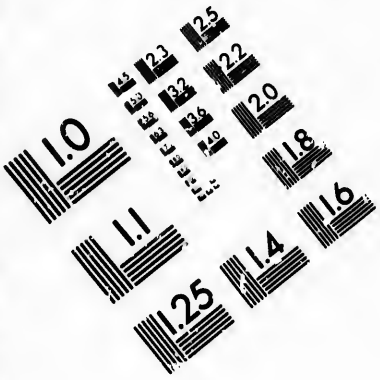

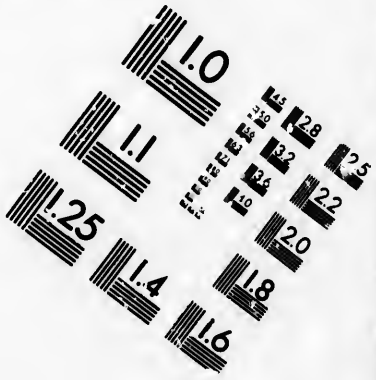

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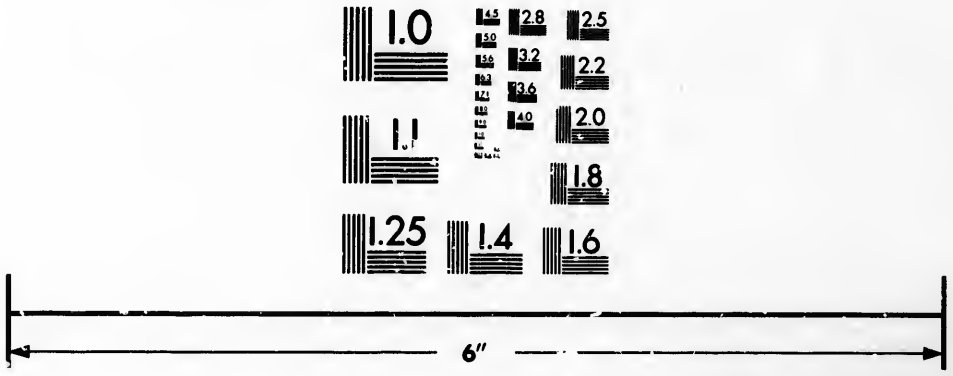

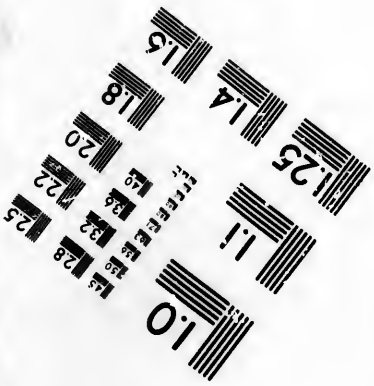

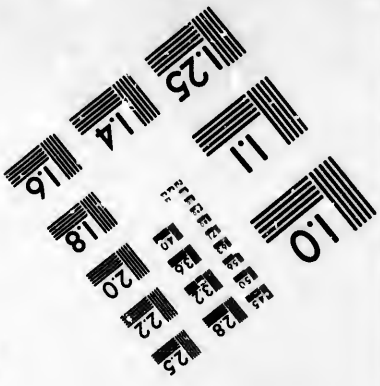

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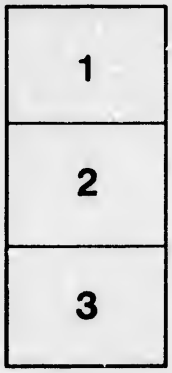

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[*From the* Quarterly Journal *of the* Geological Society *for November* 1886.]

The Geology *of* Cape Breton Island, Nova Scotia.

By Edwin Gilpin, Esq., Jun., A.M., F.R.S.C., Inspector H.M.'s Mines.

1851–

In the following notes the writer has tried to give a brief account of the geology of this island from notes of his professional work as Inspector of Mines and from other available sources. Mr. R. Brown, of the Sydney mines, lived for many years on the island when it was, geologically speaking, an unexplored region. The Transactions of the Society contain several valuable papers of his, giving many details of the Carboniferous system. Sir J. W. Dawson, in his 'Acadian Geology,' indicated the outlines of the principal geological divisions, and devoted much attention to the Carboniferous flora. During the past fifteen years Mr. H. Fletcher, of the Canadian Geological Survey, has explored and mapped the island, and the map accompanying these notes has been reduced from the large scale-plans accompanying his annual reports, from which I have taken several sections. Valuable reports were made by Professor Lesley, Mr. Lyman, and others on several districts considered of economic importance; but the list of writers is a scanty one.

The geology of Cape Breton is notable on account of the development of two great rock series—the Carboniferous and the Pre-Cambrian. There are no measures known later than the upper portion of the productive Coal-Measures, and between the basal conglomerate of this period and the Pre-Cambrian there intervene only a few areas referred to the Devonian and the Lower Silurian.

The following formations have been recognized in Cape Breton by the officers of the Geological Survey:—

- Pre-Cambrian (Laurentian):
  - Including
    - The Felsite series,
    - The Crystalline Limestone series.
- Lower Silurian.
- Devonian.
- Carboniferous:
  - Including
    - Middle Coal-formation,
    - Millstone Grit,
    - Gypsiferous series,
      - Limestones, &c.
    - Lower Coal-formation.

Pre-Cambrian, Felsite Series.

The exact age of the strata included under this term has been a matter of doubt, and many have called them Laurentian. Their isolated position has precluded the chance of following them into regions where convincing stratigraphical relations can be found. The auriferous rocks of the Atlantic coast of Nova Scotia do not extend into the island, but they supply an important link in the geological sequence. They are considered to be Lower Cambrian, the equivalents of the Longmynd series, and appear with the Acadian series of St. John, New Brunswick, to belong to the gap

between the Lower Silurian or Upper Cambrian of Cape Breton, to be alluded to as probable equivalents of the Lower Potsdam or Lingula Flags, and the series under consideration.

This formation occupies more than one half of the island. North of the Bras d'Or lake it stretches in a wide belt to Cape St. Lawrence, interrupted only by the Carboniferous of Margaree River and Lake Ainslie, and by narrow fringes of the same strata around the shore and along the valleys of some of the larger streams rising in the centre of the island. Other large areas are occupied by these strata at Cape Mabou, Washabak, Judiqué, Mira, Boisdale, Coxheath, and St. Anns, where they rise prominent among the low-lying hills and valleys of the Carboniferous.

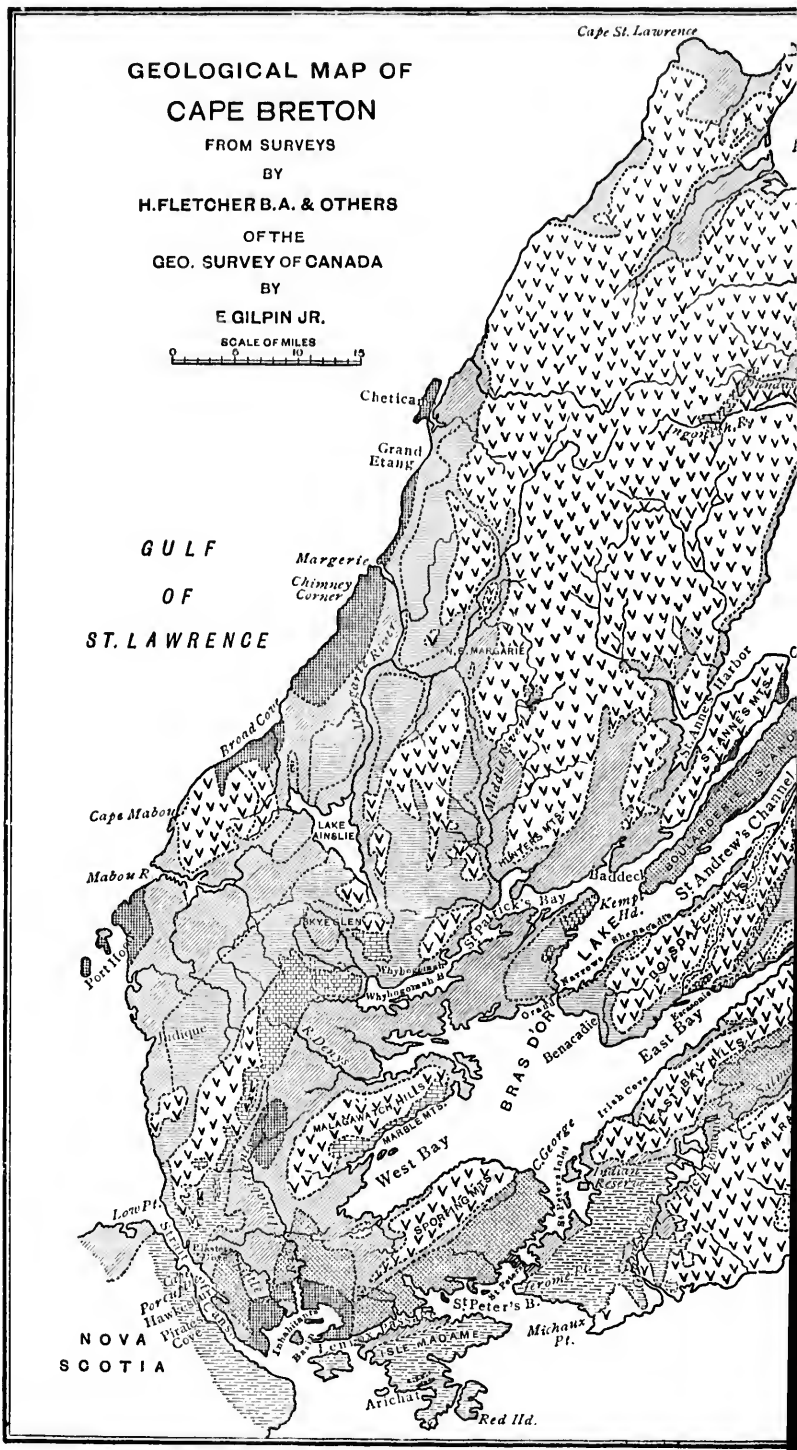
Two divisions have been recognized in these measures. The lower consists of laminated felsites and of interstratified porphyry and syenitic* and gneissoid rocks; the upper is characterized by the addition of great beds of limestone. Mr. Fletcher, speaking of the lower division, gives it as the result of his experience that both the felsitic and syenitic strata are intimately associated as part of the same group of crystalline rocks, differing not so much in composition as in the degree of crystallization they have been subjected to, and that as no evidence has been found proving the higher position of the felsites, they may at present be considered together.

The Washabak hills consist of gneiss, mica-schist, syenite, diorite, hornblende rock, quartzite, and felsite; all are more or less foliated, and sometimes in exceedingly thin laminæ. The Boisdale and Mirá hills are made up chiefly of obscurely bedded syenite, with limited areas of other rocks; the Coxheath hills of alternations of syenite, quartzite, and compact felsite; and the East Bay hills of felsite, syenite, and granite, in every gradation of colour and texture. In the Boisdale hills this series is represented principally by bluish and grey syenite. The syenite contains seams of a serpentinous mineral, and passes frequently into granite, quartzite, felsite, and a fine-grained porphyry, with interspaced flakes of hornblende, felspar, and mica.

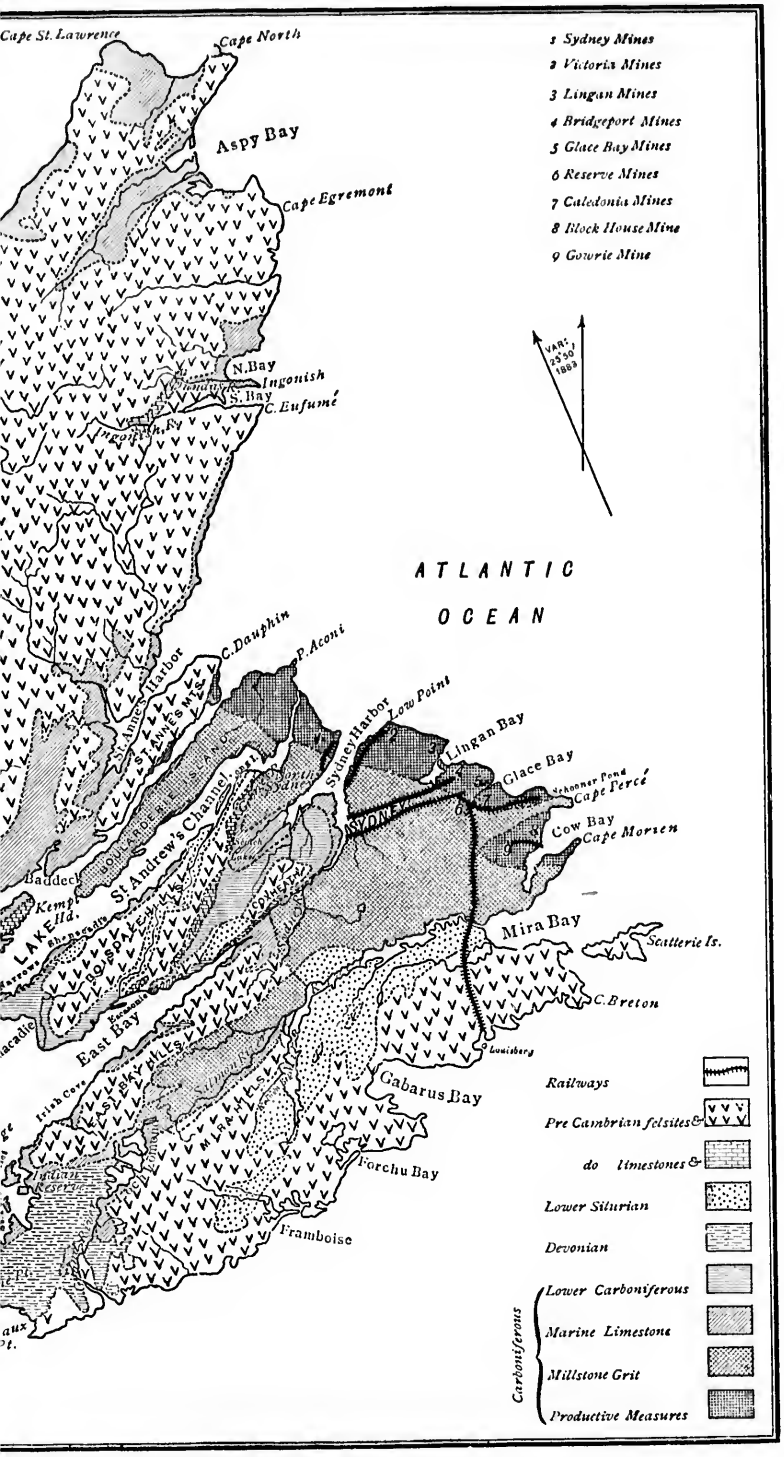
In the districts of Gabarus and Louisberg felsites predominate, and at the former place include beds of felspathic sandstone. Possibly further examination may assign these rocks to a horizon higher than that represented by the East Bay section (to be given below), or they may prove to be later than the crystalline limestone series.

At Cape Porcupine, on the Strait of Canso, slates occur with coarse syenite, and felsites resembling those of Louisberg and Gabarus. In the Sporting Mountains the felsites occur with red syenite, whereas the Craignish mountains are composed principally of reddish syenite, overlain by the limestone series. In the northern part of the island the exposures of the great expanse of these rocks present the same general features. It may be assumed that a more minute and extended study must be devoted to this interesting series of measures before it can be decided what subdivisions, if any, can be determined on.

* The term "syenite" is applied by the Canadian Geological Survey to a mixture of quartz, soda or potash felspar, and hornblende.


GEOLOGICAL MAP OF
CAPE BRETON
FROM SURVEYS
BY
H.FLETCHER B.A. & OTHERS
OF THE
GEO. SURVEY OF CANADA
BY
E GILPIN JR.
SCALE OF MILES
0 5 10 15
Cape St. Lawrence
Chetica
Grand Etang
GULF
OF
ST. LAWRENCE
Margerie
Chimney Corner
Broad Cove
Cape Mabou
Mabou R
Port Hood
Judique
LAKE AINSLIE
SKYE GLEN
Whycocomagh
Whycocomagh B
St Patrick's Bay
Baddeck
Kempt Hd.
LAKE Hd.
St Andrew's Channel
BOULARDERIE I.
BRAS D'OR
Benacadie
East Bay
MARBLE MTS
West Bay
George R
Low Pt
Port Hawkesbury
Pirate Cove
St Peter's B.
Michaux Pt.
NOVA SCOTIA
ISLE MADAME
Arichat
Red Hd.

[*To face* p. 526.


Cape St. Lawrence
Cape North
Aspy Bay
Cape Egremont
N. Bay
Ingonish
S. Bay
C. Eufumé
ATLANTIC
OCEAN
C. Dauphin
P. Aconi
St. Anne's Harbor
Low Point
Sydney Harbor
Lingan Bay
Glace Bay
Schooner Pond
Cape Percé
SYDNEY
Cow Bay
Cape Morien
Baddeck
St. Andrew's Channel
Mira Bay
Scatterie Is.
C. Breton
Louisberg
East Bay
Gabarus Bay
Forchu Bay
Framboise
1 Sydney Mines
2 Victoria Mines
3 Lingan Mines
4 Bridgeport Mines
5 Glace Bay Mines
6 Reserve Mines
7 Caledonia Mines
8 Block House Mine
9 Gowrie Mine
Railways
Pre Cambrian felsites &
do limestones &
Lower Silurian
Devonian
Carboniferous
Lower Carboniferous
Marine Limestone
Millstone Grit
Productive Measures

The following section at Irish Cove, East Bay, may serve to convey a general idea of the character of these measures, and of the association of the felsites with the red and grey syenites:—

	ft.
Greenish, white, and red laminated and granitoid felsite	480
Greenish felsite and red syenite	100
Bluish soft porphyry	85
Purple and bluish laminated felsite	233
Red syenite and reddish soft granitoid rock	247
Greenish and reddish granitoid rocks, often nearly pure felspar	269
Felsite and syenite of variable composition, with veins of calcite	130
Red granitoid felsite, with diorite	150
Similar alternations of red and greenish felsites and syenites make up a thickness of	3000
Red and grey syenite, coarse and fine	2333
Similar measures, composed of alternations of felsites, syenites, and aluminous micaceous shales, greenish and grey in colour, make up a section not less than 8900 feet in thickness.	

At numerous points throughout the island these measures are cut by dioritic dykes, some of which are as late as the Lower Carboniferous, but they have not yet been described in any detail.

Crystalline Limestone Series.

Unconformably resting on these strata, but agreeing with them in their general development and position, is an interesting series of felsites, syenites, diorites, mica-schist, quartzite, and quartzose conglomerate, interstratified with crystalline limestone and dolomite. These measures are locally known as the George's River Limestones of St. Andrew's Channel, the locality in which they are typically developed and were first referred to their true position.

The alternation of the limestone with the gneissoid and related rocks brings them into close connection with the felspathic group, from which, however, they are apparently separated, owing to the presence of red syenite and felsite pebbles in the lower conglomerates and by unconformability. Similarly the Lower Silurian conglomerates of St. Andrew's Channel have received witnesses from this limestone series. However conjectural any speculation may be as to the age of these measures, it is certain that, as compared with the metamorphic slates and quartzites of the Lower Cambrian auriferous strata of Nova Scotia and the fossiliferous Lower Silurian of St. Andrew's Channel, they mark a line equal to that observable between the latter and the indurated Devonian and Carboniferous of this island.

The area occupied by this limestone series is limited in comparison with that of the felsite group, but it was formerly, in all probability, of much greater extent, for it presents at several points traces of having suffered severe denudation prior to the deposition of the Lower Silurian strata; and this is borne out by the thickness of the George River section, viz. 6602 feet.

In the northern district a narrow band stretches between Dundas and Ingonish rivers. Excepting a small patch on Middle River, it is not met with again until the head of Whyhogomah Bay is reached,

whence it stretches in a broad band for several miles, and its former further extent is marked by isolated patches as far as Cape Porcupine, on the Nova Scotian side of the Strait of Canso. The Malagawatch hills are flanked by a narrow fringe of the same series, known as the Marble Mountain. It is most typically developed on the Boisdale and Coxheath hills, where it extends, in a narrow and interrupted band, from Escasonie, on East Bay, to St. Andrew's Channel.

The following section from the last-named district will serve as an index to its general character in the localities alluded to:—

	ft.
Compact granitoid felsite of many colours	74
Grey and greenish friable gneiss	23
Black and amber-coloured vitreous quartzite	115
White and grey syenite	140
Massive white vitreous quartzite	400
Bluish granitoid rock	3
Colourless laminated quartzite and red syenite	68
Greenish finely crystalline hornblende rock	141
Red syenite	8
White and bluish crystalline limestone	13
Red syenite	8
Greenish-grey granitoid felsite	29
White and bluish limestone and dolomite	8
Red syenite, felsite, and porphyry	7
Limestone, bluish and saccharoidal	16
Red syenite	2
White limestone and dolomite	378
Greenish fine-grained felsite	37
Greenish pyritous granite and felsite	112
Granitoid rock	18
Red syenite	37
Granite, quartzite, and bluish felsite	473
White, bluish, and grey quartz, bluish granite, and red syenite	3794

The above, with some concealed intervals, make up a thickness of 6602 feet.

These strata resemble in many points the Limestone series overlying the syenitic and felsitic group of Newfoundland and New Brunswick, and form the principal argument in favour of referring both series to the Laurentian. Mineralogically there is also a resemblance, for in Cape Breton, asbestos, mica, plumbago, and bedded iron-ores are frequently met among the limestone series, and the discovery of apatite would render the comparison with the Quebec Laurentian limestone complete.

Lower Silurian.

The area of this formation is limited. Its principal exposure extends along the southern side of the Mira River for about 30 miles, and has an average width of about 7 miles. A narrow, irregular band stretches from Escasonie, on East Bay, nearly to the mouth of the St. George's River, its width, however, never exceeds one mile. A small patch is also exposed at Shenacadie, on the Little Bras d'Or Lake.

The thickness of these measures has not been determined, as they

are greatly folded and repeated by faults. They are distinguished by numerous beds of conglomerate, and of fine and coarse grits, plainly derived from the Pre-Cambrian strata. At numerous points are found beds filled with species of *Lingula*, Trilobites (*Agnostus* and *Olenus*), *Orthis*, *Obolella*, &c., comparable with the fossils of the Lower Potsdam of the province of Quebec. At several points there are beds containing nodules of phosphate of lime, resolvable under the microscope into a bituminous paste holding siliceous matter and fragments of *Lingulæ* &c.,—coprolites, presumably of some of the larger species of Trilobites. Mr. Fletcher further draws attention to the general similarity of these measures to the primordial rocks of Newfoundland, and to those found by Mr. Richardson on the Strait of Belleisle. The following abstract of the section of these rocks, as exposed on Long Island, will show their general character in St. Andrew's Channel:—

1. Greenish-grey, coarse, calcareous conglomerate, containing red syenite, felsites, and quartzites of many colours, interstratified with coarse, micaceous, hæmatitic sandstones, and blue, purple, and red felsites.
2. Bluish, slaty felsite, with much calespar and hæmatite.
3. Greenish, calcareous, pebbly and shaly sandstones.
4. Dark blue, greenish, and red felsites, with pebbles and veins of calcspar.
5. Sea-green and bluish conglomerates, with pebbles of felsite, calcspar, quartzite, and argillite.
6. Bluish felsite, with much calcspar.
7. Bluish limestone.
8. Red conglomerate.
9. Bluish limestone, felsite, and contorted argillite, with veins of hæmatite and calcspar.
10. Bluish quartzose grit, passing into a red conglomerate.
11. Limestone and felsite alternating in thin beds.
12. Bluish-grey felspathic sandstone.
13. Alternations of felsite limestone, quartzite, and argillite.
14. Indian red sandy marl, with calcareous sandstone.
15. Bluish felsite, with beds of limestone and quartzite.

In the Mira River district, on the Sydney road, are met greenish, purple and reddish, soft, felspathic, micaceous, arenaceous shales and sandstones, quartzite, grit, and conglomerate, with pebbles of limestone and greenish argillite. On Kelvin's Brook are conglomerates containing pebbles of the Pre-Cambrian Measures, succeeded by purple, grey, and red quartzose and felspathic sandstone and grit, and by Indian red argillites; and on Salmon River are beds of whitish sandstone, with impressions of *Obolella*, &c., with red sandstone, marl, conglomerate, &c. It may be remarked that these measures are, as a rule, free from the eruptive rocks which characterize the succeeding formation at many points.

Devonian.

These measures occupy an irregular tract, extending from Loch Lomond to St. Peters, and reappear in Isle Madame. They are met with again in that part of Guysboro Co., in Nova Scotia proper, lying between Chebucto Bay and the Strait of Canso, and, recrossing the Strait, extend irregularly from Plaster Cove towards the head waters

of River Inhabitants. The available evidence points to the Devonian age of these measures, as laid down by Mr. Fletcher; but Sir J. W. Dawson is inclined to refer part, at least, to the Silurian. Further search may provide more fossil evidence, although, as Mr. Fletcher remarks, the rocks consist generally of shallow-water deposits.

The unconformability between this formation and the preceding is much more marked than between it and the Carboniferous; but the unconformable junctions with the latter are strongly marked at Arichat, Lennox Passage, and Guysboro Harbour by degrees of metamorphism, included pebbles, and stratigraphical position. The total thickness of the formation has not been ascertained, but the dimensions of various sections would corroborate that of Lennox Passage, where a vertical thickness of 10,000 feet has been measured.

The measures, as described by Mr. Fletcher, are arenaceous, argillaceous, and nacreous shales and sandstones, passing into grits of grey, red, and purplish shades, with beds of conglomerate holding quartzite and felsite pebbles. Limestones are met with at several points, and, as at St. Peters, Pirates' Cove, &c., appear to mark an upper horizon. At numerous localities masses of diorite and trap are protruded among these measures. This is especially noticeable in the vicinity of St. Peter's Canal. The canal itself is cut in a rock consisting essentially of a greenish-grey and bluish mixture of hornblende and felspars, intersected by veins of quartz and felspar. In the Indian Reserve, in the same district, the sedimentary rocks are broken through by grey and greenish compact and granular diorite, and pyritous epidotic felsite, traversed by veins of calcspar. At Jerome Point &c. are found exposures of black, greenish, and purplish compact or granular rusty-weathering trap, which is sometimes porphyritic or globular, and charged with zeolites, hæmatite, and chlorite. At several points near St. Peter's and Guysboro, important deposits of specular ore are met with, apparently associated with these eruptive rocks.

Carboniferous.

This formation is conspicuously developed in Cape Breton; and, apart from the fisheries, to its coal and fertile limestone and gypsum soils are due what measure of prosperity the island enjoys. Sir J. W. Dawson, in his 'Acadian Geology,' has arranged the Carboniferous of the Lower Provinces in the following subordinate formations:—

1. *The Upper Coal Formation*, containing coal-formation plants, but only thin coal-seams.
2. *The Middle or Productive Coal Formation.*
3. *The Millstone Grit.*
4. *The Carboniferous Limestone*, with marls, gypsum, &c.
5. *The Lower Coal-measures*, holding some of the middle coal-formation fossils and thin coal-beds.

Some districts do not present all these divisions, the lowest one being frequently wanting or sparingly represented. And in many

cases no divisional line can be drawn separating the Millstone Grit in its passage upwards from the Productive Measures, or downwards from the limestone series. The most instructive section is that at the Joggins, in Cumberland county, Nova Scotia, where all the subordinate formations are fully developed.

In several cases in Cape Breton the gradual passage of the subdivisions is strongly marked. In this island the arrangement of this formation is that of valleys between the ridges of the Pre-Cambrian hills, and their softer strata have been worn into broad river-valleys and rolling hills of inconsiderable altitude. When they rest on the flanks of the older hills, they present picturesque and charming gorges, worn by the brooks, which are long fed by the accumulated winter snows.

As the eastern district is the most typically developed, a brief description of it will answer for the central and northern ones, which resemble it in the physical characters of the rocks, and differ from it chiefly in the correlation of the subdivisions.

In the Sydney, or eastern district, as in the remainder of the island, the upper division is wanting, unless represented by a few beds at Low Point, and some of the upper beds of the River-Inhabitants district. The shore, from Cape Dauphin to Mira Bay, is occupied by the Productive or Middle Coal-measures, which are folded in three undulations having an east and west axis, corresponding to that of the Pre-Cambrian strata. As the measures are interrupted at the anticlines, the exact identification of all the seams is doubtful.

The following section in the Lingan district, in the centre of the field, will serve to show the relative thickness of the strata and of the included beds of coal:—

	ft.	in.
Seam A	3	0
Strata	306	2
Carr seam	6	5
Strata	191	0
Barasois seam	12	0
Strata	379	3
David Head seam	8	0
Strata	235	0
Seam D	3	0
Strata	78	0
North Head seam	4	0
Strata	76	0
Lingan Main seam	8	0
Strata	95	3
Seam G	2	6
Strata	340	5
Seam H	1	0

This section does not embrace lower coal-seams of workable dimensions included in the Millstone Grit of the Geological Survey.

Shales, arenaceous and argillaceous, with red and green marls, make up one half of the strata. The shales pass into sandstones, and frequently carry ironstone nodules; and the more argillaceous beds are crowded with fossils, chiefly ferns. Many trunks of erect

and prostrate *Sigillariæ*, with roots attached and growing into the coal, are seen in these shales. Trunks have been observed nearly five feet in diameter, but they do not usually exceed two feet. The term "marl" is here applied, not to beds necessarily calcareous, but to red and green shales which crumble on exposure. Sandstone-beds, grey and white in colour, and often fifty feet in thickness, are met at frequent intervals, and nearly always occur a few feet above the coal-beds. Many of the beds are calcareous, and are then flaggy, micaceous, and sometimes ripple-marked. Almost invariably underclays, highly charged with roots and rootlets, occur under the coal-beds, but in a few cases the coal-seams rest directly on thin beds of fossiliferous limestone, and, in one case, the floor is sandstone. The coal-beds do not merit any particular notice, being similar in many points to those of the Durham coal-field.

Millstone Grit.

The division-line between this formation and the Productive Measures is entirely an arbitrary one, and, as marked on the Geological Survey maps, is regarded by many as encroaching on measures that may fairly, so far as their coal contents are concerned, be considered productive. This is borne out by the fact that a collection of fossil plants, from a point apparently low down in this horizon, about two miles east of Sydney, shows species, according to Sir J. W. Dawson, occurring only in the Productive Measures, and especially in its higher beds.

As compared with the higher division, these strata show a much larger percentage of sandstones, frequently coarse and sometimes felspathic, fewer argillaceous beds, and much false stratification; and this formation is specially distinguished from those lying above and below it by the absence of calcareous matter. Near the old syenitic and felsitic rocks the prevailing colour is red; further away, where the material has been derived from the preceding Carboniferous horizons, grey shales are met with. The maximum thickness in this district is 5700 feet, but it rapidly diminishes towards the north, until at Cape Dauphin only 500 feet are found. Numerous coal-seams are met, some of workable size and persistent for long distances. The long arm of Millstone Grit, extending up the Salmon and Gaspereau rivers, contains several thin seams of coal, and may represent the formation as developed east of Sydney.

The Carboniferous Limestone.

In the Sydney district this formation occupies a triangular tract of country between the two arms of Sydney Harbour, and attains a thickness of about 2000 feet. It is composed principally of red and grey shales, sometimes approaching marls in aggregation, argillaceous and calcareous, and frequently carrying nodules of ironstone and limestone. Numerous beds of limestone are met, compact, laminated, or concretionary, usually grey and blue in colour, but sometimes black and bituminous; these are frequently associated with beds of gypsum and anhydrite, in some parts of the island over

200 feet in thickness. Beds of red and grey sandstone, usually laminated, often micaceous and ripple-marked, are frequently met with. The limestones generally contain the fossils characterizing this horizon, and are frequently charged with galena and copper pyrites, celestine and manganese ores.

The following section, from the 'Geological Survey Report,' 1875–76, p. 407, gives a good idea of the conditions under which the gypsum and limestone are usually presented:—

	ft.	in.
Bluish-grey columnar limestone	136	0
Green marl	9	0
Black bituminous nodular limestone, mottled greenish and red compact limestone	55	0
Gray, compact, green, and mottled limestone	40	0
White crumbling gypsum	15	0
Green gypseous marl	0	7
Pink gypsum	0	6½
Greenish gypseous marl	0	10
Pink gypsum and greenish marl	0	6
Red micaceous marl with gypsum	7	0
White gypsum	1	0
White gypsum and marl, with veins of gypsum	1	6
Nodular gypsum marl, and limestone	4	0

The gypsum varies greatly, and the following description of an immense cliff, over one hundred feet in height, on the Bras d'Or Lake, will serve to show its characteristic features. It is essentially white, but spotted and tinted with many colours. It lies in beds often massive, but frequently pointed in every direction. It is usually compact, but often granular, minutely crystalline, or fibrous and radiating. Crystals of selenite, of a brownish colour, frequently occur in it; they are isolated or arranged in radiating groups, and sometimes give the rock a porphyritic appearance. The rock is frequently traversed by veins filled with fibrous gypsum of various colours, or with large plates of transparent selenite. Layers and nodules of anhydrite and of limestone frequently occur in the beds or divide them. Long-continued weathering roughens the surface of the gypsum, owing to the presence of silica as sand. Glauber's salt, common salt, and carbonates of magnesia and calcium, sulphur, and several varieties of silico-borate minerals are not uncommon.

Lower Coal-Measures.

(Lower Carboniferous Conglomerate.)

This, the lowest member of the Carboniferous division, corresponding with the Bonaventure formation of Gaspé, and the basal conglomerate of New Brunswick and Newfoundland, is of variable volume, and cannot in this district be separated by any strict line from the overlying limestone formation; and it is the opinion of Mr. Fletcher that, in the districts surrounding the Bras d'Or Lake, much of it may be considered contemporaneous with the Limestone series.

In the Sydney district, near the Coxheath Hills, it has a thickness of 2525 feet, which rapidly diminishes as its strike is followed

to the north and south. This formation generally presents the aspect of a friable, reddish conglomerate, the pebbles varying in size up to a diameter of three feet. The masses are frequently of little coherence; in some cases the matrix is calcspar, hæmatite, or quartz. The conglomerates, the distinguishing feature of the formation, alternate with beds and masses of red and grey, coarse- and fine-grained, friable sandstones, and with beds of red and green marl and an occasional bed of limestone. Usually the upper beds are finer than those at the base, but many sections are largely made up of conglomerates.

Passing to the westward we meet the Carboniferous of St. Peter's Bay and the River Inhabitants. The marine limestone and some representatives of the division just alluded to border St. Peter's Bay and inlet and the northern shore of Isle Madame, and, passing under the higher divisions, skirt the Sporting Mountains, and passing round the head of West Bay, fill the valley of the River Inhabitants, and are exposed on the shore of the Strait of Canso at Plaster Cove. In this group are included measures which resemble more closely the typical Lower Coal-formation of Sir J. W. Dawson's 'Acadian Geology' than any met elsewhere in the island, and the tint on the map really includes both the marine limestone and the lowest division. These measures pass into the River Denny's basin and extend to the Grand Narrows.

The officers of the Canadian Geological Survey have grouped the Carboniferous measures overlying these subdivisions under the term "Middle" Carboniferous, including the Millstone Grit, Productive Measures, and beds referred with doubt to the Upper Coal-formation, as the dividing lines are obscure and the structure not yet fully worked out. On the map the Middle Coal-formation districts, as indicated by coal-crops, are marked by their appropriate tint, and the remainder of the debatable ground is referred to the Millstone Grit. Mr. Fletcher gives the total thickness of the Carboniferous strata at 21,960 feet, which probably embraces all the subdivisions already described in the Sydney district; and, possibly, the 1350 feet of measures referred to by him as overlying the Little-River coal-series (8926 feet thick) may represent part of the Upper Coal-formation, subdivision No. 1 of Sir J. W. Dawson. The measures do not present many points of interest calling for special mention. It may be remarked that the coal-beds and their extent are imperfectly known, and that they are not considered so valuable as those met elsewhere in the island. Some of the sandstones and shales of the River Inhabitants are little more than compact sand and mud, while at other points the rocks have the normal hardness of the Carboniferous strata.

In describing the Carboniferous strata lying north of a line drawn from Baddeck through Whyhogomah Bay to Low Point, Mr. Fletcher has adopted the following classification:—

Carboniferous { Middle: Millstone Grit and Middle Coal-formation,
Lower: Conglomerate and Marine Limestone;

but I have followed the regular classification on the map.

The Coal-measures now form patches of what was, in all probability at one time, a continuous outcrop from Judique to Cheticamp. These strata resemble those described in the Sydney district, and contain numerous beds of coal of excellent quality, which, however, have not yet been worked. The Port Hood coals, in their high contents of water, from 3 to 7 per cent., resemble lignite coals, but in all other respects are excellent bituminous coals. The Millstone Grit of this district appears to be limited in extent, and may be represented by some of the strata underlying the coal-beds of Port Hood.

The line between these strata and the Marine Limestone is sharply marked by unconformability and the change in the conditions of deposition. The general characteristics of this subdivision are similar to those already noted, and its distribution may be learned from the map.

Underlying the Limestone series are numerous wide-spread areas of grits, coarse sandstones, and conglomerates, with argillaceous shales and a few beds of limestone. At Judique, Mabou, Broad Cove, Forest Glen, Grand Etang, and Cheticamp these Measures are greatly altered by the intrusion of igneous rocks. In the Judique district these intrusive masses vary greatly in texture, colour, and composition, but are essentially dark, massive, granular, and compact, chloritic, dioritic, and felsitic rocks. At many places little change has been produced in the sedimentary rocks at the point of contact, but frequently the metamorphism has been so great that no line of contact can be observed. At other points these strata are comparatively unaltered, and at Hunter's Mountain, Whyhogomah, and Lake Ainslie they hold bituminous shales with impure coal-beds, show signs of petroleum, and resemble the Lower Coal-Measures of Plaster Cove.

Superficial Geology.

The superficial geology of Cape Breton does not present many points of interest. There are, I believe, no moraines to mark glacial action. The earth-covering varies according to the age and nature of the underlying strata. The Pre-Cambrian rocks are frequently almost bare, and their rugged and steep hill-sides afford soil only for the growth of timber; and rains following forest-fires have frequently denuded large tracts of almost every trace of earth. The more level tracts of the Pre-Cambrian, Silurian, and Devonian measures are diversified by numerous lakes, with slow streams and swamps. The soil is usually thin, clayey, or sandy, with boulders of the subjacent rocks. In the brooks and intervals sands and gravels are met with of recent derivation from the adjacent hills.

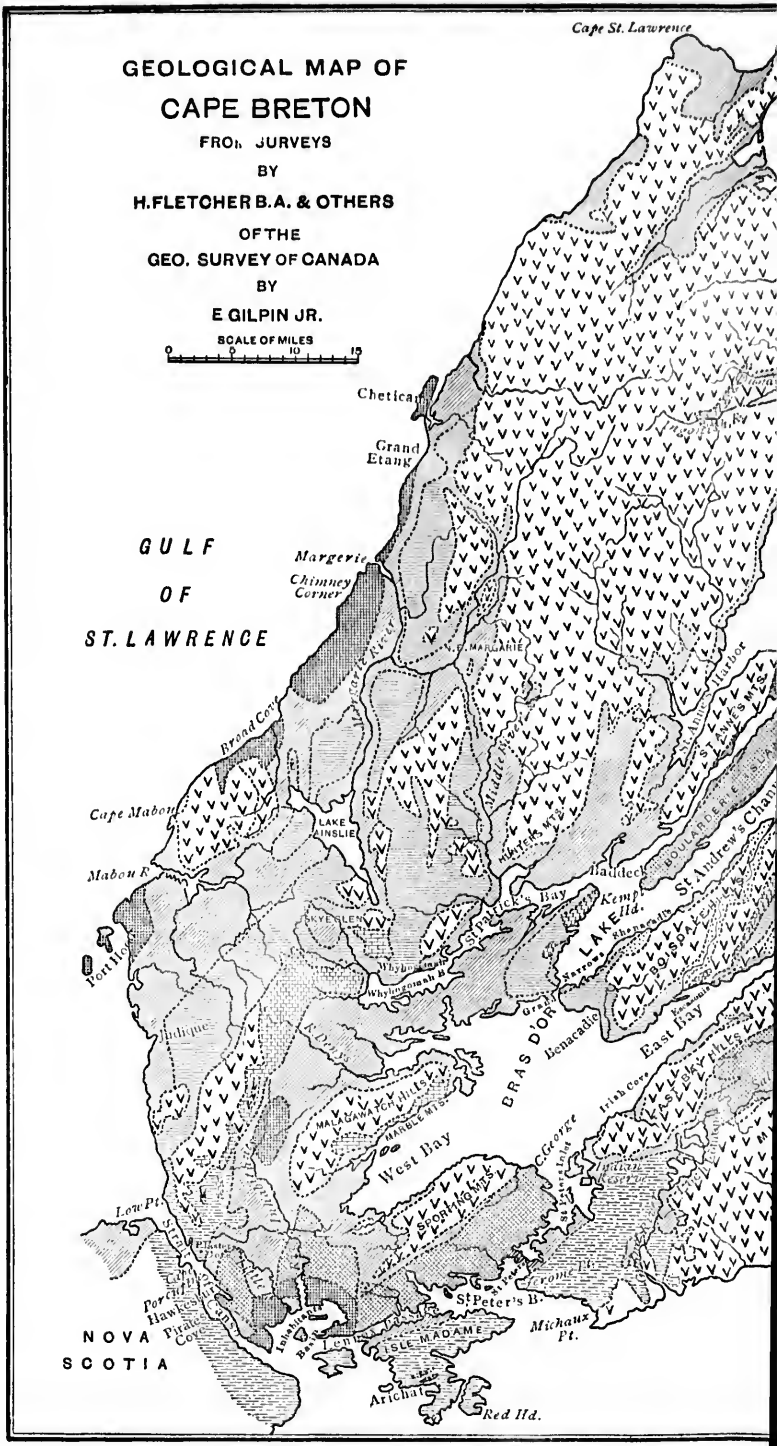
In the Carboniferous districts the soils are deeper and often of great fertility. The erratic boulders found over these measures are derived from the neighbouring subdivisions of the felsitic and syenitic series, and have seldom travelled far. In several localities peat and carbonized tree-trunks have been found under these clays, with remains apparently of *Mastodon giganteus* (?). There is a total

absence in Cape Breton of the fossiliferous marine clay characterizing the Post-Pliocene clays of the Lower St. Lawrence, and this may be due to rapid elevation of the land. At present it is thought by some that a slow subsidence is taking place.

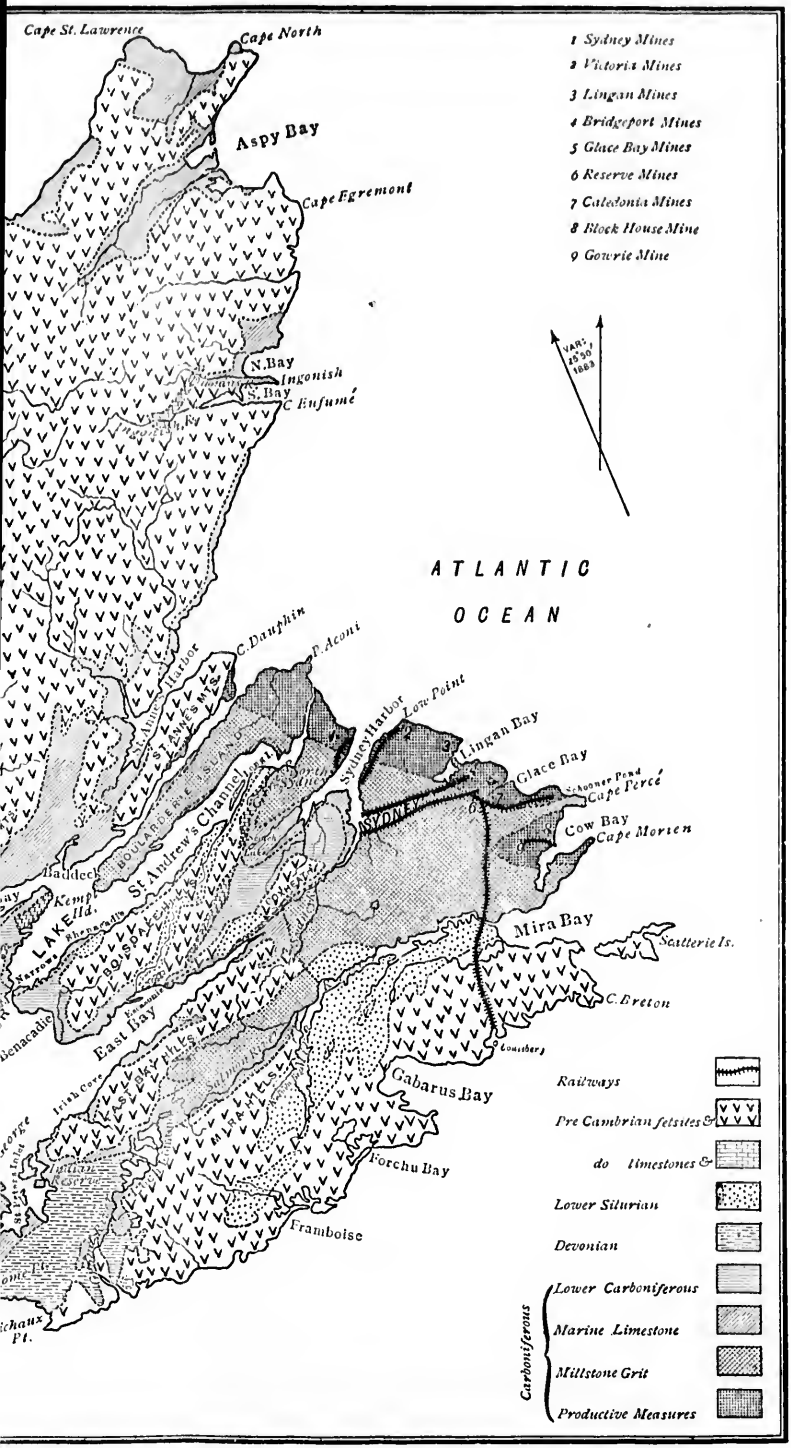
The Carboniferous measures of the Sydney district have suffered greatly by the action of the ocean, which is rapidly wearing them away. At some points, according to Mr. R. Brown, the shore recedes at an average rate of five inches per annum. This waste of the softer measures has furnished material for the sand-beaches which are numerous around the Bras d'Or Lake and along the south coast of the island. The older rocks are often rounded, but seldom show striæ. Around Sydney Harbour and to the east and south of Sydney the striæ are observed chiefly on the Millstone Grit, and vary between S. 45° W. and S. 78° W. magnetic. Similar courses are met with at East Bay, Gabarus Bay, Framboise, and other points on the south shore.

It is perhaps probable that the courses of the compact ridges of the Pre-Cambrian strata have determined much of the denudation, and that the Bras d'Or Lake and the principal river-valleys owe their form to the cutting-out of the softer shales and sandstones, which are now frequently presented as fringing the harder and older measures.

Some of the lakes present interesting marks of the action of ice. The winter's ice, when melted around the shores of the lakes and moved by the wind, frequently drives large boulders for yards before it; these leave long furrows in the mud, and remain, with a mass of small stones and earth, in front of them. In other cases, lakes are in this manner surrounded by dyke-like walls of stones and earth.


GEOLOGICAL MAP OF
CAPE BRETON
FROM SURVEYS
BY
H.FLETCHER B.A. & OTHERS
OF THE
GEO. SURVEY OF CANADA
BY
E GILPIN JR.
SCALE OF MILES
0 5 10 15
Cape St. Lawrence
Chetican
Grand Etang
GULF
OF
ST. LAWRENCE
Margerie
Chimney Corner
Broad Cove
Cape Mabou
Mabou R.
Port Hood
LAKE AINSLIE
Baddeck
Kempt Hd.
St Andrew's Channel
BRAS D'OR LAKE
Whycocomagh
Grand Benacadie
East Bay
West Bay
Low Pt.
Port Hawkesbury
Pirate Cove
NOVA SCOTIA
St Peter's B.
Michaux Pt.
ISLE MADAME
Arichat
Red Hd.

[*To face* p. 526.


Cape St. Lawrence
Cape North
Aspy Bay
Cape Egremont
N. Bay Ingonish
S. Bay
C. Enfumé
1 Sydney Mines
2 Victoria Mines
3 Lingan Mines
4 Bridgeport Mines
5 Glace Bay Mines
6 Reserve Mines
7 Caledonia Mines
8 Block House Mine
9 Gowrie Mine
Var: 25°30' 1883
ATLANTIC
OCEAN
C. Dauphin
L. Aconi
Low Point
Lingan Bay
Glace Bay
Schooner Pond
Cape Percé
SYDNEY
Cow Bay
Cape Morien
Mira Bay
Satterie Is.
C. Breton
Louisburg
St. Andrew's Channel
Baddeck
Kempt
LAKE Ild.
Bras d'Or
Narrows
Benacadie
East Bay
Irish Cove
Gabarus Bay
Forchu Bay
Framboise
Railways
Pre Cambrian felsites &
do limestones &
Lower Silurian
Devonian
Carboniferous
Lower Carboniferous
Marine Limestone
Millstone Grit
Productive Measures