of the tide, the low shores are prolonged outward into extensive mud-flats.

The maximum elevation of the hilly range is about 350 feet. It would be very incorrect, however, to regard this as a simple ridge extending through the peninsula and sloping from a

central axis to either shore. On the contrary, a series of contour lines would show that while the range is one in its relations to the lowlands, it is itself made up of many subordinate ridges, not quite parallel to the length of the peninsula itself, and so arranged as to form a series of obliquely overlapping lines. The course of the transverse valleys thus formed is usually not far from north and south, and the descent to these, as at Sandy Cove, is usually quite abrupt, while at the Petite Passage, which strikingly illustrates the feature alluded to, the shores on either side stand as well nigh precipitous bluffs overlooking the alternate rush of the tides through that wonderful channel. An admirable opportunity for the study of the orographic features of the peninsula is afforded by a high and conspicuous peak, which, with a nearly vertical face of over one hundred feet, overlooks the picturesque settlement of Sandy Cove. In the almost unobstructed view which may thence be obtained, and of which a part only is shown in the accompanying photograph, Plate IV, not only does the observer marvel at the wonderful beauty and singular characteristics of the immediate foreground, but, for miles to the westward, sees ridge after ridge presenting to the sky an outline which is conspicuously serrated, suggestive of what is actually the case, the existence of table upon table of rocky masses, resting one upon another, each abrupt upon the one side and upon the other sloping gently backward, only to meet and to be capped by other masses similarly inclined. This feature is more marked west of Sandy Cove than to the eastward, and through much of the peninsula in that direction this may be regarded as a sort of trough, formed by and parallel with these bounding ridges. In this trough, through which runs the stage road to Tiverton and Westport, are contained almost all the cultivable lands of the peninsula, and in places long narrow shallow lakes, with connecting streams and meadows.

The peninsula of Digby Neck is thus, as regards its physical features, a district of bold contrasts, including long and prominent ridges, separated in some places by broad and open valleys,

in others by narrow troughs, while across both, at intervals, stretch transverse depressions, always relatively deep, and in some instances sinking far below tide level. In these latter cases, especially at Sandy Cove and in the Petite Passage, the whole structure of the peninsula is admirably exposed, and in the craggy bluffs which border them is determined scenery which in many respects may well be compared with much of that in the vicinity of the Giant's Causeway, in Ireland. So high, indeed, and so steep is much of the shore, particularly upon the southern side, that a safe descent to the beach, if beach there be, is often hard to find and in places quite impossible.

As would naturally be inferred from such diverse physical features, the depth and character of the soil over the peninsula exhibit similar diversity. Thus, on the lowlands of the isthmus, between Annapolis Basin and St. Mary's Bay, where the underlying rocks are sandstones, the soils derived therefrom are naturally also sandy, though, like the corresponding soils of Annapolis Basin, often quite productive. Nearing the hills to the north of this tract, on the other hand, the land rapidly becomes stony, through the distribution of drift, while the hill-slopes themselves are thickly covered with scattered blocks of all sizes. Again on the tops of the hills the soil-covering is usually very scanty and often wholly wanting, but between these, and especially on the transverse valleys, the soils are both deeper and richer, giving support to numerous prosperous farms. The proportion of poor to good land increases progressively to the westward, and in Long and Briar Islands bare ridges of rock are separated only by bogs and swamps.

GEOLOGICAL FEATURES.

The general geological structure of Digby Neck has long been known, and has been made the subject of description by several writers, the most prominent being Sir William Dawson.

As in the region bordering the Annapolis Valley, of which that under consideration is the direct extension, there are in Digby Neck and its vicinity two groups of rocks, the one sedimentary, consisting chiefly of arenaceous beds, of a bright red

colour, and the other volcanic, embracing a variety of doleritic, trachytic, and amygdaloidal rocks disposed in successive sheets as the evident result of repeated lava flows. It has been usual to regard both of these groups as being of New Red sandstone or Jura Trias age. But at present there is, in this region, absolutely no proof that such is their true position, while observations made elsewhere, in rocks of similar character and associations, at least make the reference somewhat doubtful.

By far the best opportunity for the study of the sandstones is afforded by the shore section closely adjacent to the so-called "sea wall," about six miles from Digby, in the settlement of Rossway. At this point is exposed a series of bluffs which, both by their height and colour, form a striking feature in the landscape. The section is nearly half a mile in length, gradually rising with the dip of the strata from the water level at the northern end to quite one hundred feet at the southern. This height above the sea level is not very different from that seen on the road from the town of Digby to Digby Light, and would indicate that the depression in which these sandstones were deposited, and which must at one time have connected the waters of Annapolis Basin and St. Mary's Bay, must have had at least a corresponding depth below its present level.

In character the sandstones are not unlike those seen at various points in the Annapolis valley, but they lack, as far as observed, the gypsiferous aspect which is so marked a feature in the sandstones which underlie the traps of Blomidon. The prevailing colour is a brick-red, of light and dark shades. At intervals it is interstratified with light green bands varying in width from half an inch to 5 or 6 inches. The green bands especially characterize the lower beds, and these are also distinctly more arenaceous than the beds above. On one of the reefs laid bare by the tide was observed what appeared to be a tree-trunk several feet in length, together with some obscure branching markings, which resembled tracks, but both were obscure, and nothing else of this nature could be found.

The traps, which form by far the largest and most conspicuous element in the structure of Digby Neck, have been described as varied, but the diversity which is seen is due rather to mere variations of colour and texture than to any essential difference of composition. And these variations seem to recur without any definite order, the colour even within a few yards often shading off from grey, the prevailing tint, to green or purplish, while both in the coastal cliffs and in the interior, compact or columnar trap is associated very irregularly with beds which are scoriaceous or amygdaloidal. A good opportunity for the study of these rocks is to be had at Gulliver's Cove, to the north of the sandstone section described above, here forming cliffs in some places 100 feet high. They exhibit layers dipping at a slight angle towards the Bay of Fundy, and are intersected by vertical veins from mere streaks to 4 or 5 inches in width. These consist of various silicious minerals, while those occupying the horizontal fissures appear to be chiefly zeolitic. The vertical veins have a strike about NNE. (magnetic).

Other good exhibitions, especially of the columnar structure, may be seen about Digby Light and Broad Cove; but none are so remarkable as those afforded by the depressions of Sandy Cove and the Petite Passage. This latter truly wonderful gap, of which the northern entrance is shown in Plate VI, through which flows alternately a tidal current nearly 100 feet deep, and with a velocity at times of not less than 8 knots, is upon its western side, above the little fishing village of Tiverton, bordered and overlooked by beetling cliffs, of which the individual columns are most complete, and so carved by the sea as to exhibit in places all the aspects of human architecture. The boldness of the scenery is here further enhanced by the occurrence of numerous large blocks of trap, often 20 or 30 feet in diameter, and of grotesque shapes, which are perched, sentinel-like, upon the very edge of the bluffs, more than 100 feet above the water. These, if not "boulders of decomposition," must have been derived from the trappean ridges which, though now invisible through submergence, are known to lie along the Bay of Fundy trough, outside of but parallel to the present coast.

Plate V, accompanying this paper, represents the basaltic structure as seen at Israel Cove, near the southern end of Petite Passage.

Some fine basaltic scenery, of which a sketch is given in "Acadian Geology," is also to be seen on Briar Island, near Westport, but in general the land here is lower and the features less bold than about the Petite Passage.

That so prominent a ridge as that of Digby Neck should have been greatly affected by the conditions incidental to the glacial period, would naturally be expected. These are, however, shown rather in the evidences of enormous denudation than in the production of new deposits. Portions of the ridge are, it is true, somewhat deeply buried in boulder clay; and boulders (including in a few instances granitic and felsitic blocks which must have come from the other side of the Bay of Fundy) are scattered over all parts of its surface; but the occurrence in great profusion of the characteristic rocks of the peninsula along the southern side of St. Mary's Bay, and, though less abundantly, over Yarmouth and Shelburne Counties, even to the Atlantic seaboard, gives forcible illustration of the extent to which the substance of the peninsula has been removed.

The fact also that the transverse valleys of Sandy Cove, Petite Passage and Grand Passage, as well as others less conspicuous, are oblique to the peninsula and almost exactly parallel to each other, while their course corresponds with that of the glacial striation of the district, goes far to favor the view that they owe their origin, partly if not wholly, as has been suggested in the case of Digby Gut, to the excavating action of glacial streams. The occurrence of striations on the surface of the basaltic columns in Israel Cove, and within a few feet of the surface of the water, gives further probability to this view.

MINERALS.

The minerals of Digby Neck are the same as those found in other parts of the North Mountain Range, but are less abundant and less varied than in the section of the latter which lies east of Digby Gut.

Iron ores are both the most abundant and most interesting of these minerals. They occupy veins traversing the trappean rock, and with a tendency, apparently, to run in north and south directions. They occur at many points, the most prominent being along the road from Digby to Digby Light, Nicholl's mine in Rossway, Johnson's mine in Waterford, and Morehouse's mine on the St. Mary's Bay shore near Sandy Cove. At several of these points attempts have been made to remove the ore, and considerable money has been spent, but the small size of the veins and the cost of removal have in all instances prevented them from being remunerative. The ore is sometimes massive, but more generally crystalline, being partly magnetite and partly hematite. Fine crystals of *martite* or octahedral hematite, probably a pseudomorph of magnetite, are especially abundant at Johnson's mine and near Sandy Cove. The mining never proceeded beyond the digging of shallow trenches in the side of the hills, and these are now largely filled with rubbish; but it is among the latter that the most interesting specimens, both of the iron ore and of the associated minerals, are to be had.

Among these associated minerals *quartz* is by far the most abundant, rock crystal being especially common and of great variety and beauty. *Amethysts* are less common, and are now hard to obtain, but very beautiful specimens were disclosed during the opening of the trenches, and are occasionally met with in boulders on the hillsides, or upon the beaches. With these varieties of quartz, and others such as agate, chalcedony and jasper, are often found one or more of the *zeolites*, and many specimens have their beauty much enhanced by the curious way in which the iron ore, rock crystal or amethyst, the zeolitic minerals, and, it may be, white or yellow calcite, are commingled or disposed in alternating layers.

It is of little use to name definite localities for these minerals, other than the mines alluded to above, for the finding of specimens is largely a matter of chance and of diligent search. It may, however, be mentioned that the rocks near the light house in Tiverton (Petite Passage) are especially noticeable for the

large number and varied coloration of the chalcedonic and agate veins which traverse them. These are also found quite abundantly through most of the rocks which border the Bay of Fundy side of the peninsula, and among the blocks with which, in places, this shore is strewn. Among the zeolites some fine specimens, varying in colour from pure white to grey, flesh or cream-colour, red and yellow, as well as of unusual form, were obtained at Johnson's mine in Waterford, where also were observed geodes or amygdules of amethyst and chabazite enclosed in jasper of red and yellow tints. At Murphy's Cove, upon the north shore, about eight miles from Digby, was observed quite a large vein of *Thompsonite*. This has yielded some beautiful groups of crystals, but it is somewhat difficult of access, and has been to a large extent softened and decomposed by exposure to the waves. At Mink Cove, on the south shore of the Neck, in addition to a vein of magnetite, is found a small vein of crystalline calcite, carrying some galena. In general metallic ores, other than those of iron, are of rare occurrence. Native copper, it is true, occurs not unfrequently, especially on Briar Island, but, as far as known, only in the form of small granules scattered through the trappean rock.

BOTANICAL FEATURES.

If to the physical and structural characteristics of Digby Neck we add those of its relations, in contour and relief, to its surroundings, it will be readily seen that these are of such a character as must exert a marked influence upon the nature and distribution of its native plants.

It has been stated that the width of the peninsula is nowhere, except at its head, more than two miles, and is generally less. Every portion of its surface is therefore more or less subject to the influence of the adjacent waters, more particularly as regards the prevalence of fogs. But while these latter not unfrequently enshroud the whole Neck in a dense and cool atmosphere of mist, the height of the ridge is such that its upper portions are quite often bathed in sunshine, even though the shores and adjacent waters may be wholly concealed from view. The fogs

are also more frequent upon the Bay of Fundy side than upon that of St. Mary's Bay, while the former also feels most keenly the effects of cold northerly winds.

The influence of the above causes, combined with others previously noted as resulting from geological structure and depth of soil covering, are in the first place directly seen in the contrast between the northern and southern sides of the peninsula as regards the variety and vigour of the vegetation, and secondly, in a somewhat marked tendency towards an arrangement of the vegetation in zones, parallel to the length of the Neck and its bounding waters. Lastly, the depth and consequently sheltered positions of such transverse valleys as that of Sandy Cove present still other conditions, the influence of which is directly reflected upon the plants there met with.

The limits and distinctive features of these several tracts have not yet been worked out with any precision, if indeed that is possible, but some of their more general characteristics may be briefly stated.

The first of these zones is that which more immediately forms the northern shore. This, although almost everywhere rocky and in places precipitous, is more commonly low, presenting broad, bare ridges of rock, fringed below by a dense matting of *Fucus*, and sheeted above by patches of grass or low-lying shrubs. On wet and rocky cliffs tufts of *Sedum Rhodiola* are not uncommon, associated with species of Saxifrage, and well indicate the sub-arctic or sub-alpine conditions under which their existence is maintained. The effects of such conditions are also well seen in the woods which generally prevail along this shore of the Neck. They contain much fewer broad-leaved plants than occur farther inland, while their dwarfish and in many instances almost prostrate growth, together with the uniform bending of their trunks and branches away from the direction of the prevalent winds, strikingly attest the effect of their struggle with adverse influences.

From the immediate shore the land upon the north side of the Neck rises rapidly, but often in a succession of steps, with

bare ridges of rock, separated by parallel troughs. This tract is generally densely wooded, but very imperfectly drained, and still exhibits a preponderance of fir, spruce, and hemlock, beneath which are found such plants as *Clintonia borealis*, *Monotropa*, *Cornus Canadensis*, *Pyrola*, *Brunella*, *Smilacina*, &c.

Reaching the summit of the ridge more favorable conditions begin to prevail, and with them both a more vigorous growth of trees and a greater variety of herbaceous plants. Among the latter I was surprised and pleased to find a species not previously credited, so far as I am aware, to the flora of Nova Scotia, and not known to occur in New Brunswick, the *Gerardia purpurea*—its small but conspicuous flowers being found abundantly and as late as the middle of September, both on the summit and on the southern side of the trappean hills. In places it was associated with the bright little *Anagallis arvensis*, while in the woods near by were noticed such plants as *Linnaea borealis*, *Aralia racemosa*, *Circaea Lutetiana*, *Mitchella repens*, *Chiogenes hispidula*, *Chimaphila umbellata*, *Epigaea repens*, *Pyrola rotundifolia*, *Trientalis Americana*, *Spiranthes*, *Scutellaria*, *Galium*, &c. At one point, but at one only in this belt, was noticed *Clematis Virginiana*, twining its conspicuous leaves and fruits over dense clusters of alder.

The next zone is that of the cleared lands bordering on either side the main road which traverses the peninsula throughout its length. Here, in the fields, are found the plants usual in such situations, the ubiquitous Ox-eye-Daisy, two species of Thistle, and a variety of Asters and Solidagoes, while in places are to be seen dense clusters of Elecampane (*Inula Helenium*) and Tanzy (*Tanacetum vulgare*). Along the roadsides and ditches alders abound, associated generally with patches of Meadow Rue (*Thalictrum Cornuti*), Meadow sweet (*Spiraea salicifolia*), *Rubus*, *Rosa*, *Ribes*, *Eupatorium*, *Antennaria*, and occasionally *Oenothera biennis*. In portions of this belt, where ponds occur, were noticed such water plants as *Eriocaulon septangulare*, *Potamogeton natans*, *Sparganium simplex*, &c. The yellow

Lily (*Nuphar advena*) was also common, but *Nymphaea odorata*, the white Water-lily, was seen at one point only, in the little pond midway between the northern and southern outlets of Sandy Cove, its occurrence here being in keeping with the warm and sheltered position of its habitat.

The southern side of the peninsula, fronting St. Mary's Bay, may perhaps be regarded as forming another zone, but is less well-defined than those previously noted, and marked rather by the more general prevalence of broad-leaved trees and their comparatively vigorous growth, than by the occurrence of any special species.

Finally, over the red sandstone district constituting the isthmus connecting Digby Neck with the mainland, the species found are the same as those of the Annapolis Valley, of which pretty full lists have been elsewhere published. The growth of the Horse-Chestnut is especially noticeable.

Towards the western extremity of the peninsula and upon Long Island, its natural extension, the above zones (excepting the last which is here wholly wanting), tend to blend or to disappear, while the increasing amount of low and boggy ground is accompanied by the corresponding augmentation of ericaceous plants, such as *Vacciniums*, *Ledum*, *Kalmia*, *Cassandra*, &c. *Potentilla fruticosa* was also noticed here at several points, forming dense clusters. *P. anserina* was also of common occurrence. Finally, over the surface of peat bogs, especially on Briar Island, were to be found the different species of *Drosera* (*D. rotundifolia* and *D. intermedia*), *Sarracenia purpurea* and the Orchids *Habenaria psycodes* and *H. blephariglottis*. Nowhere have I seen these Orchids so abundant as over the barrens and peat bogs of Digby and Yarmouth Counties.

Appended is given a more complete list of the plants observed on Digby Neck. While by no means embracing all the species which are doubtless represented there, it may be useful as a basis both for comparison and for further exploration.

PLANTS OF DIGBY NECK.

- Clematis Virginiana*, L.
Nymphaea odorata, Ait.
Nuphar advena, Ait.
Sarracenia purpurea, L.
Drosera intermedia. *D. longifolia*, L.
Hypericum — ?
Silene — ?
Geranium Robertianum, L.
Impatiens fulva, Nutt. *I. pallida*.
Rhus typhina, L.
Potentilla anserina, L. *P. fruticosa*, L.
Rubus Canadensis, L. *R. strigosus*. *R. villosus*, Ait.
Rosa Carolina, L.
Spiraea salicifolia, L. *S. tomentosa*, L.
Trifolium arvense, L. *T. Agrarium*, L.
Aesculus Hyppocastanum.
Acer Pennsylvanicum, L. *A. spicatum*, Lam.
Saxifraga — ?
Sedum Rhodiola, D. C.
Circaea Lutetiana, L.
Epilobium angustifolium, L. *E. coloratum*, Muhl.
Oenothera biennis, L.
Cornus Canadensis. *C. alternata*.
Linnaea borealis, Grown.
Viburnum lantanoides.
Galium — ?
Eupatorium purpureum, L.
Aster nemoralis, Ait., and others.
Solidago — sp ? *S. sempervirens*.
Inula Helenium, L.
Achillea millefolium, L.
Leucanthemum vulgare, Lam.
Tanacetum vulgare, L.
Antennaria margaritacea, R. Br. *A. plantaginifolia*, Hook.

- Cirsium arvense*, Scop.
Leontodon autumnale, L.
Onopordon acanthium, L.
Lappa officinalis.
Rudbeckea hirta, L.
Maruta cotula, D. C.
Campanula rotundifolia, L.
Vaccinium Canadense, Kalm.
Monotropa uniflora.
Chiogenes hispidula, Tr.
Chimaphila umbellata, Nutt.
Plantago major, L. *P. maritima*, L.
Trientalis Americana, Pursh.
Anagallis arvensis, L.
Utricularia — sp ?
Verbascum Thapsus, L.
Gerardia purpurea, L.
Linaria vulgaris, Mill.
Chelone glabra.
Mimulus ringens.
Veronica — sp ?
Brunella vulgaris, L.
Scutellaria galericulata, L.
Polygonum persicaria, L.
Rumex acetosella.
Fagus ferruginea, Ait.
Corylus rostrata.
Betula.
Alnus incana, Welld.
Salix — sps ?
Pinus strobus, L.
Abies alba ? Muhr. *A. balsamea*. *A. Canadensis*.
Arisaema triphyllum, Tor.
Typha latifolia, L.
Sparganium simplex, Hud.
Habenaria psycodes, Gray.

Spiranthes —— ?

Iris versicolor, L.

Sisyrinchium Bermudianum, L.

Trillium erectum, L. *T. erythrocarpum*, Michx.

Streptopus roseus. Michx.

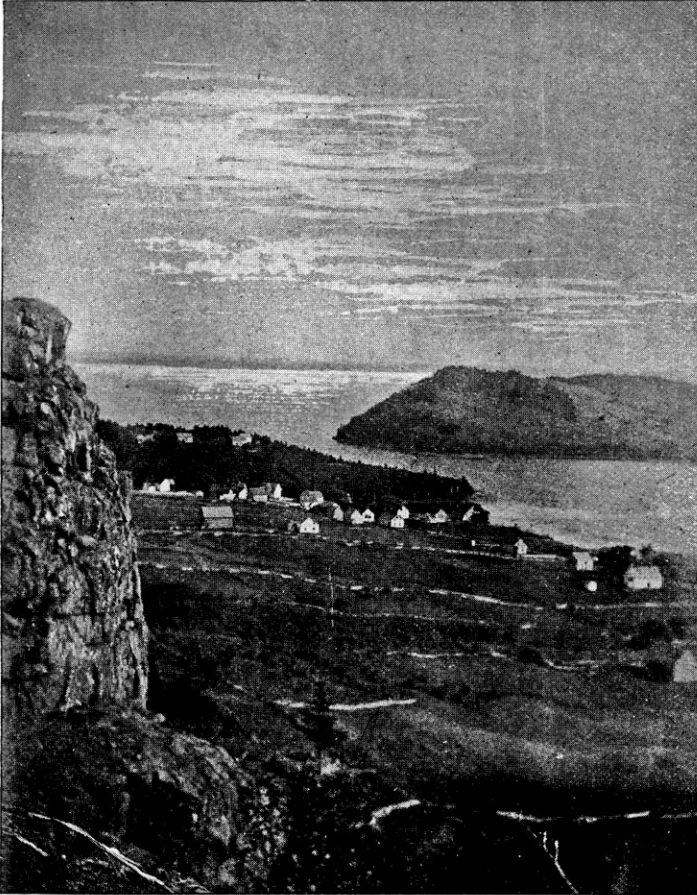
Clintonia borealis, Raf.

Smilacina bifolia, Kerr.

Eriocaulon septangulare, Witg.

Eriophorum ——

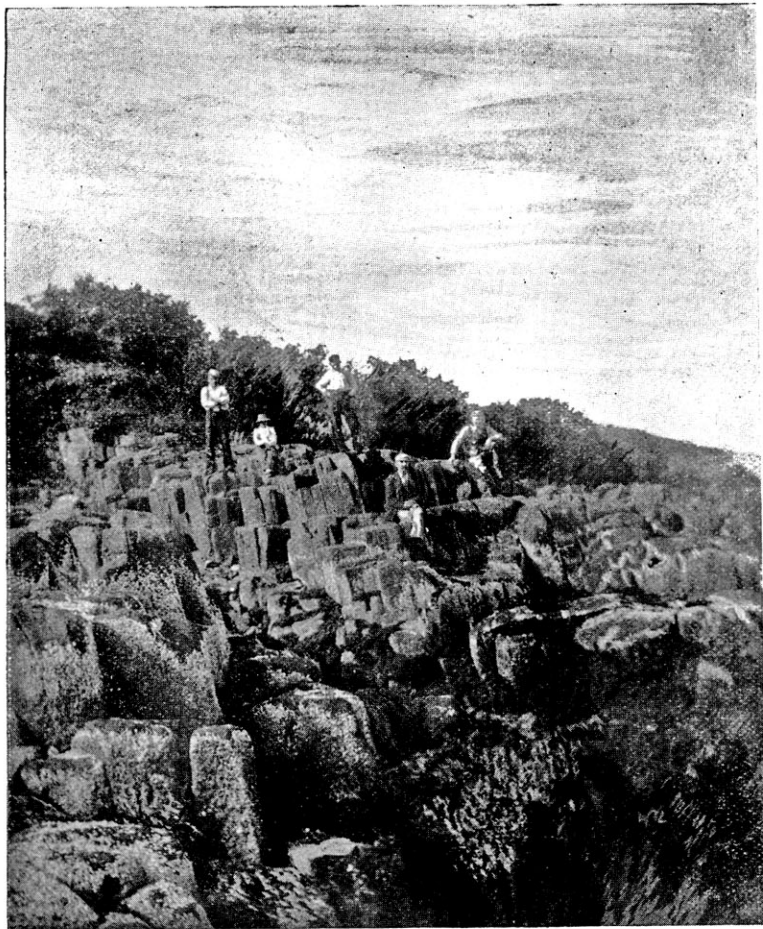
NOTE.—No attempt was made to identify Carices, Grasses, Equiseta, Ferns, or Mosses.



SANDY COVE,

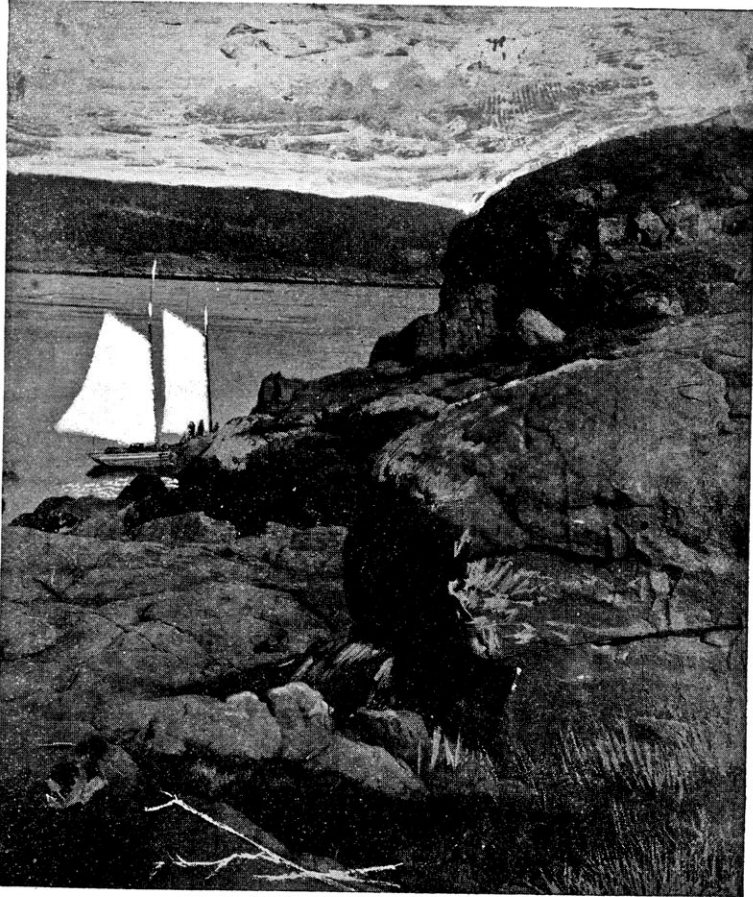
Looking towards St. Mary's Bay, shewing Vertical Bluffs of Trap.

Illustrating Prof. Bailey's Paper: "*On the Geology and Botany of Digby Neck.*"



VIEW AT ISRAEL COVE, PETITE PASSAGE,
Shewing Columnar Structure.

Illustrating Prof. Bailey's Paper: "*On the Geology and Botany of Digby Neck.*"



ENTRANCE TO PETITE PASSAGE, NORTH SIDE.

Illustrating Prof. Bailey's Paper: "*On the Geology and Botany of Digby Neck.*"