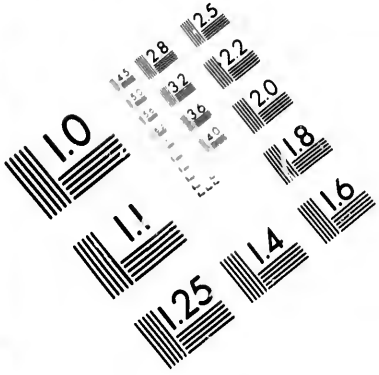

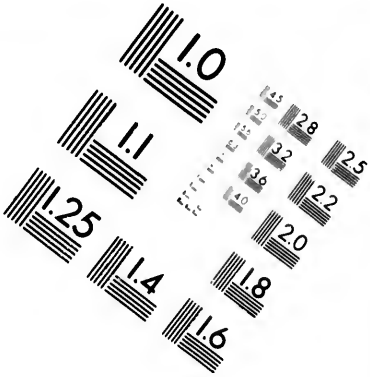

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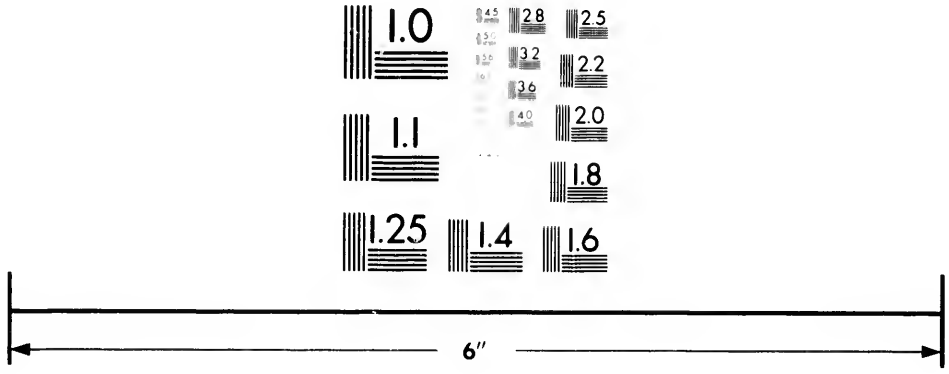

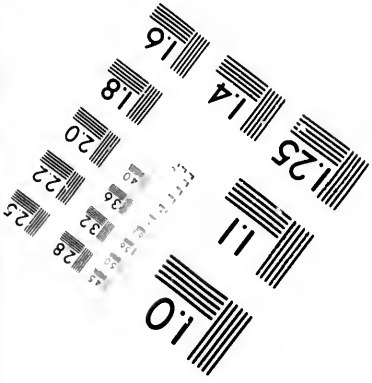

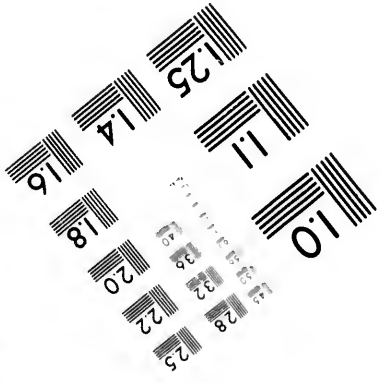

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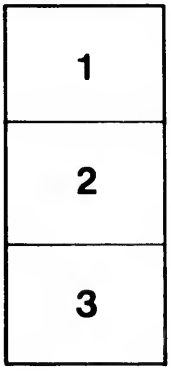

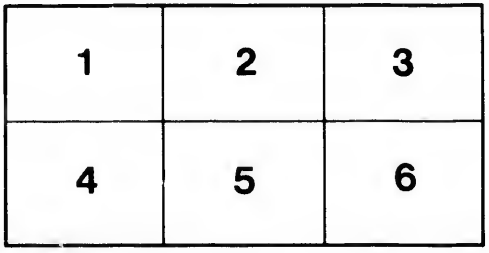

XII.—*Notes on the Limestones of East River, Pictou, N.S.*

By EDWIN GILPIN, JUN., A.M., F.G.S.

(Read May 27, 1886.)

The following analyses of limestones, from the Lower Carboniferous Marine Limestone series of Pictou County were made some years ago by the writer, when engaged in an investigation into the subject of fluxes for the extensive deposits of iron ore which characterize this district, and they may be appropriately prefaced by a few remarks on the extent and distribution of the Lower Carboniferous measures of East River.

The general arrangement of the subdivisions of the Carboniferous system in this county can be readily recognized, and is given in sufficient detail in Sir W. Dawson's "Acadian Geology." It may be remarked that, in the district more particularly referred to in these notes, viz., that extending from Glengarry, on the Intercolonial Railway, to McLellan's Mountain, the Lower Coal formation does not appear, and may be represented on the eastern edge of the district by the conglomerate beds of Irish Mountain and McLellan's Brook.

On Big Brook, a tributary of West Branch, about four miles above Hopewell, are met limestones and gypsum with red shale and flaggy sandstones, resting on Siluro-Cambrian measures, and dipping to the north. These limestones are exposed on the West Branch and can be traced south of Grant's Lake to the valley of East River. They are associated with red shales, and red and gray sandstones, and the measures are broken through by several masses of the dioritic trap, probably contemporaneous. Exposures of gypsum are not met until near the mouth of Archibald's Brook. Here a compact, blue limestone, about thirty feet thick, is overlaid by marl, and by an immense mass of gypsum, about 100 feet in thickness.

It is impure in quality, and contains layers of marl and siliceous matter. In the upper part, are layers of granular and fibrous, red gipsum. Above this come beds of hard, red, shale, having a general dip to the west. The course of the gypsum, as marked by funnel-shaped pits, is southerly or parallel to that of the river. Its final exposure in this direction is distant about three miles, at the Black Rock, where a small outcrop is visible on the east bank of the river, on the farm of Mr. J. McDonald. At this point, it is associated with a pyritous, greenish, compact marble, and a compact, blue limestone, carrying limonite, and the section rests on a great mass of an indurated breccia, connected with the Cambro-Silurian measures of the opposite bank of the river.

Underlying the strike of the gypsum, on the west side of the river, are frequent exposures of hard, shaly, red sandstone, of soft marl, and of red and green argillaceous shales, interrupted at several points by dykes of black and dark-green dioritic trap. These measures rest on the Cambro-Silurian slates, carrying specular and limonite iron ores, and

near the line of contact, at a point opposite the Black Rock, are met limestones carrying limonite. The bed of the river, and the narrow valley from this point for some distance south of Sunny Brae, are occupied by limestone beds (No. 1),[1] the principal exposures of which show a hard, compact rock, of grey and bluish colors, in places arenaceous or marly. Returning along the east bank of the river, on C. MacDonald's farm, is a compact, bluish limestone, holding rounded pebbles of the slaty breccia.

Still further north, at Bridgeville, opposite the large exposure of gypsum, already alluded to, trial pits showed limonite, filling the junction between Upper Silurian shales, and limestone and gypsum. In all probability this gypsum is connected with that exposed on the opposite bank of the river. Between this point and Springville, limonite and limestone mark the contact of the two systems. In the bank of the river, at McPhee's, is met a large bed of dark-blue, compact limestone (No. 2), weathering to an ochre, and holding nodules of hard, blackish, arenaceous limestone. The thickness of this bed is about 90 feet. At the point where the section is visible, the limestone folds over a spur of the Silurian slates, and its lower part holds fragments of it. The limestone strikes to the north-east, along the side of the hill, and is exposed again in the Cross Valley Brook in an interesting section. The gray and brown Upper Silurian slates, stained with patches of peroxide of iron, and filled with seams holding red and white quartz and calcspar, strike S. 75° E., and dip heavily to the north. Resting on them is a breccia of fragments of the slates. On the side next the older rock, the calcareous cement can hardly be distinguished, but at a distance of six inches, the slate fragments grow scattered and are united by dark-grey limestone, which quickly predominates to the exclusion of the slate. The limestone (No. 3), as exposed, is about fifty feet thick, but its normal dimensions are much greater.

Immediately overlying the limestone is a wide outcrop of gypsum and marl, imperfectly exposed, and extending to the road from Springville to New Glasgow. The line of junction then turns to the north, and passes over Irish Mountain, at the north end of which it is marked by conglomerates. The gypsum may be traced by surface pits, on the same course, but it is not exposed until A. Cameron's farm, south of Forbes Lake, is reached. Here it forms a large outcrop, resting on soft, grey marl and shale. The lower beds of the gypsum are laminated and impure in quality. In the middle of the deposit which appears to be about 60 feet in thickness, is a bed twelve feet thick, white and of good quality. A few tons are quarried annually and "boiled" for local use. The overlying beds are coarser, in quality, with layers of soft, white gypsum. Above the gypsum and marls are exposures of red and gray shales with limestones, giving in all a section of about 450 feet. The beds dip a little to the west of north, with an inclination which is heavy near the older rocks, but gradually diminishes toward the upper part of the section.

Returning toward Springville, at L. McLean's are met several thick beds of limestone (No. 4) dipping to the west of north, and overlying the gypsum, probably about 200 feet, the interval being occupied by red shales and marls. At the East River Bridge, near Springville, about on the line of McLean's limestone beds, are numerous exposures of compact, gray and blue limestone, sometimes argillaceous, succeeded by red and gray sandstones, with soft argillaceous shales and marls.

[1] The numbers given in the text correspond to those of the analyses, and to those marked on the sketch map.

The general relations of these strata may be gathered from the following section, from a survey of the East River, below Springville, made by me some years ago :—

	Feet.	In.
Black, bituminous, arenaceous shale	13	0
Black, bituminous limestone	24	6
Hard-blue limestone, with arenaceous bands	3	2
Very hard, compact, blue limestone	5	2
Soft, laminated, calcareous shale	2	3
Blue limestone	1	0
Soft, laminated, drab shale	0	4
Blue, argillaceous limestone	0	4
Calcareous, argillaceous shale, joints filled with calcspar and fluorspar	2	0
Gray, argillaceous limestone, in places passing into shale	2	0
Hard, blue limestone	2	10
Compact, white, calcareous sandstone	0	2
Shaly, drab marl, holding sandstone concretions, and veins of calcspar	13	9
Gray, compact limestone	0	6
Bluish-gray compact limestone	1	2
Drab, arenaceous shale	0	9
Soft, grey argillaceous limestone	1	4
Hard, blue, impure limestone	1	9
Gray, concretionary, argillaceous shale, with bands of arenaceous shale	10	0
Soft, gray limestone	0	11
Gray sandstone, calcareous	1	3
Bluish, arenaceous limestone	5	4
Hard, blue limestone	4	5
Gray, impure arenaceous and argillaceous limestone	5	9
Hard, blue, arenaceous limestone	1	4
Soft, drab shale	4	0
Impure, argillaceous limestone	2	4
Soft, red sandstone	1	6
Measures obscured (soft shale ?)	25	0
Rough, compact, blue limestone	3	10
Soft, grey, concretionary sandstone	2	6
Coarse, blue, argillaceous limestone	3	9
Measures concealed	39	0
Limestone	.....	
Total	186	11

Other sections show alternations of red and gray compact sandstones and red arenaceous shales, to the exclusion of limestones and marls, and, generally speaking, the limestones are not connected with extensive sections of sandstones.

About three-quarters of a mile below the Springville Bridge, is an exposure of limestone (No. 5) quarried for building purposes. Here there are several thick beds of argillaceous and calcareous shales, gray and breaking into thin splinters, and enclosing beds of pale blue or gray argillaceous limestone. These beds are very hard and compact and, owing to the presence of thin layers of calcareous fireclay or shale, split readily into blocks six to twelve inches thick. Similar limestones of a darker blue color, occur on the West Branch, and have been used successfully for construction purposes.

The measures referred to above are exposed in varying sequence in the river banks, as far as the forks, and preserve a general dip to the north and north-west, with frequent

faults and undulations. The Grant limestones (No. 6.) are apparently, about the middle of this formation, and may be paralleled with the Forbes, McLellan and Robertson limestones (7, 8, 9).

On the West Branch, a short distance above the forks, is a limited exposure of gypsum, which is associated with gray arenaceous limestone, and a series of thick bedded sandstones, holding Calcopyrite casts of plant remains. Similar limestones are met on the extension of the strike of these measures to the East Branch, and a bed of limestone (No. 10) several feet thick, composed of minute fragments of fossils, which give a rough pumice-like surface on weathering. This is, probably, the limestone referred to in "Acadian Geology" (p. 318), as showing in slices under the microscope, that it is made up of small fragments of shells, with entire specimens of very minute species.

Some of the limestones are well defined and persistent. At other points they are quite local. It sometimes appears as if there had been a local accumulation of calcareous matter (of shells or of a coral growth) which rapidly thinned from a central point, until lost in argillaceous or arenaceous matter.

The gypsum at the Forks may be considered as marking an horizon very near the summit of the Marine Limestone formation. It is difficult to arrive at any exact estimate of the total thickness of this formation in the district under consideration, starting from the basal limestone of McPhee's, and ending at the Forks. The longest continuous section that I have been able to measure, did not exceed 1,040 feet, but from all available data, the total thickness may be estimated at about 2,750 feet.

Below the forks of the river, measures referred by the officers of the Geological Survey to the Millstone Grit, are met as far as the base of the Productive Coal Formation, a short distance north of McKay's Brook, As yet, no fixed line can be drawn dividing these subdivisions. These millstone grit measures, it may be remarked, are distinguished from the corresponding horizon in other parts of the province by their highly calcareous nature—there being numerous beds of limestone, not usually equal in purity to those already noted, and the cementing material of the sandstones being often calcareous.

The Marine Limestones and their associated strata, become obscured as they approach the south side of the Coal Field on the east side of the East River, probably by east and west faults of great magnitude, similar to those which have on all sides limited the productive Coal Measures by an unconformable frame of Millstone Grit. Approaching Sutherland's River, they reappear and are noted for holding important deposits of spathic ore.

In this district I am not aware of any exposures of the peculiar "shell" limestone of Windsor, Shubenacadie, and Brookfield, referred by Sir J. W. Dawson, to Subdivision E of the Marine Limestone series, and parallelled by him with limestones belonging to the upper part of this section. This limestone is a mass of shells, principally casts, the delicate spirals of Spirifer and Athyris being frequently preserved intact. This characteristic limestone is largely quarried at Brookfield, as a flux for the Londonderry furnaces, and I am indebted to Mr. J. Sutcliffe, of the Londonderry mines, for the analysis of it, given further on, placed for comparison with one of the same rock from Windsor.

The analyses which I submit of East River limestones, were made by me sometime ago, when engaged in an enquiry into the question of fluxes for the extensive iron ore deposits of the district, some of which have been incidentally alluded to in my remarks.

They are of samples selected principally from beds considered important from their extent or convenience to transportation facilities. Their value is merely that of their being the first attempt at representing the composition of this mineral over a considerable tract of ground in Nova Scotia; and the point which is brought out, is of their comparatively non-magnesian character, except in the case of some of the lowest beds. They are arranged in ascending order, and their numbers correspond with those marked on the accompanying sketch map :—

(1.) Sunny Brae Limestone.—Color bluish, with seams of white and brownish calcspar, and occasional coarse grains of siliceous matter. Some parts of the deposit show obscure fossil marks.

Moisture	·656
Lime Carbonate	85·707
Magnesia Carbonate	3·155
Iron carbonate	1·167
Iron Sulphide	·905
Phosphoric Acid	·376
Insoluble	8·440
Total	99·866

(2.) McPhee's Limestone.—*Sample A.*—Smooth, compact, bluish gray with crystals of silica, and no visible fossils, weathers yellow.

Sample B.—From overlying bed of same exposure. Hard, black, laminated limestone, giving drab powder, and bituminous smell, fossiliferous.

Composition.	Sample A.	Sample B.
Moisture	.....	2·356?
Lime carbonate	84·220	58·112
Magnesia carbonate	11·250	6·571
Iron peroxide	·282	1·850
Manganese peroxide	1·100	.....
Sulphur	·031	·025
Phosphoric acid	trace	·351
Alumnia	·617	.....
Insoluble residue	2·650	30·760
Carbonaceous matter	.....	small
Total	100·150	100·025

(3.) Cross Brook Limestone.—*Sample A.*—From limestone near point of junction, compact, brittle, drab-colored limestone, with calcspar crystals, no visible pyrites or fossil markings.

Sample B.—From overlying part of same bed. White and gray, not very compact, crystalline limestone, weathering red, with a few crystals of galena and iron pyrites, and obscure fossil markings.

Composition.	Sample A.	Sample B.
Moisture	1·250	·115
Lime carbonate	91·500	58·766
Magnesia carbonate	·465	9·890
Iron carbonate	2·278	26·812
Manganese	trace	1·255
Alumina	·510	.....
Iron pyrites	·737	·168
Phosphoric acid	·198	.....
Insoluble residue	1·856	3·082
Total	98·794	100·088

(4.) McLean Limestone.—Compact gray limestone, with abundant fossil coral markings.

Composition.	Sample A.	Sample B.
Moisture	·18	·17
Lime carbonate	93·90	96·26
Magnesia carbonate	2·45	2·33
Iron peroxide	·59	·57
Manganese peroxide	·56	.55
Alumina	·12	·10
Sulphur	·03	.02
Phosphoric acid	·03	.03
Silica	2·10	1.99
Total	99·96	102·02

Analyst, Durham College of Science.

(5.) QUARRY LIMESTONE.—Flaggy, argillaceous limestone, drab colour, with few crystals of iron pyrites, and abundant fossils.

Moisture	·56
Lime carbonate	43·12
Magnesia carbonate	2·56
Iron carbonate	4·10
Manganese peroxide	2·55
Sulphur	....
Phosphoric acid	....
Insoluble residue, silicate of alumina, and a little sand	47·00
TOTAL	99·89

(6.) GRANT LIMESTONE.—Compact, grayish-blue, rough, red-weathering limestone, with veinlets of white iron and calcspar, and a few crystals of iron pyrites; abundant, obscure, fossil markings.

Moisture	1.110
Lime carbonate	90·660
Magnesia carbonate	2·360
Iron carbonate	2·280
Manganese	.....
Alumina	.515
Iron sulphide	·600
Phosphoric acid	·125
Insoluble residue	2·090
TOTAL	[illegible]

(7.) FORBES LIMESTONE.—Dark, earthy blue, rough limestone, with veinlets of white and brown ferruginous spar, and crystals of dogtooth spar, and grains of siliceous matter; no visible fossils.

Moisture	·124
Lime carbonate	89·600
Magnesia carbonate	1·560
Iron peroxide, Manganese peroxide	·589
Iron carbonate	1·550
Iron sulphide	·225
Phosphoric acid	·055
Insoluble residue	5·743
TOTAL	99·446

(8.) MCLELLAN LIMESTONE.—Compact, dark blue limestone, with numerous broken fossils; little visible pyrites.

Moisture	——
Lime carbonate	87·437
Magnesia carbonate	1·417
Manganese peroxide	·301
Iron peroxide	2·330
Iron sulphide	2·159
Phosphoric acid	trace.
Carbonaceous matter	·110
Insoluble residue	4·120
TOTAL	97·874

(9.) ROBERTSON LIMESTONE.—Dark, earthy blue, compact, argillaceous limestone, with numerous fossils and a few small crystals of silica and iron pyrites.

Moisture	1·156
Lime carbonate	78·344
Magnesia carbonate	trace.
Iron carbonate	2·224
Manganese carbonate	4·245
Iron sulphide	·482
Phosphoric acid	·064
Insoluble residue	11·600
TOTAL	98·115

(10.) FORKS LIMESTONE.—Compact, bluish-black limestone, with crystals of calcspar and spots of arenaceous matter.

Moisture	·330
Lime carbonate	79·130
Magnesia carbonate	2·185
Iron carbonate	5·619
Manganese oxide	trace.
Alumina	·495
Iron sulphide	·754
Phosphoric acid	·403
Insoluble residue	11·392
TOTAL	100·308

(11.) SHELL LIMESTONE.—The following are analyses of the "shell" limestone from Brookfield and Windsor, referred to in these notes:—

COMPOSITION.	BROOKFIELD.		WINDSOR.
	I.	II.	
Lime carbonate	97·39	98·844	97·64
Magnesia carbonate	·94	·396	1·10
Oxide of iron	2·70*	2·000*	·07
Phosphoric acid	——	——	trace.
Insoluble residue	trace.	trace.	·68
TOTAL	101·03	101·240	99.49

*Containing alumina.

These limestones, which can be compared most aptly to a heap of recently opened and cleaned shells thrown together, are notable for their freedom from phosphorus, sulphur, etc., and are apparently little beyond pure carbonate of lime, the iron oxide and alumina being carried in mechanically by water from the overlying clays.

CARBONIFEROUS MARINE LIMESTONE FORMATION AT EAST RIVER, PICTOU CO., N S
TO ILLUSTRATE MR. E. GILPIN, JUN.'S PAPER.

Limestones of East River Pictou County.

by

E. Gilpin.