ON THE METALLIFEROUS DEPOSITS OF GLOUCESTER, IN NEW BRUNSWICK.

Notwithstanding great part of Gloucester is still covered with virgin forests, many natural sections of the granite, slate, sandstone, conglomerate, and shale are exposed on the coast, and in the banks of several rivers, which converge towards Bathurst the County-town.*

(I.) The granite rises from beneath other rocks near the Bay de Chaleur, and extends thence in a south-westerly direction to the confines of the Province.†

* "The town of Bathurst is situated on either side of a harbour, or bay, some six or eight miles in depth, and four or five wide, which is formed by the mouths of three rivers—the Tatagouche, the Middle, and the Nepisiguit—which fall into it."—JOHNSTON, *Notes on North America*, II. (1845) p. 250.

† Lyell, *Travels in the United States*, II. (1845) p. 250, *Pl. II.*

"The granite, gneiss, and mica-slate form a broad riband extending across the Province, between two bands of clay-slate rocks."

JOHNSTON, *Report on the Agricultural capabilities of New Brunswick* (Second Edition, Fredericton, 1850), p. 8.

"The primary rocks of granite, gneiss, and mica-slate, form a broad belt extending directly across the Province, near its centre, in a north-easterly direction. * * * It enters the Province from the United States above Woodstock, embracing Mars Hill near the Des Chutes river, and the range of hills known as the Tobique mountains, all which, however, are less than 2,000 feet in height, except one which rises to the height of 2,170 feet. At the western end, this belt of hilly country, is supposed to be 40 miles wide; but it narrows gradually in its north-easterly course, and the hills decrease in height, until they finally disappear before reaching the Bay of Chaleur near Bathurst."

PERLEY, *Hand Book of Information for Emigrants* (London, 1857), p. 31.

"A low range of granite stretches from the Atlantic coast of Maine to the Bay of Chaleurs."—HIND, *Preliminary Report on the Geology of New Brunswick* (Fredericton, 1865), p. 41.

"The great central belt [of granite], entering the Province from the State of Maine, passes through the counties of York, Northumberland, and Gloucester, and extends to within a short distance of the Bay of Chaleur, at Bathurst."

BAILEY, *Observations on the Geology of Southern New Brunswick* (Fredericton, 1865), p. 84.

It occurs on both the Little and the Middle (Nepisiguit) rivers; and has been traced along the banks and in the bed of the (Big-river) Nepisiguit, at intervals, for nearly twelve miles towards the south. Greyish-white or pale-pink felspar, semi-translucent or milk-white quartz, and dark mica, are the common ingredients. The structure is mostly granular; though now and then it becomes porphyritic, as large crystals of flesh-coloured felspar abound. Sometimes, however, these preserve, among themselves, a certain parallelism; and the rock then—opening in somewhat ill-defined beds—assumes rather the character of gneiss.*

At Glendinning's island, near the last rapid in the Rough-waters of the Nepisiguit, a broad felspathic dyke of porphyritic structure †—bearing 20°—30° W. of N.–E. of S.—intersects the ordinary granite. And at the falls of the Pabineau as well as at the Middle Nepisiguit the prevailing rock is traversed by narrow veins of quartzose granite; ‡ of which the greater

* "The granite is first seen near the coast on Middle river, about a mile and a half west of the Nepisiguit, and an eighth of a mile from the Harbour. It appears on the Nepisiguit at the Rough Waters [which for] more than two miles flow over it. * * * Two and a half miles above the Pabineau falls granite also occurs in low domes on the north side of the Nepisiguit.

"At Rough Waters it consists of white felspar, black mica, and translucent quartz."—

HIND, *Preliminary Report on the Geology of New Brunswick*, pp. 42—3.

"The curious and beautiful channels of the Pabineau Falls are formed of nearly flat and water-worn masses of pinkish granite, which probably forms a great anticlinal axis."—BAILEY, *Observations on the Geology of Southern New Brunswick*, p. 11 (abridged).

† "At the foot of the Rough Waters there is a felspar dyke containing red crystals of the same mineral."

HIND, *Preliminary Report on the Geology of New Brunswick*, p. 44.

‡ Henwood, *Proceedings of the Geological Society of London*, III. (1841), p. 454.

number bear 25°–40° S. of E.—N. of W., but some range 20°–25° W. of N.—E. of S.*

Earthy brown iron-ore *(gossan)*—largely mixed with quartz in one of these—is the only metallic mineral yet found in the granite.†

The granite of different localities, is divided by joints, in the undermentioned directions.

Localities.		Directions.*		
Little Nepisiguit			25° N. of W. — S. of E.	
Middle Nepisiguit	Molloy's	20° W. of N. — E. of S.	....	30° N. of E. — S. of W.
	„ Second spot			20° N. of E. — S. of W.
	„ Third spot			25° E. of N. — W. of S.
Nepisiguit	Falls of the Pabineau	20° W. of N. — E. of S.	25° N. of W. — S. of E.	25° E. of N. — W. of S.
	„ Second spot	20° W. of N. — E. of S.	25° N. of W. — S. of E.	
	Rough-waters	20° W. of N. — E. of S.	25° N. of W. — S. of E.	40° N. of E. — S. of W.

(II.) The slate series is of varied character.

(*a.*) A fine-grained though an irregular admixture of felspar and hornblende, thinly sprinkled with small crystals of felspar, forms sometimes a crystalline, but more frequently a thick lamellar, slate, of green, grey, or brownish hue; which dips towards the west, and

* "In 1840 the Magnetic declination observed at Dalhousie (Heron) island in the river Restigouche was 20° 15′ West."

Bayfield, *Phil. Trans*, cxxxix. (1849) p. 211. Sabine, *Ibid*, *Pl. XIV.*

† "Beyond their application for building purposes * * * the rocks of this series are without economical value."

Bailey, *Observations on the Geology of Southern New Brunswick*, p. 86.

either overlies, alternates with,* or is penetrated by highly felspathic, and occasionally hornblendic, granite,† in various parts of the Middle river.

The slate contains much quartz; which occurs now and then in isolated masses, but more commonly in veins. Most of these are only a few feet, but some are several fathoms, in length; and though usually less than an inch, one here and there is three or four inches, in width. Notwithstanding their somewhat variable direction, they often affect two distinct series; one bearing 20°—25° E. of N.—W. of S., the other about E and W. The first coincides with one system of joints in the granite below; ‡ but both are oblique to the cleavage. Where they interfere—a few unite; —some are simply intersected by others;—and, occasionally one is *(heaved)* displaced by another; but the displacements—even of similar parallel veins by the same intersecting vein—are frequently in opposite directions.§ And sometimes the vein which intersects

* "The granite consists of a series of very narrow belts (at least ten in number on the Miramichi) with schists and metalliferous slates between them."

HIND, *Preliminary Report on the Geology of New Brunswick*, XIII.

De Luc, *Geological Travels.* III. p. 293. William Phillips, *Geol. Trans.*, O.S., II. pp. 152—5. Sedgwick, *Cambridge Phil. Trans*, I. p. 122. Richard Thomas, *Survey of the District between Chasewater and Camborne*, pp. 10, 34, 44. Carne, *Cornwall Geol. Trans.* II. p. 74. Hawkins, *Ibid*, p. 378. von Oeynhausen & von Dechen, *Phil. Mag. & Annals*, V. pp. 241—2. Boase, *Cornwall Geol. Trans.*, IV. p. 303. Henwood, *Phil. Mag. & Annals*, X. p. 360; *Cornwall Geol. Trans.*, V. pp. 50,—8, 61, 71, 96, 148, *Tables VII., XXI., XLIII., LIII., LVIII., Pl. VI. fig. 5.*

† "At the Middle river the granite is overlaid by thick-bedded greenish slate; which is traversed, near the junction by numerous veins of granite."

HENWOOD, *Proceedings of the Geological Society of London*, III. p. 454.

‡ *Ante*, p. 492.

§ Thomas, *Survey of the District between Chasewater and Camborne*, p. 22. *Ante*, p. 183, Note.

in one spot, is itself intersected in another. All these, however, are severed by beds and narrow veins of granite.

In the same neighbourhood a broad band of felspar porphyry * interlies the slate, conforms to its cleavage, and shades into it gradually on either side.

Neither metal nor ore, of any kind, has yet been found in the vicinity.

(*b.*) At Long Meadow, on the Nepisiguit, many irregular concretions, and short, crooked, veins of quartz, are enveloped in a thin body of much-contorted, green, chloritic slate,† which separates the granite ‡ from the sandstone.

From the Middle Landing to the Red Brook the slate still abounds in chlorite; but disintegrated felspar is not uncommon, and scales of red iron-ore often face both the planes of cleavage and the joints.

(*c.*) At Daly's—an eastern settlement—on the Tattagouche §—the slate is homogenous, deep-blue,—and of silky lustre. Its planes of cleavage—which dip towards the north-west—are interlaid by short, thin, conformable beds and small concretions of quartz, slightly sprinkled with iron-pyrites, and minute quantities of yellow copper-ore.

* Henwood, *Proceedings of the Royal Geological Society of Cornwall*, 9th Oct., 1840.

† "Near the Long Meadow a greenish slate-rock is in contact with the granite." Henwood, *Proceedings of the Geological Society of London*, III. p. 454.

‡ *Ante*, p. 491.

§ In the Maps of the Society for the Diffusion of Useful Knowledge (130—1) this river is called the Jittingouche.

(*d*.) About eight miles north-west of Bathurst the Tattagouche rushes through a wooded ravine, scarcely a stone-throw in width, but, perhaps, one hundred feet in depth; where—from the different hardness, and the unequal wear, of various parts of its bed,—it forms a singularly beautiful cascade.

The rocks immediately below the fall, and their continuation in either bank, consist mostly of greenish chlorite irregularly banded with brown felspar; opening—obliquely to such bedding—in a somewhat imperfect lamination, which dips towards the south.

The precipice is flinty-slate of chocolate hue; divided, by short curved joints, into small lenticular masses, of compact structure at the surface,* but slightly schistose underground.

The succeeding rocks are generally thick lamellar, but occasionally they are fissile; their colours are of every variety between chocolate-brown and light-pink, yet sometimes they are either shaded with green, or mottled with black and white. Isolated cubic crystals, as well of vitreous copper-ore as of iron-pyrites, occur at considerable intervals; and from this part of the series, — but from no other, — a few specimens of *Crinoïdea* have been obtained.† The grey and black

* "Close to an interesting fall of the Tatagouche, where it partly cuts its way through, and partly falls over, the edges of hardened slate-rocks, a manganese mine [was formerly wrought]."—JOHNSTON, *Notes on North America*, II. p. 10.

† "In a reddish-brown slate near the Tatagouche falls some portions of an *Encrinite* were found."

HENWOOD, *Proceedings of the Geological Society of London*, III. p. 454.

"At the falls of the Tattagouche * * * the beds of slates are highly colored, oxides of manganese are often separately aggregated,—but are occasionally mixed with brown iron-ore,—in short, narrow, lenticular masses, small shapeless lumps, and thin strings of quartz flecked with slaty matter; which—generally conforming to the planes of cleavage, though now and then throwing off *branches* on either side,—are, at intervals, enclosed in the slate, for a width of several fathoms.*

(*e*.) The rocks next in succession have much the same composition and structure, but are of bluish-green hue, and silky lustre. They alternate, at wide intervals, with bands of greenstone; which, unlike the flinty-slate at the falls,—are compact underground, but schistose at the surface. Both the clay-slate and the greenstone are interlaid by conformable beds of rather different character; which are usually several

in some parts red, in others deep brown or black, and strongly resemble those near the Falls of the Nepisiguit. They cross the stream with a strike E. 10° S., having a dip of about 50° towards the South."

BAILEY, *Report on the Mines and Minerals of New Brunswick*, p. 12.
HIND, *Preliminary Report on the Geology of New Brunswick*, p. 149.

* "At the Tattagouche falls a reddish-brown slate contains many small vermicular and nodular masses of the oxide of manganese."

HENWOOD, *Proceedings of the Geological Society of London*, III. p. 454.

"Grey oxide of manganese, highly crystallized and of fine quality, has been worked to some extent on the Tattagouche river, near Bathurst, and thence shipped to England."—PERLEY, *Hand Book of New Brunswick*, p. 36.

"The manganese is found in veins of various sizes, imbedded in quartz, and running without much regularity through the slates, which are everywhere stained with it. The manganese, which is the black oxide, is highly crystallized and affords very handsome and brilliant specimens, the crystals being sometimes as much as half an inch long, and grouped in fibrous, radiating, and stellate forms. The lode-stone of the manganese is both heavy-spar and quartz, the lode-walls being slates."

BAILEY, *Report on the Mines and Minerals of New Brunswick*, p. 13.

fathoms—though at times of but a few feet—in length; and commonly from twelve to eighteen inches—yet now and then of three or four feet—in width. Their central parts consist mostly of quartz; but towards their extremities they shade gradually into the slate, and are no longer identified. Several of these, and a few of the joints, contain quantities of iron-pyrites; sometimes slightly mixed and thinly sprinkled with yellow copper-ore.*

(*f.*) Near Clarke's camp, an upper part of the same river, and at Armstrong's brook, one of its tributaries, homogenous, blue, clay-slates,† which alternate with narrow bands of greenstone, are interlaid by conformable beds of quartz mixed, more or less, with slaty clay, calcareous-spar, and galena, as well as with iron and copper pyrites. Several such beds have been opened at both places, but in vain.

(*g.*) Within a short distance of Bathurst the Little (river) Nepisiguit falls, in a picturesque cascade, over a broad bed of greenstone; disposed in layers alternately of compact and of schistose structure; fine-grained in some, but coarse and porphyritic in other, places. The cleavage of the rather fissile, homogenous,

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* "The copper lodes do not approach those of manganese, although both are imbedded in metamorphic slates. There is, however, a marked difference of color between them; the manganese rocks being reddish and approaching black, while those bearing copper are of a bluish tint. The two are conformable—*i.e.* their planes of stratification are parallel—the manganese being superior. Both are inclined at a very high angle. * * * The lodes containing the copper ore are numerous, there being no fewer than seven within sixty feet. * * * They are composed of quartz, rocks called *flugan* and *gossan* by the miners, with *mundic* or iron pyrites, and the ore, copper pyrites."—Bailey, *Report*, p. 13.

† Henwood, *Proceedings of the Geological Society of London*, III. p. 454.

glossy, bluish-grey, slate it interlies is, on both sides, parallel to that of the schistose greenstone. Both above and below the fall, the clay-slate, for a width of several fathoms on either side of the broad band, is likewise interlaid by conformable beds, composed chiefly of quartz, yet here and there mixed with slaty matter, scaly red iron-ore, and iron pyrites.* After short ranges, however, all such beds merge in the *(Country)* slate.

(*h.*) From ten to twelve miles up the Middle (river) Nepisiguit the quartzose clay-slate which prevails is interlaid by lenticular bodies of quartz; but—though enclosing isolated masses of slate—they afford no trace of ore.

(*i.*) At the Narrows of the (Big river) Nepisiguit homogenous, glossy, deep-blue clay-slate alternates with broad bands of quartz, here and there friable, but generally of granular structure. These are, in many places, heavily charged with iron-pyrites; which has yielded to atmospheric influence and deeply tinged its matrix.†

* "Among the specimens shown me by Mr. Baldwin, formerly Sheriff of Gloucester County, was one of auriferous quartz, which he had found upon Grant's Brook, a branch of the Little Nepisiguit several years ago. Its surface exhibited numerous branching veins of gold, and promissed to yield, by crushing, considerably more. He had since hunted for more in the same locality, but without success."

BAILEY, *Report on the Mines and Minerals of New Brunswick*, p. 14.

† Red slates, similar to those which are found near Woodstock, are seen a little above Nine Mile Brook. The river runs on the strike of the rock here, and the purple-red slates which occur five miles higher up the stream, are repetitions of the red slates, more deeply colored with manganese than iron. Indeed, it may be said that for a distance of six miles the river appears to flow on or close to the belt of red slates, with their iron and manganese ores."

HIND, *Preliminary Report on the Geology of New Brunswick*, p. 148.

(*j*) In the crumpled and contorted chloritic slate,* which prevails near the Middle Landing, disintegrated felspar is occasionally a large ingredient. The joints are often faced with minute crystals of quartz, and filled with earthy red iron-ore.

(*k*.) Between the Middle Landing and the Portage-brook spheroidal concretions of argillaceous matter abound in certain beds which alternate with the ordinary thick-lamellar, bluish-grey, clay-slate. At and near the water's edge, it contains a few thin layers of quartz sprinkled with iron-pyrites; but, after very short courses, they dwindle and disappear.

(*l*.) The Chain of Rocks consists of fine-grained greenstone-slate.

(*m*.) The Grand fall of the Nepisiguit has worn a deep pit in the, slightly quartz-veined, dark-blue clay-slate at its foot.†

(*n*.) At the edge of the fall globular and reniform masses of quartz, crystals of felspar, and lamellar hornblende form thick beds; interlaid by a band of similar ingredients, but of compact structure, in one spot; and by lenticular bodies of quartz, said to contain copper-pyrites, in other places.‡

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* *Ante*, p. 494.

† "Below the Falls, and close to the first Salmon Pool there is a belt of glistening talcose-micaceous schist, * * * of a brilliant and lustrous golden color."—HIND, *Preliminary Report on the Geology of New Brunswick*, p. 148.

"All the rocks in this vicinity are highly ferruginous, the slates being sometimes micaceous, and at others containing cubical crystals of the sulphuret of iron."—BAILEY, *Report on the Mines and Minerals of New Brunswick*, p. 10.

In this pool two Indian boatmen, who accompanied the writer, speared, by torch-light, twenty-three salmon in an hour.

‡ "The slates just below the Falls are porphyritic, but a cursory examination failed to detect in them any traces of copper. * * *

The following columns show the *strike* and dip of the cleavage, as well as the directions of certain joints, in the slate-rocks already mentioned.

Localities.		Cleavage. Direction.	Cleavage. Dip.	Joints. Direction.
Tattagouche	Daly's]	25° E. of N. — W. of S.	N.W. 60°-70°	
	Falls*	20° N. of E. —S. of W.	S. 60°—70°	
	Above Falls	E.—W.	S. 45°—50°	
	Clarke's camp	N.E.-S.W.	S.E. 65°	S.E.—N.W.
		25° E. of N. —W. of S.	S.E. 70°	25° S. of E. —N. of W.
	Armstrong's brook	25° E. of N. —W. of S.	S.E. 70°	25° S. of E. —N. of W.
Little Nepisiguit		25° E. of N. — W. of S.	S.W. 70°	S E.—N.W.
Middle Nepisiguit		25° S. of E. — N. of W.		
Nepisiguit	Narrows	25° W. of N. — E. of S.	S.W.	
	Long Meadow †	—	Contorted.	
	Middle Landing†	40° W. of N. — E. of S.		

"At the Grand Falls a highly siliceous rock, of slaty character, was seen to contain specks of sulphuret of copper."

HIND, *Preliminary Report on the Geology of New Brunswick*, p. 147—8.

"Contorted slates form the wild scenery of the Nepisiguit Falls."

BAILEY, *Report on the Mines and Minerals of New Brunswick*, p. 10.

"On the lower Nepisiguit, near the Grand Falls, I collected the sand and gravel which had been lodged in crevices on the side of a deep declivity down which a small stream flows in spring and autumn. I washed about one gallon of the sand and found several small grains, two filaments, and some very fine gold."—HIND, *Preliminary Report on the Geology of New Brunswick*, p. 224.

* "These beds of slate * * * cross the stream with a strike E. 10° S., having a dip of about 50° towards the south."—BAILEY, *Report*, p. 13.

† "Pursuing our way from the Falls, we pass over sandstones and slates dipping westward."—*Ibid*, p. 10.

Localities.		Cleavage. Direction.	Cleavage. Dip.
Nepisiguit	A furlong below Grand Fall*..	40° W. of N. — E. of S.	S.W. 60°-70°
Nepisiguit	Below G. Fall*	40° W. of N. — E. of S.	S.W. 70°
Nepisiguit	Grand Fall ..	40° W. of N. — E. of S.	S.W. 70°

(III.) The succeeding rocks are conglomerates, sandstones, and shales.

(*a.*) About two furlongs below Blackstock's mill on the Tattagouche, the conglomerate—which abounds in rounded masses of slate and quartz,—rests, in almost horizontal beds, on a fissile, greenish, but somewhat variegated, slate; of which the cleavage dips about 70° towards the S.W.†

(*b.*) The thin stratum of contorted slate, which rests on granite at the Long Meadow,‡ is overlaid by nearly horizontal beds of conglomerate,§ and these

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* "Below the Falls, the talco-micaceous schist [has] an easterly dip."
HIND, *Preliminary Report on the Geology of New Brunswick*, p. 148.

† "The clay-slate * * * which forms both banks of the Tattagouche * * * is overlaid near Blackstock's mill by the * * * conglomerate of the coal-measures."—HENWOOD, *Proceedings of the Geological Society*, III. p. 464.

"The country over which we passed [between Dalhousie and Bathurst] consisted of the highly-inclined upper Silurian beds, with occasional limestones occurring among them, * * * . Over these rocks, in many places were spread, in patches more or less extensive, horizontal old red-sandstone beds."
JOHNSTON, *Notes on North America*, II. p. 2.

‡ *Ante*, p. 494.

§ "Near the Long Meadow a very much contorted greenish slate-rock, which rests on the granite is overlaid by a coarse quartzose conglomerate, with apparently a ferruginous basis."
HENWOOD, *Proceedings of the Geological Society*, III. p. 464.

"Two miles below the Second Landing [nearly horizontal strata belonging to the *Bonaventure* formation] cover up rocks belonging to the *Quebec* Group; and on the north side of the river they form cliffs 20 feet high, consisting of brick-red shales and sandstones, resting upon a coarse conglomerate."
HIND, *Preliminary Report on the Geology of New Brunswick*, pp. 57,—9.

are succeeded by layers of siliceous sandstone deeply tinged with iron.

(*c*.) From the Red Brook upward a similar conglomerate rests almost horizontally on the granite.*

Notwithstanding a dyke of porphyry and veins of granite traverse the granitic mass within a short distance,† and similar veins penetrate the slate at the Tattagouche,‡ neither one nor other enters either the conglomerate, sandstone, or shale.

(*d*.) A few fathoms above the high-road from Bathurst to Miramichi the left bank of the Nepisiguit presents the following section §;—

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* "From within a mile of Bathurst to the Pabineau falls the granite is surmounted by conglomerates and sandstones of the coal-measures; the beds of which are almost exactly parallel to the surface of the rock beneath."

HENWOOD, *Proceedings of the Geological Society*, III. p. 454.

"The Rough Waters, more than two miles long, flow over granite, but on either side the *Bonaventure* [conglomerate and sandstone] formation may be recognized reposing horizontally upon it, and filling all depressions."

HIND, *Preliminary Report on the Geology of New Brunswick*, p. 59.

Messrs. Hind and Bailey describe various parts, and tributaries, of the Nepisiguit by names different from those by which they were known, to the inhabitants of Bathurst, and to the Indian-boatmen who accompanied the writer on that river, in 1840.

† *Ante*, p. 491.

‡ *Ante*, p. 494.

§ "This formation was seen at Bathurst, by Sir William Edmond Logan, and described by him in the *Geology of Canada*. * * * The following section of the strata occurs at and near the abandoned mine, on the Nepisiguit;—

	feet
1. Chocolate-red micaceo-arenaceous shale, with casts of shrinkage cracks.	30·
2. White quartzose conglomerate, the thickest part of which is two feet, diminishing in one direction to two inches, in the space of 15 yards. The bottom is very white, and contains quartz pebbles, some which are an inch in diameter	1·
3. Whitish-red argillo-arenaceous shale, forming a passage to the next bed below	0.5
Carried forward	31·5

North—north-east.	feet.	South—south-west.	feet.
1. *Drift*, containing pebbles of granite, slate, & quartz ..	2	1. *Drift*, containing pebbles of granite, slate, & quartz ..	2
2. Reddish-brown siliceo-micaceous sandstone	30	2. Reddish-brown siliceo-micaceous sandstone	30
3. QUARTZOSE CONGLOMERATE.	1	3. *Blue argillaceous shale*, containing lignite and the remains of plants, impregnated in some places with copper-ores.............	0—3
4. *Blue argillaceous shale*, containing lignite and the remains of plants, impregnated in some places with copper-ores	0—3	4. QUARTZOSE CONGLOMERATE.	1
5. Siliceous sandstone ..	thickness unseen.	5. Siliceous sandstone ..	thickness unseen.

A joint, bearing 25° E. of N.—W. of S., less than an inch wide.

(*e*.) About two furlongs further up the river, the materials—in a lower part of the bank—are somewhat differently disposed;—

	feet.
1. *Drift*, containing pebbles of granite, slate, and quartz	2·
2. Coarse quartzose conglomerate	1·5
3. Reddish-brown siliceo-micaceous sandstone	1·5
4. Quartzose conglomerate, interlaid by a few thin beds of sandstone..	3—5·
5. Brownish-red sandstone, interlaid by thin beds of greenish hue ...	1·5
6. Blue argillaceous shale, containing lignite and the remains of plants; slightly penetrated in some places with copper-ores.	1—4·
7. Quartzose conglomerate	thickness unseen.

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	feet.
Brought forward........	31·5
4. Whitish-red argillo-arenaceous shale in parallel layers; this bed thins out about 30 yards up the stream. It is charged with the remains of broken plants, some of which are replaced by the vitreous sulphuret of copper, coated with a thin covering of green carbonate. Some are in part replaced by the copper ore, and partly converted into coal. Small nodules of the sulphuret of copper also occur, chiefly in the lower part, and traces of nickel are said to have been found in them. The greatest thickness of the bed is four feet; its average	2·
5. White quartzose conglomerate, similar to that of the summit. This does not thin out in the distance examined, about 50 yards	4·
6. Red Sandstone conglomerate with white quartz pebbles; of which some would weigh three ounces [each]	6·
7. Red Shale	6·
8. Red Sandstone conglomerate, with quartz pebbles, some weighing a pound and a half [each]	10·
	59·5

HIND, *Preliminary Report on the Geology of New Brunswick*, pp. 57,—9.

In those portions of the shale, which are numbered 3 on the S.—S.W. side of the joint and 4 on the N.—N.E. side of it in the first section, two *(levels)* drifts—one about twenty, the other nearly thirty, fathoms long—have been opened; in the part marked 6 in the second section another—though a much smaller—opening has been made; and, at some distance from all three, a shaft was sunk to the same horizon.

The shale presents many slight undulations; but, on the whole, it dips 6°—10° towards the E. Its thickness seldom exceeds four feet, and is generally between two and three; but in at least one instance it gradually dwindles and at length dies out; a second thin bed, of nearly similar character, however, appears a few feet above the last traces of the first. The rock, when newly broken, is often thick-lamellar; but a slight exposure developes its fissile character; and, under the influences of heat and moisture, it is rapidly degraded.

The principal bed of shale is rich in the remains of plants; but they are often broken and decomposed. Amongst them, however, the following have been identified by William Lonsdale, Esq., F.G.S., Sir Charles Lyell, Bart., D.C.L., F.R.S., and Robert Etheridge, Esq., F.R.S.E., F.G.S.: viz.—*Pinnularia capillacea,** *Pecopteris Cistii,** *P. ovata,** *P. pteroïdes,**† *P. muricata,**† *P. Sillimani* (?),† *Neuropteris Loshii,** *Sphenopteris elegans,** *S. acutifolia,** *S. Höninghausi,**

* Named by Robert Etheridge, Esq., F.R.S.E., F.G.S., Palæontologist to the Geological Survey of Great Britain.

† " Sir Charles Lyell, Bt., D.C.L., F.R.S., *Travels in North America*, First Series, II. pp. 198, 201,—2.

*Calamites Suckovii,** *C. dubius,* ‡ *Lepidodendron,** *L. undulatum,*†‡ *Asterophyllites longifolia,** *A. equisetiformis,** *A. cuneata,** *A. tuberculata.** Other genera and species have since been found, in the same neighbourhood, by Sir William Edmond Logan, LL.D., F.R.S.§

(*f.*) At Parrot's-brook, near the Capes, an erect fossil tree,‖ of about fourteen inches in diameter and some twenty-two feet in length, was (1840) exposed in the face of the cliff. It was rooted in a thick bed of argillaceous shale, which rested on a thin seam of coal; but at different heights its trunk was enveloped in alternate

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‡ " William Lonsdale, Esq., F.G.S., late Assistant Secretary and Curator of the Geological Society.

§ The undermentioned plants have been discovered, near the Bay de Chaleur, by Sir William Edmond Logan, LL.D., F.R.S., F.G.S., Director of the Geological Survey of Canada: viz.—*Calamites Cistii*, *Asterophyllites grandis*, *Annularia galoides*, *Sphenophyllum saxifragifolium*, *S. emarginatum*, *Nœggerathia dispar*, *Neuropteris rarinervis*, *N. Loshii*, *Odontopteris Schlotheimii*, *Sphenopteris Canadensis*, *S. obtusiloba* (?), *Alethopteris nervosa*, *A. Serlii*, *A. grandis*, *Beinertia Gœpperti*, *Lepidodendron verticillatum*, *Cordaites borassifolia*.

DAWSON, *Quarterly Journal of the Geological Society*, XXII. pp. 151—164.

‖ Jackson & Alger, *Mineralogy* &c. *of Nova Scotia*, (1832) pp. 69, 70. Gesner, *Geology* &c. *of Nova Scotia* (1836), p. 158. Lindley, *Penny Cyclopædia*, VII. p. 294. Binney, *Reports of the British Association for* 1842, Part II. p. 50. Lyell, *Travels in North America*, First Series, II. p. 195; *Proceedings of the Geological Society*, IV. p. 176. Dawes, *Ibid*, p. 292. Binney, *Lond., Edin., & Dublin Phil. Mag.*, XXIV. p. 167. Binney & Harkness, *Ibid*, XXVII. p. 241. Dawson, *Quarterly Journal of the Geological Society*, II. p. 136. Lyell, *Ibid*, p. 171. Binney, *Ibid*, p. 390. Brown, *Ibid*, p. 393. Lyell, *Ibid*, III. p. 262. Brown, *Ibid*, IV. p. 46; V. p. 354. Binney, *Ibid*, VI. p. 20. Brown, *Ibid*, p. 128. Dawson, *Ibid*, VII. p. 124. Jackson, *Report on the Albert Coal Mine*, p. 8. Dawson, *Quarterly Journal of the Geological Society*, X. p. 1. Logan, *Ibid*, p. 39. Dawson, *Acadian Geology*, pp. 129,—59,—61—85. Phillips, *Quarterly Journal of the Geological Society*, XIV. pp. 90,—8. Dawson, *Ibid*, XV. pp. 67, 635; XVI. p. 269; XVII. p. 522; XVIII. p. 5; XXII. pp. 104, 108—25,—28,—32,—34,—50—1,—9.

layers of carbonaceous shale rich in the remains of plants, and of almost barren ferruginous sandstone; fragments of both which strewed the beach. One well-marked system of persistent joints bears about 25° E. of N.—W. of S.; but innumerable others, in different directions, though of shorter range, give some of the surfaces a tessellated aspect.*

Lignite is largely mixed with the other remains of plants in the shale wrought—as already mentioned—at the *Victoria* mine near Bathurst; but pieces of more than a few inches in length are rare.† Whether

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* Jukes, *Quarterly Journal of the Geological Society*, III. p. 248.

† "Wherever traces of woody fibre occur, in the soft bluish shale, copper appears to have been deposited. The largest quantity of ore occurs, however, in small concretions, the inner parts of which are usually composed of vitreous copper and the outer of copper-pyrites, or the reverse; whilst a few nodules consist of vitreous copper, and still fewer entirely of pyrites. Thin scales of the green and blue carbonates of copper invest the other ores. Although this impregnation has been found over a considerable tract, the ores obtained have not repaid the expense.

"Some portions of the shale give out, on being broken, a most powerful odour of garlic."—HENWOOD, *Proceedings of the Geological Society*, III. pp. 454—5.

"The Gloucester Mining Company expended much labour and money in searching for copper at the mouth of the Great Nepisiguit."

GESNER, *New Brunswick*, p. 198.

"Grey sulphuret of copper has been found in small quantities * * * on the left bank of the river Nepisiguit, near Bathurst, and a Company was formed some years since to work the deposit; but the irregular distribution of the mineral rendered their operations uncertain, and the mine has been abandoned."

PERLEY, *Hand Book of New Brunswick*, p. 37.

"The Bonaventure strata contain fossil plants, which about a mile above Bathurst, on the Nepisiguit, have been replaced in part by sulphuret of copper, which again has become converted into the carbonate at the surface. * * * The replacement of vegetable matter by the ores of copper is by no means uncommon; it has been described by Dr. Dawson as occurring * * * in some of the lower beds on the Joggins coast in Nova Scotia, and Sir William Logan states that a combination of coal and grey sulphuret of copper occupies the forms of vegetable remains in a regular eighteen-inch bed which seems to crop out all around a considerable mountain in the Spanish Pyrenees."—HIND, *Preliminary Report on the Geology of New Brunswick*, pp. 57—8 (Abridged).

it has been derived from a single, or from more than

"In light bluish shales, sandstones, and both fine, coarse, and crumbling conglomerates, * * * about a quarter of a mile from the Nepisiguit bridge, copper was found and removed to the extent of 20 or 30 tons. It consisted of grey copper and the green carbonate intimately associated with the mineral called lignite, a peculiar variety of coal. * * * The distribution of the ore, being found irregular, and the whole deposit uncertain in its character, the enterprize was abandoned. At the time of my visit very little of the pure copper-bearing lignite could be found. The few specimens obtained were removed from a fine bluish clay, interstratified with the sandstones and conglomerates. These latter, like the lignite, are charged with copper, and a general greenish appearance, due to the weathering of that metal, is seen along the bank for a considerable distance."

BAILEY, *Report on the Mines and Minerals of New Brunswick*, p. 11.

"On the banks of the Carriboo river, two miles from where it empties itself into the Gulf of St. Lawrence, occurs a bed of copper ore, included between the strata of sandstone passing into coarse conglomerate. It is associated with lignites of enormous size, which generally lie over the copper ore. * * * The lignites are black, and some of them resemble common charcoal. Some are fibrous, and exhibit evident traces of the organized structure of plants. * * * The lignite forms thin layers over masses of the copper ore, which sometimes presents substitutions or casts of culmiferous plants. The lignite sometimes contains minute flattened crystals of red oxide of copper. Green and blue carbonates of copper invest some of the lignites, fill interstices in the sandstone, and encrust the masses of vitreous copper ore. This valuable substance occurs in beds of from two to four inches thick, which, covered with lignites, alternate with each other, the lowest bed being thickest and most compact. The most compact variety is 5·7, but the granular varieties seldom exceed 4·8 or 5· in specific gravity. This ore yielded by our analysis

Copper	79·5
Sulphur........	18·0
Iron	2·5
	100· "

JACKSON & ALGER, *Geology and Mineralogy of Nova Scotia*, pp. 73—6. (Abridged.)

"About eight miles north of Pictou, on the banks of the Carriboo River there is a bed of copper ore, enveloped and intermixed with lignites. Large trees, in some instances retaining the vegetable fibre of the wood, and impressions of the leaves, bark, and all those figures so common on the surface of the living plant, are sometimes wholly transformed into lignite, [whilst] in other cases the ancient herbage of a productive climate [has become] half stone, half coal. * * * In breaking open masses of these once majestic trees, now transformed into jet and bituminous lignite, the green carbonate of copper often appears, forming an efflorescence in their crevices, The blue carbonate, and the red oxide of copper, also appear occasionally, both in the lignite and the sandstone. The copper ore one, kind of wood has not been ascertained. In many

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is deposited in narrow veins, from one to four inches in thickness, and alternating with the lignite and sandstone. * * * Compact masses [are] of the specific gravity of 5·5."—Gesner, *Remarks on the Geology and Mineralogy of Nova Scotia*, pp. 139—40. (Abridged.)

Near "Seaman's Brook in Mill Cove * * * we see in the low cliff and in the shore reefs beds of reddish and greyish sandstone, alternating with reddish shales. * * * In a few places we find amongst these beds layers of gypsum and of sandy limestone. In several of the grey beds there are fragments of trunks and branches of trees, converted into coal; [and] associated with these remains, we find in four of the beds small quantities of the grey sulphuret and green carbonate of copper."—Dawson, *Acadian Geology*, p. 124.

"The principal fossils found near Pictou are *Calamites*, *Lepidodendron*, *Endogenites*, coniferous wood, ferns, *Artisia*, and carbonized fragments of wood impregnated with iron pyrites and with sulphuret and carbonate of copper."
Ibid, p. 252.

"In the coast-section westward of the entrance to Pictou harbour * * * much red sandstone appears; and a bed of limestone from two to three feet thick, and a small bed of coal have been discovered. Some grey sandstones also appear: in one of which there are numerous fragments of carbonized wood, containing sulphuret and carbonate of copper,"—*Ibid*, p. 253.

"In all these places the principal ore is the grey sulphuret of the metal, with films and coatings of the green carbonate. * * * The only reason which prevents them from being worked, is the conviction that the deposits are too limited to be of economical importance."—*Ibid*, p. 267.

"At the Zavods of Yugofski and Motovilika * * * cupriferous grits, sandstones, and shale have been largely excavated in several places. These beds, which are pierced by shafts from 35 to 130 feet deep, consist of thick flaglike grits of grey and dingy colour, rarely ferruginous, sometimes of greenish hue, and occasionally slightly calcareous, with courses of red and grey ribboned marl and shale. The ores of copper, chiefly the green carbonate, are disseminated at intervals through all the beds, but in this district the grits are the most cupriferous. On the whole, the lower beds are more grey and dark coloured, and the upper strata redder. Plants of at least twenty species diversify the series in this locality, and in some of the lower they are so numerous as to have given rise to thin seams of coal, occasionally from two to three feet thick. Concretions, often cupriferous, six to eight inches long, occur here and there, and they have been generally formed around carbonized stems of plants. Both here, and in other places, the copper ores are very frequently found to be arranged in the interstices, and around the fossilized stems and branches of plants; exhibiting passages from the common oxide of copper to the grey sulphuret or copper pyrites, and occasionally to the finer varieties of bright green acicular malachite, mixed with crystals of the blue ore. All these beds are nearly horizontal. The cupriferous beds contain 2½ per cent. of ore only, but from the wide dissemination of the ore through vast masses, its extraction is profitable. * * * In the districts near Perm, 108 cubic feet of wood are consumed to extract a *poud*, or about specimens all trace of organic character has been obliterated; but, wherever it remains, the fibrous structure strictly conforms to the nearly horizontal bedding of the contiguous shale. Such masses are not unfrequently penetrated by irregular veins of vitreous copper; but they seldom exceed two inches in length, or one-eighth of an inch in width, and are generally much less. The minute *branches*, which, at intervals, diverge from their sides, are often crooked and unsymmetrical in the massive lignite: but—though often of different lengths and thicknesses,—they strictly interlie the fibres, wherever the original structure prevails; and thus sections of chosen specimens often display segments—and at times entire rings—alternately of vitreous copper and of lignite.

The richest portions of the formation, however, consist of rough globular and reniform concretions, sometimes as small as pease, frequently as large as pigeons' eggs, though generally about the bigness of marbles: of these—one, here and there, is wholly of copper-pyrites,—a few are entirely of vitreous copper,—and many present a nucleus of copper-pyrites enveloped in vitreous ore; but for the most

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[36·1] lbs. English of copper ore; and the cutting and converting the wood into charcoal cost 2½ roubles (about 2*s.* 1½*d.* Stg.). The *poud* of copper sells at from 32 to 34 roubles (from £1. 7*s.* 1*d.* to £1. 8*s.* 9½*d.*), and costs the Government 23 (18*s.* 9*d.*), whilst individuals whose establishments are not so expensive, produce it at 18 roubles (15*s.* 3*d.*). The Imperial Zavods near Perm afford 16,000 *pouds* (257·9 tons *Avoir.*) per annum, and as the net gain per *poud* is 10 roubles 60 copecks (nearly nine shillings), the Government profit is [169,600] roubles, or about [£7,180] sterling per annum, after defraying all costs, pay of officers included."—Murchison, de Verneuil, & von Keyserling, *Russia in Europe and the Ural Mountains*, i. pp. 144, 477.

part they consist of vitreous copper within and pyrites without. Both they and the cupriferous lignite are thinly encrusted with fibrous malachite, and slightly speckled with the blue carbonate of copper; both occur at irregular intervals, and both are most numerous where the shale inclines most towards the south.

From this part of the series, however, neither vein nor isolated granule of copper-ore has yet been obtained.

At the Capes kidney-shaped nodules of red iron-ore —made up of concentric layers alternately earthy and of diverging fibrous structure—abound in upper shales.

From 1838 to 1841 costly proceedings were carried on, by an English Company, in several parts of the district; but the returns were small, and any prospect of success, which might have lent countenance to the earlier operations, had vanished before the works were abandoned.