OF THE POLAR SEA.

strengthened by the information obtained during the present Expedition. The Northern Coast of America has now been actually surveyed from the meridian of 109° to $149\frac{1}{2}^{\circ}$ west; and again by the exertions of Captain Beechey, in His Majesty's ship the Blossom, from Icy Cape eastward to about 156° west, leaving not more than fifty leagues of unsurveyed coast, between Point Turnagain and Icy Cape. Further, the delineation of the west side of Melville Peninsula, in the chart of Captain Parry's Second Voyage, conjoined with information which we obtained from the Northern Indians, fairly warrants the conclusion, that the coast preserves an easterly direction from Point Turnagain towards Repulse Bay; and that, in all probability, there are no insurmountable obstacles between this part of the Polar Sea and the extensive openings into the Atlantic, through Prince Regent Inlet and the Strait of the Fury and Hecla.

Whenever it may be considered desirable to complete the delineation of the coast of the American Continent, I conceive that another attempt should be made to connect Point Turnagain with the important discoveries of Captain Parry, by renewing the Expedition which was undertaken by Captain Lyon, and which, but for the boisterous weather that disabled the Griper, must have long since repaid his well known zeal and enterprise with discoveries of very great interest.

In considering the best means of effecting the North-West Passage in a ship, it has hitherto been impossible not to assent to the opinion so judiciously formed, and so convincingly stated, by Captain Parry, that the attempt should be made from the Atlantic rather than by Behring's Straits, because the enterprise is then commenced after a voyage of short duration, subject to comparatively few vicissitudes of climate, and with the equipments thoroughly effective. But important as these advantages are, they may, perhaps, be more SECOND JOURNEY TO THE SHORES

than balanced by some circumstances which have been brought to light by our Expedition. The prevalence of north-west winds during the season that the ice is in the most favourable state for navigation, would greatly facilitate the voyage of a ship to the eastward, whilst it would be equally adverse to her progress in the opposite direction. It is also well known, that the coast westward of the Mackenzic is almost unapproachable by ships, and it would, therefore, be very desirable to get over that part of the voyage in the first season. Though we did not observe any such easterly current as was found by Captain Parry in the Fury and Hecla Strait, as well as by Captain Kotzebue, on his voyage through Behring's Straits; yet this may have arisen from our having been confined to the navigation of the flats close to the shore; but if such a current does exist throughout the Polar Sea, it is evident that it would materially assist a ship commencing the undertaking from the Pacific, and keeping in the deep water, which would, no doubt, be found at a moderate distance from the shore.

The closeness and quantity of the ice in the Polar Seas vary much in different years; but, should it be in the same state that we found it, I would not recommend a ship's leaving Icy Cape earlier than the middle of August, for after that period the ice was not only broken up within the sphere of our vision, but a heavy swell rolling from the northward, indicated a sea unsheltered by islands, and not much encumbered by ice. By quitting Icy Cape at the time specified, I should confidently hope to reach a secure wintering place to the eastward of Gape Bathurst, in the direct route to the Dolphin and Union Straits, through which I should proceed *. If either, or both, of the plans which I have suggested be adopted, it would add to the confidence and

^{&#}x27; See Dr. Richardson's opinion in favour of this route, p. 264.

safety of those who undertake them, if one or two depoits of provision were established in places of ready access, through the medium of the Hudson's Bay Company.

Arctic discovery has been fostered principally by Great Britain; and it is a subject of just pride that it has been prosecuted by her from motives as disinterested as they are enlightened; not from any prospect of immediate benefit to herself, but from a steady view to the acquirement of useful knowledge, and the extension of the bounds of science. Each succeeding attempt has added a step towards the completion of northern geography; and the contributions to natural history and science have excited a general interest throughout the civilised world. It is, moreover, pleasing to reflect that the loss of life which has occurred in the prosecution of these discoveries does not exceed the average number of deaths in the same population at home under circumstances the most favourable. And it is sincerely to be hoped that Great Britain will not relax her efforts until the question of a north-west passage has been satisfactorily set at rest, or at least until those portions of the northern shores of America, which are yet unknown, be laid down in our maps; and which, with the exception of a small space on the Asiatic continent eastward of Shelatskoi Noss, are the only intervals wanting to complete the outline of Europe, Asia, and America.

END OF THE NARRATIVE.

SUMMARY OF THE DISTANCES TRAVELLED BY THE EXPEDITION, FROM ITS LANDING IN AMERICA, UNTIL ITS EMBARKATION.

Distance travelled in 1825, as given in page 50	Statute Miles. 5,803
Dr. Richardson and Mr. Kendall's excursion on the ice to the eastern parts of	7
Bear Lake, in the Spring of 1826	359
Distance travelled by the Western Party in 1826 (given in page 285.)	2,048
Distance travelled by the Eastern Party in 1826, after its separation from the	
Western Party	1,455
Return from Fort Franklin to New York	4,000
Captain Back and Lieutenant Kendall's journey to York Factory, after quitting	
Captain Franklin's route	520
Distance travelled by the Expedition in going and returning, including the excur-	
sions of detached parties	14,185
Number of miles surveyed and laid down in the maps, but not all included under	5
the head of discoveries, because the routes have been traversed by Traders	5,000,

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No. I.

TOPOGRAPHICAL AND GEOLOGICAL NOTICES,

BY

JOHN RICHARDSON, M.D., F.R.S., &c.

SURGEON AND NATURALIST TO THE EXPEDITION.

[Read before the Geological Society.]

A VERY limited portion of my time could be allofted to geological inquiries. For eight months in the year the ground in the northern parts of America is covered with snow; and during the short summer, the prosecution of the main object of the expedition rendered the slightest delay in our journey unadvisable. The few hours that could be stolen from the necessary halts, for rest and refreshment, were principally occupied in the collection of objects for the illustration of botany and zoology. It is evident, that an account of the rock formations, drawn up under such circumstances, cannot be otherwise than very imperfect; but I have been led to publish it from the belief that, in the absence of more precise information, even the slightest notice of the rocks of the extreme northern parts of the American continent would be useful to those employed in developing the structure of the crust of the earth; the more especially, as it is not probable that the same tract of country will soon be trod by an expert geologist. The specimens of rocks I obtained have been deposited in the Museum of the Geological Society, and are referred to in the ensuing pages by the numbers affixed to them. The notices are arranged nearly in the order of the route of the expedition, commencing with Great Bear Lake, where our winterquarters were situated.

GREAT BEAR LAKE.

GREAT Bear Lake is an extensive sheet of water, of a very irregular shape. being formed by the union of five arms or bays in a common centre. The greatest diameter of the lake, measuring about one hundred and fifty geographical miles, runs from the bottom of Dease Bay, which receives the principal feeding stream, to the bottom of Keith Bay, from whence the Bear Lake River issues, and has a direction from N.E. to S.W. The transverse diameter has a direction from N.W. by W. to S.E. by E., through Smith and M'Tavish Bays, and is upwards of one hundred and twenty miles in length. M'Vicar Bay, the fifth arm of the lake, is narrower than the others, and being a little curved at its mouth, appears less connected with the main body of water. The light bluish-coloured water of Great Bear Lake is everywhere transparent, and is particularly clear near some primitive mountains, which exist in M'Tayish Bay. A piece of white rag, let down there, did not disappear until it descended fifteen fathoms. The depth of water, in the centre of the lake, was not ascertained; but it is known to be very considerable. Near the shore, in M'Tavish Bay, forty-five fathoms of line did not reach the bottom. Owing to the barometers supplied to the expedition having been broken in an early period of its progress, the height of the surface of Bear Lake above the Arctic Sea could not be ascertained; but it is, probably, short of two hundred feet *. If this supposition comes near the truth, the bottom of M'Tavish Bay is below the level of the sea, and towards the centre of the basin of the lake the depression is probably still greater. The great lakes, Huron, Michigan, and Superior, which discharge their waters into the St. Lawrence, are reported to sink three hundred feet below the level of the ocean; and the Lake of the Mountains or Chipewyan Lake and Great Slave Lake †, through which the Mackenzie flows, have, it is highly probable, some portions of their beds below the sea level.

In the autumn of 1825, I coasted the western and northern shores of the

This was estimated by allowing one foot descent per mile for Bear Lake River, whose length is seventy miles; and three inches per mile for the descent of Mackenzie River, from the junction of the former river to the sea, being a distance of five hundred miles.

t, In our former journey, we sounded near the Rein-Deer Islands in Slave Lake, With sixty-five fathoms line, without reaching the bottom.

No. I.] TOPOGRAPHICAL. AND GEOLOGICAL NOTICES.

Great Bear Lake; and in the spring of 1826, travelled on the ice along its eastern and southern arms, leaving no part of its shores unexamined on these two surveys, except the north side of M.Tavish Bay. I did not, however, on these occasions, make excursions inland.

PRIMITIVE ROCKS .- GREAT BEAR LAKE.

At the south-east corner of M'Tavish Bay, primitive rocks form a hilly range which, at the distance of a mile or two from the shore, attains an elevation of eight hundred or one thousand feet. The steep face of the range forms the shore of the lake for fifteen miles, and perhaps further, on a direction from N.W. by W. to S.E. by E., and is prolonged on the latter bearing, at the back of the lower country lying towards Point Leith. The general form of the hills is obtuseconical, in some instances approaching to dome-shaped. None of them rise much above the others, and the vallies between them are seldom wide or deep. At a distance, some of the masses of rock appear round-backed; and in certain points of view, the crest of the ridge seems to consist of mammillary peaks. On a nearer approach, the individual hills are found to be composed of rounded eminences, having summits, generally, of an oblong form, and consisting of smooth, naked rock. Small mural precipices are frequent, and many detached blocks of stone lie beneath them. Between the eminences, there are level spots destitute of vegetation, and covered with small stones or gravel not much worn. A considerable portion of the gravel is granite or quartz, the debris, perhaps, of the rocks, of which the hills consist; it contains also some pieces of slate, and not a few of quartzose sandstone, neither of which I observed in situ. In the course of a walk of two miles over these hills, the only rock I observed was granite, verging in a few places towards gneiss, and generally whitish, with black mica. Sometimes the felspar is brownish-red, and the rock not unfrequently contains disseminated augite? The weathered surface of the stone was everywhere of a brick-red colour. In many spots the rocks split into such thin slaty looking tables that they have the appearance of being stratified. The slaty masses are, generally, vertical; but in one hill they were observed dipping 80° to the south-east. The direction of the tabular masses is mostly across the oblong summits of the hills. The appearances of stratification were not observed

to extend through a whole hill, and seemed, in fact, to be confined to the more decomposable granites; but the naked rocks are everywhere traversed by smooth fissures. The blocks, which lie under the cliffs, have sometimes a tabular form, but more generally come nearer to a cube or rhomboid, and present one or two very even faces. Few veins were noticed. In the more sheltered vallies, some clumps of white or black spruce trees occur; but the hills are barren.

The point of land which lies between M'Tavish and M'Vicar Bays has low shores; but five or six miles inland an even-backed ridge rises gradually to the height of three or four hundred feet, and abuts obliquely against the primitive hills. I did not visit this ridge, and the snow prevented me from seeing any flat beds of rock, if such exist on the shore. On one point, however, near the north end of Dease Bay, many large angular blocks of whitish dolomite were piled up, and I have little doubt of the rock existing *in situ* in that immediate neighbourhood.

M'Tavish Bay is forty miles long, and twenty wide, and its depth of water, near the eastern shore, exceeds forty-five fathoms. Some shoals of boulders skirt the coast near Point Leith. M'Vicar Bay is about seventy miles long, and from eight to twelve wide; and at the "fishery," in a narrow part, not far from its bottom, its depth of water, two miles from the shore, is twelve fathoms. Dease Bay is equal to M'Tavish Bay in extent, and opens to the S.W. into the body of the lake. The high lands at the N.E. end, or bottom of this bay, have an even outline, and appear to attain an elevation of eight or nine hundred feet, at the distance of six or seven miles from the shore. Near its east side lie the lofty islands of Narrakazzæ, which rise seven hundred feet above the lake. Dease River, the principal feeder of the lake, falls into the bottom of Dease Bay. It is two hundred yards wide, and from one to three fathoms deep near its mouth. A few miles up this river a formation of soft red sandstone occurs, which will be noticed hereafter.

LIMESTONE .- GREAT BEAR LAKE.

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At the mouth of Dease river there are hills five or six hundred feet high composed principally, or entirely, of dolomite in horizontal strata. Some of the beds consist of a thick-slaty, fine-grained dolomite, containing No, L] TOPOGRAPHICAL AND GEOLOGICAL NOTICES.

dispersed scales of mica, which is most abundant on the surfaces of the slates. Most of the beds, however, consist of a thin-slaty, dull, purplish 228 dolomite, traversed by veins of calc-spar. The structure of this rock is

compact, approaching to fine granular; and some of the beds have what quarry-men term "clay-facings," that is, they are encrusted with a thin film of indurated clay.

Greenstone slate? occurs in horizontal beds on the north shore, eight or nine miles to the westward of Dease River: and at Limestone Point,* about twenty miles from the river, a small range of hills terminates on the borders of the lake, in shelving, broken cliffs, about two hundred feet high. These cliffs consist chiefly of nearly compact light-coloured dolomite, interstratified with greenstone, and a brownish red limestone, such as occurs in the hills at the mouth of Dease River. In contact with the greenstone, there is a bed of talcose limestone,

Section of the cliffs at Limestone point-strata dipping to the N.N.W.

In the section the strata are represented much more inclined than they really are.

231 Fine-grained, nearly compact, yellowish-gray dolomite, forming the summit of the hill, but the first, or lowest stratum, in the language of geologists.

232 Compact, splintery dolomite, with a conchoidal fracture, and wax-yellow colour-second stratum.

233 A cherty dolomite; containing cale-spar-third stratum.

- 234 Bluish-gray dolomite, traversed by calc-spar-is nearly compact, and has an uneven, splintery fracture-forms the uppermost portion of the fourth stratum.
- 235 Talcose ? limestone, having a curved, slaty structure, and containing cherty portions-from the lower part of the fourth stratum.
- 236, 237 Earthy greenstone ? forms the fifth stratum.

238 Brownish-red dolomite, with an uneven fracture, scarcely splintery. It has a compact structure,

and is intersected by veins of calc-spar-from the sixth stratum.

239 Light yellowish gray dolomite, passing into chert-seventh stratum.

240; 241 Thin-slaty beds of brownish-red dolomite, like 238-eighth stratum.

242 Bluish-white porcelain chert, sometimes mixed with red dolomite-243--ninth stratum

having a curved, slaty structure: most of the beds of dolomite are hard, and pass into chert.

ALUMINOUS SHALE .- GREAT BEAR LAKE.

The north shore of Bear Lake is low, and is skirted by many shoals, formed by boulders of limestone. No rocks, *in situ*, are exposed between Limestone Point and the Scented Grass Hill, a remarkable promontory, which separates. Smith and Keith bays. Its height above the lake is betwixt eight and nine hundred feet, and in form and altitude it corresponds with the Great Bear Mountain, which, lying opposite to it, separates M'Vicar and Keith bays. I did not ascend either of these hills; but cliffs, corresponding in character to those of the alumnous shale-banks at Whitby, flank their bases; and the same formation probably extends along the north shore of Keith Bay and some way down Bear Lake River. The ground skirting the Scented Grass and Great Bear Mountains is much broken, and consists of small, rounded, and steep eminences, separated by narrów vallies and small lakes. Several shelving cliffs, about one hundred feet high, and some miles in extent, are washed by Bear Lake. They

consist of slate-clay and shale, more or less bituminous, and the dip of the strata is in several places to the N.W. by N. 251 At the foot of the Scented-Grass Hill a rivulet has made a section to the depth of one 244 hundred feet, and here the shaly beds are interstratified with thin layers of blackish-brown, earthy-looking swinestone, containing sclenite and pyrites. 246 Globular concretions of the same stone, and of a poor clay iron-stone, also 247 occur in beds in the shale. The surfaces of the slates were covered with an efflorescence of alum and sulphur. Many crystals of sulphat of iron 249 lie at the bottom of the cliff, and several layers of plumose alum, half an 250 inch thick, occur in the strata. At the base of Great Bear Mountain, the 248

bituminous shale is interstratified with slate-clay, and I found imbedded in the former a single piece of brown coal, in which the fibrous structure of wood is apparent. Sections of slate-clay banks, and more rarely of bituminous shale, occur in several places on the north shore of Keith Bay. In one place, about seven or eight miles from Bear Lake River, a bed of plastic and bituminous clay occurs, and in another, near Fort Franklin, there is a deposit of an earthy coal, which possesses the characters of *black chalk*.

No. L] TOPOGRAPHICAL AND GEOLOGICAL NOTICES.

It is probable that a magnesian limestone underlies this formation of bituminous shale. I have already mentioned the beds of dolomite, which are exposed on the north side of Bear Lake, and similar beds occur to the southward of the Great Bear Mountain, forming cliffs on the shores of M Vicar Bay. At Manito Point, on the west side of the isthmus that connects Great Bear Mountain to the main shore, a low ridge of limestone rocks terminates on the borders of the lake, forming some bold cliffs and a remarkable cave. The stone has a gray colour and bituminous smell, and contains much interspersed calc-spar. The strata dip to the north-west.

VICINITY OF FORT FRANKLIN, GREAT BEAR LAKE.

FORT Franklin stands on the northern shore of Keith Bay, about four miles from Bear Lake River, upon a small terrace, which is elevated twenty-five or thirty feet above the lake. The bay, contracting towards the river, is about four miles wide opposite to the fort, and the depth of water there does not exceed four fathoms. Farther from the river, the east and west shores of Keith Bay recede to the distance of thirty miles from each other, and the depth of water in the centre of the channel greatly increases. The bottom of this bay, wherever it could be distinguished, was observed to be sandy, and thickly strewed with round boulders* of various primitive rocks of large size, which were particularly abundant

* List of boulders gathered on the beach at Fort Franklin.

- 261 Coarse crystalline granite; felspar flesh-red in large crystals; quartz gray; mica black.
- 262 Granite; felspar paler, and less distinctly crystallized; quartz in small quantity, gray; mica blackish, and rather abundant.
- 263 Granite; felspar partly reddish, partly yellowish-white, quartz in small grains; mica equalling the quartz in quantity, black.
- 264 Granite, fine-grained; quartz and felspar, white, the former nearly transparent, black mica imsmall specks, garnets.
- 265, 268 Granite; quartz in regular crystals; mica blackish, in small quantity.

- 266 Granite ? red felspar in large crystals; quartz gray; mica replaced by chlorite ?
- 267 Granite; felspar gray; chlorite? in small quantity.
- 269 Granite, small grained, passing into gneiss; reddish-brown felspar and gray quartz,
 intimately mixed, and having in the aggregate, a vitreous lustre; mica in layers.
- 270 Granite coarser-grained than the preceding, containing more quartz; the mica disseminated.
- 271, 273 Granite with little mica, some portions of the felspar tinged green,

near the river, and with large square blocks of limestone, most plentiful near the cape formed by the Scented Grass Hill. In the small bay between the fort and the river, shoals are formed by accumulations of boulders, and the shores are

thickly strewed with them. Many of these travelled blocks consist 261 to 308 of flesh-red granite, having only a small quantity of black mica,

exactly resembling the primitive rocks seen in M'Tavish Bay, but noticed no where else near the lake. Boulders of the same description occur in shoals at the mouth of M'Tavish Bay, and on the shores which skirt the Scented Grass Hill which faces that bay, to all which places they may have been brought from the parent rock, by a current flowing from the east. On the northern shore of Bear Lake the great majority of the boulders consists of

limestone. Two varieties of granite, which occur amongst the boulders, 266 282 were recognised as being abundant rocks at Fort Enterprise, which is situated about one hundred and seventy miles south-east from

M'Tavish Bay. Some of the boulders were of a peculiar-looking porphyry,

272, 274,	286 Reddish-brown hornstone porphyry.
275, 277, Granite, gravish and small grained,	287 Crystalline greenstone.
278, 279, mica black.	288 Fine-grained greenstone.
280	289 Porphyritic greenstone.
276 Granite ; brick-red felspar ; quartz ; and	290 Pitchstone porphyry.
angite ?no mica.	291 Greenstone slate with pyrites.
The mica is mostly black in all the granite	292 Amygdaloidal elaystone porphyry.
boulders that occur here, the felspar most fre-	293 Compact grayish-blue dolomite.
quently reddish.	294 Splintery dolomite.
281 Porphyritic granite ? felspar imperfectly crys-	295 Cellular dolomite.
tallized, containing large, imbedded crys-	296 Swinestone.
tals; quartz; and chlorite?	297 Limestone with corallines.
282 Granite ? composed of felspar, or quartz,	298 Chert.
with, perhaps, a few minute grains of	299 White quartz.
chlorite ?	300 Quartz-rock.
283 Granite? contains little quartz, and a few	301 Coarse sandstone.
scales of mica, with some chlorite?	302 Fine-grained white sandstone.
284 Sienite; felspar somewhat granular, a little	303 Fine-grained red sandstone.
quartz and chlorite ?	304 Fine-grained striped sandstone.
285 Porphyritic sienite? having a basis of	305 Fine-grained spotted sandstone.
slightly granular felspar, with light-co-	306 Slaty sandstone verging towards slate-clay.
loured crystals of felspar, some quartz	807 Dark-red claystone.
and disseminated grains of chlorite?	308 Light-coloured claystone.
e 76	 Constant Constant<

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[No. I.

exactly resembling that which occurs in the height-of land betwixt the Coppermine River and Dease Bay; several of sandstone and conglomerate, which probably came from the same quarter; of greenstone, perhaps, from the Copper Mountains, and of limestone from the northern shores of the lake, and from the isthmus of the Great Beat Mountain; all these places lying to the eastward or north-east.

The soil in the immediate vicinity of Fort Franklin is sandy, or gravelly, and covers, to the depth of one or two feet, a bed of clay of unknown thickness. Gravel taken from a spot thirty feet above the present high-water level of the lake, and out of the reach of any stream or torrent, contained rounded pebbles of granite, of greenstone, of quartz rock, of lydian stone, and of various sandstones, of which some were spotted, and others presented zones of different colours. These sandstones form a considerable portion of the gravel.*

The clay which lies under the soil is of a bluish-gray colour, and is plastic but not very tenacious. It is more or less mixed with gravel. During the greater part of the year it is firmly frozen; the thaw in the two seasons we remained there never penetrating more than twenty-one inches from the surface

List of Specimens from Diluvial Gravel, Fort Franklin.

- 1 Amphibolic granite, rather coarse crystalline, felspar flesh-red.
- 2 Ditto, approaching to gneiss.
- 3 Gneiss approaching to mica-slate, felspar white, and in small quantity.
- 4 Greenstone with much felspar and minute disseminated pyrites.
- 5 Quartz rock? having brownish and imperfect crystals, and a reddish disintegrated mineral disseminated.
- 6 Brownish-red and fine granular quartz-rock, with a somewhat splintery fracture. It has the aspect of compact felspar.
- 7 Quartz rock, reddish crystalline texture, and vitreous lustre, but with small rounded grains imbedded in it, bringing it near to sandstone.
- 8 Coarse sandstone; rounded grains of quartz united by a clayey basis.
- 9 Fine-grained purplish sandstone, with grayish spots. This sandstone occurs in silu near the Copper Mountains, between Dease Bay and the Coppermine River.
- 10 Fine-grained yellowish-white sandstone.
- 11 Yellowish-gray sandstone. composed of small rounded grains of quartz united by a powdery
- 12 Sellevish gray residence, composed of fine grains of vitreous quartz.
- 13 Sendstone, having different shades of brownish-red colour, in layers.

14 Lyching stone.

of the earth. In spots where the sandy soil is wanting, the clay is covered a foot deep, or more, by mosses, mostly *bryum palustre*, and some marsh *hypna* and *dicrana*, in a living state, for they seem to be converted very slowly into peat in this climate.

The ground rises gradually behind the fort, until it attains, at the distance of half a mile from the lake, the height of two hundred feet, forming, when viewed from the southward, an even ridge, running nearly east and west-which ridge is, in fact, the high bank of the lake, as it corresponds in height with the summit level of the banks of Bear Lake River, and of the southern shore of Keith Bay. The country extending to the northward, from the top of the bank, is nearly level, or has a very gentle ascent for about five miles, when a more abrupt ridge rises to perhaps three hundred or four hundred feet above the lake. The view* from the summit of this second eminence is very extensive, the whole country as far as the eye can reach appearing to be a level, from which several narrow precipitous ridges of limestone arise. But, although the country around these ridges appears from a distance to be level, or very slightly undulated, yet it abounds in small eminences and steep-sided vallies of various shapes, some being rounded and basin-shaped, others long and narrow. Lakes and swamps are here so numerous, that the country, for at least sixty miles to the northward, is impassable in summer, even to the natives. There are many mounds of sand and gravel. and fragments of sandstone are frequent; but having travelled in this direction only in winter, when the ground was covered to the depth of upwards of three feet with snow, I had not an opportunity of examining its geological structure. White spruces cover the drier spots ; larches, black spruces, and willows abound in moist places; the sandy hillocks are clothed with aspens, and the sides of the vallies support some canoe birches, with a thick undergrowth of dwarf birches, alders, and rose-bushes. The eminence from whence the view just described was obtained, appears like a ridge only in approaching it from the lake, for it rises very little above the general level of the country behind it. It has a direction from N.W. by N. to S.E. by S., and terminates about eight miles to the eastward of the fort, in a small bluff point on the shores of the lake, and there the strata consist of slate-clay slightly bituminous. The banks immediately behind the fort also exhibit, in their ravines, a bluish slate-clay.

See Sketch, No. 3, Plate 31.

No. 13 TOPOGRAPHICAL AND GEOLOGICAL NOTICES.

The land on the south side, or bottom, of Keith Bay, presents a nearly similar aspect to that just described, rising, on the borders of the lake, to the height of one hundred and fifty feet, and then running back to a great distance nearly level. It may be characterised as full of hollows, narrow vallies, ravines, and lakes; but it is not hilly, although it is traversed by ridges of limestone, which rise like walls through the flat country. The nearest of these ridges terminates on the borders of the lake at the *Manito Point*, (noticed in page vii.) It may be proper to remark here, that, in addition to the limestone ridges visible from Fort Franklin, or from the heights behind it, the summit of Clark Hill, bearing south, and forming part of a ridge about fifty miles distant, was distinctly seen. This hill lies behind Old Fort Norman on the Mackenzie, and has more the outline of a granitic rock, although some of the peaks which skirt it have the serrated crests which the limestone ridges in this quarter show. It was guessed to be 1500 feet high above the Mackenzie.

This sketch of the general features of the country about Fort Franklin being premised, the ensuing geological notices follow in the order of the route of the Expedition.

BEAR LAKE RIVER-SANDSTONE, LIMESTONE.

Bear Lake River is about seventy miles long, from its origin in the lake till it falls into the Mackenzie, and throughout its whole length, its breadth is never less than one hundred and fifty yards, except at the *Rapid*, a remarkable place, about the middle of its course. It is from one to three fathoms deep, and very rapid, its velocity being estimated at six miles in the hour. Its waters are clear as they issue from the lake, but several branches of considerable size bring down muddy water, particularly one which flows from the north, and falls in below the rapid.

Above the rapid the valley of the river is very narrow, the banks everywhere sloping steeply from the level of the country. Their summit line, which is nearly straight, is about one hundred and fifty feet above the bed of the river. In some places they have an even face elevated at an angle of about forty-five degrees, and they are not unfrequently cut by ravines into pretty regular figures, resembling hay-ricks, or the parapet of a fort, the ravines representing the

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b 2

Sections made by the river presented generally sand or city whe embrasures. sand probably proceeding from the disintegration of a friable, gray sandstone, which showed itself occasionally in a more solid form. The rapidity of our voyage, however, afforded us little opportunity of searching for the solid strata which are generally hid by the debris of the bank. About twelve miles above the rapid, a small-grained, friable sandstone, of a yellowish gray colour, and irregular earthy fracture, is associated with beds of bluish-gray slateclay. These beds consist of concretions of various sizes and irregular shapes, but which may be said to approach in general to a depressed orbicular form; their surfaces are coloured purplish-brown by iron, and studded with crystals of sulphate of lime. This slate-clay contains many small round grains of quartz, and is exactly similar to that which occurs at the rapid, and which will be afterwards noticed. In other places the banks are covered by the debris of a slateclay slightly bituminous, resembling wacke in its mode of disintegrating.

The Rapid is caused by the river struggling through a chasm bounded by two perpendicular walls of sandstone, over an uneven hed of the same material. On escaping from this narrow passage, it winds round the end of a lofty cliff of limestone, which forms part of a ridge that is continued through the country on both sides of the river. The annexed sketch* presents the outlines of the ridge and banks of the river as seen from the middle of the stream a short way above the commencement of the rapid.

Viewed from the summit of this ridge, which rises about eight hundred feet above the river, the country towards Bear Lake appears level. The view down the river presents also a plain country, bounded on the Mackenzie by another limestone ridge, which, unless the eye was deceived by the distance, gradually inclined to the one at the rapid, and appeared, by joining it to the northward, to form a great basin. These ridges are also prolonged to the southward. The plain is covered with wood, intersected by chains of lakes, and seemed to lie rather below the summit level of the banks of Bear Lake River. It is only comparatively, that the country deserves the name of plain, for its surface is much varied by depressions, ravines, and small eminimies, that do not, however, destroy the general level appearance when seen from a

Sketch No. 2., plate 31. See also plate 4 of the Narrative, for a view of the same bill from the westward,

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No.I.] TOPOGRAPHICAL AND GEOLOGICAL NOTICES.

distance. The view from the hill is terminated, to the westward, by the distant chain of the Rocky Mountains, running nearly N.W. by N. A little below the rapid, a small stream from the southward flows into the Bear Lake River, near whose sources the Indians procure an excellent common salt, which is deposited from the springs by spontaneous evaporation.

The walls of the rapid are about three miles long, and 120 feet high. They are composed of horizontal beds, the lower of which consist of an earthy-25 looking stone, intermediate between slate-clay and sandstone, having interiorly a dull yellowish-gray colour. Concretions, with smooth surfaces, about the thickness of a swan's quill, pass perpendicularly through the beds like pins, are prolonged beyond the partings, and bear some resemblance to portions of the roots or branches of a tree. The seam surfaces are very uneven. These beds are parted by thin slaty layers, of a stone similar in ap-

pearance, but rather harder, and containing many interspersed scales of 18 mica, and also some minute portions of carbonaceous matter in the form of lignite. The thin layers contain impressions of ferns, and from the debris at the bottom of the cliff I gathered impressions of the bark of a 19 1827 tree (lepidodendron) and some ammonites in a brown iron-shot sandstone.* The upper beds are composed of a fine-grained, quartzose, gray sandstone, 18,20,21, having an earthy basis, and occasionally interspersed carbonaceous 22,23,24, matter. Some of the beds are a foot and a half thick, and have sufficient tenacity to be fitted for making grindstones; most of the 26,27 sandstone is, however, rather friable. Near the summit there is Wersty. 28 interposed a bed of fine-grained dolomite, and a friable sandstone, which forms the crest of the cliff, and exhibits in its weathering bat-NO LO DE COM dement shaped projections and pinnacles. Covering this sandstone, but not in quite to the margin of the cliff, there is a layer of slaty limestone, 29. having a bluish or blackish-gray colour, a dull fracture, and rather compact structure. In the lower beds of the cliff there are some globular and disk-

Min

[&]quot;Mr. Sowerby, who inspected all the specimens containing organic remains, says of this species of animonity," it is, as far as I can discover, new. It contains sulphate of barytes, and is probably referrible to some of the Oolites near the Oxford clay." Although it was found lying on the beach, "The bary of its having fatient from some of the beds of clayey sandstone, which form the walls of the remid.

shaped concretions, of an indurated iron-shot slate-clay, or poor clay-iron-30 stone, containing pyrites. They vary in magnitude from six inches to

a foot and a half in diameter, and appear to be formed of concentric layers, which are rendered apparent by the weathering of the stone. The sandstones and shales of the rapid have a strong resemblance in appearance to those of the coal measures; but pitch-coal was not detected at this place. Several distinct concretions of indurated slate-clay, assuming the appearance termed *cone in cone*, were picked up among the boulders on the banks of Bear Lake River, some way below the rapid, but they were not traced to their parent beds. They effervesce with acids.

Between the walls of the rapid and the limestone ridge there is a piece of meadow-ground, having a soft, claycy soil, in which, near the base of the hill, a small rivulet flows to join the river. The bed of this rivulet presents accumulations of boulders of large size, arranged so as to form two terraces, the upper of which is considerably above the highest level either of the rivulet, or of Bear Lake River. The boulders consist of varieties of granite, gneiss, mica-

slate with garnets, greenstone and porphyry. One of the porphyries is
a beautiful stone, composed of hyacinth-red felspar, and irregular crystals of milky quartz, with a few specks of a dark green mineral, and very much resembles a rock which is not uncommon in the gneiss districts about Fort
Enterprise, Many of the boulders consist of conglomerates and sandstones

45 Enterprise. Many of the boulders consist of conglomerates and sandstones 47 that strongly resemble those of the old red sandstone formation, which

50 forms the height of land between Dease Bay and Coppermine rivers.

51 Also some flinty slates, mixed, in thin layers, with compact, yellowish

49 limestone, and some pebbles of jasper interleaved with flinty slate.

The limestone ridge below the rapid stands on a narrow base, whose transverse diameter does not exceed a quarter of a mile. Its summits are generally conical, but very rugged and craggy; the highest peak I had an opportunity of visiting is about a mile from Bear Lake River, and it has been already stated to be estimated at eight hundred feet above that stream, or nine hundred and fifty above the sea. The general direction of the ridge is from S.E. by S. to N.W. by N., or nearly parallel to the great Rocky Mountain chain, and to the smaller ridges betwixt it and that chain. Its prolongation through the flat surrounding strata, to the southward of Bear Lake River, can be traced for at least forty miles, and it is visible at nearly an equal distance, as it runs through the still more

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No. 1] TOPOGRAPHICAL AND GEOLOGICAL NOTICES.

level country to the northward; but here, as has been already said, it appears to incline towards the similar ridge * which is cut by the Mackenzie, at the mouth of the Bear Lake River, and is about twenty-five miles to the W.S.W., in a direct line. That part of the ridge which I had an opportunity of visiting, consisted entirely of limestone, generally in thick beds. Its stratification was not very evident, and in my very cursory examination the general dip was not clearly ascertained. A precipitous cliff, four hundred feet high, facing the S.E., and washed by the Bear Lake River, presents strata, inclined to the S.W. at an angle of 45°, which may be perhaps considered as the general dip; for the ridge on that side slopes down to the surrounding country at an angle of about 30° or 40°, while on the N.E. side it presents lofty precipices formed by the cropping out of the strata.

Many of the beds in this hill consisted of a blackish-gray fine-

- 39, 34 grained limestone, intersected by veins of calc-spar; but several layers
 40 of gray and dark coloured dolomites, and some of a yellowish-gray
 rauchwacke, were interstratified with them, and the upper parts of the
 precipitous cliff, and also of the highest peak, consisted of a calcareous
- 35, 36 breccia, containing rounded pieces of brown limestone, and angular fragments of chert; and the faces of some cliffs, on the N.E. side of
- 42,43,44 the hill, were incrusted with a fine crystalline gypsum to the depth of from one to two feet.
- * Part of this ridge is seen in sketch No. 1, plate 31.
- † 33 This limestone appears as if composed of an aggregate of small crystals, and presents many drusy cavities.
- 34 Is an adjoining bed of a similar colour, of a fine crystalline texture, but without the drusy cavities. It appears to be a dolomite. These two beds dip to the northward.
- 85, 86 Calcareous breccia. The two preceding beds (33 and 34) were from the summit of the portion of the hill which forms the cliff, but taken a little farther to the N.W. In the cliff the beds dip, as has been stated, to the S.W. The following beds occur in going to the north-westward, towards the summit of the highest peak, commencing near its base, in a valley behind the cliff.
- 37 A fine-grained blackish-gray dolomite, having interspersed many nodules of chert, or grayishwhite quartz, not crystallised.
- S8 A very compact, opaque limestone, of a smoke-gray colour, having a flat and slightly splintery
- fracture. Effervesces briekly.
- 39 Blackish-gray rather compact limestone, having a flat and dull fracture, and intersected by small reines of calc-apar. This is a prevalent stone in the hill, and also occurs in quantity in other limestone ridges in the neighbourhood.

The banks of Bear Lake River below the rapid have a more gentle declivity than those above it, and they occasionally recede from the stream, so as to leave a grassy slope varying from a few yards to half a mile in breadth. The sections of these banks by torrents present only sand or clay; and the hollows of the ravines are lined with boulders principally of primitive rocks. No stone was

observed in situ from the rapid until we came to the junction of the river with the Mackenzie.

The Bear Lake River flows into the Mackenzie at a right angle, and on its north bank, at its mouth, there is a hill,* which has been already noticed as forming part of a ridge visible from the one at the rapid, with which it probably unites to form a great basin. These two hills seem to belong to the same

formation. The body of the hill consists of highly-inclined beds of 61, 62 blackish-gray limestone, with sparry veins, and of brownish-gray dolo-

mite, which cannot be distinguished in hand specimens from that of 60 the hill at the rapid. The superior beds are formed of a calcareous

breccia.⁺ Associated with these strata, however, there are beds of lime-57 58,59 stone, highly, charged with bitumen ; and at the base of the hill there are

63, 64 beds of bituminous shale, some of which effervesce with acids, whilst

40 An ash-gray, fine-granular dolomite.

41 A conglomerate, forming the summit of the highest peak.

* See sketch No. 1, plate 31.

- † 57 This breccia has a white calcareous basis, which incloses angular fragments of compact, yellowish-gray limestone, with smooth dull surfaces.
- 58 Grayish-white limestone, having a fine crystalline texture, with drusy cavities, incrusted with bitumen.
- 59 Limestone, apparently composed of crystalline fragments, highly charged with bitumen, cemented by a whitish carbonate of lime in minute crystals. I could not satisfy myself whether this variety of colour proceeded from partial impregnations of bitumen, or from a brecciated structure Specimens 58 and 59 were from beds near the western part of the hill.
- 60 A fine-grained dolomite, approaching to compact, having a flat and somewhat splintery fracture, and a brownish-gray colour.
- 61, 62 Limestone in the body of the hill, resembling No. 39 in the hill at the rapid in Bear Lake River, but with larger veins of calc-spar.
- 63, 64 Dark blackish-brown bituminous shale, veined with calc-spar, and passing into http:// marl-slate. It contains nodules of iron pyrites.

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No. I.] TOPOGRAPHICAL AND GEOLOGICAL NOTICES. xvii

65 others approach in hardness, and other characters, to flinty slate. These shaly beds were seen by Captain Franklin and Mr. Kendall in autumn 1825, and they also saw, at that time, some sulphureous springs and streams of mineral pitch issuing from the lower parts of the limestone strata; but the whole of them were hid by the height of the waters of the Mackenzie in the spring of 1826.* The same cause prevented me from seeing some beds of lignite and sandstone, at the same place, of which Captain Franklin obtained specimens.

LIGNITE FORMATION.-MACKENZIE'S RIVER.

HAVING noticed the general features of this portion of the river, I have next to state, that the formation constituting its banks may be characterised as consisting of wood-coal in various states, alternating with beds of pipe-clay, potter's clay, which is sometimes bituminous, slate-clay, gravel, sand, and friable sandstones, and occasionally with porcelain earth. The strata are generally horizontal, and as many as four beds of lignite are exposed in some parts, the upper of which are above the level of the highest river-floods of the present day.

The lignite, when recently detached from the beds, is pretty compact, but soon splits into rhomboidal pieces, which again separate into slates more or less fine. It burns with a very fetid smell; somewhat resembling that of phosphorus, with little smoke or flame, leaving a brownish-red ash, not one-tenth of the original bulk of the coal. The blacksmith found it unfit for welding iron when used alone, but it answered when mixed with charcoal, although the stench it created was a great annoyance. Different beds, and even different parts of the

66, 67, 68 Bluish-gray, fine-grained sandstone, some of them passing into slate-clay, and scarcely to be distinguished from those at the rapid in Bear Lake River. Capt. Franklin took these specimens from horizontal beds at the foot of the hill facing Bear Lake River.

Sir Alexander Mackenzie, in p. 95 of his Voyage to the Arctic Sea, states, that he saw several small mineral springs running from the foot of this mountain, and found lumps of iron ore on the beach.

⁶⁵ Thin bed of indurated shale, approaching to flinty slate, lying at the foot of some beds of bituminous limestone. Their connection not clearly made out.

[No. T.

same bed, presented specimens of the fibrous brown-coal, earth-coal, conchoidal brown-coal, and trapezoidal brown-coal of Jameson. Some of the pieces have the external appearance of compact bitumen, but they generally exhibit, in the cross fracture, the fibrous structure of wood in concentric layers, apparently much compressed. Other specimens have a strong external resemblance to charcoal in

structure, colour, and lustre. A frequent form of the lignite is that of slate,
48 of a dull, brownish-black colour, but yielding a shining streak. The slate is composed of fragments, resembling charred wood, united together
by a paste of more comminuted woody matter, mixed, perhaps, with a small portion of clay. In the paste there are some transparent crystals of sulphate of lime, and occasionally some minute portions of a substance like resin. These shaly beds bear a strong resemblance to peat, not only in structure but also in the mode of burning, and in the light whitish ashes which are left. The external shape of stems or branches of trees, is best preserved in some fragments impregnated with slate-clay, and occasionally with siliceous matter, which occur imbedded in the coal. The bark of these pieces has been converted into lignite. Some of them exhibit knots, such as occur where a branch has decayed, and others represent the twists and contortions of wood of stunted growth. The lignite is generally penetrated by fibrous roots, probably *rhizomorpha*, which insinuate their ramifications into every crevice.

The beds of lignite appear to take fire spontaneously when exposed to the atmosphere. They were burning when Sir Alexander Mackenzie passed down the river in 1789, and have been on fire, in some part or other of the formation, ever since. In consequence of the destruction of the coal, large slips of the bank take place, and it is only where the debris has been washed away by the river that good sections are visible. The beds were on fire when we visited them, and the burnt clays, vitrified sand, agglutinated gravel, &c. gave many spots the appearance of an old brick-field.

The gravel interstratified with the lignite, consists of smooth pebbles 81 of Lydian stone, of flinty slate, of white quartz, of quartzose sandstone,

and conglomerate, like the sandstones and conglomerates of the old red sandstone formation, of clay-stone, and of slate-clay, varying in size from a pea to that of an orange. The gravel is often intermixed with a little clay, which gives the bed sufficient tenacity to form cliffs, but does not prevent the pebbles from

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No. I.] TOPOGRAPHICAL AND GEOLOGICAL NOTICES.

separating, in the attempt to break off hand specimens. It is seamed by thin layers of fine sand : beds of sandstone are of occasional occurrence.

Potter's clay occurs in thick beds, has generally a gray or brown colour, and passes, in some places, into a highly bituminous thick-slaty clay, penetrated by ramifications of carbonaceous matter resembling the roots of vegetables.

The *pipe-clay* is deserving of particular notice. It is found in beds from six inches to a foot thick, and mostly in contact with the lignite. It has commonly a yellowish-white colour, but in some places its hue is light lake-red. The natives use it as an article of food in times of scarcity, and it is said to have sustained life for a considerable time. It is termed *white puud* by the traders, who whitewash their houses with it. It occurs also in lignite deposits on the upper branches of the Saskatchewan, and is associated with bituminous shale on the coast of the Arctic Sea. Mr. Nuttall mentions a similar substance, under the name of pink-clay, as being found in the lignite deposits on the Arkansa.*

The *porcelain earth* was observed only at one place where the beds were highly inclined, and there it appeared to replace the sandstones of other parts of the deposit. It has a whitish colour, and the appearance, at first sight, of chalk; but some of its beds, from the quantity of carbonaceous matter interspersed through them, have a grayish hue. Its beds are from two to three yards thick.

In a note + I have mentioned the most remarkable sections of this formation

Travels in the Arkansa, p. 52-54.

+ Section I.

The section of the bank at the mouth of the Bear Lake River is as follows, beginning with the lowest bed :--

83 Potter's clay of a bluish gray colour, alternating with layers of sand 40 A sloping uneven brow, covered with soil, extends to the summit of the bank 20

Lydian stone is the most abundant, and whitish quartz the least so of the pebbles mentioned in the text as entering into the composition of the gravel.

A little farther up the Mackenzie, this bed of gravel passes into sand, which, in some spots, has sufficient coherence to merit for it the name of sandstone. During a great part even of the summer season, all the beds of sand are frozen into a hard sandstone; but a piece having been broken off and put into the pocket, speedily thawed into sand. SB Specimens

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which occur on the banks of the Mackenzie. The depth of the formation was not ascertained, but the sections will show the thickness of the beds which were

83 Specimens of the clay, which I have denominated potter's clay, taken from near the beds of

lignite, have a colour intermediate between yellowish-gray and clove-brown, a dull earthy fracture, and a slightly greasy feel. It is not gritty under the knife, and acquires a slightly shining smooth surface, adheres slightly to the tongue, and, when moistened with water, assumes a darker colour, and becomes plastic.

Section II.

About five miles above Bear Lake River, the cliff consists of	
Slaty sandstone evidently composed of the same materials with the friable kinds	
described in the text, but having tenacity enough to form a building-stone.	
It incloses some seams of lignite	10 feet
Lignite	43
Clay and Sand	50
Irregular slope from top of cliff to summit of bank	90
1	5.4.1
1	043

Section III.

	A little farther up the river than the preceding :	
85	Pipe-clay on a level with the water	1 foot
86	Lignite	1
90	Potter's clay	14 feet
87	Pipe-clay	1 foot
89	Lignite	1
91	Potter's clay	10 feet
	Lignite	1 foot
	Sandstone	8 feet
	Lignite	21
	Potter's clay	10
94	Friable sandstone and clay	20
	Sandstone a little more durable	12
	Sloping summit	40
	a de la companya de la	21

The pipe-clay, when taken newly from the bed, is soft and plastic, has little grittiness, and when chewed for a little time, a somewhat unctuous but not unpleasant taste. When dried in the air it acquires the hardness of chalk, adheres to the tongue, and has the appearance of the whiter kinds of English pipe-clay, but is more meagre.

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[No. L.

exposed. The height above the sea of the summit of the banks it forms on the Mackenzie, was estimated to be from two hundred and fifty to three hundred feet.

Section IV.

A little above the preceding :---

A precipitous bank of gravel	12 feet
Lignite and clay, the beds concealed by debris	40
Friable sandstone	30
Height of the cliff	82

Section V.

Ten miles above Bear Lake River, at the junction of a small torrent with the Mackenzie, there is a cliff about forty feet high, in which the strata have a dip of sixty degrees to the southward.

98	Bed, No.	. 1	Porcelain clay	2 yards
		2	Potter's clay, slightly bituminous	1
99		3	Thin-slaty lignite, with two seams of clay-iron stone, an inch	
100	, 101,		thick	21
		4	Pipe clay, (nine inches)	¥
104		5	Porcelain clay	3
105		6	Bituminous clay	3
106	;	7	Lignite, with a conchoidal fracture	2
		8	Pipe clay	ł
107		9	Porcelain clay	8
		10	Bituminous clay	3
110)	11	Lignite, carthy paste, enclosing fibrous fragments	2
		12	Porcelain earth	
		13	Bituminous clay	9
		14	Porcelain earth	
	20			

31 yards.

The three last beds, it is probable, once inclosed seams of coal which have been consumed, but the quantity of debris prevented this from being ascertained satisfactorily during the hurried visit I paid to them.

Over these inclined beds there is a shelving and crumbling cliff of sand and clay, covered 108 by a sloping bank of vegetable earth. A layer of peat at the summit has a thin slaty structure, and presents altogether, except in colour and lustre, a striking resemblance to the shaly lignite, forming bed No. 8 in the preceding Section. The

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NOTICES OF OTHER LIGNITE FORMATIONS.

Similar formations of lignite occur near the foot of the Rocky Mountain range farther to the southward; but I have not, after many inquiries, heard of any traces of them in the eastern parts of the Hudson's Bay lands. Sir Alexander Mackenzie, after describing the general course of the Rocky Mountains, says. that "along their eastern edge, there occurs a narrow strip of marshy, boggy, and uneven ground, which produces coal and bitumen;" and that "he saw these on the banks of the Mackenzie in lat. 66°, and, in his second journey, on the Peace River, in lat. 56° and 146° W. long. ;" and further, that " the same was observed by Mr. Fidler, on the south branch of the Saskatchewan, in lat 52°, long. 1125° W." Mr. Alexander Stewart, an intelligent chief factor of the Hudson's Bay Company, and well acquainted with those countries, informs me that there are beds of coal on fire, on the Smoking River, or east branch of the Peace River, and on the upper parts of the Rivière la biche, or Elk River; and that coal, although not on fire, occurs at Lesser Slave Lake, on a line with the other two localities. Mr. Small, a clerk to the Hudson's Bay Company, likewise acquaints me, that coal occurs at Edmonton, on the north branch of the Saskatchewan, in beds, sometimes seven or eight feet thick. Most of the coal is thin-slaty; but some beds yield shining, thick lumps, which break, as he expresses it, like Spanish liquorice. It lies over beds of bluish-gray sandstone, and is associated with a white clay, which froths in water and adheres to the fingers.

104, 98. The substance composing beds Nos. 1 and 5, which I have denominated Porcelain clay, has a fine, granular texture, and the appearance of some varieties of chalk. It adheres slightly to the tongue, yields readily to the nail, is meagre, and soils the fingers slightly. There are many specks of coaly matter disseminated through it, and some minute scales of mica, and perhaps of quartz. When moistened with water, it becomes more friable, and is not plastic. It does not effervesce with acids.

Bed No. 9 is the same mineral that forms beds 1 and 5; but it has a grayer colour from the greater quantity of coaly particles, and its structure is slightly slaty.

The bituminous clay of bed No. 6, has a thick-slaty structure, a grayish-black colour, and a shining resinous streak. It is sectile, but does not yield to the nail. Pieces of lignite occur imbedded in it, and it is traversed by fibrous ramifications of carbonaceous matter.

Specimens 115, 116, 117, 118, 119, are of substances altered by contact with beds of burning coal.

No. I.] TOPOGRAPHICAL AND GEOLOGICAL NOTICES.

Mr. Drummond brought specimens from the spbt which Mr. Small alludes to, and remarks, that the lignite occurs in beds from six inches to two feet thick,

separated by clay and sandstones. His specimens of the lignite are precisely similar to the slaty and conchoidal varieties, which occur at the mouth of the Bear Lake River;

1055 and there is an equal resemblance betwixt the sandstones from the two places. The slaty beds of lignite, at Edmonton, pass into a thin, slaty,

1053 friable sandstone, much impregnated by carbonaceous matter, and containing pieces of fibrous lignite. In the neighbourhood of the lignite, there are some beds of rather inducated, but highly bituminous

1056, 1062 shale, and the clayey banks contain clay-iron stones, in form of septaria. Mr. Drummond likewise found beds of a beautiful bitu-

minous coal, which Professor Buckland, from its peculiar fracture, considers to be tertiary pitch-coal. The banks of the Saskatchewan, near the same place, exhibit beds of a very compact stone, having a brown colour, and inclosing many

fragments of bituminous limestone and some organic re-

1058, 1059, 1060 mains; likewise beds of a somewhat similar stone, but full of drusy cavities, and more resembling a recent calcareous

tufa. I could not learn how far these beds were connected with the lignite deposit.

Captain Franklin * saw beds of lignite and tertiary pitch-coal at Garry's Island, off the mouth of the Mackenzie, and there is an extensive deposit of it near the Babbage River, on the coast of the Arctic Sea, opposite to the termination of the Richardson chain of the Rocky Mountains.

MACKENZIE RIVER FROM SLAVE LAKE TO THE BASE OF THE ROCKY MOUNTAINS.

HAVING now described the strata in Bear Lake River, together with the exposed beds of the lignite at its mouth, as far as opportunities of observation enable me, and also added a slight account of similar formations which occupy a like situation at the foot of the Rocky Mountain range, were I to adapt the

* See Page 61 of the Narrative.

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[No.I.

order of my notices strictly to the route of the expedition, I should next describe the banks of the Mackenzie from the junction of the Bear Lake River downwards to the Arctic Sea. It seems, however, more advisable to commence at the origin of the Mackenzie, in Great Slave Lake, and give as connected a view as I can of the principal geological features of that great river.

The west end of Slave Lake is bounded by horizontal strata of a limestone, whose characters shall be afterwards given in detail; and I have merely to remark, at present, that it forms flat shores, which are skirted by shoals of boulders of limestone, and of primitive rocks. Much drift-timber is accumulated in the small bays at this end of the lake, which, in process of time, is converted into a substance like peat. A chain of islands extends obliquely across the lake at the origin of the river, or where the current is first felt; and the depth of the water there is less than six feet. Below this, there is a dilatation termed the first little lake, and the river afterwards contracts to less than a mile in breadth; forming in one place, when the water is low, a strong rapid. A second dilatation, about twentyfive miles below the first, is termed the second little lake. The shores throughout this distance are generally flat and covered with boulders of limestone, compact felspar, granite, gneiss, and sienite, and there are many of these stones imbedded in a tenacious clay, which forms the beach. A ridge, having an even outline, and apparently of small elevation, commences behind Stony Point, in Slave Lake, some distance inland, and, running nearly parallel to the river, disappears about Fishing River, a stream which joins the Mackenzie, below the Second Little Lake. The Horn Mountains, a ridge of hills, of considerably greater elevation, and having a more varied outline than that on the south shore, are first visible on the north side of the Second Little Lake, and continue in sight nearly as far as the junction of the "River of the Mountains," or "Forks of the

Mackenzie," as the traders term the union of the two rivers. The only rocks seen *in situ* between Slave Lake and the Forks, were a bituminous shale of a brownish-black colour, in thin slates, and a slate-clay of a pure

yellowish-gray colour, which, as well as the bituminous shale, forms steep banks.

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ROCKY MOUNTAINS.

ABOUT twenty-five or thirty miles below the forks, the first view is obtained of the Rocky Mountains, which there appear to consist of short-conical peaks, scarcely rising two thousand feet above the river. Some distance lower down, the river, changing its course from W.N.W. to N.N.E., turns sharply round the mountains, which are there disposed in ridges, having bases from one to two miles wide, and a direction of S.S.W. or S.W. by S. being nearly at right angles to the general course of the great range to which they belong. The eastern sides of the ridges present a succession of wall-sided precipices, having beneath them shelving acclivities formed by debris, and exhibiting on their faces regular lines of stratification. The western sides of the ridges are of more easy ascent. The vallies which separate these ridges and open successively to the river, are narrow, with pretty level bottoms, but very steep sides well clothed with trees. In the first ridge the strata seemed to dip to the northward at an angle of 35°. In some of the others they were horizontal, or had a southerly dip. The third ridge presents, when viewed from the westward, a magnificent precipice, seemingly about one thousand two hundred feet high, and which extends for at least fifteen miles.* After passing this ridge, the river inclines to the eastward, and the forms of the hills are less distinctly seen. The views, taken by Captain Back and Mr. Kendall, will give a better idea of the appearances of these remarkable mountains than can be communicated by description.

As I could not visit the Rocky Mountains, I know nothing of their structure except from report. An interpreter in the Hudson's Bay Company's service, who had travelled over them, informed me that there are fourteen or fifteen ridges, of which the three easternmost are the most rugged, those that succeed

being broader and more rounded. This man gave me a specimen of a
122 pearl-gray semi-opal, resembling obsidian, brought from the third or fourth ridge. The natives, by means of fire, cause this stone to break off

in thin, flat, conchoidal fragments, with which they form arrow-heads and knives.

The thin pieces are nearly transparent on the edges. He also gave me a 123 specimen of plumbago, from the same quarter, and some specular iron.

• Plate SI, sketch 1.

Mr. Macpherson, of the Hudson's Bay Company, in a letter respecting the Rocky Mountains, near *Fort au Liard* on the River of the Mountains, or south branch of the Mackenzie, informs me, that "these mountains may be traced into somewhat uniform ranges, extending north-westerly and south-easterly, nearly parallel with the River of the Mountains, and are in appearance confusedly scattered and broken, rising here and there into high peaks." This gentleman had the kind-

ness to send me specimens of a cherty rock, some of which, he 124, 125 states, were from the third range westward from the river, and others

from a spur which projects in a southern direction from the fourth range, and rises about six hundred feet above the adjacent valley. These specimens cannot be distinguished from those of Limestone Point, on the north shore of Great Bear Lake, (noticed in page v.)

Mounts Fitton and Conybeare, two remarkable peaks which terminate the Eastern range of the Rocky Mountains on the shores of the Arctic sea, were found by Captain Franklin to consist of transition rocks, of which an account is given in the subjoired note.*

* List of specimens, collected by Captain Franklin, on the sea-coast, to the westward of the Mackenzie.

From Mount Fitton, in the Richardson Chain.

344 Grauwacke-slate in columnar concretions, detached from the rocky strata by an Esquimaux.

- **348 Grauwacke-slate**, resembling the preceding, from the same place. Used by the Esquimaux as a whetstone.
- 345, 346 Globular balls of dark, blackish-gray, splintery limestone, and of flinty-slate, traversed by minute veins of calc-spar. Picked up at the base of the mountain.
- 347 Worn pebbles of quartz, lydian stone, splintery limestone, and grauwacke, from the same spot.
- 349 Fine-grained, mountain-green clay-slate, approaching to potstone; quarried by the Esquimaux in the Cupola Mountain of the same chain, and used to form utensils.
- 350 Rock-crystal, from the same chain of mountains.

From the beach between Point Sabine and Point King.

- 351 Brown-coal, woody structure scarcely perceptible. There are beds of this coal in the earthy cliffs where the party was encamped on the 13th and 14th July, near Point King.
- 352 Clay-iron stone, forming boulders in the channels of the rills, which cut the earthy banks containing coal.
- 353, 354 Pitch-coal, having a fibrous structure and a very beautiful fracture, presenting a congeries of circles. (This coal was recognised by Professor Buckland to be a tertiary pitch-coal, and

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No. I.] TOPOGRAPHICAL AND GEOLOGICAL NOTICES.

Sir Alexander Mackenzie, towards the conclusion of the interesting narrative of his voyages, says, of the Rocky Mountain range, "The last line of division

is precisely similar to specimens brought from the upper branches of the Saskatchewan, by Mr. Drummond: see page xxiii.) The specimen was picked up from the gravelly beach at the mouth of the Babbage River.

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355 Greenish-gray limestone, with a somewhat earthy granular aspect; containing shells which Mr. Sowerby considers to be very like the cyclas medius of the Sussex weald-clay. Picked up at the same place with the preceding specimen.

Captain Franklin remarks, that "the Babbage flows between the mountains of the Richardson Chain, and that there were no solid strata nor any large boulders near its mouth. The gravel consisted of pebbles of red and white sandstone, slaty limestone, greenstone, and porphyry, much worn by attrition."

From Mount Conybeare, in the Buckland Chain.

- 856 Greenish-gray grauwacke-slate, (resembling No. 348,) with specks of effervescent carbonate of lime. The surfaces of the slates exhibit interspersed scales of mica. The specimens were broken from the summit of Mount Conybeare, at the western extreme of the Buckland Chain: latitude 69° 27′, longitude 139° 53′ west.
- 358 Fine-grained grauwacke-slate in columnar concretions, from the same place with specimen 356.
- 357 Grauwacke-slate, in thick-slaty columnar concretions, besprinkled with scales of mica. Taken from a bed about the middle of Mount Conybeare. The resemblance of this stone to that of Mount Fitton (No. 344) is very remarkable.
- 360 Similar rock to 358; with an adhering portion of a vein of crystallised quartz, and on one side a bit of bluish-gray slate. From the middle of Mount Conybeare.
- 359 Columnar concretion of a slaty rock, like 356, but more quartzose, breaking into rhomboidal fragments. From the middle of Mount Conybeare.
- 361, 362 Grauwacke-slate, with a thin adhering voin of carbonate of lime and numerous particles of disseminated mica. From the middle of Mount Conybeare.
- 363 Bluish-gray grauwacke-slate, resembling Nos. 348 and 344. From the Upper Terrace, at the base of Mount Conybeare.
- 364 Dark-bluish-gray and very fine-grained grauwacke-slate, with a glimmering lustre, traversed by a vein of quartz. From the same place.
- 365 A thick-slaty angular concretion of a very quartzose grauwacke-slate, (similar to Nos. 348 and 358,) decomposed on the surface and breaking into rhomboidal fragments. From the Middle Terrace, at the base of Mount Couybeare.
- 366 A somewhat rhomboidal portion of flinty slate, apparently part of a bed. From the Lower Terrace of Mount Conybeare, which is composed of this rock. The terrace is ten miles distant from the sea-coast, and the intervening ground is swampy.

The whole series of specimens from Mount Conybeare, (Nos. 356 to 366,) appear to belong to transition rocks; and the continuity of the formation with that of Mount Fitton is rendered probable, both by the resemblance of the specimens and the geographical situation of the mountains.

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is, the immense ridge, or succession of ridges of the stony mountains, whose northern extremity dips in the Arctic Sea in latitude 70° north, and longitude 135° west, running nearly south-east, and begins to be parallel to the coast of the Pacific ocean from Cook's inlet, and so onwards to the Columbia. From thence it appears to guit the coast, but still continuing with less elevation to divide the waters of the Atlantic from those of the Pacific. In these snow-clad mountains rises the Mississippi, if we admit the Missouri to be its source, which flow's into the Gulph of Mexico; the river Nelson which is lost in Hudson's Bay; Mackenzie's river that discharges itself into the North Sea, and the Columbia emptying itself into the Pacific Ocean. The breadth of the mountains from Cook's inlet to the Columbia 'is from four to eight degrees easterly." I may add, that the great rivers mentioned by Mackenzie not only take their origin from the same range of mountains, but almost from the same hill; the head waters of the Columbia and Mackenzie being only about two hundred yards apart in latitude 541°. Mr. Drummond, who crossed the mountains at that place, informs man that the Eastern side of the range consists of conglomerate and sandstone, to which succeed limestone hills exceedingly barren, and afterwards clay-slate and granite.

James, the intelligent naturalist, who accompanied Major Long on his first expedition, says of the Rocky Mountains to the southward of the Missouri, "They rise abruptly out of the plains which lie extended at their base on the east side, towering into peaks of great height, which renders them visible at the

Captain Franklin saw no rocks, *in situ*, on the coast to the westward of the Richardson Chain; but he gathered boulders of the following rocks from the bed of the Net-setting Rivulet, which flows from the British Chain of the Rocky Mountains, and falls into the Arctic Sea, between Sir P. Malcolm River and Backhouse River.

367 Greenstone; 368, yellowish-gray sandstone; 369, dark-coloured splintery-limestone; 370, 371, 372, dolomite; 373, quartzose sandstone, like the old red sandstone; 374, grauwackeslate; 375, quartz and iron pyrites.

Boulders of the under-mentioned rocks were gathered on Flaxman Island.

- 378 Fine-grained, greenish clay-slate, obviously of primitive rock, abundant in the neighbourhood, and supposed to have been brought down by the rivulets which flow from the Romanzoff Chain. 379, quartz.
- 376 and 377 were from Foggy Island, and are rolled specimens of flinty-slate; one of them containing corallines.

NA TOPOGRAPHICAL AND GEOLOGICAL NOTICES.

distance of more than one hundred miles from their base. They consist of ridges, knobs, and peaks, variously disposed, among which are interspersed many broad and fertile valleys. James's peak, one of the more elevated, was ascertained by trigonometrical measurement to rise 8500 feet above the common level. The rocky formations are uniformly of a primitive character, but a deep crust of secondary rocks appears to recline on the east side of the mountains, extending upwards from their base many hundred feet." In another place, he says, "The woodless plain is terminated by a range of naked and almost perpendicular rocks, visible at the distance of several miles, and resembling a vast wall parallel to the base of the mountain. These rocks are sandstone, and rise abruptly to an elevation of one hundred and fifty or two hundred feet." The sandstone walls seem to present an appearance not very dissimilar to some of the cliffs seen from the Mackenzie.

Having thus mentioned as briefly as I could the extent of the information I was able to collect, respecting the Rocky Mountain range, I may remark, that a formation of primitive rocks, but little elevated above the general level of the country, appears to run from near the west end of Lake Superior, gradually and slightly converging towards the Rocky Mountains, until it attains the east side of Great Bear Lake. In lat. 50°, the two ranges are nearly seven hundred miles apart, and there, and as far as lat. 60°, the space between them is principally occupied by horizontal strata of limestone. There is also much limestone in the narrower interval north of 60°, but the strata are more inclined, and form abrupt hills and ridges, particularly about lat. 66°, where the primitive rocks on the east of Bear Lake are within two hundred miles of the Rocky Mountains. Sir Alexander Mackenzie has noticed that a chain of great lakes skirts this eastern range of primitive rocks, where they are approached by the flat limestone strata which lie to the west of them. Thus the primitive rocks bound Great Slave Lake to the eastward of Slave River, and the flat limestone strata occupy the country westward of that lake, as has been already mentioned.

After this digression, which seemed necessary for the purpose of giving a general ides of the structure of the country, I return to the description of the banks of the Machenere.

XXIX

TO BEAR LAKE RIVER.

MACKENZIE RIVER FROM THE FIRST SIGHT OF THE ROCKY MOUNTAINS

Most.

At the sharp turn of the river round the Rocky Mountains, its east bank swells gently into a hill several feet high. Below this the banks are broken into conical masses by ravines, and present a finely variegated outline. A pretty high ridge, looking like a continuation of the Horn Mountain, is visible on the east side some distance inland. Opposite to the Big Island there is a green hill three or four hundred feet high, which, as we descended the river, showed itself to be part of a range that had a direction apparently to the N.N.W., and towards its northern end became more rugged and craggy, exhibiting cliffs and rude embrasures, at the same time increasing in height to eight hundred or one thousand feet. The boulders on the beach change their character considerably about this place. Farther up, the yellowish-white limestone which occurs in Slave Lake formed a great portion of them; but here a greenish-gray, and rather dark-coloured, compact limestone, with a flat-conchoidal fracture, replaces it. Variegated-sandstone, and some purplish, felspathose-sandstone, or compact felspar, also occur pretty frequently, together with slaty limestone, bituminousshale, lydian-stone, pitchstone-porphyry, and various sienites, granites, and greenstones, almost all porphyritic.

The Rock by the river's side* presents the first solid strata that occur on the immediate banks of the river after passing the Forks. It is a round bluff hill about five hundred feet high, with a short obtuse-conical summit. A precipice three hundred feet high, washed by the river, is composed of strata of limestone, dipping N.W. by W. at an angle of 70°; but the strata in other

parts of the hill have in appearance the saddle-formed arrangement. The limestone is of a blackish-gray colour, slightly crystalline structure, and

much resembles the stone of the principal beds in the hills at the rapid and mouth of Bear Lake River. Its beds are from one to two feet thick, and much intersected by small veins of calc-spar. There are also some larger veins a foot and a half thick, which traverse the strata obliquely, having their sides lined with

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calc-spar, and their centres filled with transparent gypsum. I observed 128 a small imbedded pebble of white sandstone in the gypsum. Some of 127 the beds of limestone consist of angular distinct concretions. A small island lying off this rock, having its strata dipping south at an angle 131 of 20°, presents a bed a foot thick, entirely composed of these angular 132 concretions, covered by a thin-slaty limestone, and reposing on thicker beds, all of which are dark-coloured. No organic remains were observed. A few miles below the "Rock by the river side," a very rugged ridge appears on the eastern bank. It has sharp craggy summits, and is about five or six hundred feet high. For nearly sixty miles below this place the river continues about eight hundred yards wide, bounded by banks chiefly of clay; but in some places of a clayey shale having a bluish colour. The banks are in many places one hundred and fifty feet high, with a beach beneath covered with boulders. A little above the site of the Old Fort Norman the river dilates, and is full of islands; and a short way inland, on the east side, stands Clark's hill, which is visible from Fort Franklin, and is supposed to be near 1500 feet high. It is charled somewhat like the amphibolic-granite mountain of Criffel in Galloway, and in its immediate neighbourhood there are some less lofty, but very rugged and precipitous hills, resembling in outline the ridges of limestone on Bear Lake River. From this

place to the commencement of the lignite formation, already described, the banks of the Mackenzie are high and clayey.

MACKENZIE RIVER FROM BEAR'LAKE RIVER TO THE NARROWS.

BELOW Bear Lake River the general course of the Mackenzie for eighty miles is about N.W. by W., when a remarkable rapid is produced by ledges of stone which cross its channel. The width of the river varies in this distance from one to three miles, but the water-course is narrowed by numerous islands, and the current continues strong. The Rocky Mountains are visible, running in a direction from S.E. to N.W. Judging merely by the eye, we did not estimate their altitude above four thousand feet, and I may remark, that the snow disappears from their summits early in the summer. A back view of the hill at the mouth of Bear Lake River is also obtained for upwards of twenty miles, but the ridge of which it forms a part curves inland, probably uniting, as was formerly

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remarked, with the one which crosses Bear Lake River near the middle of its course. The banks of the Mackenzie are in general from one hundred and twenty to one hundred and fifty feet high in this part, and there are occasional sections of them, but we had little leisure to examine their structure. In the voyage of 1826 we drifted down the stream night and day, landing only when necessary to cook our provisions; and in the following geological notices, as far as the passage of the river named the Narrows, I have done little more than describe the specimens collected by Captain Franklin, when he ascended the

permitted me to make, as to the direction of the strata, &c., were inserted in the book that was purloined by the Esquimaux at the mouth of the river. About fifty miles below Bear Lake River there is an almost preci-

About mity miles below Bear Lake River there is an almost precipitous cliff of bituminous-shale, one hundred and twenty feet high, strongly resembling the cliffs which occur near the bases of the hill of Scented-Grass and Great Bear Mountain in Bear Lake already described*, and at the mouth of the Clear Water River in lat. $56\frac{1}{2}$. In the two former localities the shale is in the neighbourhood of horizontal strata of limestone; and in the latter it actually reposes on the limestone, which extends in horizontal strata as far as Great Slave Lake, is connected with many salt springs, and possesses many of the characters

ascribed to the zechstein formation. Captain Franklin observed the 133 beach under the shale cliffs of the Mackenzie to be strewed not only with

fragments of the shale, but also with much lignite, similar to that which occurs at the mouth of the Bear Lake River. Twelve or fourteen miles below these cliffs there is a reach seventeen or eighteen miles long, bounded by walls

of sandstone in horizontal beds. Specimens obtained by Captain 134 Franklin at the upper end of the reach consist of fine-grained quartzose 135 sandstone † of a gray colour, and having a clayey basis, resembling those

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† 134. These specimens have a wood-brown colour internally, and appear to be composed of minute grains of quartz, variously coloured, white, yellowish-brown and black, cemented together by an earthy basis. It is a hard and apparently durable stone, occurring in layers an inch thick, and having its seam-surfaces of a grayish-black colour, with little lustre, as if from a thin costing of bituminous clay.

135, are specimens of a more compact, harder, and finer-grained quartzose sandstone, with lens cement, and of a deeper bluish-gray colour.

No. I.] TOPOGRAPHICAL AND GEOLOGICAL NOTICES.

which occur in the middle of Bear Lake River. At the commencement of the "Great Rapid of the Mackenzie" there is a hill on each side of the river; named by Captain Franklin the Eastern* and Western mountains of the Rapid. The Rocky Mountains appear at no great distance from this place, running about N.W. by W., until lost to the sight; and as the Mackenzie, for forty or fifty miles below, winds away to the northward, and, in some, reaches a little to the eastward, they are not again visible, until the river has made a bend to the westward, and emerges from the defile termed "the Narrows."

The "Eastern mountain of the rapid" seems to have a similar structure, with the "Hill by the River's side," the hill at the mouth of Bear Lake River, and the other limestone ridges which traverse this part of the country. From

some highly inclined beds near its base I broke off specimens of a
 limestone, having an imperfectly crystalline structure, and a brown colour, which deepens into dull black on the surfaces of its natural seams. A piece of dark-gray, compact limestone, having the peculiar

137 structure to which the name of "cone in cone" has been given, was found

138 on the beach; also several pieces of chert, and some fragments of a trap-

139 rock, consisting of pieces of greenstone, more or less iron-shot, cemented

141 by calc spar.

Immediately below the rapid there are horizontal layers of sandstone which form cliffs, and also the bed of the river. Captain Franklin obtained specimens

of this stone, which do not differ from the sandstones above the rapid. And amongst the debris of the cliff he found other specimens of the '' cone in cone," such as it occurs in the clayey beds of the coal measures, and also some pieces of crystallized pyrites.

About forty miles below the rapid, the river flows through a narrow defile formed by the approach of two lofty banks of limestone in highly-inclined strata, 144 above which there is a dilatation of the river, bounded by the walls of 144[•] sandstone, which have weathered, in many places, into pillars, castellated

* Mackenzie attempted to ascend this hill, but was compelled to desist by clouds of mosquitoes, (July 6th, 1759. Voyage to the Arctic Sea, p. 40.)

130. This Innestone effervesces strongly with acids, breaks into irregular fragments, but with an imperfect slaty structure, and has a brown colour, with considerable lustre in the cross fracture.

The specimens collected by Captain Franklin were as follows :--

144 Sandstone of an ash-gray colour, composed of rounded grains of semi-transparent quartz

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- 145 forms, caves, &c. The sandstone strata are horizontal, have slate-clay
- 146 partings, and seams of a poor clay-iron stone, but do not differ in general
- 147 appearance from the sandstone beds at the rapid, except that a marly 144^b stone containing corallines, and having the general colour and aspect of
 - the sandstone beds, is associated with them at this place.

The very remarkable defile, below these sandstone beds, is designated " the second rapid" by Sir Alexander Mackenzie, and "the ramparts" by the traders, a name adopted by Captain Franklin. Mackenzie states it to be three hundred yards wide, three miles long, and to have fifty fathoms depth of water. If he is correct in his soundings, its bed is probably two hundred and fifty feet below the level of the sea. The walls of the defile rise from eighty to one hundred and fifty feet above the river, and the strata are inclined to the W.N.W., at an angle of seventy or eighty degrees. It is worthy of remark, that the course of the river through this chasm is E.N.E., and that just above the eastern mountain of the rapid it runs about W.S.W. through the sandstone strata, as if it had found natural rents by which to make its escape through the ridge of hills which cross its course here. Similar elbows occur in various parts of the river, as a reference to the map will show; and they may be almost always traced to some peculiarity in the disposition of the hills which traverse the country.

Captain Franklin gathered many specimens of the limestone strata of the Ramparts, which are specified in a note.* Some of the beds at the

148, 149 upper part of the Ramparts consist "of a granular foliated limestone, which was not noticed elsewhere on the banks of the river, but the

of various sizes, imbedded in a considerable proportion of a powdery basis which effervesces with acids. This bed weathers readily.

145. Thick-slaty sandstone passing into slate-clay, having a very fine-grained earthy fracture, and a light bluish-gray colour. It is very similar to some of the softer sandstones that occur in the coal field at Edinburgh, particularly in the Calton Hill.

146. Sectile ash-gray slate-clay which forms the partings of the beds.

144^b Bluish-gray marl, impregnated with quartz, forming a moderately hard stone, and containing corallines (amplexus.)

* Upper part of the ramparts.

- 148 A fine-granular, foliated limestone, of a white colour, having large patches stained yellowishbrown, apparently by bitumen.
- 149 A yellowish-gray slightly granular limestone, with disseminated calc-sper.
- 150 Compact, white limestone, which, when examined with a lens, appears to be entirely compared of madrepores.

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greater part are of limestone, strongly resembling that which has been already described, as forming the ridges in this quarter. Most of the beds are impregnated wholly, or in patches, with bitumen. Some of these specimens contain corallines and terebratulæ; and at the lower end of the defile there are horizontal strata of limestone, covered by a thin layer of flinty slate.

Below the ramparts the river expands to the width of two miles, and for a reach or two its banks are less elevated. In lat. 663° , about thirty miles from the ramparts, there are cliffs which Captain Franklin, in his notes, remarks, "run on an E. by S. course for four miles, are almost perpendicular, about one hundred and sixty feet high, and present the same castellated appearances that are exhi-

159, 160, bited by the sandstone above the defile of the "ramparts." The cliffs*
are, in fact, composed of sandstones similar, in general appearance, to those which occur higher up the river; but some of the beds contain

- 151 Specimens of limestone, having a crystalline texture, a brownish colour and slaty structure :
- 152 the seams are dark, as if from carbonaceous matter—portions of this bed have the appearance of old mortar; but contain obscure madrepores.

From the middle of the ramparts.

- 153 Fine-granular limestone, having a pale, wood-brown colour, and u splintery fracture. It resembles the limestone of the hill at the mouth of Bear Lake River.
- 154 Pale yellowish-brown limestone, with a dull fracture, but interspersed with small, shining, sparry plates, and traversed by concretions of calc-spar, that appear to have originated in corallines.
- 155 Yellowish-gray limestone, passing into a soft marl slate.
- 156 Some beds contain a shell, which Mr. Sowerby refers, though with doubt, to the species named terebratula sphæroidalis, a fossil of the corbrash. The substance of the shells is preserved.Some of the specimens contain producti, and fragments of the coral named amplexus.

Lower end of the ramparts.

- 157 Fine-grained limestone, of a dark-brown colour, containing some small, round, smooth balls of dark limestone-occurs in horizontal strata.
- 158 Brownish-black flinty-slate, which forms a layer an inch thick, and covers the horizontal beds of limestone last mentioned. (157.)

Specimens from the cliffs in lat. 663.

159 Very fine -grained sändstone, with much clayey basis-portions of the bed iron-shot.

- 160 Sandstone, fine-grained, and appearing, when examined with a lens, to be composed of minute grains of whitish translucent quartz, black Lydian stone, and ochre-coloured grains, probably of disintegrated felspar.
- 161 Rounded grains of nearly transparent quartz united without cement-this stone is friable.
- 162 Sandstone composed of grains like the preceding, united by a basis, and forming a firmer stone.

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163, 164,
165, 166,
167, 168,
169, 170,
169, 170,
the quartz in coarser grains, with little or no cement. The beds are horizontal, and repose on horizontal limestone,* from which Captain Franklin broke many specimens in 1825. We landed at this place in 1826 to see the junction of the two rocks, but the limestone was concealed by the high waters of the river. Captain Franklin's specimens are full of shells, many of which are identical with those of the

flat limestone strata of the Athabasca River. One bed appears to be 171. almost entirely composed of a fine large species of terrebratula, not vet

described, but of which Mr. Sowerby has a specimen from the carboniferous limestone of Neho, in Norway. Some of the beds contain the shells in fragments; in others, the shells are very entire.

About forty miles below these sandstone walls the banks of the river are com

posed of marl-slate, which weathers so readily, that it forms shelving 172 acclivities. In one reach the soft strata are cut by ravines into very re-

gular forms, resembling piles of cannon shot in an arsenal, whence it was named Shot-seach.[†]

The river makes a short turn to the north below Shot Reach, and a more considerable one to the westward, in passing the present site of Fort Good Hope. The banks in that neighbourhood are mostly of clay, but beds of sandstone occasionally shew themselves. The Indians travel from Fort Good Hope nearly due north, reach the summit of a ridge of land on the first night, and from thence following the course of a small stream they are conducted to the river *Inconnu*, and on the evening of the 4th day they reach the shores of Esquimaux Lake. The situation and supposed extent of this lake are marked on the map : its water

163 Hard, thin, slaty, bluish-gray sandstone, much iron-shot.

164 Fine-grained bluish-gray sandstone, not to be distinguished in hand-specimens from some of the sandstones which occur at the rapid in Bear Lake River.

Horizontal limestone beds lying under the sandstone.

- 166 Fine-grained limestone, with an earthy fracture, coloured brown and grayish-white in patches.
- 167, 168 Similar stone to preceding, containing many shells. Some beds contain only broken shells.
- 169 Bed of imperfectly crystalline limestone, of a brownish-gray colour, traversed by veins of calc-spar.
- 170 Fragments containing madrepores and chain coral-occur amongst the debrie of the limestone' cliffs.

† See Plate, No. 21, sketch 3.

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is brackish, the tide flowing into it. The neck of land which the Indians cross from Fort Good Hope is termed "isthmus" on Arrowsmith's map, from Mackenzie's information; and its breadth, from the known rate at which the Indians are accustomed to travel, cannot exceed sixty miles. The ridge is named the Carrebœuf, or Rein-deer Hills, and runs to lat. 69°, forming a peninsula between the eastern channel of the Mackenzie and Esquimaux Lake.

A small stream flows into the Mackenzie some way below Fort Good Hope, on the banks of which, according to Sir Alexander Mackenzie, the Indians and Esquimaux collect flints. He describes these banks as composed of "a high, steep, and soft rock, variegated with red, green, and yellow hues; and that, from the continual dripping of the water, parts of it frequently fall, and break into small, stony flakes, like slate, but not so hard. Amongst these are found pieces of petroleum, which bears a resemblance to yellow wax, but is more pliable." The flint he speaks of is most probably flinty-slate; but I do not know what the yellow petroleum is, unless it be the variety of alum, named rock-butter, which we observed in other situations, forming thin layers in bituminous shale.

About twenty miles below Fort Good Hope there are some sand-173, 174 stone cliffs,* which Captain Franklin examined in 1825. The sandstones are similar to those occurring higher up the river, but some of

the beds contain small pieces of bituminous shale; and they are interstratified with thin layers of flinty-slate, and of flinty-slate passing into bitu-

175, 176 minous shale. The flinty-slate contains iron pyrites, and its layers are covered with a sulphureous efflorescence. Some of the beds pass into a slate-clay, which contains vegetable impressions, and some veins of clayiron stone also appear in the cliff.

Sixty miles below Fort Good Hope the river turns to the northward, and makes a sharp elbow betwixt walls of sandstone eighty or ninety feet high, which continue for fifteen or twenty miles. Captain Franklin named this

* Sandstone cliffs twenty miles below Fort Good Hope.

- 173 Friable sandstone, composed of grayish-white quartz, in smooth, rounded grains, cemented by a brownish basis. Some carbonaceous matter is interspersed through the stone, and it contains small fragments of bituminous shale.
- 174 Calcarcous sandstone passing into slate-clay-bluish-gray colour.
- 175 Black, flinty-slate, with a flat conchoidal cross fracture. Some of the pieces appear to be rhomboidal distinct concretions,
- 176 Doll, Binty-slate, with an even fracture.

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178 passage of the river "The Narrows."* The sandstones of the Narrows

179 lie in horizontal beds, and have generally a dark gray colour. They are

180 parted by thin slaty beds of sandstone, containing small pieces appa-

181, 182 rently of bituminous coal, and some casts of vegetables. Most of the

183 beds contain scales of mica, and some of them have nodules of indurated iron-shot clay which exhibit obscure impressions of shells. A bed of imperfectly crystalline limestone was seen by Captain Franklin underlying the sandstones.

MACKENZIE RIVER BELOW "THE NARROWS."

The Mackenzie, on emerging from the Narrows, separates into many branches. which flow to the sea through alluvial or diluvial deltas and islands. The Rocky Mountains are seen on the western bank of the river, forming the boundary of those low lands; and the lower, but decided ridge, of the Rein-deer Hill holds nearly a parallel course on the east bank. The estuary lying between these two ranges, opens to the N.W. by N. into the Arctic Sea. I have already mentioned the specimens of rocks obtained at the few points of the Rocky Mountains that were visited, † and therefore shall now speak only of the Rein-deer Hills. We did not approach them until we had passed for thirty miles down a branch of the river which winds through alluvial lands. At this place there are several conical hills about two hundred feet high, which appeared to consist of limestone. Specimens taken from some slightly-inclined beds near their bases, consisted of a fine-grained, dark, bluish-gray limestone. After passing these limestone rocks, the Rein-deer Hills were pretty uniform in appearance, having a steep acclivity with rounded summits. Their height, on the borders of the river, is about four

* Mackenzie notices the precipices of "gray stone," which bound the river here, p. 71.

178 Thin-slaty blackish-gray sandstone, much indurated, containing scales of mica.

179, 180 Bluish-gray sandstone, containing many minute specks of carbonaceous master; also, in patches, grains of chert, and flinty slate, and imbedded pieces of iron-shot clay, which has obscure casts of shells. Scales of mica are interspersed through this stone.

181, 182 Sandstone, containing specks of bituminous? coal, and casts of some vegetable? substance.

163 Gray limestone, much impregnated with quartz, and having an imperfect crystalline sirubture

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XXXVIII

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hundred feet, but a mile or two inland they attain an elevation of perhaps two hundred feet more. Their sides are deeply covered with sand and clay, arising most probably from the disintegration of the subjacent rocks. A section made

by a torrent, showed the summit of one of the hills to be formed of 184,185 gray slate-clay, its middle of friable gray sandstone much iron-shot,

and its base of dark bluish-gray slaty clay. The sandstone predominates in some parts of the range, forming small cliffs, underneath which there are steep acclivities of sand. It contains nearly an equal quantity of black filmty slate, or lydian stone, and white quartz in its composition, and greatly resembles

the friable sandstones of the lignite formation at the mouth of Bear Lake 186 River. In some parts the soil has a red colour from the disintegration of a reddish-brown slate-clay. The summits of the hills that were visited

187 were thinly coated with loose gravel, composed of smooth pebbles of lydian stone, intermixed with some pieces of green felspar, white quartz, limestone, and chert. In some places almost all the pebbles were as large as a

goose-egg; in others none of them exceeded the size of a hazel nut. The Reindeer Mountains terminate in lat. 69°, having previously diminished in altitude to two hundred feet, and the eastern branch of the river turns round their northern extremity. White spruce trees grow at the base of these hills as far as lat. $68\frac{1}{2}^{\circ}$; north of which they become very stunted and straggling, and very soon disappear, none reaching to lat. 69° .

Sir Alexander Mackenzie, who, on his return from the sea, walked over these hills, says, "Though the country is so elevated, it is one continued morass, except on the summits of some barren hills. As I carried my hanger in my hand, I frequently examined if any part of the ground was in a state of thaw, but could never force the blade into it beyond the depth of six or eight inches. The face of the high land towards the river is, in some places, rocky, and in others a mixture of sand and stone, veined with a kind of red earth, with which the natives bedaub themselves." It was on the 14th of July that he made these observations. On the 5th of the same month, in a milder year, we found that the thaw had penetrated nearly a foot into the beds of clay at the base of the hills.

XXXIX

ALLUVIAL ISLANDS AT THE MOUTH OF THE MACKENZIE.

THE space between the Rocky Mountains and Rein-deer Hills, ninety miles in length from lat. 67° 40' to 69° 10', and from fifteen to forty miles in width, is occupied by flat alluvial islands, which separate the various branches of the river. Most of these islands are partially or entirely flooded in the spring, and have their centres depressed and marshy, or occupied by a lake; whilst their borders are higher and well clothed by white spruce trees. The spring floods find their way, through openings in these higher banks, into the hollow centres of the islands, carrying with them a vast quantity of drift timber, which, being left there, becomes water-soaked, and, finally, firmly impacted in the mud. The young willows, which spring up rapidly, contribute much towards raising the borders of the stream, by intercepting the drift sand which the wind sweeps from the margin of the shallow ponds as they dry up in summer. The banks, being firmly frozen in spring, are enabled to resist the weight of the temporary floods which occur in that season, and before they are thawed the river has resumed its low summer level. The trees which grow on the islands terminate suddenly, in lat. 68° 40'.

I have already mentioned, that a large sheet of brackish water, named Esquimaux Lake, lies to the eastward of the Rein-deer Mountains, running to the southward, and approaching within sixty miles of the bend of Mackenzie's River at Fort Good Hope. This lake has a large outlet into Liverpool Bay, to the westward of Cape Bathurst, and there are many smaller openings betwixt that bay and Point Encounter, near the north end of the Rein-deer Hills, which are also supposed to form communications betwixt the lake and the sea. The whole coast-line from Cape Bathurst to the mouth of the Mackenzie, and the islands skirting it, as far as Garry and Sacred Islands, present a great similarity in outline and structure. They consist of extensive sandy flats, from which there arise, abruptly, hills of an obtuse conical form, from one to two hundred feet above the general level. Sandy shoals skirt the coast, and numerous inlets and basins of water divide the flat lands, and frequently produce escerpments of the hills, which show them to be composed of strata of sand of various colours, sometimes inclosing very large logs of drift timber. There is a coating of black vegetable earth, from six inches to a foot in thickness, covering these sandy hummocks, and some of the escarped sides appeared black, which was probably caused by soil washed from the summit.

It is possible that the whole of these eminences may, at some distant period, have been formed by the drifting of moveable sands. At present the highest floods reach only to their bases, their height being marked by a thick layer of drift timber. When the timber has been thrown up beyond the reach of ordinary floods, it is covered with sand, and, in process of time, with vegetable mould. The *Elymus mollis*, and some similar grasses with long fibrous roots, serve to prevent the sand-hills from drifting away again. Some of the islands, however, consist of mud or clay. Captain Franklin describes Garry's Island as present-

ing cliffs, two hundred feet high, of black mud, in which there were inclined
beds of lignite. Specimens of this lignite have the same appearance with the fibrous wood-coal occurring in the formation at the mouth of Bear Lake River, and, like it, contain resin. Imbedded in the same bank, there

189 were large masses of a kind of dark-brown calc-tuff, full of cavities con-

190 taining some greenish earthy substance. Some boulders of lydian stone

strew the beach. The cliffs of Nicholson's Island also consisted of sand and mud, which, at the time of our visit, (July 16th.) had thawed to the depth of three feet. This island rises four hundred feet above the level of the sea, and is covered with a thin sward of grasses and bents.

SEA-COAST .- BITUMINOUS ALUM SHALE.

THE main land to the east of Nicholson's Island, as far as Cape Bathurst, presents gently swelling hills, which attain the height of two hundred feet at the distance of two miles from the beach, and the ground is covered with a sward of moss and gasses. At Point Sir Peregrine Maitland there are cliffs forty-feet high of sand and slaty-clay, and the ravines are lined with fragments of whitish compact limestone, exactly resembling that which occurs in Lakes Huron and Wisipeg, and which was afterwards seen forming the promontory of Cape Parry, bearing E.N.E. from this place. The beach, on the south side of Harrowby Bay, not far from Point Maitland, was thickly strewed with fragments of dark red and of white sandstone, together with some blocks of the above-mentioned limestone, and a few boulders of signite.

From Cape Bathurst the coast line has a S.E. direction, and is formed by precipitous cliffs, which gradually rise in height from thirty feet to six hundred. The beds composing these cliffs appear to be analogous to the alumshale banks at Whitby, and similar to those which skirt the Scented-grass Hill and Great Bear Mountain, in Great Bear Lake. The Scented-grass Hill is distant from Cape Bathurst about three hundred miles, on a S.E. bearing, which corresponds, within a point, with the direction of the principal mountain chains in the country. A glance at the map will show a striking similarity in the form

of the ground plan of these two promontories. At the extremity of Cape 191 Bathurst the cliffs consist of slaty-clay, which, when dry, has a light bluish-gray colour, a slightly greasy feel, and falls down in flakes. The rain-water had penetrated the cliff to the depth of three yards from the summit; and this portion was frozen, on the 17th July, into an icy wall, which crumbled down as it thawed. On proceeding a little further along the coast, some beds were observed that possessed, when newly exposed to the air, tenacity enough to be denominated stone, but which, under the action of water, speedily softened into a tenacious bluish-clay.

At Point Traill we were attracted by the variegated colours of the cliff, and on landing found that they proceeded from clays baked by the heat 192 of a bed of bituminous-alum-shale which had been on fire. Some parts of the earth were still warm. The shale is of a brown colour and thin 193 slaty structure, with an earthy fracture. It contains many interspersed 197 crystals of sclenite; between its lamina there is much powdery alum, 198 199 mixed with sulphur, and it is traversed by veins of brown selenite, in slender prismatic crystals. The bed was much broken down, and hid by the debris of the bank, but in parts it was several yards thick, 200 and contained layers of the wax-coloured variety of alum, named Rock-194* The shale is covered by a bed of stone, chiefly composed of butter. 195 oval distinct concretions of a poor calcareous clay-iron stone. These con-196 cretions have a straight cleavage in the direction of their short axis, and are often coated by fibrous calc-sinter and calcedony. The upper part

of the cliff is clay and sand passing into a loosely cohering sandstone. The strata are horizontal, except in the neighbourhood of ravines, or of consumed

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shale, when they are often highly inclined, apparently from partial subsidence. The debris of the cliff form declivities, having an inclination of from fifty to eighty degrees, and the burnt clays variously coloured, yellow, white, and deep red, give it much the appearance of the rubbish of a brick-field. The view of the interior, from the summit of the cliff, presents a surface slightly varied by eminences, which swell gently to the height of fifty or sixty feet above the general level. The soil is clayey, with a very scanty vegetation, and there are many small lakes in the country.

Ten miles further on, the alum-shale forms a cliff two hundred feet high, and presents layers of the Rock-butter about two inches thick, with many crystals of

selenite on the surfaces of the slates. The summit of the cliff consists of

201 a bed of marly gravel two yards thick, which is composed of pebbles of granite, sienite, quartz, lydian-stone, and compact limestone, all coated by a white powdery marl. The dip of the strata at this place is slightly to the northward.

A few miles to the south-east of Wilmot Horton River the cliffs are six hundred feet high, and present acclivities having an inclination of from thirty to sixty degrees, formed of weathered slate-clay. Some beds of alum-shale are visible at the foot of these cliffs, containing much sulphate of alumina and masses of baked clay.

Two niles further along the coast the shaly strata were on fire, giving out smoke, and beyond this the cliffs become much broken but less precipitous, having fallen down in consequence of the consumption of the combustible strata.^A These ruined cliffs gradually terminated in green and sloping banks, whose summit was from one to two miles inland, and about six hundred feet above the sea level. Considerable tracts of level ground occurred occasionally betwixt these banks and the beach. Wherever the ground was cut by ravines, beds of slate-clay were exposed. On reaching the bottom of Franklin Bay, we observed the higher grounds keeping an E.S.E. direction until lost to the view, becchning, however, somewhat peaked in the outline.

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SEA COAST.-LIMESTONE.

Parry's Peninsula, where it joins the mainland, is very low, consisting mostly of gravel and sand, and is there greatly indented by shallow bays, but it gradually increases in height towards Cape Parry. The bays and inlets are separated from the sea by beaches composed of rolled pieces of compact limestone; and which, although they are in places only a few yards across, are several miles in length. The northern part of Parry's Peninsula belongs entirely to a formation which appears, from the mineralogical characters of the stone composing the great mass of the strata, and the organic remains observed in it, to be identical with the limestone formations of Lakes Winipeg and Huron.

202 On the north side of Sellwood Bay, in lat. 69° 42', cliffs about 204 twenty feet high are composed of a fine-grained* brownish dolomite, in angular distinct concretions, and containing corallines and veins of calcspar. In the same neighbourhood there is a bed of grayish-black

203 compact lucullite, with druses of calc-spar, very similar to the limestone which occurs in highly inclined strata at the "Rock by the River

Side," on the Mackenzie, and in horizontal strata in an island near that rock, where it forms angular concretions.

After passing Sellwood Bay, the north and east shores of Cape Parry, and the islands skirting them, present magnificent cliffs of limestone, which, from the weathering action of the waves of the sea, assume curious architectural forms. Many of the insulated rocks are perforated.[†] Between the bold projecting cliffs of limestone there are narrow shelving beaches, formed of its debris, that afford access to the interior. The strata have generally a slight dip to the northward,

Specimens from Sellwood Bay.

- 202 Fine-grained dark brownish-gray dolomite, with corallines filled with white calc-spar.
- 203 Lucullite grayish-black, compact, and without lustre.
- 204 Gray dolomite.
- 205 A rolled piece, evidently of the same rock with the preceding, containing the impression of cardium.
- 206

+ See Plate 26.

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and the most common rock is a yellowish-gray dolomite which has a very compact tructure, but presents some shifting facets of disseminated calc-spar. This stone, which is not to be distinguished by its mineralogical characters from the prevailing limestone of Lake Winipeg, and at the passage of *La cloche* in Lake Huron, forms beds six or eight feet thick, and is frequently interstratified with a scellular limestone, approaching to chert in hardness, and exhibiting the characters of rauchwacke. In some parts, the rauchwacke is the predominating rock, and has its cells beautifully powdered with crystals of quartz or of calcspar, and contains layers of chert of a milky colour. The chert has sometimes the appearance of calcedony, and is finely striped.

The extremity of Cape Parry is a hill about seven hundred feet 208, 209 high, in which beds of brownish dolomite, impregnated with silica,

are interstratified with a thin-slaty, gray limestone, having a compact structure. The vegetation is very scanty, and there are some spots covered with fragments of dolomite, on which there is not the vestige even of \mathbf{a}_{1}^{*} lichen. Many large boulders of greenstone were thrown upon the N.W. point of Cape Parry. The islands in Darnley Bay, between Capes Parry and Lyon, are composed of limestone.

SEA-COAST.-FORMATION OF SLATE-CLAY, SANDSTONE, AND LIMESTONE, WITH TRAP-ROCKS.

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From Cape Lyon to Point Tinney, the rocks forming the coast-line are slateclay, limestone, greenstone, sandstone, and calcareous puddingstone.

Specimens from the Promontory of Cape Parry, which "rises into a hill, seven hundred feet high. Strata dipping lightly to the northward.

- 207 Yellowish-gray dolomite, imperfectly crystalline, being similar to the limestone of Lake Winipeg.
- 208 Brownish dolomite impregnated with silica.

209. Thin-slaty, gray limestone. Very common also in Lake Winipeg.

210, 211 Boulders of dolomite.

212

213 Brown dolomite, with drusy cavities and veins, lined by calc-spar.

here have

xl#

214 Near the extremity of Cape Lyon the slate-clay predominates, occurring in straight, thin, bluish-gray layers, which are interspersed with detached scales of mica. It sometimes forms thicker slates, that are impreg-

nated with iron, and occurs alone, or interstratified in thin beds with a 215 reddish, small-grained limestone. The strata, in general, dip slightly

to the N.E., and form gently-swelling grounds, which at the distance of about fifteen miles to the southward terminate in hills, named the Melville Range. These hills are apparently connected with those which skirt the coast to the westward of Parry's Peninsula, have rather a soft outline, and do not appear to attain an altitude of more than seven or eight hundred feet above the sea. Ridges of naked trap-rocks, which traverse the lower country betwixt the Melville hills and the extremity of the Cape, rise abruptly to the height of one hundred or one hundred and fifty feet, and have, in general, an E.N.E. di-When these trap ridges reach the coast, they form precipices which rection. frequently have a columnar structure, and the nearly horizontal strata of slateclay are generally seen underlying the precipices. In many places the softer clay strata are worn considerably away, and the columns of greenstone hang over the beach. Columns of this description occur at the north-eastern extremity of the Cape, and the slate-clay is not altered at its point of contact with the greenstone. The soil in this neighbourhood is clayey, and some small streams have pretty lofty and steep clayey banks; the shaly strata appearing only at their base. A better sward of grasses and carices exists at Cape Lyon, than is usual on those shores. Many boulders of greenstone and large fragments of red sandstone strew the beach.

At Point Pearce, four or five miles to the eastward of Cape Lyon, a reddish, small-grained limestone forms perpendicular cliffs two hundred feet high, in which a remarkable cavern occurs. Near these cliffs the slate-clay and reddish limestone are interstratified, and form a bold rocky point, in which the strata dip to the N.E. at an angle of 20°. The coast line becomes lower to the eastward, and at Point Keats a fine-grained, flesh-coloured sandstone occurs. This sand stone is quartzose, does not possess much tenacity, and is without any apparent basis.

At Point Deas Thompson the limestone re-appears, having reddish-brown and flesh-red colours, and a splintery fracture. There are some beautiful Gothic arches formed in the cliffs there by the weathering of the strata. Five miles farther along the coast, near Roscoe River, the same kind of limestone forms cliffs twenty-five feet high, and is covered by thin layers of soft slate-clay. On the top of these cliffs we observed a considerable quantity of drift-timber and some hummocks of gravel. The spring-tides do not rise above two feet. The Melville Range approaches within three miles of the coast there, and presents a few short conical summits, although the hills composing it are mostly round-backed.

At Point De Witt Clinton, a compact blackish-blue limestone, traversed by veins of calc-spar, forms a bed thirty feet thick, which reposes on thin 217 layers of a soft, compact, light, bluish-gray limestone or marl. The cliffs 218 at this place are altogether about seventy feet high, but their bases 219 were concealed by accumulations of ice. Veins filled with compact and fibrous gypsum traverse the upper limestone. Naked and barren ridges of greenstone, much iron-shot, cross the country here, in the same manner as at Cape Lyon. The soil consists of gravel and clay; the former mostly composed of whitish, magnesian limestone; and the vegetation is very scanty.

At Point Tinney, in lat. 69° 20', cliffs of a calcareous' puddingstone, about forty feet high, extend for a mile along the coast. The basis, in most of the beds, is calc-spar; but in some small layers it is calcareous sand. The imbedded pebbles are smooth, vary in magnitude, from the size of a pea to that of a man's hand, and are mostly or entirely of chert, which approaches to calcedony, and, when striped, to agate in its characters. Perhaps, much of the gravel which covers the country is derived from the destruction of this conglomerate rock.

SEA-COAST.-LIMESTONE.

FROM Point Clifton to Cape Hearne, the whole coast consists of a formation of limestone precisely similar to that which occurs on Lake Winipeg and **Parry's Peninsula**.

Dolomite, the prevailing rock in this formation, is generally in thin layers, and has a light smoke-gray colour, varying occasionally to yellowish gray, and buff. Its structure is compact, with little lustre, except from facets of dissemimated calc-spar. It sometimes passes into milk-white chert, which forms beds. xlvii

APPENDIX.

In some places the dolomite alternates with cellular timestone, which is generally much impregnated with quartz, and has its cavities powdered with crystals of that mineral. No organic remains were observed in the strata, but fragments, evidently derived from some beds of the formation, contained othoceratites, like those of Lake Huron. The strata, though nearly horizontal, appear to crop out towards the north and east, forming precipices about ten feet high, facing in that direction, and running like a wall across the country. In many places, however, and particularly at Cape Krusenstern, the strata terminate in magnificent cliffs upwards of two hundred feet high, the country in the interior remaining level. Mount Barrow is a small hill of limestone, of a remarkable form, being a natural fortification surrounded by a moat. The coast line is indented by shallow bays, and skirted by rocks and islands.

In the whole country occupied by this formation, the ground is covered with slaty fragments, sometimes to the depth of three feet or more. These slates appear to have been detached from the strata they cover, by the freezing of the water, which insinuates itself betwixt their layers. At Cape Bexley the fragments of dolomite cover the ground to the exclusion of all other soil; and in a walk of several miles, I did not see the vestige of a vegetable, except a small green scum upon some stones that formed the lining of a pond which had dried up. In this neighbourhood there are a number of straight furrows a foot deep, as if a plough had been drawn through the loose fragments. After many conjectures as to the cause of this phenomenon, I ascertained that the furrows had their origin in fissures of the strata lying underneath.

At the commencement of this formation between Point Tinney and Point Clifton, the coast is low, and a stream of considerable magnitude, named Croker River, together with many rivulets, flow into the sea. Its termination to the southward of Cape Hearne is also marked by a low coast line, which is bounded by the bold rocky hills of Cape Kendall.

FORMATION SIMILAR TO THAT AT CAPE LYON.

The beach between Cape Hearne and Cape Kendall is in some places composed of slate-clay, and of a clay resembling wacke. Many large boulders of greenstone occur there. Cape Kendall is a projecting rocky point, about five or six

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hundred feet high, and nearly precipitous on three sides, which are washed by the sea. On the north its rocks consist entirely of greenstone, but on the south side of the Cape the greenstone in lofty columns reposes on thin-slaty beds of fine-grained, bluish-gray limestone. Back's Inlet presents on each side a succession of lofty precipitous headlands, which have the shape termed, by scamen, "The gunner's quoin."* Most of the islands and points near the mouth of the

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Coppermine have this form, and are composed of trap rocks. One of 220 Cowper's islands on which we landed consists, of beds of gueenstone propping out like the steps of a stair.

A low ridge of greenstone exists at the mouth of the Coppermine river, and from thence to Bloody-fall, a distance of ten miles, the country is nearly level, with the exception of some low ridges of trap which run through it. The channel of the river is sunk about one hundred and fifty feet below the surrounding country, and is bounded by cliffs of yellowish white sand, and sometimes of clay, from beneath which, beds of greenstone occasionally crop out.[†]

At Bloody-fall, a round-backed ridge of land, seven or eight hundred feet high, crosses the country. It has a gentle ascent on the north, but is steep towards the south. The river at the fall makes its way through a narrow gap, whose nearly precipitous sides consist of tenacious clay, the bed and immediate borders of the stream being formed of greenstone. ‡ From thence to the Copper Mountains, gently undulated plains occur, intersected in various parts by precipitous ridges of trap rocks, and the river flows in a narrow chasm, sunk about one hundred feet below their level. A few miles above Bloody-fall, strata of light gray clay-slate, dipping to the north-east, at an angle of 20°, support some green-

stone cliffs on the banks of the river. From this place to the Copper
Mountains the rocks observed in the ravines were a dark reddish-brown,
felspathose sandstone, and gray slate-clay in horizontal strata, with

' See plate 28.

† An accurate view of the banks of the Coppermine, as seen from Bloody-fall, sketched on the spot by Lieutenant Hood, is given at p. 350 of Captain Franklin's narrative of his first journey.

† In the geological notices appended to the narrative of Captain Franklin's Journey to the Coppermine, I have termed this rock a dark purplish-red felspar rock. On examining it again on this journey, I perceived it to be a greenstone, whose surfaces weather of a rusty brown colour.