REPORTS

ON THE

PHYSICAL, DESCRIPTIVE, AND ECONOMIC GEOLOGY

OF

BRITISH GUIANA.

BY

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AND

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CONTENTS.

GEOLOGY OF BRITISH GUIANA.

When these Reports passed through the press I was abroad, and had no opportunity of correcting the proofs. Many errors, chiefly in the spelling of names of places, have thus unavoidably occurred. These, and some errors in punctuation, I have corrected in the subjoined table of errata, omitting, however, to notice words which, coming under the heading of misprints, will be at once apparent to the reader.

C. B. BROWN.

June 18th, 1875.

34328*a*. Wt. 4209.

ERRATA.

Table of Contents, line 16, for Pararaima, read Pacaraima.
„ „ „ 22, and at page 150, for Camuku, read Canucu.
„ „ „ 37, for Treng, read Ireng.
„ iv. „ 11, for Raieteur, read Kaieteur.
Page 8, line 43, for Cuyucirni, read Cuyuwini.
„ 16, „ 1, „ granite, „ granitic.
„ 20, 26, 29, 30, 121, and 131, the word Curiebrong is incorrectly spelt.
„ 21, line 8, for Weynamon, read Weynamou.
„ 24, „ 3, „ Pelpee, „ Peepee.
„ „ „ 7, „ Wamsou, „ Waemou.
„ „ „ 46, „ Caliohadekeur „ Calishadekeur.
„ „ „ 47, „ Maturuvow, „ Maturuwow.
„ „ „ 49, „ Watericow, „ Waterticow.
„ „ „ 58, „ Warw, „ Waru.
„ 25, „ 54, „ Taispong, „ Taiepong.
„ 26, „ 3, „ Arriosaro, „ Arrissaro.
„ „ „ 15, „ information, „ observation.
„ „ „ 54, „ Macudoord, „ Macudood.
„ 28, „ 22, „ Motrayparu, „ Mokayparu,
„ 34, „ 18, „ Himuzacabarra, „ Himuracabarra.
„ „ „ „ „ Wazamurie, „ Waramurie.
„ „ „ 32, „ Itabooto, „ Itaboo to.
„ 37, „ 9, „ the rocks, „ the metamorphic rocks.
Pages 57 and 58, the word Makarapan is incorrectly spelt.
Page 58, line 33, for Karinaucho, read Karinambo.
„ 61, „ 29, „ Sacabuta, „ Sacaouta.
„ „ „ 32, „ Maratrang, „ Marakang.
„ 62, „ 10, „ Mavritia, „ Mauritia.
„ 67, „ 12, „ many contains, „ many places contains.
„ „ „ 31, „ W. 55° W. „ N. 55° W.
„ 68, „ 3, „ This rock, „ This latter rock.
„ „ „ 16, „ Cuyariwaha, „ Cuyariwaka.
„ 71, „ 21, „ quartz, gravel „ quartz-gravel.
„ „ „ 37, „ quartz ore, „ quartzose.
„ 72, „ 28, „ or quartz, „ of quartz.
„ 97, „ 11, „ Tahuta, „ Takutu.
„ „ „ 12, „ Tahutuwow, „ Takutuwow.
„ 98, „ 3, „ tortuous with, „ tortuous river with.
„ „ „ 5, „ Qultaro, „ Quitaro.
„ „ „ 11, „ earthly, „ earthy.
„ „ „ 32, „ Porto, „ Poto.
„ 99, „ 24, „ altitude but „ altitude; but.
„ 101, „ 6, „ Otonani, „ Otonam.
„ 102, description of Diag. on this page refers to Dig. No. 10, page 104, which should occupy this position.
„ „ line 14, for arenoargilaceous, read areno-argillaceous.
„ 104, description of Diag. on this page refers to Dig. No. 8, page 102, which should occupy this position.
„ 106, line 16, for, and being over, read and over.
„ „ „ 50, „ calcopar, „ calcspar.
„ 116, „ 50, „ Owentick, „ Owenteik.
„ 117, „ 5, „ white red, „ white, red.
„ 111, „ 11, „ Ayangeanna, „ Ayangcanna.

Pages	120 and 131,			the word Kaieteur is incorrectly spelt.	
Page	123,	line	5,	for fertile, in,	read fertile ; in.
„	„	„	6,	„ trees ; there,	„ trees there.
„	„	„	7,	„ oil,	„ soil.
„	130,	„	10,	„ one,	„ me.
„	133,	„	1,	„ plain as,	„ plain stretching as.
„	138,	„	44,	„ them, and,	„ them ; and.
„	147,	„	6,	„ night on,	„ night, on.
„	„	„	„	„ by and,	„ by, and,
„	„	„	23,	„ Wapiriana,	„ Wapisiana.
„	„	„	39,	„ shallow owing,	„ shallow, owing.
„	„	„	„	„ width that,	„ width, that.
„	„	„	51,	„ north at,	„ north, at.
„	149,	„	34,	„ yards and,	„ yards, and.
„	„	„	44,	„ country and,	„ country ; and.
„	159,	„	21,	„ well I,	„ well, I.
„	„	„	29,	„ them paid,	„ them, paid.
„	160,	„	24,	„ me as,	„ me, as.
„	„	„	28,	„ rock by,	„ rock, by.
„	161,	„	17,	„ Alreo,	„ Abreo.
„	163,	„	1,	„ foot mountains,	„ foot of the mountains.
„	164,	„	26,	„ seen and,	„ seen, and.
„	„	„	27,	„ left formed,	„ left, formed.
„	„	„	„	„ line shown,	„ line, shown.
„	165,	„	19,	„ mountains reaching,	„ mountains, reaching.
„	„	„	20,	„ Pinniyettinow where	„ Pinniyettinow, where.
„	„	„	33,	„ prceceding,	„ proceeding.
„	„	„	42,	„ between out,	„ between, out.
„	„	„	43,	„ colours from,	„ colours, from.
„	166,	„	15,	„ followed and,	„ followed, and.
„	„	„	21,	„ Quitaro, savanna,	„ Quitaro savanna.
„	167,	„	„	„ river coming,	„ river, coming,
„	„	„	22,	„ rock and,	„ rock, and.
„	„	„	25,	„ village which,	„ village, which.
„	„	„	41,	„ land the,	„ land, the.
„	„	„	47,	„ deeper and,	„ deeper, and.
„	„	„	50,	„ beeches,	„ beaches,
„	168,	„	22,	„ river which,	„ river, which.
„	„	„	30,	„ parts and,	„ parts, and.
„	169,	„	14,	„ in to,	„ in, to.
„	„	„	22,	„ weather only,	„ weather, only.
„	172,	„	14,	„ having,	„ have.
„	175,	„	9,	„ tin,	„ thin.
„	176,	„	5,	„ clay with,	„ clay, with.
„	177,	„	2,	„ southward as,	„ southward, as.
„	„	„	5,	„ colour which,	„ colour, which.
„	„	„	24,	„ taste and	„ taste, and.
„	178,	„	20,	„ quartz, gravels	„ quartz gravels.
„	179,	foot note	„	No. 16,	„ No. 18.
„	180,	line	31,	„ orgin,	„ origin.
„	181,	„	20,	„ fort,	„ foot.
„	182,	„	15,	„ horizontally along,	„ horizontally, along.
„	„	„	„	„ top as,	„ top, as.
„	188,	foot note,	„	No. 19,	„ No. 21.
„	186,	line	4,	„ came,	„ became.
„	„	„	16,	„ characters its,	„ characters, its.
„	„	„	20,	„ at,	„ on.

Page	186,	line	39,	Cass-kityu,	read Cassikitu.
„	188,	„	26,	Manarswah,	„ Manarowah.
„	189,	„	7,	hitherto	„ hitherto,
„	191,	„	24,	layer some,	„ layer, some.
„	„	„	„	amygdaloid	„ amygdaloid,

„ 192, explanation of Dig. No. 26, for rests and banks, read nests and bands.

„	193,	line	43,	for crystals and,	read crystals, and.
„	203,	lines	39 and 42,	for Apurn,	„ Apuru.
„	„	line	46,	for day and,	„ day, and.
„	205,	„	31,	„ fall the,	„ fall, the.
„	207,	„	14,	„ and the,	„ from the.
„	„	„	49,	„ an,	„ and.
„	„	„	50,	„ slight,	„ straight.
„	209,	„	37,	„ large branch,	„ large, branch.
„	210,	„	32,	„ shut the,	„ shut out the.
„	215,	„	47,	„ forest called,	„ forest, called.
„	217,	„	27,	„ particularly,	„ partially.
„	223,	„	7,	„ at,	„ as.
„	236,	„	24,	„ construction,	„ constriction.
„	241,	„	26,	„ Ackaiuron,	„ Ackaiurou.
„	„	„	32,	„ north-west-north,	„ west-north-west.
„	245,	„	6,	„ Ackraima,	„ Ackaima.
„	„	„	10,	„ Arridaro,	„ Arrissaro.
„	246,	„	12,	„ alluvia,	„ alluvial.
„	249,	„	5,	„ Arriosano,	„ Arrisaro.
„	251,	„	41,	„ Wahmana,	„ Wahmara.
„	255,	„	17,	„ granite,	„ granitic.

Pages 258, 267, 275, the word Weynamou is incorrectly spelt.

„ 262 and 264, „ Cukuie „ „

Page	271,	line	24,	for Tomehri,	read Temehri.
„	273,	„	45,	„ Mazaruni,	„ Mazurine.
„	275,	„	1,	„ junction of the,	„ junction the.
„	280,	„	17,	„ first the,	„ the first.
„	„	„	„	„ river called,	„ river, called.
„	„	„	„	„ Arissaro on,	„ Arissaro, on.
„	281,	„	16,	„ was the,	„ was then the.
„	„	„	19,	„ bateau it,	„ bateau, it.
„	„	„	20,	„ cataract and,	„ cataract; and.
„	283,	„	6,	„ journey, a,	„ journey—a.
„	„	„	7,	„ great fall,	„ Great Fall.
„	„	„	27,	„ passing Partamona,	„ passing the Partamona.
„	288,	„	40,	„ Tukine,	„ Tukuie.
„	„	„	42,	„ Oriedouk,	„ Osiedouk.
„	290,	„	29,	„ 88 feet,	„ 81 feet.

„ 297, all the last paragraph is a quotation.

PREFACE.

THE Geological Survey of this Colony was commenced in November 1867 by Mr. Sawkins and myself, and so conducted till the month of June 1870, at which time Mr. Sawkins retired, and I continued the work single handed.

It can be readily understood that to explore such a vast extent of thinly-inhabited country, equal in size to England and Scotland together, covered with boundless forests, and situated within the Tropics, was at best a difficult and laborious undertaking.

The cultivated portion made accessible by roads is but an atom of the whole territory, and lies along the sea coast, so that to explore the interior we had to ascend the rivers in boats, and make walking journeys across country along Indian paths. To penetrate to the utmost limits of the colony it became necessary to make long excursions, sometimes of eight months' duration, upon which, owing to the dangerous rapids and cataracts on the rivers, strong boats with crews of river-men had to be employed, and most of the provisions for our maintenance carried with us. At times, on long walking journeys, we had to depend for sustenance on coarse food procured at the Indian villages passed through on the route. Thus it frequently happened that in places where I wished to stop and examine interesting geological areas, I was obliged to hurry forwards for the purpose of obtaining provisions; whilst in other parts, comparatively valueless, I was sometimes detained whilst food was being prepared for us. Oftentimes the task of making out the geology of the country was rendered a hopeless one by the dense forests, through which we travelled for days together, hiding completely the contour of the country, as well as the outcrop of the rocks.

During four months of the year the rain falls heavily, the rivers are flooded, hiding all the rocks, and the surrounding country bordering them to some extent submerged; even in the high lands the mountain streams and torrents are rendered impassable. Our time during these months was occupied in preparing maps and reports, which were sent in to the Government from time to time.

In the face of all these difficulties I succeeded in tracing all the rivers of any size almost to their sources, and made besides many land journeys on foot, thereby gaining a pretty fair knowledge of the geological structure of the colony. To make an accurate survey would, however, require an immense outlay, and occupy three times the number of years already spent on the present explorations.

A short general account of the physical features and geology of the colony is given in this volume, followed by reports on each district, as examined and described during the continuance of the survey.

The attached map, containing the geological work of the survey, is from tracings of Sir R. Schomburgh's large map (reduced one half), furnished by the Colonial Office. As parts of it were found to be incorrect in details, much time has been expended in trying to rectify them.

CHAS. B. BROWN.

Georgetown, Demerara, April 1873.

REPORTS

ON THE

GEOLOGY OF BRITISH GUIANA.

General Report on the Physical, Descriptive, and Economic Geology of British Guiana,

By CHARLES B. BROWN, Esq.

APRIL 1873.

CONTENTS.

PART I.

GENERAL PHYSICAL FEATURES OF THE COLONY OF BRITISH GUIANA.

THE Colony of British Guiana is situated in the north-eastern portion of South America, between the 1st and 9th parallels of north latitude and 57th and 61st degrees of west longitude, and lies between Dutch Guiana, Venezuela, and Brazil. Its boun-

daries, as defined by Sir Robert Schomburgh, and claimed by England, embrace an area of 88,000 square miles, of which about 6,500 is undulating open savanna, and 3,000 grass-covered mountains, the remainder being clothed with dense forests. Its greatest length from north to south is 550 miles, with a maximum breadth of 286 miles.

The surface of the eastern portion of the colony, from the sources of the Corentyne and Essequebo rivers to the sea coast, may be regarded as a rough inclined plain, commencing at a height of about 800 feet above the sea, and sloping down gradually to the sea level near the coast. Of this the most elevated portion is mountainous, but no part of it is elevated to a greater height than 2,000 feet above the sea, or 1,200 feet above the river's level in the vicinity of the Essequebo, and 300 feet above the level of the source of the Corentyne. This plain extends westward to the head of the Takutu river, and from that northward to the base of the Canucu, Cumucumu, and Coratamung mountains. Beyond these it spreads across from the Essequebo to the Cotinga river, coming up to the base of the Pacaraima mountains, where its general level is 300 feet above the sea. The western portion of these two last-mentioned plains is devoid of large forest trees, and is covered with grass, being portions of the great savanna stretching eastward from Brazil.

The views from the savannas have a beauty and singularity of their own, and it stirs one with a sense of boundless freedom to stand upon a knoll midst one, and view the grassy plain fading away to the horizon in the distance, and melting gradually, as it were, into the atmosphere.

The first-mentioned portion of the great sloping plain is crossed at Wenkobat by a range of hills leading to the falls of Wonotobo on the Corentyne, and there its general level is only 250 feet above the sea. The next range of mountains rising from it, and lying in a north-east and east-north-east direction, is that from Makarapan to Maccari mountains, which end at the Christmas cataracts on the Berbice river.

To the northward of this, on the eastern side of the Essequebo, opposite the end of the Pacaraima mountains, comes a cluster of mountains stretching from Akaiwanna to Parish peak, and southward about the sources of the Demerara river, the highest being not more than 1,000 feet. Further north, at Ororu-mallali, there are isolated ranges of hills from 500 to 700 feet in height.

Northward of the savanna or plain extending from the Essequebo to the Cotinga river, before mentioned, lies the great Pacaraima mountains, a wide extent of rough mountainous country traversed by wide valleys, lying chiefly in a north-west and south-east direction, extending from about the 4th parallel of north latitude to 5° 30′ north, gradually rising from a height of 300 feet to above 3,000 feet between the Potaro and Siparuni rivers, and to a height of 7,500 feet at Roraima mountain, at the extreme western limits of the colony. The southern portion is composed of rugged hills and valleys strewn with rocks, and quite devoid of

large forest-covered areas, whilst to the north, where the mountains of sandstone assume table-shaped forms, the whole is covered with dense forests, except about the sources of the Mazaruni river. To the eastward this great mass of mountains narrows rapidly, reaching the Essequebo river in a blunt point at Cumuti and Twasinki.

The scenery amongst these mountains—where the view is wholly unobstructed by the dense forest which clothes all the other mountains, and the greater portion of the sandstone table-lands—is grand, varied, and beautiful in the extreme. Peaks and ridges of every variety of form are grouped together, packed one behind the other, fading away in the distance, their sides being clothed with grass and clusters of little dark green groves, with here and there large frowning masses of rock far up their heights. Nestling between them comes level-bottomed grass-covered valleys, containing small streams near which lie belts of wood.

Their northern face forms a bold escarpment, some parts of which are 2,300 feet in height, and from its foot northward to the sea coast extends a vast undulating tree-covered plain, from which rises here and there a few low isolated ridges of from 300 to 700 feet in height. The level of this plain on the Mazaruni river, near Merumé, is 150 to 200 feet above the sea; on the Cuyuni, at Otomong river—the boundary line between British and Venezuelan Guiana—295 feet; and at Manarie village, between the Barima and Barama rivers, 113 feet. From that the ground falls rapidly to the vast interminable swampy land bordering that portion of the sea coast.

Between the Cuyuni and Barama rivers comes the Imataca range, which terminates near the sources of the Waini river, and is of no considerable extent or height in this part.

Thus we see two great parallel mountain systems crossing the colony from west to east, the greater being that of the Pacaraima and Merumé mountains, which is a continuation of the Parima mountains; and the lesser the Canucu, Camucumu, and Coratamung mountains, extending from the Takuta river to the Essequebo, but not eastward of it; which in their widest part occupy a distance of 30 miles.

The Sierra Acarai range, which forms the watershed between the Essequebo and the tributaries of the Amazon, does not rise to a greater height than some 2,500 feet, and its northern base is 800 feet above the sea. It decreases rapidly in height to the eastward.

The level of the coast land varies in certain localities, and at different distances from the sea, being below the level of high spring tides at 10 miles inland on part of the east coast, and at its level on parts of the Arabisci coast.

Upon this depressed land where the soil is rich are situated all the sugar estates of the colony. The sea is kept from these lands by a line of dams along the coast, and side dams between each estate, the drainage being effected by sluices or "kokers" when

the tide is low. The drainage of the swampy lands behind the estates has to pass through the trenches of the estates, and in wet weather the supply of water being very great, it accumulates rapidly when the tide is high, so that dams have been erected in rear of each estate.

With the exception of the cultivated portions, nearly all this land is covered with high forest trees and dense jungle, chiefly of courida (*Avicennis nitida*), mangrove (*Rhizophom mangle*), and corkwood near the coast, and mora (*Mora excelsa*) upon the slightly raised portions. Small areas also are covered with coarse grass and rush in the immediate vicinity of the estates, and are termed "floating savannas."

From the coast line seaward the ocean deepens very gradually, and at low tide extensive mud flats and sand banks are left bare.

Tracing this fluvio-marine deposit inland, it is found to rise gradually until it becomes some 10 or 12 feet above the level of high-water mark, at different distances in various localities from the coast line, and ends at the sloping front of an older deposit of sand and clay beds, which forms a vast extent of undulating country rising to not more than 150 feet above the sea, and stretching back to where the solid rock strata underlying it comes out at the surface.

The colony is traversed by numerous large rivers and streams some of which flow northward and empty themselves into the Atlantic Ocean, and others flow southward into the Rio Branco, a tributary of the Rio Negro. The watershed between the two systems, though 250 miles inland, is only 350 feet above the sea.

Of these there are five large principal ones, viz., the Essequebo, Corentyne, Mazaruni, Cuyuni, and Berbice. The Essequebo, Mazaruni, and Berbice are rivers belonging entirely to the colony, while the Corentyne is a boundary river between it and Dutch Guiana; and the Cuyuni, coming from Venezuela, runs a course of only 120 miles in it, from west to east.

The rivers next in size to these are the New River, Demerara, Ireng, Cotinga, Rupununi, Takutu, Rewa, Quitaro, Puruni, Waini, Barima, Potaro, Siparuni, Burro-burro, Mahaica, Maiconi, and Canjé. Of these again the Cotinga and Takutu are boundary rivers between the colony and Brazil, and they, together with the Ireng, are tributaries of the Rio Branco.

The Essequebo river rises in 0° 40′ north latitude in the Acarai mountains, at a height of 850 feet above the sea, and flows at first in a north-east direction to its junction with the Cuyucirni river, then pursues a comparatively straight general course in a northerly direction, emptying itself into the Atlantic Ocean in the 7th parallel of north latitude, after running a distance (including windings) of 600 miles. About 43 miles from its mouth it is joined by the Mazaruni river, which is itself joined by the Cuyuni at 8 miles from its mouth. The estuary of the Essequebo is about 14 miles in width at its mouth, and contains a number of large islands.

The Corentyne rises in the second parallel of north latitude,

at a height of 700 feet above the sea, about 100 miles to the eastward of the Essequebo, and running in a north-north-west direction approaches within some 30 miles of the latter river in about half its course, then flowing north-north-east, discharges its waters by a broad estuary into the ocean, in the sixth parallel of north latitude.

Of all the rivers the Mazaruni has the most singular course, for rising in the table land of the Merumé mountains, part of the Pacaraima group, at a height of 2,400 feet above the sea, near the 60th degree of west longitude, it runs eastward for some miles, curving round to the south in 68° 8′ 30″ west longitude, and 5° 34′ 23″ north latitude, and descends to a level of 2,000 feet. From this it flows a tortuous course in a west-north-west direction to the Cako river mouth in 60° 44′ 0″ west, and 5° 47′ 11″ north, being joined on the way by numerous large tributaries, and descending by a set of high falls at Chi-chi to a level of 1,400 feet above the sea. Flowing smoothly along at this altitude, in a north-north-west direction to Sericoeng, it is precipitated down a succession of lofty falls, occupying a distance of 8 miles, to a level of 500 feet. Passing along at this level with a north-north-east course, it plunges over two more sets of falls to a height of 150 feet, and emerging from the sandstone mountains in 6° 26′ 14″ north latitude, turns suddenly to the east-south-east for a distance of 105 miles to Teboco cataract, in 59° 44′ 40″ west longitude, and 5° 45′ 29″ north latitude, passing on the way near the foot of the Merumé mountains, 20 miles to the northward of its source. From Teboco it traverses a winding course having a general east-north-east direction, through a level country to the Essequebo river.

The Rupununi river rises in the same great plain as the Takutu river, some 20 miles to the eastward of it, at a height of 745 feet above the sea, and flowing north passes through a deep and narrow valley in the Canucu and Cumucumu mountains, while the Takutu flows to the westward on the plain, close past their western termination. The average height of these mountains is 2,000 feet. Hence if the Rupununi does not follow a fissure in them (which is more than probable), it must at one time have had its upper course at a greater elevation than their present summits, and it, together with its branch streams, must have been the chief agents in effecting the entire removal of an immense mass of rocky country.

Owing to the peculiarly heavy specific gravity of by far the greater number of forest trees, floating wood is seldom met with, and the large trees which fall into the river from its banks sink and decay upon the spot.

The colour of the water of the rivers varies greatly, ranging from milk white to dark blackish-brown. Those which have their sources in mountainous tracts amongst forests are principally of dark colours, whilst those whose courses run for considerable distances in savannas, where the banks are of white clay, contain whitish and milky waters. The dark colour of these rivers is

owing to an infusion of vegetable colouring matter, principally derived from wallaba tree leaves and bark, which in small streams imparts a faint acid astringent flavour to it, Some small streams rise as springs, and contain clear colourless water.

The water in the estuaries of the large rivers, for some distance up from their mouths, and the sea water along the coast stretching oceanwards for over 12 miles, is of a yellowish gray muddy colour, from the enormous amount of fine earthy sediment in suspension. The water of the rivers themselves, even when in flood, is never so highly charged with solid matter, so that this sediment must be stirred up by the currents and waves passing over the muddy shallows off the coast, and carried by the tide into the river's mouths, as well as seaward.

The surfaces of the rocks in the beds and on the banks of the rivers, of both coloured waters, are covered with a thin black or brown polished and metallic looking coating,* and in some instances by a dark black stain. The brown coating resembles in appearance a thin layer of tar, while the black looks as if black-lead polish had been applied to the rock. Sometimes these stains occur over every portion of a group of rocks, at others only in patches upon them; as often upon the underneath inclined portions, as on the upper horizontal surfaces. I have frequently observed that on coarse friable rocks the coating is of a brown colour, and on hard fine-grained rocks it is chiefly black. In some places it is a true coating, in others it looks like a decomposed portion of the rock, and may be due to some sort of electro-chemical action produced by the water, containing salts of iron and manganese in solution, flowing swiftly over the surface of the rock.

All the rivers, above the points on them to which the tide reaches, are crossed by numerous bars of rocks forming cataracts and rapids of various sizes, from a few inches to 50 feet in height, and upon some of them amongst the sandstone mountains are large and beuatiful falls, ranging in height from 20 to 800 feet. It is these impediments to the navigation of the rivers that have so long prevented the opening up of a fine and extensive territory.

PART II.

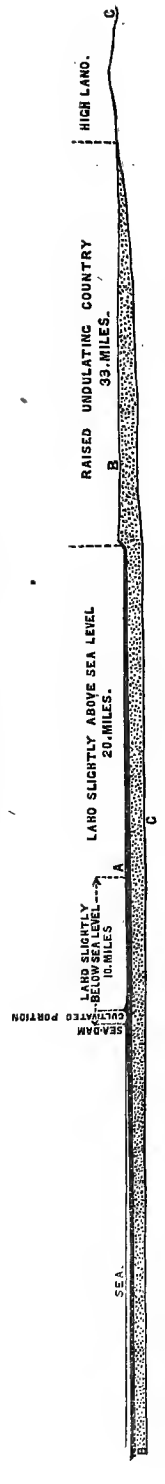
General Descriptive Geology.

1. *Alluvia.*

a. Alluvium.—Alluvium of recent deposition is found bordering small branch streams, and in swampy depressions all over the country, as well as at the bends of some of the large rivers. It is a dark variety of loam, and appears to be very productive.

b. Fluvio-marine Alluvium or Coast Deposit.—This great deposit extends along the whole sea coast of the colony, stretching inland to various distances in different places, as

* This coating is composed of the oxides of iron and manganese.



No. 1.
Section of Coast Alluvium and Sandbeds.

will be seen by glancing at the map, being seldom more than 35 miles in its widest portion, and not less than 5 miles. Its level on the coast is a few feet below the level of high water of spring tides, and rising gradually inland it attains a height of some 10 or 12 feet above that level, resting upon the sand and clay deposit. (*See* Fig. No. 1.) The thickness of this deposit, as shown by borings, is about 100 feet, and it is composed of layers of sand and bluish clay, containing portions of decayed wood and vegetable matter. The soil upon it on the estates is a dark loam, and on the uncultivated portions, in rear of them, of a black bog earth, chiefly of decayed vegetable remains, similar to that deposited in silted-up lakes.

The following sections were obtained by borings at various periods for artesian wells, and give in a rough way the sequence of the different materials of this deposit.

1. *On Plantation Woodlands near Mahaica Creek.*

5	feet of	surface soil.
1	,,	fine sand.
3	,,	blue clay.
30	,,	soft mud mixed with sand.
14	,,	rotten wood and decayed vegetable matter.
2	,,	stiff bluish clay.
2	,,	red and gray clay.
13	,,	reddish clay.
12 ft. 10 in.		stiff yellowish-gray clay, with a little sand and ochre.
3 ft. 10 in.		streaked bluish-gray clay.
5 ft. 4 in.		bluish-gray clay streaked with yellow.
92 ft. 0 in.		

2. *Near Georgetown Waterworks.**

27	feet of	stiff clay.
43	,,	hard buff-coloured clay.
70		

In portions of this deposit between the Demerara and Berbice rivers, numerous low narrow strips of yellow sands, called sand reefs, slightly raised above the sea level, run parallel to the coast and contain numbers of sea shells of the genera, Mactra, Venus,

* These borings were made by Mr. Lloyd for the town council of the city of Georgetown.

Plicatula, Marginella, Fasciolaria, Nassa, &c., of the same species as those now inhabiting the ocean off the coast. These reefs no doubt mark the different lines of coast of former times, as the currents forming land beyond them caused a recession of the sea. A large portion of detrial matter, forming this great deposit, has been brought by currents from the mouth of the Amazon river.*

c. River Loam.—On the river's edges the fluvio-marine deposit passes into a fluvatile loam, which borders them to their sources. The outlines of this deposit are not shown on the map, because from the points on each river where the first rocks appear they have been mapped to its exclusion. Besides it would be impossible to trace out their boundaries in the forest covered portions of the country. On the large savannas, where the boundaries of this deposit and the valley gravels are more clearly defined, it has been mapped.

It is formed of an upper portion of yellowish and gray homogeneous loam, resting upon a lower portion of coarse and fine gravel beds. In these are patches and layers of hydro-oxide of iron. The soil upon this is of a dark vegetable nature.

d. Valley Gravel and Sand and Clay Deposit.—These two post-pliocene deposits are most probably equivalents of each other, the former being seen on the great savanna, and on the large rivers in the Pacaraima mountains, and the latter between the highlands and fluvio-marine deposit of the coast, where it forms low undulating land.

The valley gravel is composed of gray and reddish loam, containing blocks and beds of quartz gravel, and layers of hydrated-oxide of iron.

Behind the coast region the sand and clay beds form a tract of country averaging from 60 to 150 feet in height, its southern edge being in the eastern part of the colony, some 35 miles from the sea, and in the western part approaching to within a few miles of the shore. Outlying patches of these sandbeds are often seen, having been preserved from denudation, as that of Waramurie on the Marooca river, and elsewhere. The soil upon it is poor and sandy, but in the valleys cut by small streams a good yellowish loam is often seen.

This deposit consists of white and mottled false-bedded sands, resting upon white and drab-coloured clays. These beds form a low escarpment at the southern limit of the fluvio-marine deposit, facing north, which has long been taken for a ridge running parallel to the coast. Artesian borings show that these beds underlie the above-mentioned deposit near the sea shore, at a depth of about 100 feet.

Although no sea shells have been found in them, still from their great extent they must have been deposited in the ocean, probably at a time when the sea washed the base of the sandstone escarpments.

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* This fact has been recorded by Sir Chas. Lyall in his Principles of Geology.

In Mr. Lloyd's borings for artesian wells in Georgetown, the following beds of this deposit were passed through:—

1. *Boring at Newburgh, half a mile south of the Waterworks.*

At a depth of 118 feet sand was met with, the overlying beds not being recorded.

Then came 44 feet of white clay with sand.

9	„	brown clay.
15	„	sand.
3	„	clay.
18	„	white sand.
9	„	white clay.
9	„	lumps of white clay in sand.
9	„	stiff brown clay.
18	„	sand.
9	„	coarse sand.
9	„	sand.
152		

2. *Boring near the Waterworks.*

Sand and clay deposit.

70	feet of	fluvio-marine beds.
38	„	sand.
32	„	clay.
13	„	sand.
27	„	coarse sand, containing pieces of decayed wood.
36	„	sand with white clay.
216		

2. *Sandstone Formation.*

This formation constitutes the greater portion of the northern part of the Pacaraima mountains, spreading westward into Venezuela. Tracing it eastwardly, it crosses the Essequebo river, in a low narrow belt, at Cumuti and Twasinki mountains, and the Berbice river near Marlissa rapid. It forms a high mountain range at Itabru near the Berbice river, and is seen crossing the Corentyne in two places, one at Cabalebo river, and the other higher up near Akalikatabo island. The upper portion of the Maccari mountain is also formed of the same sandstone.

It is composed of interstratified beds of coarse conglomerate, red and white sandstone, and red shale.

Interbedded with the sandstone are three great layers of greenstone, partly contemporaneous and partly intrusive. This greenstone is of a coarse variety of diorite, composed of hornblende and felspar; the crystals of the latter in some instances showing the striæ of Plagioclastic felspar.

To make out the actual relations of the sandstone and greenstone would be a most difficult task, requiring an immensity of time, and could only be performed by following the outcrop of each layer of greenstone.

During my explorations I have been able to examine their relative positions in crossing the sandstone area in two places, and by exploring the sandstone escarpment in eight. In all of these I found a different arrangement as regards the position and elevation at which the greenstone layers occur, and a different constitution of the underlying rocks.

In some places the sandstone above and below these layers has been altered, chiefly by the development of large and small felspar crystals in that rock, and by its assuming a greenish slaty appearance for some distance above and below the planes of contact. In others it is hardly altered at all, which would lead one to suspect a contemporaneous origin, while in the former cases it is no doubt intrusive. It is very evident that the igneous action at the time was deep seated and very active, and may in some measure account for the total absence of organic remains in the sandstone.

The occurrence of great layers of conglomerate in the neighbourhood of the greenstone, and the presence of sun cracks and ripple marks in the shales, on the other hand, lead us to suppose that it was deposited in a shallow sea; whilst the fact of the igneous rock being a greenstone contradicts this assumption, and they can only be assimilated by the supposition that immense and sudden upheaval and depression took place, which the undisturbed state of the sandstone forbids.

The absence of fossils in the sandstone is very singular, and prevents one from arriving at the age of the geological epoch during which it was deposited. It appears to me, however, to be an equivalent of the new red sandstone.

In some layers there are numerous thin beds of fine red jasper.

The total thickness of this sandstone formation, including the layers of greenstone, is about 7,000 feet; the three layers varying in thickness in different localities from 400 to 1,000 feet each.

The sandstone, as a whole, lies nearly in a horizontal position, dipping northwardly with but few local disturbances, and as far as could be seen singularly free from faults and dislocations.

It forms two extensive and one minor plateau, the first having a high escarpment to the north, its base being from 85 to 250 feet above the sea. To the south its escarpment is not so regular, and its base is at an elevation of from 1,000 to 1,400 feet.

The sandstone at Maccari and Itabru rests immediately upon the quartz-porphyry and felstone, and has no greenstone layers. In other places it rests upon quartz-porphyry, schist, and greenstone.

It is evident that the sea at one time covered the whole face of the country up to the sandstone escarpment, and surrounded the mass of the Paccaraima mountains entirely. The perpendicular faces of the great table mountains of sandstone were evidently produced by the action of the sea, and no one can view the singular and lofty mountain of Roraima without being

impressed with the same idea. Its perpendicular sides, 2,000 feet in height, have their base 5,500 feet above the sea, and are inaccessible. Having been an island at some remote period of the earth's history, and all communication between it and the surrounding country being cut off, it is interesting to speculate upon the strange animal forms that may at present exist upon it. Kukenam, Waiacka-piaper, and other lofty surrounding mountains, are similarly constituted.

3. *Greenstone.*

The same layer of greenstone that lies beneath the sandstone extends from the Pacaraima mountains at Twasinki across to the Corentyne at Mattapi, and spreading northward forms many low isolated hills. It rests upon granite, having been forced up through fissures in that rock, and spread out in a great layer over 700 feet in thickness, forming evidently at one time a continuous area, since partially removed by denudation. It also spread over the granite to the north of the sandstone escarpment, on the plain of the Mazaruni river.

Over the whole surface of the colony the rocks are traversed by extensive dykes of greenstone. This rock, like that forming the layers in the sandstone, is composed of hornblende and felspar. Its texture, which is usually crystalline-granular, varies greatly even in parts of the same mass, becoming sometimes almost compact, at others porphyritic.

It is a true plutonic rock, which varies slightly in mineral character in various places, being chiefly diorite and diabase. Its colour also varies from dark-green to greenish gray, gray, and dark gray.

Amygaloidal greenstone or vesicular diabase is seen in only two places (on the Rupununi at Urua, and on the Rewa river), and some of its cavities are filled with crystals of calcspar, a white stellate zeolite (natrolite), and a dark green mineral, probably glauconite.

The dykes of greenstone pierce through granite, gneiss, quartz-porphyry, and sandstone, and are connected with the layers and masses of the same rock, having been the feeders which supplied the material of those masses during the deposition of the sandstone.

4. *Schists.*

Mica schist, hoorblende schist, quartz schist, talc schist, and chlorite schist are found associated with gneiss in many localities, and appear to be in layers in that rock, their fussile structure being parallel to its foliation.

These rocks are principally of highly crystalline varieties, and contain nests and veins of quartz.

5. *Gneiss.*

The surface of a very large portion of the colony is composed of gneiss, which is seen in large rounded bosses in the rivers' beds.

It is often of a granite variety, but more frequently is true gneiss with extremely contorted foliation. Its bedding is exceedingly obscure; the only place where it can be clearly made out is on the Quitaro river, where it is seen apparently in beds of great thickness, dipping east at an angle of five degrees. These show the foliation to be at right angles to the bedding.

There seems to be no regularity with regard to the strike of the foliation,* for on the Upper Corentyne river, where I examined this structure very carefully, I found the strike of the foliæ to vary from east and west to north and south in a short distance, and have recorded the following directions of strike in my notes, viz., east and west, east-north-east and west-south-west, south-east and north-west, east-south-east and west-north-west, and north and south.

The angle of the dip of the foliation also varies from 80 to 15 degrees from the horizontal plane, on either side of the line of strike.

The directions of the rolls of gneiss generally agree with the strike of the foliation, but there are exceptions also to this. At one place on the Cotinga river, near Wanakara hill, a long roll of gneiss lying in a north-east and south-west direction is foliated from north-west to south-east.

In many areas the gneiss contains large and small nests of quartz, and in places immense numbers of garnet crystals. It rests chiefly upon granite, but is also seen overlying quartz-porphyry.

6. *Quartz-porphyry and Felstone.*

These rocks are associated in layers of considerable thickness, occupying extensive areas over the surface of the granite, and underlying the gneiss.

In some layers the quartz crystals are well developed in the form of double hexagonal pyramids, in the felspathic matrix, along with chlorite crystals, which are in little clusters. The quartz crystals are usually small, and often of rounded forms, the angles of the crystals not having been fully developed. In other layers the quartz crystals die out, and the rock still containing felspar crystals becomes a porphyritic felstone, and from that passes into a true felstone by the loss of the felspar crystals.

In Report No. 8 I have described a third rock associated with the quartz-porphyry and felstone, which I called a hornblende porphyrite, but have since termed it a porphyritic felstone.

The porphyry often assumes a fissile structure, and the felstone passes into a sort of petrosilex.

The colours of these two rocks vary from liver-coloured to various shades of gray, green, and black.

In many places the quartz-porphyry can be traced passing into granite, through an intermediate rock containing mica. As an accessory mineral this rock often contains iron pyrites.

* Humboldt records that in Venezuela the strike of the foliation of gneiss was uniformly N.E. and S.W.

7. *Granite and Syenite.*

A very large proportion of the rocks appearing at the surface of the interior of the colony is composed of granite, whilst syenite associated with it occupies a very subordinate position.

There are many varieties of the former rock as regards texture, colour, and composition. It sometimes assumes a porphyritic texture, containing large crystals of orthoclase, which themselves contain small crystals of quartz and mica.

The quartz in the granite ranges from transparent, colourless, and white varieties, to a curious bluish chalcedonic or opalaceous variety, and sometimes in the same specimen silver-white potash mica is seen along with dark green magnesian mica.

Large black crystals of schorl as an accessory, as well as garnet crystals, are seen in a few places in it.

The granite lies at the base of all the rocks of the colony, and is of great antiquity, but coarse veins of it have pierced through the gneiss, and even the sandstone formation in one place.

A small vein of gray granite is seen in the greenstone at Christmas cataract, and also another in the same rock near the Chi-chi falls on the Upper Mazaruni river, while similar veins are seen piercing the main mass of granite itself.

It usually is seen in rolls lying across the rivers, or in great ridges running across the country, which trend in various directions from north-east, east-north-east, to east-south-east.

The specific gravity of a specimen of granite from the penal settlement I found to be 2·6506, and that of the decomposing portion of the same rock was 2·554.

PART III.

Economic Geology.

1. *Soils.*

The soil on the coast region is usually of a dark coloured loamy nature, and is very fertile. That upon the estates that have been long under cultivation requires to be highly manured to give large returns of sugar.

Upon the river deposit the soil is chiefly of a stiff yellowish loam, which appears to be fertile.

The soil upon the greenstone is generally of a dark red colour, and is held in high estimation by the Indians of the interior, who always choose it for their provision grounds.

The following table is made from a list of the analysis of soils made in London for the Colonial Company by Mr. John Newlands, F.C.S., that was kindly furnished me by Mr. R. T. Hadow. I have only copied one analysis of the surface soil of each estate, in the subjoined table, as it is sufficient for the purpose of giving the reader a correct idea of the composition of the soils of the coast lands.

—	Hampton Court.	Haarlem, West Coast.	Windsor Forest, West Coast.	Peter's Hall, Demerara river.	Farm, Demerara river.
*Organic matter and combined water.	26·317	9·515	9·295	8·346	11·165
Insoluble silicious matter	59·600	73·553	77·396	77·372	73·820
Potassa	·345	·055	·325	·150	·054
Soda	·161	·016	·169	·298	·087
Lime	·171	·250	·184	·264	·189
Magnesia	·452	·474	1·437	1·059	·377
Peroxide of iron	1·778	4·169	5·819	5·439	2·618
Alumina	10·733	11·475	5·135	6·998	11·263
Sulphuric acid	·079	·032	·109	Mere trace.	·081
Chlorine	·039	·013	·042	·030	·003
Phosphoric acid	·119	·099	·046	·044	·097
Carbonic acid	·206	·349	·043	Mere trace.	·246
	100·000	100·000	100·000	100·000	100·000
*Containing nitrogen	·846	·156	·169	·127	·198
Moisture in soil as received	12·584	8·086	10·714	12·225	10·623

(*continued.*)

—	Success, East Coast.	Mara, Berbice river.	Ma Retraite, Berbice river.	Friends, Berbice river	Albion, Corentyne Coast.
*Organic matter and combined water.	8·073	11·518	15·834	16·211	9·342
Silicious matter	75·053	73·796	67·292	70·734	70·769
Potassa	·235	·019	·040	·290	·313
Soda	·009	·015	·013	·498	·144
Lime	·122	·176	·154	·259	·384
Magnesia	·108	·151	·144	·227	·501
Peroxide of iron	11·072	2·764	2·932	4·266	5·134
Alumina	5·140	11·226	13·117	7·318	13·197
Sulphuric acid	Trace	·069	·103	·085	·075
Chlorine	·026	·023	·014	·074	·013
Phosphoric acid	·044	·139	·185	·020	·106
Carbonic acid	·118	·104	·172	·018	·022
	100·000	100·000	100·000	100·000	100·000
*Containing nitrogen	·201	·271	·301	·325	·166
Moisture in soil as received	6·063	8·224	17·272	11·610	9·440

2. *Sand.*

The white sand at the sand hills on the Demerara, and in many other places (of which there is an inexhaustible supply), is very pure and well adapted for glass making. "Experiments "were made with it in Boston, United States, which proved "highly satisfactory, and produced a better glassware than is "generally manufactured from the sands in the United States."*

* A Description of British Guiana, by Sir R. Schomburgh, page 92.

3. *Clay.*

The white clay at Oreala appears to be well adapted for the manufacture of porcelain and earthenware.

Portions of it are very pure, whilst others contain some traces of oxide of iron and silicious grains, which deduct from its value in that respect. A similar clay can be obtained in many places on the Berbice and Demerara rivers.

As the upper portion of the clay bed lies on a level with high-water mark, and is covered by some 50 feet of sand beds, the cost of obtaining a large quantity would no doubt be considerable, and incommensurate with the value of the article.

In places too numerous to mention, all over the interior of the colony, beds of white and red clay, mixed with mica scales, resulting from the decomposition of gneiss and granite, occur, from which the Indians manufacture rude earthenware articles for culinary purposes.

A red earthy clay with mica spangles, found near the mouth of the Essequebo river, is used as a substitute for *puzzalana* in making a hydraulic cement for the Georgetown sea wall.

There are also many beds of clay in the coast region which are suitable for brickmaking. The bluish clay immediately beneath the soil is extensively used for mending the roads, after having been burnt in heaps like open kilns.

4. *Building Stone.*

There is every variety of building stone in the interior of the colony, with the exception of limestone, but the cost of transport being very great it is not used to any extent.

In the tidal portion of the Essequebo river, and in the mouth of the Mazaruni at the penal settlement, Palmers point, &c., granite of a good quality has been quarried for many years, almost entirely for the construction of the sea wall at Georgetown, and for macadamising the streets of that city.

From the beds of sandstone good stone for building, paving, and other purposes could be obtained, but as the distance and difficulty of transport would be very great, the cost would be enormous, in fact far beyond the value of the material. The chief difficulty in transport would be in passing the dangerous cataracts of the rivers, which must be done before the sandstone area is reached.

On the Corentyne river, however, some of this rock could be obtained below the cataracts, at Akalikatabo island, which still is at too great a distance from the coast to be profitable.

5. *Road Material.*

Rock for this purpose is obtained from the granite quarries at the mouth of the Mazaruni river, and occurs in abundance in the interior. But the same difficulties present themselves in procuring it in the latter instance as just mentioned with regard to building stone.

Within the tidal portion of the Essequebo, Cuyuni, Mazaruni, and Demerara rivers, there is an abundance of granite and gneiss suitable for this purpose.

The greenstone is on the whole the best material for road making, and it can to some extent be procured on the Essequebo, near the foot of the first cataracts, and on the Demerara above Lacodia.

6. *Jasper.*

This rock occurs in layers in the sandstone of the Pacaraima mountains, where it is met with in abundance, alternating with sandstone, for upwards of 100 feet in thickness. It also forms irregular patches, plates, and strings in the same beds. Its usual colour is a fine red, varying to purplish and light red. Where layers are exposed at the surface, the ground for miles is strewn with blocks and small pieces of this rock, and in the gravels of some rivers running from these mountains it is seen as round, smooth, waterworn pebbles. The Indians use it for striking fire with steel in lieu of flint, and call it cako.

This, like many other varieties of jasper, might be used for inlaid work.

7. *Porphyry.*

Many of the quartz and felstone porphyries could be made useful as ornamental stones.

One variety of the former rock near Maringdouk cataract, on the Siparuni river, is very beautiful, being composed of reddish felspar crystals in a black matrix, together with crystals of quartz. Being exceedingly hard it would take a fine polish.

Some green varieties of felstone on the Upper Berbice river when polished resemble nephrite.

8. *Granites.*

There are many kinds of granites which when polished would also make fine ornamental stones, especially those containing opalaceous quartz at Wonotobo and Achramucra cataracts, and on the Upper Berbice; also the porphyritic granite on the Curielrong river.

9. *Graphite* (*Plumbago*).

Thin layers of this mineral occur in decomposed mica-schist in two localities, viz., on the Barima river at Marucuru creek and at the mouth of the Carabung; but they are not of sufficient purity to be of any economic value.

10. *Iron Ore.*

Impure ores of iron are most extensively diffused throughout the interior in beds in alluvial deposits, and on the surfaces of the greenstone masses. They are chiefly composed of brown hæmatite in parts, and clay impregnated with hydro-oxide of iron in others, often containing in their purest portions angular grain of silica.

The largest mass of this ore occurs at Mount Wahmarra on the Upper Demerara river. Near Darunow village, on the Upper Rupununi savanna, there is a large patch, probably a vein, of fine specular iron ore in greenstone.

11. *Manganese.*

Very small quantities of manganese ore, or bog manganese, are met with associated with the iron ores. In fissures in some altered shale beds on the Mazaruni river, beyond Weynamon river, this mineral is seen as reniform coatings.

12. *Gold.*

In his introduction to the Life of Sir W. Ralegh, p. lxii., Sir R. H. Schomburgh says that "In 1721 the Council of Ten "in Holland granted a privilege, whereby it was enacted that all "persons disposed to work mines in Guiana might do so upon "certain conditions, and Mr. Hildebrand, a miner, was sent from "Holland for that purpose. A shaft was sunk at a short distance "from the first cataracts in the Cuyuni, but the small quantity "of ore found did not repay the expenses of working it, and the "attempt was abandoned."

The spot here mentioned may possibly be the one at which the British Guiana Gold Mining Company had their workings about seven years ago, some 40 miles up the Cuyuni river, above the first set of cataracts. The quartz containing gold at this mine is in a thoroughly decomposed gneiss and schistose rock, and apparently not as a true vein, but rather interfoliated with the gneiss, similar to the development of quartz schist in gneiss in other parts of the colony. At the surface it is some 10 feet in width, but separates into narrow bands as it passes downward.

Owing to the neglected state of the workings, and the tangled growth of shrubs and trees over the place, which hid everything at the time of our short visit there in 1868, I could form no opinion of its value; but beyond a doubt the quartz contains gold, specimens of which I procured.

The gold mining company, however, worked the quartz for some years, as well as *placer diggings* to the south-west of it, but did not procure gold in sufficient quantity to repay their outlay. This may have been owing as much to the expense of labour and cost of getting stores, machinery, &c., above the cataracts to the place, as the absence of gold in paying quantity.

Some 50 miles further up the Cuyuni river we obtained small particles of gold by washing in the sand near a quartz vein, and in the alluvium at the foot of a hill.

Schomburgh also states that he saw a piece of gold at Fort San Joachim attached to quartz which came from the Takutu river, and that he "observed minute particles of gold in the dry bed of that river." I examined the sands of the Takutu river by washing carefully in many places for gold, but without success. Amongst the particles of magnetic iron, the remnant of washed

sands, were minute crystals of garnet, and small particles of a yellow mineral.

There are many promising looking veins of quartz in schists, gneiss, quartz-porphyry, and granite, which contain a black mineral and iron pyrites, but in none of them could I detect any gold, nor did I ever obtain that metal by washing in any river except upon the Cuyuni.

At a place bearing the name of Gold Mines, near Groote creek, I have been informed by a resident there that the remains of an adit, arched with bricks, can be seen in a hill side, which is said to have been a gold working of the Dutch.

There is a cataract above Ouropocari bearing the Indian name of Caricurie, which means gold. It did not receive this name on account of gold being found at the spot, but owing to an Indian tradition that many years ago a Spanish boat bringing down gold from the interior was upset and lost there.

During my travels over all parts of the interior I never met any Indians wearing gold ornaments, nor ever had any gold shown to me by them; but whenever I questioned them as to whether it existed in their neighbourhoods, they always answered in the negative.

13. *Salt* (*Chloride of Sodium*).

Common salt occurs in small quantities in patches upon the surface of the river Loam, on the savannas in a few localities near the Chemow, Ireng, Watama, and Takutu rivers. It is found in hollows in minute crystalline particles, mixed with fine sand, after the evaporation of the water left in those places by the heavy rains, and is collected by the Indians of those districts.

BAROMETRICAL OBSERVATIONS showing the Height above the Sea Level of various Places in British Guiana, taken during the Expeditions of the Geological Survey.

Name of Station.	Height in Feet.
Santa Rosa mission, Marooca	23
Barama river, near Aranka	100
Manarie village	113
Turkparu village, Barima river	45
Canyaballi village	25
Waramurie shell mound, Marooca	33
Matope cataract, Cuyuni river	30
Camaria „	59
Woka mountain „	377
Aruka-matuba cataract „	133
Warrerie gold mine hill „	207
„ „ „	140
Tomona rapid „	216
Wakuapang cataract „	190
Appa river mouth „	192

Name of Station.	Height in Feet.
Maripa cataract, Cuyuni river	195
Tamamure „ „	275
Otomong river mouth „	295
„ hill „	425
Between Cuyuni and Cartoonie rivers	318
Cartoonie village	300
Camp on Cartoonie river	295
„ Purunie „	265
Junction of Puruni and Mazaruni rivers	180
Cowenamou village „ „	223
Foot of Water-barru mountain on Carabung river	170
„ Macrebah fall „ „	175
Top of „ „ „	357
„ first table land on path leading to the Upper Mazaruni river	963
Camp of 5th November 1868 on path	1,480
„ 6th „ „	1,425
Top of mountain above Stenaparu river	1,925
„ next mountain on the path	2,215
A little beyond last observation	2,385
Top of next mountain	2,565
Highest part of table land	2,590
Camp of 7th November at precipice foot	1,945
Table land beyond	1,657
Large river	1,525
Ashieparu river	1,537
Mountain beyond	1,915
Mazaruni river at upper end of path	1,299
Buhuri-bunacu island, Essequebo river	63
Rupununi river mouth	200
Curassawaka „ Rupununi river	240
Annai mountain, near „	775
Monushuballi hill, near „	370
Carenacru village, on savanna	475
Savanna west of Ireng river	295
Enamouta village, near Unamara river	500
Mountain pass north of Enamouta	750
Highest part of do. do.	928
Conewyutelli river in second valley	720
Pass between Conewyutelli and Curiewakie river valley	964
Curiewakie river	900
Camp of January 28th, 1869	1,007
Top of pass to next valley on Cowieparu river	1,388
Highest point of same pass	1,705
Cumparuyamo valley	1,585
„ village	1,805
Top of ridge north of do.	2,117
Valley beyond last observation	1,450
Cumararing mountain top	2,630
Camp on Marakang river	1,335
Ridge beyond to the north	2,370
Heads of large river in valley beyond	2,035
Next ridge to the north-west	2,630
Valley beyond	2,025
Karakanang village	2,025
Ridge top north-west of Karakanang	2,425
„ not far beyond	2,805
Valley beyond to the north-west	2,143
Ridge bounding last valley on north-west	2,740
Weyanock river	2,574

Name of Station.	Height in Feet.
Mountain ridge two miles on	3,125
Next ridge	2,880
Ridge beyond Pelpee river	2,690
Ourindouk fall fording Cotinga river	2,400
Ridge beyond	3,025
River in valley beyond last observation	2,380
Mountain between Wamsou and Waetipu villages	3,390
Waetipu village	3,570
Table land at south end of Waetipu mountain	3,805
„ between Waetipu and Roraima	3,705
Ridge near Roraima	4,260
„ at foot of „	4,507
Foot of Roraima mountain	4,925
Sloping side of Roraima to highest point ascended	5,148
Ipelemouta village near Roraima	3,725
Peepee river village	2,450
Marooca or Pirara landing	251
Karinambo village, Rupununi river	261
Pirara	330
Quatata village	328
Between Mopay and Pipicho villages	370
Mora river landing, Rupununi river	249
Cawulibar village	330
River beyond last observations	590
Ridge north of Cawulibar valley	1,405
Camp in valley to the north	845
Itabay village	974
Pass north-west of Itabay	1,180
Uorora river	412
Valley of Ireng river near last observation	355
Pass across mountains to the north	1,005
Sheepaouta river	840
Quonga village	1,978
Kicuche river valley	425
Mora river	340
Mora village	495
Essequebo river, foot of Cumuti mountain	177
Top of Cumuti mountain	1,400
„ rock	1,310
Mouth of Rewa river on Rupununi river	205
End of path on Quitaro river leading to Ataraipu rock	357
Hill top on same path	573
Ataraipuruwow river	415
Foot of Ataraipu rock	857
Side of Coomacaba rock	910
Caliohadekeur „	1,150
Maturuvow village, Quitaro savanna	590
Curawashinang village „	740
Watericow or Watuticaba village, Quitaro savanna	670
End of Tomboro mountain „	777
Between Tomboro and Carawaimentow mountains	767
Cotoewow village	895
Coomoctabawow river	803
Carawaimintow mountain	1,210
Saberewow river	835
Between Heherap and Matuatowow villages	945
Matuatowow village	925
Warw village	1,007
Head of Takutuwow river	900

Name of Station.	Height in Feet.
Savanna near last observation	960
Head of Rupununi river	745
Waripuow village	690
Irribisinow village	630
Savanna near Aruauwow river	745
Parearabatonwow village	645
Granite rock near Cobanawow river	690
Warraweow river	655
Otonam hill, near Warraweow river	777
Shea rock	1,195
„ village	705
River north of Shea	675
Landing on Quitaro river at end of path leading to Maturuow village	415
Furthest point reached on Rewa river	385
Pacutout cataract, Siparuni river	205
Cataracts and rapids „	305
Maringdouk cataract „	335
Surama landing, Burro-burro river	228
On path to Archiculloch village, near Burro-burro river	620
Archiculloch village	970
Paloureouta „	340
Annai „	393
Cuyariye river	385
Between Annai and Surama	650
Surama village	305
Taramu „	395
„ river head	775
Camp beyond Taramu river head	1,225
Itabay village	860
Curapowta river	795
Carona fall, Ireng river	500
Hill west of Carona fall	1,035
Mataparu river	800
Awarapearu river, west of Caracara	945
Caracara village	1,000
Hill north of Caracara	2,180
Awarapearu river, north of Caracara	1,725
Coniapeur village	2,060
Quarquia „	1,335
Tarawa „	998
Mowarieteur mountain foot	1,005
Owenteik village	2,207
Mowarieteur „	2,090
Otomanda	1,495
Encaco village	1,965
Jackiquocki village	2,088
Elichiliqua „	2,735
Mountain top one mile north of last observation	2,798
Saranieparu river	2,670
Mountain path on top of highest table land	3,135
Emoy river	1,750
Arnick river	1,485
Taispong village	1,890
Caruputa „	1,437
Potaro river, near last observation	1,385
Top of Kaieteur fall	1,130
Foot „	308
Landing place three miles below the fall	196

Name of Station.	Height in Feet.
Tumatamari cataract foot	65
Foot of Amutu „	84
„ Arriosaro mountain	60
Top „ „	725
Landing on Curielrong river below Amailah fall	83
Top of Amailah fall	1,280
„ Twasinki mountain	825
Foot of King William IV.'s cataract	210
„ Manarowah „	231
Top „ „	329
Foot of next great cataract	468
„ great cataract at camp of November 5th, 1870	752
End of path on Canerua river landing to Woyawais country, Essequebo head	825
Camp on Essequebo, not far above last information	828
Cassikityu river mouth	741
Hill between Murray's and King William IV.'s cataracts	746
Essequebo river opposite last observation	205
Yarewah village, Takutu river	160
Cotinga river mouth	90
Warara-sararu cataract	108
Waiquah river fording	195
Terchilewan village	303
Junction of Cumparu and Cotinga rivers	590
Camp, 22nd January 1871	1,065
Cumararing village	1,377
„ mountain pass	1,672
Mountain north of Cumararing village	1,580
Tacar-erimone village	1,350
Arawaitah „	1,488
Escarpment foot north of Wailongteur river	1,488
Top of same escarpment	1,900
Foot „ „ on north side	1,615
Karnang river	1,598
First Orindouie fall top	1,590
Uwahparaduie village	1,652
Camowta rapids, Ireng river	1,560
Top of Orindouie great fall, Ireng river	1,929
„ Wantuănă „ „	1,942
Landing below Orindouie fall	1,769
Waramepai village	1,780
Waipah „	1,598
General level of ridges between Ireng and Karnang rivers	1,560
Highest part of ridge north of Wailongteur river	2,174
Ireng river bend north of Cumararing	1,332
Mountain top north of Waiquah valley	1,037
Tamarchelle village, Cotinga river	383
Aringwong village	270
Warabara-chilen village, Macumucu river	268
Suwara-oura river mouth on Takutu river	180
Dahdaad village	200
Cursato mountain top	1,300
Cocobeanarruwow village	240
Macudoord river, near Pinniyette mountain	375
Mepitewow „	254
Coarawow „	338
Gravel ridge on savanna near Rupununi river	400
Rupununi river near Mount Pattighetiku	283
Berbice river east of Primos inlet	200

Name of Station.	Height in Feet.
Primos inlet, Essequebo river	200
Foot of sandstone cliff, Maccari mountain	890
Top of quartz-porphyry „	578
„ Maccari mountain	1,270
Essequebo river opposite Maccari mountain	190
Foot of Wonotobo cataracts portage, Corentyne river	115
Highest point of „ „ „	218
Head of Wonotobo „ „	205
Corentyne river above Wonotobo cateracts	210
Camp of Sunday, 24th September 1871	250
Foot of King Fredrick William IV.'s cataract, Corentyne river	370
Top „ „ „ „	420
Camp of October 8th, 1871, New river	501
Landing on New river of track cut by Survey to the Essequebo river	670
First breakfast place on track	675
First ridge crossed „	755
Second „ „	733
First camp on track	747
Second „	776
Third „	693
Top of mountain north of third camp	1,240
„ spur of Amuccu mountain	1,030
Fourth camp on track	719
Fifth „	710
Sixth „	719
Seventh „	715
Essequebo river track end	698
Pani river mouth on Curuni or Corentyne river	585
Camp of December 2nd	675
Near site of old Indian village, Cutari river	680
Aramatau river	670
Hill near do.	773
Great cataract on Aramatau river	746
Camp on path cut by the Survey from the Corentyne river above Wonotobo cataracts to the Berbice river	329
Hill crossed on track	329
Second camp „	374
Third camp „	329
Hill beyond last observation	296
Fourth camp on track	283
Berbice river at end of track	192
Landing of track on Corentyne river	240
First village on path from Etuni river to Demerara river	160
Second „ „ „	180
Hill on path near Demerara river	200
Harewah river	30
Camp of February 5th, 1872, on Berbice river	150
Foot of Christmas cataracts „	159
Camp of 18th, furthest point reached in boat	200
Berbice river opposite Itabru mountain	88
Top of Itabru mountain at precipice	720
„ „ near Itabru cataract	728
High ground in forest between Berbice and Demerara	177
Camp on small savanna near "Burnt ground"	170
„ Itaburro river, branch of Demerara	180
Paintecobra village landing	150
Top of Wahmarra mountain	762
Head of Demerara great cataracts of Ororu mallali	88
Foot of „ „ „	25

Name of Station.	Height in Feet.
Hill on portage of Demerara great cataracts of Ororu mallali	107
Enowdah village	34
Mabouroo river	90
Top of Mabouroo mountain	844
„ sand beds near Giles'	80
Foot of Frazer's hill	25
Top of „	137
„ Siberie hill	100
Sororieng landing, Mazaruni river	80
Hill near do. „	300
Portage landing, Peaimah fall	142
Hill on portage at „	251
Camp of 4th September at foot of Aruwai falls	246
Hill top above landing of Aruwai fall portage	411
Highest point on portage „ „	535
Landing at head of Aruwai falls	516
Foot of Sericoeng falls	520
Top of table land on portage	1,358
Large stream „	1,202
Camp „	1,222
Top of Sericoeng falls at portage landing	1,246
Village Motrayparu above Siparimer fall	1,405
Caywaeck village	1,423
River landing, Carabung path end	1,299
Camp one mile on from last observation	1,300
Mouth of Cuknie river	1,392
„ Aapow „	1,400
Camp past Ackai	1,410
Ouruway cave	1,882
Top of mountain near Cowaeng village	1,754
Camooda mountain top	1,882
Foot of Chi-chi falls portage	1,430
Tops of first cliff „	1,671
Highest part of „	2,268
Landing on Mazaruni river above Chi-chi falls	2,084
Camp on Haiacker river branch	2,090
„ Mazaruni river at furthest point reached at end of path to Karanang river	2,120
Hill on Haiacker savanna	2,275
Waioclaypaloota village	2,267
Warumatta „	2,246
Top of watershed between Mazaruni and Ireng rivers crossed by path	3,326
Camp on Sanmonawong river at junction with Ireng river	2,884
Ireng river passed on path	2,430
Mountain between Ireng and Cakoparu rivers	2,758
Waipahyaracapu village	2,546
Cassowa village	2,160
Portage end Oweang river	1,980
Top of plateau close to Mazaruni river in its highest course	2,400
Mazaruni river crossed in its highest course	2,315
Top of Merumé mountain escarpment	2,353
Camp on mountain side	1,304
Merumé river landing at path end	260

CATALOGUE of ROCKS and MINERALS collected by the Geological Survey of BRITISH GUIANA, for the Geological Museum in Jermyn Street, London.

No.	Name.	Period.	Locality.
1	Clay impregnated with hydro-oxide of iron.	From Post Pliocene deposits.	Berbice river.
2	Sand cemented by hydro-oxide of iron.		Etunie „
3	Sand cemented by hydro-oxide of iron.		Berbice „
4	Hydro-oxide of iron rock - -		Wabmara mountain, Demerara river.
5	Quartz pebbles cemented by hydro-oxide of iron.		Upper Essequebo river.
6	Sandstone, with cast of markings -	Sandstone formation.	Amailah fall, Curielrong river.
7	„ ripple marks -		Amailah fall, Curielrong river.
8	Altered sandstone, with black crystals		Near Akalikatabo island, Corentyne river.
9	„ „ near greenstone layer, with developed felspar crystals.		Head of Mazaruni river.
10	Sandtsone with granite vein -		Akalikatabo island, Corentyne river.
11	Conglomerate - - -		Kaieteur fall, Potaro river.
12	Jasper from sandstone -		Karakanang, Pacaraima mountains.
13	Amygdaloidal diabase -		Curua rapids, Rupununi river.
14	Greenstone layer (diorite) -		Mona cataract, Curielrong river.
15	„ „ „ - -		Upper Demerara river.
16	„ „ „ -		New river, Corentyne.
17	„ „ „ - -		Chemapeur, Ireng river.
18	„ dyke „ -		South of Tacri-erimone, Ireng river.
19	Porphyritic greenstone - -		Curuni river, Upper Corentyne.
20	Mica schist - -	Metamorphic rocks.	Peaimah fall, Mazaruni river.
21	„ „ - - -		Upper Essequebo river.
22	Hornblende schist		Curuni river, Upper Corentyne.
23	„ „ -		Curuni river, Upper Corentyne.
24	Quartz-vein in schist		Curielrong river.
25	Quartz-schist in gneiss -		Cotinga river.
26	„ „ - -		Curuni river, Upper Corentyne.
27	Gneiss - -		Upper Corentyne river.
28	„ - -		„ „ „
29	„ - - - -		„ „ „
30	„ -		„ Essequebo „
31	„ -		„ Corentyne „
32	Pitchstone from gneiss - -		„ Essequebo „

No.	Name.	Period.	Locality.
33	Felstone - - - -	Granite rocks.	Berbice river.
34	Petrosilex from felstone - -		Mora, Rupununi river.
35	Porphyritic felstone -		Berbice river.
36	„ rock -		„ „
37	Quartz-porphyry -		Curielrong river.
38	„ - - -		Ouropocari cataract, Essequebo river.
39	„ - - -		Itabru cataract, Berbice river.
40	Decomposed granite - -		New river, Corentyne.
41	Granite - - - -		Upper Berbice river.
42	„ vein - - -		Sir W. Raleigh's cataract, Curuni Corentyne.
43	„ - - - -		Upper Essequebo river.
44	Porphyritic syenite - -		Ororu-mallali, Demerara river.
45	Granite with opalaceous quartz -		Below King Frederick William IV. cataract, Corentyne river.
46	Impure plumbago - - -		Barima river.

REPORT No. 1.

Geological Report of the North-western portion of British Guiana.

By Jas. G. Sawkins and Chas. B. Brown.

1868.

We arrived in this colony on the 23rd November 1867, and during the months of December, January, and part of February following were engaged in making the necessary preparations for a journey into the interior, and in copying Sir R. Schomburgh's large map, to serve as a basis for our geological work, as directed by the Colonial Office.

For many reasons, but more particularly with the view of carrying out our labours systematically, we commenced our investigations at the extreme north-western portion of the colony, instead of at the south-eastern or centre of the eastern coast.

On February the 14th we started for the Pomeroon district, meeting the Indians sent by Mr. McClintock at Airy Hall. Those Indians were Accawais, Arawaaks, Warrows, Spanish Arawaaks, and Caribise, four of whom were discharged at Maccasseema, and four absconded at Marooca, causing some hours delay before we could replace them. With these men we entered into a contract to serve us for two months, or during the excursion. Descending the Pomeroon river to its mouth, we crossed by sea to the entrance of the Marooca river, and ascended it. On leaving Marooca we found it necessary to hire a corial, to convey some of the provisions through the shallow itaboos between Marooca and the Waini river, on reaching which we descended a few miles to examine a granite rock which forms an island in the river. We slept upon it that night (February 22nd), and the following day, in order to obtain information and examine some remarkable granite rocks, we went to Canyaballi. Leaving early on the 24th, we ascended the Waini as far as the Barama, and journeying up that river for twelve days reached the falls of Dowocaima, near the boundary line of the colony as drawn on Schomburgh's map. Our main object, an examination of the rocks of the district, being accomplished, we returned down the river.

We had sent some of our men on various occasions to villages known to them, for the purpose of purchasing provisions, all of which they found had been abandoned a short time before their

visits, the inhabitants having evidently fled on our approach. About mid-day on the 7th of March we met a man, with his wife and children, in a canoe, returning to his house, from which he had departed in great fright, having heard that we were on the river, and were Venezuelans coming to take them to the war. How this report originated we are unable to say, but it was a source of considerable inconvenience to us in the way of procuring provisions.

From this man we also obtained information of a track across the hills to the Barima river. We therefore determined to make a land journey to that river, and turned back to Aranka for the purpose. There we made preparations, and started on the 9th of March, reaching Manarie village on the following day. Heavy rain fell during the next afternoon and through the night and the whole of the next day, which prevented our proceeding. On Friday afternoon we started, and reached the Barima river at 5 P.M. on Saturday, having experienced heavy rain on the way, which continued for the next twenty-four hours with little intermission. On Wednesday the 11th we sent two Indians to procure wood-skins or corials to take us up the Barima; these men returned on Sunday at 6 P.M. to the place where we were encamped, near Yackieparu creek. Starting from this as early as possible on Monday, March 16th, in wood-skins, and seated on tin canisters, with only umbrellas to shelter us from rain, which continued the whole day, we did not reach our destination (Turkparu) till dark, after which we had to walk a mile through the woods by torch-light, before reaching an Indian village wherein to shelter ourselves. The following day, although showery, we managed to dry some of our clothes and ascend to the cataracts near the boundary line of Venezuela. Having examined the geological formations thus far, and had a further supply of food for our men put into the wood-skins, we returned down the river to Yackieparu creek. The following morning, although raining hard, we started and reached our former camp, on the slope of a high hill, early in the afternoon, and the rain still falling heavily we got our canvas shelters up for the night. The following day we reached Manari at breakfast time; then fearing some of the swamps would become impassable, we hurried on, as the rain continued with even greater force. At last, on reaching the spot where we slept the first night after leaving the Barama, we resolved to stop and camp at 3 P.M., to give the men time to build a shelter for the night. By 4 P.M. on the following day we reached our boats on the Barama, much to the satisfaction of all. Next day, March 22nd, being Sunday, every one was glad to rest.

Leaving Aranka on Monday 23rd, on the swollen waters of the Barama, we descended with considerable rapidity. The falls or rapids and large rocks we had examined on our way up the river were now passed over almost imperceptibly, and as we approached the Waini the places on which we had encamped or stopped to cook a meal were inundated. On arriving at the Waini the weather was more encouraging, and we determined upon sending

to Morooca for further supplies of salt provisions, while we remained at Canyaballi to get cassava, yams, &c., sufficient to last during the time we expected it would take us to examine the heads of the Waini, and the country between that river and the Pomeroon.

Early on the 30th the men who had been sent to Marooca returned, and as soon as the tide rose high enough to float the boats we started up the Waini river. On Tuesday evening we reached Aniparie, beyond which there was not water enough for our boats; and in order to carry out our investigations as far as possible, Mr. Brown proceeded in a wood-skin up to the falls of the Waini, while Mr. Sawkins walked across the hills between Aniparie and Imanicuru, by the course of the upper branches of the Tacuapaparn and Marimaru, arriving at the Schururi creek on the fourth day. On Sunday morning, being short of provisions, he proceeded down that creek in a wood-skin, reaching Maccaseema on the Pomeroon at 4 P.M. on the 6th of April. Having been exposed to seventeen days' rain, with every appearance of its continuance, he was compelled, by his own judgment and the advice of Mr. M'Clintock, to defer further examination for the present of that section between the Pomeroon and the Essequebo over the Blue Mountains to the penal settlement, as he intended. Mr. Brown reached the falls in three days, and then returned, *viâ* Marooca, to examine the Waramurie shell mound, reaching Maccaseema on the 11th, and Georgetown on the 12th.

Our movements often depended on surrounding circumstances, as supplies for our men, &c., which convinced us that in the present state of the country, as regards population, difficulty of access or transit, labour, &c., it will require more time and expense than can be estimated by us, to work out the boundaries of the different geological formations with that accuracy we have been accustomed to, or even with sufficient correctness to be satisfactory to ourselves. All we can promise, under these circumstances, is to give a detailed account of our observations, placing the different formations on the best map we can construct as we proceed.

We may observe here that the map furnished us by the Government requires revising, as it is evident much of it has been laid down without actual observations. On this map we have, as far as our time admitted, made those corrections we considered accuracy demanded, and it is our intention, during the rainy season, to project a map according to our geographical as well as geological observations.

Descriptive Geology.

Going southwardly from the coast at La Belle Alliance, we passed over a low country composed of alluvium for about nine miles, until we reached the Richmond lock, where a low ridge of fine white sand appears, about 15 feet in height and some 300 yards in width, trending north and south. From this an alluvial swamp extends to the borders of the Tapacooma lake. This lake

is naturally a swamp or savanna, which would be almost dry during a great portion of the year, were it not that the water is now retained in it artificially by the dam at the head of the Tapacooma river, which is its natural outlet. At this dam just mentioned there are a few low hills to the north and south, composed of a greyish sandy deposit.

All down the Tapacooma river the banks are composed of a yellowish clayey alluvium, raised only a few inches above the ordinary high tide. At the Hill Mission, and again at Maccaseema, are hills of not more than 20 feet in height above the level of the river, composed of clayey material, with a few small partially decomposed rocks. The land bordering the Pomeroon river consists of alluvium, now slightly raised above the tide, and in many places, especially near its mouth, submerged at high water. Up the Morooca, from its mouth, the land is similar, but at three places on the left bank, before reaching Santa Rosa Mission, there is a rise of a few feet above high water. One of these places, situated a little beyond the mouth of the Himuzacabarra creek, called Wazamurie, is highly interesting from its possessing a relic of a past age, in a circular mound raised by the hand of man, and regarding which no history or even tradition now exists. This mound is situated on the highest point of an extensive ridge of white sand, some 20 feet above the river, which must have been the site of a large village at one period, and the mound is no doubt the remnant of the village refuse or "kitchen heap." The bones, shells, &c. forming the mound belonged to animals of species still in existence.

At Santa Rosa there are hills from 20 to 30 feet above the river, extending northward for some distance. The soil there is of a light yellowish colour, containing small ferruginous nodules or pellets scattered over the surface. From Santa Rosa on through the Itabooto, the head of the Barabara river, there are many tracts of open land, composed of a black bog-mud, formed of decayed vegetable matter, covered with a growth of rank sedges and rushes; these are called savannas, and are evidently old silted-up lakes. The land adjoining the Barabara and Baramanie creeks is composed entirely of alluvium.

A mile or so down the Waini river, below its junction with the Baramanie, there is a small island, formed by a mass of granite of a grey colour and fine-grained texture. Upon the western side of the same river, above the junction with the Baramanie, there is a similar development of granite, much water-worn and furrowed. All the surrounding land is low and swampy, and of an alluvial nature. Three quarters of a mile up the Canyaballi creek the granite again occurs, but here it is composed of a coarser-grained variety, and protrudes in huge masses, which are most curiously furrowed by straight and tortuous grooves of considerable depths. From some masses the quartz crystals stand out in relief on the rock, illustrating the gradual decomposition of the mica and feldspar. Some little distance down the bed of the creek is com-

posed of a white silicious sand, resulting from the waste of these masses of granite. The country to the south and south-west around the vicinity of the village is composed of granitic hills, covered with a coarse sandy soil containing very little clayey matter, the feldspar having, when decomposed, been almost entirely washed away. A dark vegetable mould, which has become mixed with the sand, renders it productive. The granite of this district is composed of a clear quartz, white feldspar, and greenish-black mica.

Just beyond the junction of the Waini with the Barama the land loses much of its swampy nature, and is raised a foot or two above the level of the highest tide. When the river is in flood, however, the water becomes backed up, as it were, and the whole country becomes submerged, as we saw it on our return down stream. The soil is a good rich brownish yellow alluvium, and supports a growth of large forest trees. About 10 miles up the Barama the first rocks to be seen in that river make their appearance at a spot on the right bank, where a hill, some 70 feet in height, comes to the edge of the river. These rocks are composed of mica schist and gneiss, of a brownish colour, and are very friable near the surface. Two miles further up the river large masses of white and grey quartz, of a semi-transparent kind, interlaminate or traverse the gneiss. White and coloured quartz occurs in irregular veins, intersecting the gneiss and schistose beds, sometimes at right angles to the line of bedding and at others nearly coinciding with it. It also occurs as single and branching veins, as nodules in beds, and in large masses. Owing to the decomposing power of the water, the surface of the quartz in many places has become granular and friable, so that it can be crushed with great ease.

The banks of the Barama river within tidal influence seldom are more than five feet above the water; about two days' journey above that point they rise to 16 feet. These banks are composed of a micaceous clayey deposit, coated with oxide of iron in a concretionary form, which is derived apparently from the decomposition of pyrites, so abundantly diffused in the schistose rocks. So highly charged are the waters of these rivers with iron that every rock on their borders is coated with a deposit presenting a perfectly black surface. Beds of schist and a dark stratified quartzite occur, altering the course or traversing the rivers. Frequently the schistose rocks are so much decomposed as to fall to pieces in the hand. At other places they are quite hard, separating on the line of bedding, and presenting a smooth polished surface. The quartzite is very hard, granular, semi-transparent, and of a dark grey colour. By far the most common rock is a light greenish schistose rock of fine texture, and containing crystals of iron pyrites thickly disseminated throughout it. Greenstone dykes occur in two places, while granite is seen in irregular bosses at Cariaco and the island and rapid of Apaequa. A dyke of amygdaloid, of a purplish colour, with white and iron-

stained kernels, makes its appearance near the mouth of the Waiwa. The falls or cataracts of Dowacima are produced by a mass of green mica schist (containing veins of grey granite) running across the river, over which the water falls from a height of 15 feet. The country across from Aranka to the head of the Manarie creek consists of hilly ground, rising in ridges from 50 to 100 feet in height, running chiefly south-east and north-west, with intervening swampy hollows, through which run small winding brooks. The beds of each of these small streams are composed of hard, white, finely divided silicious sand, and in one or two boulders of fine-grained granite occur. The greenish chlorite schist makes its appearance in many places, and is pierced in some localities by grey trap dykes. Quartz in masses and in veins is frequently met with, which on close examination does not appear to contain even a trace of gold. The soil over the whole of this tract of land is of a yellowish colour, while the subsoil seen at the roots of the fallen trees, and where dug up by armadillos (*dasypus*), is invariably of a fine red colour. The soil at Manarie village is light and sandy.

The rocks occurring on the Barima are similar in both composition and appearance to those of the Barama, being granite, gneiss, and schistose rocks. The cataracts near the Venezuelan boundary (laid down by Schomburgk) are produced in a similar manner to those on the Barama, and by rocks of the same lithological character. In the Takari river, above the cataracts, a mass of dark chlorite is exposed. Below Turkparu, on the Marucuru creek, a small tributary of the Barima, we obtained a small specimen of plumbago, or graphite which is a common mineral in gneissic and schistose rocks. The specimen we procured is not of a sufficient granular texture to be turned to account, but it would require further investigation to determine its value.

On the river Waini, above its junction with the Barama, the left bank, close to the river's edge, attains an elevation of 15 feet above the highest tide, and extends eastwardly and southwardly as a level table land. The soil is loose and sandy, and the few small rocks upon it are granitic. All the right bank is low and swampy, and composed of alluvium. Just before reaching Aniparie both banks become slightly elevated a foot or two above the river. This place is the head of the tide, and no rocks whatever are to be seen on the river up to this point. They first appear a short distance above this, and continue to be seen to and beyond the Waini falls, and are chiefly gneiss or granite. Mica schist and a grey granite also occurs in few spots, but chiefly at the falls. Few true quartz veins are to be seen, but veins of a coarse-grained crystalline granite, having very much the appearance of quartz, are of frequent occurrence. In these the quartz is semi-transparent and of crystals of over an inch in length; the feldspar is milk-white and of the same dimensions, while the mica is in crystals of $1\frac{1}{2}$ inches in diameter and half an inch thick, of a dark colour. On splitting the mica into thin plates it is of a fine silver-white

colour. On all the sandbanks at the bends of the river the plates of silver-white mica are to be seen.

A huge dyke of fine-grained grey granite, running across the river nearly east and west, and of about 200 yards in width, forms the falls, which are about 20 feet in height. The rocks on this river vary in a marked degree from those of the Barama, and on the whole are more gneissic. Hills approach the river in many places, and around the falls are about 120 feet above its level.

With regard to the geological epoch to which the rocks above described may be referred, the evidence is in favour of their being Palæozoic, and most probably are equivalents of the Præ-Cambrian rocks. From their being metamorphosed and pierced by quartz veins, and from their possessing all those lithological characters which are considered auriferous, we regret that our means of supporting labourers with the necessaries of life prevented us from carrying our examinations to the extent we would recommend.

REPORT No. 2.

Geological Report on the Cuyuni and Supinaam Rivers.

By Jas. G. Sawkins.

1868.

The exact limits of the alluvial deposits which extend from the base of the Imataca range, have not been determined by actual survey; but they may be considered approximately defined by the course of the Supinaam river, and the junction of the principal tributaries of those rivers that run into the Atlantic ocean north-west of the Essequebo, as the Pomeroon, Waini, Barama, Barima, &c.

The alluvium is distinguished for its fertility and extensive agricultural establishments for the growth and manufacture of the great staple of the colony, viz., sugar; also in the uncultivated parts by magnificent forests with which nature has covered it. The fertilising qualities of this extensive deposit are due principally to the accumulated admixture of vegetable matter with the sands and clays derived from the disintegration of the rocks forming the Imataca hills. These sands and clays are frequently found in distinct areas on the surface, as if separated during the process of deposition, or by the suspension of the particles from the difference of their specific gravity, or by the greater or less force of the currents that brought them from the higher lands; hence an area of very poor arenaceous soil is sometimes found in juxtaposition or surrounded by a very rich loam, and *vice versâ*.

It is from the various stages of decomposition of the rocks we find the configuration of the Imataca hills is due, producing depressions and elevations according to the resistance of the rock to atmospheric influences.

I observed both on the hilly land and river beds that elevations are greater where the porphyritic or metamorphic rocks predominate. Most of those hard, fine grained, dark, blackish, or grayish rocks are trap and greenstone that have passed up between the fisures or lines of weakness in the granite, syenite, &c. On ascending the rivers we find them frequently traversed by dikes of trap

rocks, producing obstructions to navigation in the form of cataracts, cascades, or rapids.

Descriptive Geology.

Having given in the foregoing remarks a key to the various rocks described in the following report, it becomes my next object to designate their localities, their mode of occurrence, and the geological deductions derived from the facts collected. As no fossils have been found, I am as yet unable to determine at what period the granite rocks were brought to the surface, or those associated with them, all being, as stated on a former occasion, azoic or hypogine (rocks void of life). Deprived of these most interesting palæontological facts for the present, I am compelled to confine my observations to the composition of the rocks, minerals, and metallic ores that have come under my notice during the second excursion into the interior of this colony.

Having given some idea of the nature of the alluvium that is derived from the disintegration of rocks and vegetable matter, it is only requisite to observe that the alluvium extends along the coast, from the low range of sand hills at the base of the Imataca range to the sea, running nearly parallel with it at distances varying from 30 to 60 miles.

On the Supinaam creek, about the Mission of Indiana, the land rises nearly 50 feet; the creek divides into many streams near the rapids, and numerous small islands are formed by deposits accumulated on the rocks, and now sustain a forest vegetation. These rocks, as well as those on the banks of the creek, are covered with a considerable thickness of decomposed granite, or rocks of the granitic family. Quartz occurs as aggregate pieces of conglomerate, cemented by red, white, or pink clay. Where the clays are separated from the sands, they are mottled or streaked with red lines of oxide of iron, appearing to follow the lines of silicious matter by a process of segregation. Sands increase ascending the creek, and occur in many instances without any argillaceous admixture.

The Supinaam river is much more tortuous than represented on those maps I have seen, but the general course is the same from S.W. to W.S.W.; it narrows to 30 feet after leaving the Mission of Indiana, and subsequent to a heavy fall of rain discharges its waters with such force that it was found to be very difficult to ascend in a boat or canoe.

By proceeding up Groote creek, which runs parallel to the Supinaam on the south, the same series of granite rocks were observed exposed here and there, and the manner of their occurrence along the bank under the deposits of sand and clay. A vein of hematite was observed a little below a wood-cutting grant, now abandoned.

The next point of the Essequebo river where a fair sample of the granite occurs is at Saxacalli point. This appears to be the remains of a dike that extended across the river, and once formed

a solid mass. The alluvium forming the banks that once covered this dike has been removed by a subsequent encroachment, due to the river currents, tidal action, and atmospheric agencies that now prevail over this spot, and by which this dike has been re-exposed.

On examination it is found that none of the rocks comprising this group present any sharp edges, all are rounded by attrition or disintegration. The surface of the granite is worn away below the surface of the veins of quartz that have been less affected by these influences. These quartz veins present no regularity of disposition through the granite, yet there is in them such an amount of parallelism as we frequently find in false bedding of sand and gravel, while the separation in the granite appears more constant, such as the cleavage structure dividing the quartz veins as well as the granite.

At Swarte Hock point the same characteristics appear on a larger scale through the granite, but in the place of the cleavage a foliaceous structure predominates.

At the penal settlement the land rises 56 feet, which is the highest point on the lower portion of the river. There are some granite quarrying operations carried on here by convicts, where good sections are obtainable, and the character of the granite may be studied to advantage. The sea wall of Georgetown is built of granite from the quarries in this vicinity. Almost immediately opposite the Commissioner's house on the other side of the river is an intrusive dike of either porphyry or greenstone, which I could not determine on account of the shallowness of the water and the difficulty of landing near it.

At the mouth of the Mazaruni there is a large quarry of granite well worthy of examination.

Proceeding up the Cuyuni river, instead of going over the falls of Seregatava, Tivruni, and Ematuba, I walked across the land, over which a road had been cut for the purpose of conveying machinery, but is now nearly closed with undergrowth. The rocks observed on this path were granite, syenite, and quartz, the latter not in veins but granulated. Sand occurs on the elevations, forming patches of gray colour. Clays occupy the sides and summits of the hills, also depressions of the lands when so formed as to permit water to collect and remain. Sand and clay mixed with vegetable matter also occur in many places, and would no doubt yield good returns to the cultivator. No determination of dip was obtainable, and although quartz was frequently observed, it nowhere appears on this route in what miners call true quartz veins or reefs.

Granite and syenite occur above the cataract of Camaria, also quartz associated with them, but, as in those previously observed, not in dykes or reefs. Between that cataract and Woka creek granite again occurs on one of the numerous nameless islands.

By ascending Woko or Powis hill I found hydro-oxide of iron and hematite, and quartz in detached pieces of two or six inches in

diameter, lying on variegated clay. The scenery from this point is very tame and unpicturesque. At Aruakaumatabo there occurs an intrusive hornblendic rock associated with granite. On the surface ironstone or hydro-oxide of iron, in the form of gravel or cemented by clay, but not hard enough for conglomorate, occurs here in abundance, a good specimen of which is lying at the mouth of a small stream, by which it appears to have been brought from the east end of the Tapori hills.

It is on the western part of these hills that some money has been expended in erecting a small stamping mill and a comfortable dwelling by the British Guiana Gold Mining Company.

On the north-west apex of this range of hills lies a mass of quartz containing minute specks of gold, a little of which has been removed for the purpose of crushing; but I suppose, judging from the amount of work done, that most of the quartz yet remains where nature placed it.

There are also some very judicious excavations and adit workings that have been cut with the object of intersecting the quartz had it been a vein or "reef," *i.e.*, a continuation of the quartz of equal dimensions below the surface. Now from all the information I have received from the directors and others of the company, and from such examinations as the fallen state of the work in the adits permitted me to make, the quartz rock does not descend as a true vein in either of the adits, although driven in different directions. My inferences are that this mass of quartz is lying on mottled clay, resulting from the decomposed schist and rocks of the granitic family, but not beresite or metamorphic clay, slates, and such rocks as generally occur where gold-bearing quartz are in sufficient quantities to pay for extracting.

I then went to examine the alluvial washing places up a creek to the west of the works, about $1\frac{1}{2}$ or 2 miles distant, where it appears to me there are reasons for expecting more profitable results than from the crushing of the quartz. The men who accompanied me had little experience in gold washing, and discovered no gold, but I did, and satisfied myself of the existence of gold in the alluvium. Nevertheless the small quantity obtained would not justify me or any other geologist to proclaim this particular spot or place as a "gold field," any more than many other places to be found on this river (Cuyuni), the heads and main sources of which being in that far-famed and well-known gold district of Upata, it is not surprising that particles of gold or small nuggets should be deposited over a district that has for ages and ages received the sediment of this river, coming from the higher and auriferous country. An evidence of this has been determined by the character of the quartz of this locality, nor is it possible that the gold found in this creek could have come from the hill where the quartz lies, because the creek is considerably higher up the river. I, however, advise further investigation, for it must be understood the Government geologists cannot bestow extensive examinations, which might occupy at least three months instead of

four days, or make expensive chemical analysis, required for such investigation, for any private enterprise without express orders from the Government.

Proceeding up the river, syenite appears again at the rapids on the south side of Suwaraima island and at the extreme north-west point, in juxtaposition with an intrusive trap of greenstone; these occur again about three miles further up the river, beyond the four hills that appear to be a continuation of the Tapori range.

Near the Berebisi creek and Tonoma rapids granite and syenite occupy a considerable part of the river bed; they also appear at the next rapids, Payuca, and up as far as the island between Quive-Kura river and the Yane-Kura, at the extreme west end of which there is a development of quartz, where Mr. Brown informed me he had found, after some hours washing, two specks of gold from the black sand. I could discover no gold in the quartz at this locality under a strong magnifying power. I therefore refer to this as an instance of the diffusion of the precious metal by the river, and not from any local veins or quartz reef that has come under my notice.

After passing decomposed granite, syenite, and quartz, and going up a narrow channel between the islands and coming into the main river about a mile below the Caruma or Catuan creek on the north, and on the south-west a smaller one called Wairyarra, the rocks become decidedly schistose. There is also a small dyke of quartz in the course of the river, which is red and white, but contains no gold visible under a strong magnifying power. Then, passing along the rapids of Olupikai, a variety of greenstone and talcose schist occurs, with slaty structure and of light yellow colour.

The following day I went up one of the hills in this vicinity, at the base of which there is a small rivulet, where I directed washing for gold; two or three specks were obtained in a short time. On the sides of the hill I saw nothing but mottled clay and hydro-oxide of iron.

Proceeding up the river I soon observed masses of white foam, those undoubted indications of our approach to some formidable obstructions in the river; this proved to be the rapids of Atete, where the rocks are of a slaty-structure and a greenish colour.

Another island was passed, and on coming to the full breadth of the river a long low hill was seen in the distance, which was supposed to be either the Parapapu or Waikurie.

On reaching the Copang creek our pilot informed us there were inhabitants living near the mouth of it. We therefore ascended the creek until obstructed by fallen trees. As we had not seen any inhabitant since we left the settlement, and anxious to obtain some fresh vegetables or cassava, as well as a guide and pilot, I determined to stop a day, it being very evident to me our men were beyond that portion of the river they were acquainted with. No person was found at the house. It was supposed the inhabitants had fled from fear, so unaccustomed are they to see so many boats and people together.

On crossing the river we came to the residence of the captain of the river, a middle-aged man by the name of Peter, with whom and his son as our guides we started on our upward course, and before mid-day we reached the Waicuri cataract, where there is a great development of brecciated rock lying on a phonolite, with small grains of pyrites and a blackish mineral that, like the pyrites, dissolves out of the rock, leaving square cavities, more or less filled with oxide of iron.

We arrived at the great falls of Wakupang, where we stopped for the night. The rocks that form this barrier to the river are principally greenstone or schist; there is also a considerable deposit of white sand on a portion of it. After leaving these falls the rocks become more slaty and foliaceous by the presence of talcose schist, with a little quartz in veins of two inches. The talcose schist contains a good deal of iron pyrites.

On arriving at Toroparu river we found that the path to the Puruni river, which is laid down on the map of Sir R. Schomburgk, had been long abandoned.

The granite rocks from this point of the river in our course became more gneissic, with occasional quartz veins and greenstone; therefore the distance between the Copang and the Maruparu creeks may be regarded as the schistose district of the Cuyuni river within the supposed boundary of British Guiana.

Between the Maruparu and Sudamong rivers talcose schist occupies a considerable portion of the north bank of the Cuyuni river.

On approaching the cataract of Duquari the granite rises in large bosses, alternating with syenite, porphyry, greenstone, hornblende, and talcose schist, which lie on the granite at different angles, sometimes conformable, at others not so. Above Iroma river these rocks are more decomposed, and assume a red colour, but still preserve their laminated structure.

As the rocks of Duquari falls are exposed over a large area, the geologist has a better opportunity of observing the relations they have to each other and determining their relative age. It appears evident from the observations made there that the greenstones have displaced the granite, and have intruded through lines of weakness or fissure without materially altering the granite, by which it appears that the greenstone was at a low temperature during its ejection, *i.e.*, below a white heat, as the lava of the present day of Vesuvius and Hawaii.

Granite with red felspar occurs at the Duquari falls, as also a dense gneiss. Above the falls greenstones and rocks of laminated structure occur on the main river, which is here impassable. We therefore passed by the south of an island where there is a clear channel that led us to the Paccu falls, after passing which we came to a small creek called Cartuni, along the banks of which there is an Indian path to the Puruni river, a tributary of the Mazaruni.

From this place onwards our pilots knew nothing of the river, consequently we had to return some distance to obtain a pilot, who conducted us over the Arowyamo, Callo, Dara, Corrocoroo-pung, Icarima, Poinka-amarka, Tacarrie, and Aberiwaika cataracts, which damaged one of the boats so much that only one proceeded from Poinka-amarka as far as Otomong river, which forms the boundary line between this colony and Venezuela.

After passing the Paccu falls the granite assumes various colours and different size crystals, and the trap rocks as dikes, with quartz veins of two inches wide, occur in the fine-grained granite.

At the falls of Womuipong there are rocks of the same character, all constituting members of the granite family, such as are technically defined at the commencement of this report, which report, to suit the desires of the Honourable the Court of Policy, has been contracted as much as possible, consistent with the inquiry.

This concludes my observations on the Cuyuni river.

REPORT No. 3.

Geological Examinations of the Puruni and Mazaruni Rivers.

By JAS. G. SAWKINS.

1868.

HAVING examined the Cuyuni river geologically as far as the boundary line of Venezuela, according to the map furnished us, I considered it important, if possible, to make a transit by land to the Puruni, a tributary of the Mazaruni river, as this would economise about 30 days of my time. Returning, therefore, to the path leading to the Puruni, I determined on walking across the country between these two rivers. On Sunday noon, September 27th, we started, accompanied by all but two of the crew, laden with provisions that were to last us until the boats could be taken down the Cuyuni and carried up the Mazaruni to Cowenamo, where I proposed waiting for them.

After two days' walking we came to a settlement comprising two houses, where we obtained a few Indians to go with us down the Puruni river. About seven miles distance from this place there is a tributary of the Puruni, large enough for wood-skins or bark canoes, by which we would reach the Mapa-aima and Puruni.

After these arrangements were made Mr. Brown and I divided the crew, taking only our cooks and two other men to accompany us; the rest I sent back to the boats with instructions according to the above plan. I had, however, to wait here four days, in order to give the Indians time to collect the number of wood-skins required.

The distance between the Indian settlement and the Cuyuni I consider 15 miles, the way the path runs, and seven to the stream where we embarked, making about 22 miles from river to stream.

The rocks observed on this transit were granite, granular quartz, syenite, and trap; in the creeks black sand occurred very generally; but as any detention may have frustrated my object, time did not allow my stopping to wash for gold, although I consider this part of the Cuyuni valley as likely to contain auriferous deposits as that in the vicinity of the "gold mines." The greatest elevation attained between the Cuyuni and Puruni rivers was 320 feet.

October 6th. We started in wood-skins down the Cartuni (the name of the stream before alluded to). We had not proceeded far before the axes, hatchets, and cutlasses were required to cut away the trees that were lying across the stream. After passing two creeks from the south, the Tapara and the Tariparu, granite and syenite occur in two places. We then passed the Waini creek from the north and some small islands, where the river divides into many branches or streams; there is also an artificial cutting through the clay bank, which shortened the distance considerably. After passing this labyrinth some hornblende schistose rocks appear, near Maraparu creek; these rocks occur again further down the river, after passing two creeks for which there was no name obtained.

The banks of the river are generally low, composed of red, white, yellow, and mottled clay, with sand. Granite occurs near Tuvastimpi creek on the south and Maimaraparu on the north, also near Tineparu creek, with gneiss of a blue colour. On approaching Curaspara creek a soft schist occurs.

During the time breakfast was being prepared, on the 8th, we walked up a hill on the north shore; the ascent is rather steep, being on an average 30 degrees at an elevation of 600 feet. I found the trending of the ridge N.E. and S.W. It is generally covered with hydro-oxide of iron in the form of pebbles or concretionary masses, sometimes conglomerated and hematitic.

Approaching the falls of Marehughi the hydro-oxide of iron occurs, forming a soft rock with blackened surface, also diorite, trap, and greenstone.

Near Cariar creek from the north and Pakiamparu on the south are red, white, and yellow clays.

About 5 p.m. on the 9th we arrived at the junction of this river (which on Sir R. Schomburgk's map is called Mapa-aima) with the Puruni, where we rested for the night. Here I contemplated a division of our party, the one to go up the Puruni, the other to continue down to the Puriari. This was settled by the Indians refusing to go up the Puruni, because they were at enmity with the people living up that river.

On reaching the Puriari we found it so obstructed by timber and so very little water as to render it impracticable for canoes to ascend.

About a quarter of a mile below the junction of the Mapa-aima and Puruni are the falls of Pyuca, divided into three different streams. The rocks forming this barrier to the river are principally composed of trap, coated with black and red hydro-oxide of iron. The greenstone and mica schist dip to the S.E.

Ombarra creek enters the Puruni from the north a little below these falls, and the hills of Ruminga and Warupina soon appear, forming the south banks. At the base of these hills are dikes of a dense greenstone that appear to run under their centres, also schist, and the ferruginous rock or ironstone. Between these two hills is a small watercourse, above the Curaparu creek, near which

are hornblende rocks, schist, and decomposed schist, succeeded by granite, syenite, and trap at the little falls. Near Gasparupa creek that comes from the north there is a curious conglomerate and trap with quartz veins.

We rested on Sunday at an uninhabited settlement called Miahpi. Proceeding down the river on Monday, October 12th, we passed Aswara creek, near which occurs trap, quartz, gneiss, and laminated quartz in talcose schist.

After passing Gangrooma and Langoomau creeks greenstone occurs, and below Cabili and Humaribaro creeks quartz, greenstone, sandstone, and conglomerate, and at Paraani creek red and green schist, with quartz veins; these extend down to the vicinity of Mara-mara creek, where gneiss and blue clay slate appear. A short distance below is a bed of conglomerate, which continues on until near two small creeks that come into the river nearly opposite to each other, the names of which were unknown to my guide; below which there is a conglomerate, quartz, red ironstone, yellow sand, and greenstone. The river here passes through a ridge trending N.E. and S.W.; soon after another hill is seen about the same height (estimated 600 feet), but the course of it is more southwardly; soon after the highest hill (Urieon) appears, with Runa creek, and another the name of which I could not obtain. Another hill rises on the left, called Sacarhouriki, near which occurs a decomposed red rock, then a hard tough hornblende rock, again ironstone, and a fine close-grained trap resembling basalt. The same was observed decomposing.

Near Tacuparu creek a decomposed granite appears, also at the rapids of Maritote and those below them, where the granite and syenite are extensively exposed.

After passing several rapids, and that of Alabamaloo, the syenite is more general. A remarkable dike of porphyry, four feet wide, that has passed through the granite, occurs at the falls, which were about 12 feet in height at the time we descended.

The granitic series with trap dikes are most abundant at Huamata; they cross the entire river. Most of this granite is very coarse grained, with green and red felspar. At the rapids and the island of Taparu, also at the rapids of Presatu, white granite occurs; and near Cubangau gneiss, which continues down to the Ourasassartur rapids, near Puriari creek and rapids.

The land rises here on each side of the river about 150 to 200 feet. At the base granite, syenite, trap, and quartzose rocks expand out to a considerable extent in comparison with those on the upper part of this river.

After passing the great cataracts at the junction of the Puruni with the Mazaruni, the effect of so large an expanse of water studded with numerous islands, with the low distinct confines of the river, presents a scene rarely to be met with. Through this labyrinth of the islands, on comparatively still water, it is difficult to determine that the pilots are not going down stream instead of up it.

My first object on entering the Mazaruni was to place signals on points most conspicuous to those coming up the river, so that our boatmen should know we had passed up.

The number and extent of these masses of rock present to the geologist a field which, if there was not a constancy and uniformity in the formation, would require much more time to survey than I have occupied.

At the junction of these rivers the granitic family of rocks are principally represented with trap dikes. Below the numerous rapids above the junction there are several extensive sandbanks and innumerable islands, some covered with vegetation, others not.

The Mazaruni being low many rapids are created that had the river been in flood, would not have been noticed, and under the circumstances many of the rocks were exposed which, in the latter case, would not have been seen. All are so uniform in their character, granite, syenite, with small veins of quartz, gneiss, and dikes of trap, and the constancy with which they pervade the whole of the district so great, that the labours of the geologist are rendered monotonous, and the features of the country tame and unpicturesque.

Having arrived at a landing place of the small settlement Cowenamo, on October 18th, where I had directed the boats to meet me, the first object was to obtain cassava, the settlement being about a mile from the landing, a low and swampy place. This became so very unpleasant after a few showers of rain that I determined on removing to one of the islands that commanded a better view of the river, where we remained until October 22nd, on the morning of which day we were very glad to see three of our boats come in sight. There was one less than we expected, the other being so much damaged on the descent of the Cuyuni that she was condemned on arriving at the penal settlement.

Proceeding from Cowenamo up the Mazaruni the syenite continues, and some hornblende rocks of fine grain; this series continues up as far as the Wonamu and Maribisi river. The first day after leaving Cowenamo the high lands are seen in the distance, which give a fresh charm to the scenery, particularly about the heights of Teboco.

At the falls of Teboco quartz-porphyry occurs, followed by greenstone.

Above the Karanang the rocks on the island are like those passed yesterday, schist, greenstone, trap, granite, syenite, diorite, quartz in veins, both black and white. This formation continues some miles. Some of the quartz veins are bold, being several feet across, but no gold could be discovered in them with the aid of a strong magnifying power.

About this part of the river there is an interesting view of the cliffs of Maribiacru, seen rising 2,000 feet over the forest trees growing on the banks of the river.

A singular block of quartz was observed of cubical form, being part of a dike that traverses the river.

At a point turning south towards the cliffs it was observed that the granite underlies 8 or 10 feet of recent gravel and sand beds interstratified, then the granite again rises to the surface. The heights of Caribisi present a peak from this point, S. 10° E. at a distance of 18 or 20 miles. Not far above this point of the river gravel beds are seen lying on white granite, with quartzose veins; this is followed by greenstone of a grayish hue, forming a dike in a N.E. and S.W. direction. The river was so shallow just below this dike that all hands had to get out of the boats in order to lighten them sufficiently to be hauled above the barrier.

At Ouranapai there are rapids produced by the dike last mentioned, and a short distance above this is a large gravel beach. Beyond this point were observed greenstone and a dark gray trap, followed by quartz-porphyry.

At the mouth of the Carubung river there is a talcose schist, in which there are small veins of plumbago or graphite; these are followed on the Carubung river by syenite, granite, ironstone conglomerate, and sandstone. On the lower portion of the south bank there is a deposit of green clay of fine grain, eminently calculated for earthenware; also yellow ochre, which by the simple process of washing, as that practised for preparing arrowroot, would be equal in quality to any imported.

The alluvial deposits appear to be on granite, schist, and greenstone. A view of the Morokina mountains is seen near the creek Corolyamo, where large blocks of granite and green clay again appear on the opposite bank of the river.

Several precipitous cliffs are seen here, and the high land of Wataparu and Curumina mountains rise above the forests not more than a mile from the river or creek.

Here the granitic and metaphoric series of rocks are occasionally covered by blocks of old conglomerate, composed of white quartz pebbles in a very hard silicious matrix; these blocks lie in the river at different angles of inclination. Soon after passing these the gray and pink granite disappears under extensive beds of conglomerate, composed almost entirely of silicious rocks or quartz pebbles and boulders, coated, as all the rocks in the rivers we have visited are, by hydro-oxide of iron, with or without manganese. An extensive development of conglomerate occurs at the Macrebah falls on this river, to which place it is navigable.

A little below the Macrebah falls is the small creek or river Seroun, on the south side of which a rugged track used by the Indians leads to the Cako, a stream that runs from the great mountains of Roraima into the Upper Mazaruni, above the great fall of Peaimah.

All the lower portion of this hill, which attains the height of 1,300 feet at the top of the first level, is composed of the same strata of conglomerate which has been before mentioned. On

that lie sands red, yellow, and white, with small white quartz pebbles.

By a slight divergence to the north of this track may be seen a cascade, reported by Hillhouse to be about 400 feet perpendicular fall, but neither time nor circumstances permitted me to go to it.

On reaching the summit of that portion where the land becomes comparatively level, it was found to be by aneroid barometers (my mountain barometer having been broken by the fall of a tree) 1,500 feet above the sea, continuing to rise until it attains 2,534.

The distance I estimated at 18 geographical miles, but by the Indian path certainly double that distance.

Nothing but sand, greenstone, ironstone conglomerate, and quartz pebbles as white as milk are to be seen. The beds of conglomerate are exposed by the removal of the sand in the watercourses, many of which are a considerable size, that were traversed or forded on the route.

On reaching the descent from the highest portion of this range we were obliged to go down a precipice by ropes tied to the trees that grow scantily out of its mural side, of about 700 feet to the level below, whence there is a considerable stream. All the rocks in the beds of these streams present the same character, conglomerate, sandstone, trap, and ironstone.

The walking on this route is exceedingly fatiguing, from the fact of the sand being washed away from between the roots of the trees, so that the traveller is obliged to place his foot on these roots, which are sometimes very slippery as well as highly inclined. Miles can be passed over in this manner without touching the ground. After descending the precipice the tract becomes very rugged, steep ascents and descents from it to the Mazaruni river, which we ascended to a settlement called Maiahpai.

The alluvial banks of this part of the Mazaruni present the same general aspect as they do below the great falls of Peaimah, but become much narrower on reaching its junction with the Cako.

The Cako hill is seen at the junction of the two rivers, and appears to be composed of the same series as those passed over between the Carubung and Upper Mazaruni, viz., quartz, conglomerate, ironstone, sands, and trap.

My investigations were here brought to a cessation by the impossibility of obtaining food, which compelled me to retreat with all speed to save the 29 men that were with me from starvation.

After descending the river to where the path leads across the mountains, and then down the Carubung and Mazaruni rivers to where we obtained provisions, we again ascended the Lower Mazaruni for four days. During the first day the rocks that appeared above the surface of the river consisted of trap, with iron pyrites (red decomposed pyrites), and at an island (no name) a greenish porphyry occurs with quartz veins. During the second

day trap and diorite were the only rocks seen. The third day we came to the mica schist, quartz, and a very hard gray and purple trap, which occur at the little falls, for which I could obtain no name; they are a short distance below the great Peaimah fall, which falls over beds of conglomerate and sandstone that present walls like mason work, so regular are the lines of stratification.

Having been now nearly four months exploring under great exposure and privations, and the December or autumnal rains having already swelled the rivers, our field operations were stopped. The boats wanting repairs, and a new one to be built, I considered it more economical to return, and taking the river at its flood reached Georgetown in 12 days.

REPORT No. 4.

Geological Survey of the River Demerara.

By JAS. G. SAWKINS.

1868.

THE physical features of the valley of the Demerara river are exceedingly monotonous and uninteresting, the country being formed of low alluvium from the coast up to the sand hills. Between these two points there is little else than swamp or low muddy flats, covered by caladium, arborescent arums, mangroves, &c., forming not even a landing place of sufficient firmness to support a man, save where a drifted log or tuft of grass has stranded, or the sugar planter has erected a wharf.

Three islands rise on the horizon not far from each other, about 25 miles from Georgetown, composed of alluvium of the same character as the banks of the river.

The sand hills are low and undulating, composed chiefly of a whitish sand, with a little clay. These hills rise a little as they recede from the river, but nowhere I believe exceed the height of 70 feet above the sea until arriving at Berlin. It is from the base of these hills that rich alluvium extends to the coast, constituting the wealth of the colony in an agricultural point of view, as the sugar estates are confined within that area and occupy a small proportion of those unsurveyed limits, shadowed by the most luxuriant forest trees known in the world.

About Dalguin the hills rise higher, but still may be considered undulating, as none rise to 200 feet until reaching Christianburg, where the country becomes hilly. About 2 miles above this a trap rock is seen near the centre of the river when the tide is low, and is remarkable as being the first rock to be seen on the river from its mouth. A similar rock appears again on some of the hills, appearing through the sands and red clays that are generally covered with hydro-oxide of iron, either in concretionary form or as ironstone pebbles, which result from the decomposition of the mica of the granitic series, or hornblende of the syenite and trap.

At Akyma a sand hill such as occurs about Christianburg is cleared of the forest timber, and gives an opportunity of seeing the configuration of the surrounding country; to the east and south the land is low and swampy, and often overflowed by the river.

At Seba a boss of common granite rises from 15 to 18 feet on the east side of the river, exposing an area of more than 50 yards. On the north it is much weathered and traversed by quartz veins

that are prominent in some places and more parallel to each other than at others.

At Tiger's Leap, near a hill about 350 feet high, some large boulders of granite occur.

On a sand hill near Manabadin there is a landslip or breakway, by which the lines of stratification are seen lying on the granite that appears in the river as high up as Cumacar creek, immediately above which the last white sand bank is seen.

At the little falls or rapids of Mouranierocaba the granitoid schists make their appearance, constituting the barriers across the river, which form rapids and falls of five or six feet in perpendicular height.

After passing the falls the water becomes deep, and granite again appears near Labacabra, and continues up the river as far as the Curuwa creek, where a fine-grained hornblende rock occurs; the same appears at Curabelicabra creek, also at Moracabra, and alternately as high as Arampa, where clay and sand occupy the surface, sand forming the points at the arms of the river, while the opposing banks are composed of clay, mixed and unmixed with sand and iron.

At the base of a hill near Ampa a white clay forms a bold bank, which may be used for pottery. At the north of the next creek, Courubara, there is an island composed entirely of sand.

About two miles further up there is a hill covered chiefly with hydro-oxide of iron, bearing the appearance in some instances of cellular lava, or scoria. The same formation crosses the river near Couchman's Grant, where the river is very shallow; this rock forms the great gravel bank at the base of Mecropie hill. There is also a bank of gravel, chiefly composed of ironstone. On the western base of the Mecropie hill there is a stratified deposit of clay that extends nearly to Yaraparu creek. Sand banks form the points at the turns of the river, and just above Appaparo there is a pond inclosed by clay and sand.

Derrire hill is covered with hydro-oxide of iron, and much of it has been brought down and deposited in the form of gravel at the mouth of the creek bearing the same name.

At Camoodicabra creek a trap rock rises and extends to Anabaro creek, forming a large pond on the south side of the river, and rapids that present a dangerous barrier to boats descending the river.

Before arriving at Turubannacabra there is a large pond on the north, and after passing Waburicabra another large gravel bank, and falls or rapids that extend up almost as far as Coomaparo, from which they derive their name.

At Coomaparo there is an Indian track to the Essequebo river, distant about 18 miles. After preparing provisions, &c., I started on this track, which leads along the bank of the creek Coomaparo, about a quarter of a mile, where the land rises in undulating swells, gradually rising up to the burnt ground, where it attains the height of 200 and odd feet; and after continuing about that level for a few miles it gradually descends like steps until it reaches the low

swampy flat of Moraboo, forming the banks of the Essequebo. In this distance of nearly 18 miles the only rocks to be seen are a quartzite, which decomposes into white sand, and the hydro-oxide of iron pebbles, resulting from the decomposed rocks of the granite and hornblende series.

The land forming the banks of the river continue low until reaching Acururi hill, that connects with a ridge that extends to the Lucananycabra, chiefly composed of white sand. By proceeding up Marbooroo creek about a mile, and then walking southwest a few miles, the Mabura hill rises to about 800 feet in height, with perpendicular sides. It is composed of trap, and appears to be connected with the same range which forms the dike at the great falls of Malalli, the principal barrier to the navigation of the river Demerara.

These falls are about 35 feet in height; the land which forms the eastern bank rises about 12 feet above the river at the highest part of the path that leads from below to above the falls. The transit is difficult on account of the numerous loose boulders that must be walked over and the slippery nature of the clay, which is generally moistened by the spray that arises from the cataract.

At the foot of the falls may be seen the junction of the granite with the trap, and on the confines of the basin below the falls the granite without admixture, showing several interesting examples of the weathering and decomposition of the granite, which has been eaten out in curious cavities, leaving many ragged edges. They may, by a little imagination, be compared to the profile of a man's face or of a beast, which the Indian has done to such an extent that every one of these rocks has a name given to it according to such imaginations.

The trap or greenstone that has pierced the fissure or lines of weakness appears very dense, and so fine-grained that it might be taken for petrosilex. The curious contortions and the splitting of veins that have forced their way through the masses of granite are exceedingly interesting and instructive.

This river being extremely low, I had a better opportunity than often occurs for examining the upper part of the Demerara river; many rocks that are usually covered by the black water, which runs with greater intensity of colour above the falls, were then uncovered, and gave me an advantage which may not occur again in many years.

The trap rocks forming the western side of the river rise to a considerable height, and are covered with forest trees even to the summit; but on the southern side the hills above the falls slope off into low land.

The hornblende trap rocks continue about 10 miles up the river, but do not rise to the surface, except in dikes as seen at the first turn above the large pond near the first creek, coming in on the east side of the river again about two miles above; they then sink and are not seen again for eight miles, the space between being covered by the clay and sand, resulting from the decomposition

of this rock. About five miles above the great falls the clay so derived forms an island.

Where the clays or sands occupy the banks the land is low, and often swampy. Now, when I consider the low state of the water at present in the river, I feel convinced that the whole of this section of the country is under water the greater part of the year. The numerous bayous, which are here called itaboos, is an additional evidence of the land being covered, or very much intersected by watercourses.

On approaching Navaroo creek, granite occurs of a very beautiful character, with purplish felspar and greenish mica. There are several very large boulders near Kunimapoo's landing, where the river takes a turn to the west and north-west. This series of granite continues up the river four or five miles, and where it is much decomposed there are deposits of very good yellow ochre, which only require a little preparation to render them equal to that imported into the colony.

This body of granite disappears before arriving at Uribaroo hill, where there is a very bold escarpment of trap and schist, with iron pyrites; also a large gravel bank of ironstone. A little below is the Uribaroo creek, which falls as a cascade over a cliff forming the westward bank of the river. On each side of the river trap and ironstone are seen until near the Caraparu creek, where the ironstone gravel appears to be detained by a trap dike across the river, producing a rapid. Above Caraparu the ironstone gravel appears on both sides of the river, on the east of which there is a large pond and low land. Ironstone gravel continues to form the only banks over this swampy region.

There is a path from the Ecook creek that leads to the Essequebo, occupying an Indian ten hours from river to river, provided he carries no burthen. From Ubarroo creek a path once led to the Berbice river, but it has long since been abandoned for another from near Kunimapoos, by which the distance is less.

The trap rock rises again between the Ubarroo and Tidurii, but is soon covered by clay, ironstone, gravel, and low swampy lands, as high up the river as I went, where the water was too shallow for the canoe or woodskin. Believing, from the number and extent of the ponds after leaving the Tidurii creek, that a further ascent of the river would only occupy my time without increasing my knowledge of the geology of the country, and having suffered from fever, which was very general throughout this portion of the country, even among the natives, I determined on returning to civilization, having been absent therefrom several weeks.

REPORT No. 5.

Geological Report on a portion of the Essequebo River, and of the Pacaraima Mountains.

By CHARLES B. BROWN.

1869.

PART I.

DESCRIPTION OF THE PHYSICAL FEATURES OF THE COUNTRY ALONG THE ROUTE, EMBRACING AN ACCOUNT OF THE JOURNEY.

ON the return of our expedition from the Mazaruni river to her Majesty's penal settlement on the 3rd of December 1868, it was arranged between Mr. Sawkins and myself that I should proceed up the Essequebo river to Pirara, and explore the country between that place and Roraima mountains, returning by the same route before the rainy season set in.

With this object in view I had the three bateaux repaired, supplies for four months procured, and everything prepared for as early a start as possible.

By the 17th December everything was ready, and on the 18th, Peterson, the captain of my boat, having brought his three crews of river men, 20 in number, I started on my journey. At mid-day on the 19th we reached the head of the tide at the Aretaka rapids, and found the river extremely low for this time of the year, it being the short rainy season. The scenery here is very fine, rapid succeeding rapid as far as Gluck island. Up to this place neither bank of the river is visible, owing to the rock obstructions (which form the cataracts) having forced the river into numerous channels, thereby widening it and forming many islands. At the Tipuri river mouth the Essequebo deepens and becomes sluggish, being narrowed in by high clay banks which continue to the Curatoka rapids. In this portion of the river there are numerous sand beaches, with here and there an island. The banks are clothed with lofty forest trees, their tops forming an almost uniform level for miles, excepting where the Arissaro and Yaya mountains on the east bank, and the Oumiah mountain on the west, rise some few hundred feet above them.

On the 23rd of December we reached the Curatoka rapids, and were for seven days toiling amongst cataracts and rapids up to the Cuyariwaka cataract, where still water was reached once more and the boats were enabled to make better progress. Christmas day was spent at Waraputa, the site of a once flourishing Indian village and missionary station, not a vestige of which now remains. Many small hills and isolated mountains lie close to the river sides, and glimpses of them over the tree tops are now and then obtained. Besides these there are three mountains chains called the Twasinki, Taquiari, and Maccari. The position of these mountains, &c., will be seen on reference to the map. Against the bluff end of the Taquiari mountain stands a curious isolated column known as Comuti rock.

From the Cuyariwaka to the Ouropocari cataract the river is narrow and contains but few islands, while onwards to the Aruan inlet they are again met with. The remaining portion of the river up to the mouth of the Rupununi is narrow and deep with high clay banks.

We reached the mouth of the Rupununi river on the 6th of January, and camped at a Carabise village in order to procure cassava bread and fresh vegetables.

The following morning we entered the Rupununi, and our course now became almost due west. The water of this river being of a yellowish white colour forms before mixing a curious contrast with the dark water of the Essequebo, one half of the latter river at their junction containing white water and the other brownish black. Owing to the long drought there was very little water in this river, and the banks of gray clay rose some 15 feet above its level. In many places it widened out and shallows were formed, and it became necessary to drag the boats over the sand bars which cross the river at right angles. The foliage here was still dense, but not of that luxuriant description seen on the Essequebo lower down.

On the 11th we reached the first spot where the forest terminates and is replaced by an extensive open grass-covered savanna. Climbing on to the savanna a fine clear view was obtained of this park-like level land, studded here and there with small low trees, and stretching away for miles to the Annai mountains on the north-west and Makarapau mountain on the east. The last-mentioned mountain rises some 3,000 feet above the plain and is covered with trees. The low hills to the north are also tree-covered. The Annai mountains from this spot appear like huge bare rounded hillocks, backed on the north by forest-covered mountains seen lying one behind the other as far as the eye can reach.

We camped at the mouth of the Watama river, a tributary of the Rupununi, on the evening of the 12th, for the purpose of obtaining an interpreter from amongst the Macusi at Annai village. Early on the following morning I walked to the village, some three miles from our camp in a northwardly direction, and engaged

one. With this man as guide I went to the Annai mountains and ascended to the top of one ridge, 750 feet above the sea. The southern slope was steep and rocky and devoid of trees, a coarse dry grass and small shrubs growing upon it. The view from this ridge of the surrounding country is magnificent and extensive. All to the south, south-east, and south-west, is one vast extent of low undulating forest-covered land as far as the horizon, with the exception of the Rupununi savanna, and another large open plain to the south-west. To the north is a mountainous country very densely wooded, while to the east Matrarapau mountain towers in the air.

I returned to camp in the evening, and on the following morning we resumed our journey. At the elbow of the river, near Mora, the grass-covered mountains come close to the river, and the scenery at this spot is exceedingly pretty.

Early in the forenoon on the 16th we passed the village of Karinambo, and by 3 o'clock in the afternoon reached Pirara landing, at the mouth of the Marooca river, where we camped and landed all the stores. Next day I sent the interpreter to the village of Carenacru to Pasico, the chief of the Macusi Indians of this part of the country, to ask for men to carry loads of provisions for my journey to Roraima. He returned after sundown with the intelligence that Pasico and his people would pay us a visit in the morning, and that he would furnish me with any number of men that I might require. On the 18th I started the "Warimambo," one of the bateaux, with a crew of eight men, on her return voyage to the penal settlement to be paid off, keeping two bateaux and their crews of six men each with me. Pasico came out to my camp attended by some 50 of his people, 16 of whom came to act as carriers, the remainder to satisfy their curiosity.

The loads of provisions being packed in cartowries, the surplus stores were sent down the river to Karinaucho village, and placed in one of the houses there in charge of the head Indian of the place. The two bateaux were safely moored in an inlet close by the landing, and everything prepared for a start.

On the 20th I left the landing accompanied by my 12 river men, the interpreter, and 16 Macusis, all carrying loads of provisions, my private effects, and two loads of "negotiæ" to barter for provisions. Along the river side, at the landing, there is a narrow belt of wood which ends abruptly where the savanna begins. Passing through this we emerged on the open savanna, which differs from that of the Annai before mentioned in being undulating and rough, but resembles it in its sparse vegetation.

The feeling of relief that one experiences in walking over these savannas and breathing the pure dry air, after a long cooped-up river journey, is beyond description. After about four hours' walk in a south-westwardly direction we reached the village of Carenacru, at which we remained for one day to have cassava bread made.

At an early hour on the morning of the 22nd we got fairly started on our journey, which I looked forward to with some anxiety, knowing the danger and difficulties attending an overland transit in so wild and sparsely populated a country. The chief danger I expected was in the probable scarcity of provisions in villages along our line of march, and subsequent events unfortunately proved these anticipations to have been well founded. My party consisted of 38 men, under the charge of Peterson, all of whom, with the exception of the huntsman, carried their packs. Two Macusis acted as guides, having been to Roraima before.

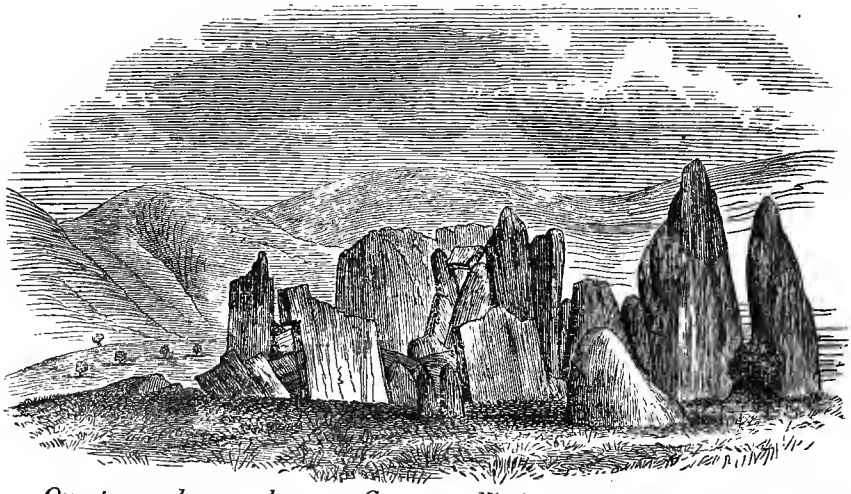
From Carenacru to Pirara river, near its junction with the Nappi, we passed over an undulating savanna, its ridges rising in some cases to 80 and 100 feet above the general level of the plain. We crossed the Ireng or Mahu river in a small corial, which only taking over four men and their loads at a time, delayed our progress considerably, so that, when all had crossed over and walked some two miles to a small river, we were obliged to camp.

One day's walk from this camp brought us to the Pacaraima chain near the Unamara river. On the way we passed a beautiful picturesque lake of deep clear water, the sight of which alone had a refreshing effect on our thirst-stricken party. A strong breeze from the north-east stirred up miniature waves, which, beating on the white sand beach with a grateful murmuring contrasted pleasantly with the dry arid plains over which we were travelling. Viewed from this spot, the nearer ridges and peaks of the Pacaraima mountains form a fine picture, rising above the dead level plain and displaying such bright and varied tints in their rich colouring. The fine clear atmosphere, and the absence of haze in these regions at this time of the year, has the effect of rendering the outline of distant hills and plains extremely distinct. We gained the foot of the mountains in the evening, and camped for the night on the bank of a small river containing pools of milk-coloured water. By sunrise we were again on the march, and soon began to ascend a steep place in the hills about 200 feet high, and then descended into an extensive valley lying nearly east and west, in which runs the Unamara river. This valley is some two miles wide where we entered it, but it narrows to the westward. The path leads up it and crosses the Unamara in two places, and also two large tributaries coming into it from the north. We reached the village of Enamouta in the afternoon. It is prettily situated on the level valley at the foot of a high frowning ridge, the sides of which are covered with large masses of rock, both *in situ* and detached. To the north is a somewhat similar mountain range, the western extension of which we crossed after leaving the village, and descended into an extensive valley, which we traversed in a north-west direction, then over another pass, and into the valley beyond. The height of the first pass was 928 feet above the level of the valley, that of the second

about 1,000 feet, while the valley beyond at our camp on the Conewyntelli river was 700 feet.

The scenery amongst these mountains and valleys is magnificent in the extreme. The dark rugged pointed rocks on the hills, and

No. 2.



Quartz-porphyry rocks, near Conewyntelli river, Pacaraima Mountains.

here and there in patches in the valleys, give a wild character of the scene, and a purple tint to the distance, which contrasts most pleasingly with the yellow tints of the withered grass, and the dark green foliage of the scattered groves lining the water-courses.

Our general course day after day was about north-west, but in crossing the ridges from valley to valley the path leads sometimes north-west, while in the valleys it often led west-north-west. We felt the want of water severely, seldom meeting with it more than twice a day, and even then often finding it semi-stagnant and in muddy pools.

On the 28th we passed a steep and rocky pass soon after leaving camp, and descended into an extensive valley lying north-east. This led to another large valley at right angles to the last in which runs the Curawaka river, a tributary of the Ireng.

From this our course was north-west for some distance across a large river and over a number of low ridges, dividing this valley from the next, it then changed to the north-north-west for a few miles, and we came to a small river containing water in pools, and camped.

Resuming our journey on the following day, we had again to ascend a steep, dry, rocky watercourse, and across the top of a ridge into the next valley. On the top there was a large depression, in which was a pool of fine clear cool water, the head of

the river course up which we had come. Crossing north-west from this, the path led into an extensive savanna valley, lying east and west, in which ran a river with numerous tributaries, flowing west, and emptying itself in the Cotinga or Quating river, as the Indians call it. To the west, some 10 miles distant, high mountains shut in the end of the valley, and at the eastern foot of these runs the Cotinga. This valley and the surrounding mountains are singularly devoid of groves of trees and shrubs, and are but thinly covered with dry grass and a few stunted trees. Midway in this valley lies a village called Cumparuyamo, composed of five houses, belonging to a tribe called Tasoulemas. When we reached the village, our stock of cassava being very low, in fact almost exhausted, I purchased all I could get, but, finding that this was not sufficient, we remained till the following morning in order to procure more, which was made in the afternoon.

After leaving this village the path led in a north-west direction across the valley and up a steep mountain to the height of 2,100 feet above the sea, from the top of which a most extensive and magnificent view of mountain scenery was obtained. The striking characters here observable are the terrace-like formation of the mountains, and the absence of the dark rock masses on their sides. From this point also the first glimpse of Roraima mountains, far off in the north-west, was obtained. At the foot of this ridge is a large level valley, opening to the west, while a similar valley, separated from the former by low hills, widens out to the north-east, and contains two rivers, branches of the Ireng.

Crossing the first-mentioned valley, and passing through a narrow defile, we emerged into another bottom and crossed a river called the Sacabuta, near which are four small villages, in which dwell a tribe of Indians called the Sacaoutas. Late in the afternoon we came to the foot of the sandstone mountains, and camped near a fine running stream named Maratrang, coming from the sandstone beds.

The next day being Sunday I gave my men a rest, and with a guide ascended a mountain to the north-east of our camp, to take observations of the surrounding country. The height of this mountain was 2,600 feet above the sea, and 1,200 feet above our camp. At a distance of four miles from the point of observation the Ireng river was seen to the east-north-east, and its valley clearly defined northward, then bending south-east, and finally turning due south. On the 1st of February we continued our journey up the valley of Marakang river, and crossed a ridge to the west, at a height of 2,370 feet above the sea. Descending gradually to a river which runs into the Ireng, then passing over another ridge, we came at 2 p.m. to a large river called the Karakanang, which runs into the Cotingo, and at 3 p.m. arrived at a large village higher up the stream.

Here we remained a day in order to get a supply of provisions. The villagers had large quantities of Indian corn stored in their

houses, upon which they were living, making therefrom a kind of porridge, as well as an acid drink. They only made a small quantity of cassava bread for us, though promising to make plenty. Being informed of the existence of a village a day and a half on, we pushed forward over a similar country to that of last day's walk, crossing two high ridges and the Karakanang river where it runs eastward before turning south, and came at 3 p.m. to a small stream called Wayanock, where we had to camp on account of water. The mountains of this district are very bleak, and few trees are to be met with. The Itah palm (*Mavritia flexuosa*) is seen in the vicinity of swampy places in a few isolated spots, and a stunted growth of forest trees line the hollows and gorges cut by the mountain streams.

On the morning of the 4th, from an elevation of 2,100 feet, the mountains Roraima, Marima, and Waetipu were seen in all their grandeur through a remarkably clear atmosphere. Waetipu from this point covered the southern half of Roraima. We reached a small village on the Peepee river at noon, and were much disappointed at learning that the villagers had no cassava or provisions of any sort to spare. I therefore had the remaining 20 pounds of rice divided, some articles of "negotiæ" selected and packed, and with the guide, two other Macusies, my second interpreter (an Accawai), and my Arawaak servant, all carrying the necessary articles, I continued on my journey to try and reach Roraima if possible. Before starting I sent off all the rest of the party under the charge of Peterson, on their return to the village of Karakanang, with instructions to remain there till I returned from Roraima. I gave Peterson orders to purchase any kind of food that could be procured for the men with the "negotiæ;" and knowing that there was plenty of corn at the village, I felt satisfied that they would fare very well till my return. Our course, after crossing the river, led over the mountains to the north-west, and into the valley of the Cotinga river. I found this river some 50 yards wide at the place where we reached it. As it was becoming dark when we got there, we had to wade to a small island in it, in order to get trees to hang our hammocks to for the night. Early on the following morning we waded with great difficulty across the river in the shallow rapids at the head of a large fall called Orinedouke.

The flat rocks at the fording were so completely covered with a minute sponge, the gelatinous protoplasm of which rendered the footing most insecure and perilous. We then climbed from this valley over mountains to the west, and came to a small river, a tributary of the Cotinga, where there was an Accawais village. Much to our disappointment there was no cassava bread to be obtained at this place, unless we waited a day till it was made We therefore pushed on, and reached a solitary untenanted house. about two miles to south-south-west of Waetipu mountains, situated on the table land 3,500 feet above the sea. An Indian had accompanied us from the last village to this house, and it turned out

that he was the owner of it. He went out, and before dusk returned with a quake of sweet potatoes, a welcome addition to our small stock of provisions. The night was so cold that we were obliged to hang up the screen of palm leaves, which served as a door, and keep fires burning in the house all night.

Just before daybreak we were again on our journey, and by 9 a.m. had passed the south-western point of Waetipu mountain. Before us stood Roraima, partially shrouded in fleecy clouds, with Marima at its northern end, and an undulating table land to the south and south-west. The features of this mountain are very peculiar and extremely interesting. Viewed from a distance it resembles a huge massive fortification, surrounded by a steep glacis, which descends to the level of the surrounding country. A fine valley, in which winds the Arapu river, lies to the east of it, and many small streams come from its sides. All the country to the south-west is bare, while the sloping portion of the Roraima and all the country to the north is densely wooded. About 3 p.m. on Saturday the 6th we reached an Arecuna village named Ipelimouta in the Arapu valley, and took up our abode in one of the large untenanted houses, the owners of which were away on a visit to a neighbouring village.

Early on Sunday morning I took two Macusis with me, and crossing the intervening hills arrived at the foot of Roraima after three hours' hard walking. We climbed up its sloping surface on a portion devoid of trees till we reached a point 5,100 feet above the sea level, and not far from the foot of the mural precipice. The level of the table land from which the mountain rises averages 3,000 feet above the sea, and from this to the top of the sloping portion at the foot of the precipice averages 5,500 feet above the sea, which leaves a height of 2,000 feet for the precipice. The top of the mountain forms a level table land covered with trees, which can just be distinguished from below.

All my expectations of the magnificent scenery of Roraima and its vicinity were fully realized, and all the toilsome travelling day after day over rugged and steep paths well paid for in the delight experienced on beholding this wonderful work of nature.

On Monday the 8th we turned our backs upon Roraima, leaving it completely enveloped in white clouds, which were still hanging round it as we again passed the end of Waetipu, and it was lost to view.

By Wednesday evening we reached the village of Karakanang, and I was glad to find that my men had not suffered from their five days' diet of Indian corn. Remaining one day there I obtained enough provisions to take us to the Sacaouta, and on getting to that place received a further supply. When we arrived at Cumparuyamo village all the hands had to be put on short allowance, as the people here did not keep their promise of having cassava made for us on our return. Giving what we had already procured to one half of the men, I sent them on to the village of

Enamouta, and waited with the remainder (a day) for more cassava to be made, so as to economise as much as possible, knowing that the people here did not intend to make enough. We then made a forced march, doing in two days what it took us two and a half to accomplish in going to Roraima, thereby reaching the village of Enamouta on the 18th. We crossed the Ireng on the 22d, and arrived at Carenacru on the 23d, where we remained a day to rest, and also to pay off the Macusis belonging to this place. The following day we went on to Pirara landing, got our boats to right, and reached Karinambo, where our stores were, on the 26th. The overland journey occupied 37 days including stoppages, and the distance travelled over was 360 miles.

After resting two days at Karinambo I again ascended the Rupununi to the village of Mopay, about half a day's journey up, on my way to visit Pirara, taking a guide and seven of my own men. Mopay is about half a mile from the river on the savanna. We passed a small village at noon on the following day named Pipicho, situated near the edge of an extensive morass, which stretches and widens out towards the north. The path led across the narrowest part of it, which is the outlet to the water when in the rainy season it becomes a lake. The black mud and water took us over the ankles, and in places where we broke through the rush roots all beneath was soft and without bottom. From Mopay up to this place the savanna is well wooded, but all to the west is open.

We got to the village of Quatata in the afternoon, and found it to consist of seven houses, containing a large population. It is situated on the same low ridge, on the south side of Lake Amucu, and within one mile east of the old village of Pirara, where in the year 1838 the Rev. W. Youd established a mission. Within a radius of three miles around Quatata there are three small Macusi villages to be seen. I remained that night at Quatata, and early next morning visited the site of Pirara, hardly a vestige of which now remains except the decaying posts of the old church, and the intrenchments of the Brazilians, made in 1839, when they seized the place and drove away the missionary. Half a mile due east of this, and divided from it by a deep narrow swamp, is a small circular earthwork some 30 yards in diameter, and with walls 3 feet high, which were thrown up by the English troops, who were sent to drive out the Brazilians. Lake Amuca was quite dry, and the bottom (except where the Pirara river passed through it) was covered with withered grass like the rest of the savanna.

We returned that evening to Pipicho, and on the succeeding day reached Karinambo. On the morning of the 8th of March we left Karinambo with the remainder of our stores, and descending the Rupununi arrived at Mora creek about mid-day on the 9th.

As I wished very much to make a journey from this across the mountains to the Ireng river with the view of examining the

structure of this district, I sent to the village of Mora to get provisions for the trip. In the afternoon the villagers came out and promised to furnish a guide and a stock of cassava bread. I did not get the latter till Friday afternoon, and was obliged to put off my journey till the following Monday the 15th.

We started on that day, and following the path which led up the Mora creek, came to the village at the foot of the mountains after about 15 minutes' walk. I had 12 of my men with me, and at the village was joined by the Macusi guide. The path then led across a ridge some 200 feet in height and down into a valley lying east and west, in which was the dry bed of the Cawulibar river, a tributary of the Mora. In this valley a few miles on was a Macusi village. Our course ran from this along the river westwardly for a considerable distance and then, turning more to the north, crossed a high ridge 1,400 feet high, from which a magnificent and extensive view of savanna country was obtained, perhaps one of the most charming views in British Guiana. Crossing the ridge we descended into a beautiful valley, the physical features of which, as also of the surrounding mountains, are precisely similar to those seen in the vicinity of Enamouta, and before described. Next day we came to a large village and passed into another valley, camping for the night on the Mora river, a fine stream and a tributary of the Ireng.

On the following day at 10 a.m. we got to a large level plain, on the opposite side of which, at a distance of two miles, ran the Ireng river. We were now in the fourth valley to the north of the open savanna, with Cucuye mountain bearing S. 32° W. Wishing to explore to the north of this we took a path leading across the mountains to the Macusi village of Quonga, getting there late in the afternoon. The mountains to the north of this place are densely wooded. We left Quonga on the 18th and descended a most precipitous declivity from a height of 2,000 feet to 425 (above the sea), reached the valley of the Uorora river. We then returned by the same path to Itabay, before reaching which we were overtaken by a violent rain storm, the first I experienced in this portion of the country. From this place, on the following day, we took another path leading to the head of the Mora river, a more northerly route than the one by which we came, and turning south over a high mountain came to the village of Cawulibar. The rain fell all the forenoon, but not heavily; and when safely housed at Cawulibar a heavy thunder and rain storm came on which did not last long. In the forenoon on the following day we reached our boats at the Mora landing.

On the 22nd we left Mora creek and descended the Rupununi river as far as Watama creek. There we remained two days in order to fill up with provisions from Annai village, and then continued on our course down the stream. The Rupununi was now about one foot lower than when we ascended it in January. I landed, and walking across through the bush in a northwardly direction struck the head of the Anourimé inlet, and ascended

a short distance on the Anourimé hills for the purpose of examining the structure of this part.

We entered the Essequebo river on the 27th and remained all next day (Sunday) at the Caribisi village. On the 29th we commenced our homeward voyage down the Essequebo, stopping for part of a day to ascend and examine the Comuti rocks. We passed Bartica Grove in the afternoon of the 7th of April, and arrived soon after at the penal settlement. For a few days I was employed in seeing the bateaux, &c., stored away in safety for another trip and in paying off my men, so that I did not reach Georgetown until the 13th of April, after a sojourn of eight months in the interior.

PART II.

Descriptive Geology.

I did not examine any of the rocks appearing in the Essequebo river until I had passed Mora.

On an island near Morabally I found a broad tract of coarse greenstone. From the Aretaka at the head of the tide to the Ahara rapids (the last of this series of rapids and cataracts) numerous rounded water-worn masses of grey granite rise above the surface of the water, forming cataracts and rapids as well as countless islands, and indicate the granite structure of the whole neighbourhood. This granite in many places at the Marahi, Malalli, and Itaballi cataracts contains patches and irregular blocks of gneiss twisted and interwoven with it in a most curious manner. Above those cataracts, where the river narrows, its banks are formed of a stiff grey alluvial clay, and are almost perpendicular. In many parts this alluvium rests upon yellowish sand beds.

Near Itubucurra island the granite again appears, and at Monticuri island there are some masses of hornblendic gneiss. At the mouth of the Dahalibani river there is a development of coarse syenite containing large grayish-white crystals of felspar, some of which measure three inches in length, constituting a syenitic porphyry. From this river up to Waraputa there are numbers of broad trap dikes which cross the river at various angles. These are so well defined and so clearly marked in the visible area which they occupy that they form highly interesting studies of intrusive dikes. Being extremely hard and tough they have resisted the forces of denudation and decomposition more obstinately than the granite, thereby preserving their true forms, while the granite remains only in bosses and large water-worn eroded masses. They are of a dark grey colour, and are composed of felspar and hornblende finely crystallized. At the mouth of the Akuina river there is one of these dikes 20 yards in width in the granite. Their planes of contact is here clear and abrupt

and the granite has evidently been compressed for a short distance from their junction. The dike has two main systems of joints, besides many inferior ones; the first set is at right angles to the plane of the direction of the dike, and continues into the granite on either side. The second set is parallel to the plane of their direction. Beyond Oumiah the rocks have a thin polished copper-coloured coating of oxide of iron.

Immediately below the Waraputa great cataract there is exposed a set of greenish rocks with rude cleavage, and of a schistose character.

From this place up to Itababo island not far from the Comuti mountains the rocks are all composed of granite, which in many contains veins of greenstone, and in one place a mass of hornblende schist. There is a singular column of granite (called Paiwarie Cayra) left resting upon a small pedestal of the same rock, which itself rests upon a platform of granite. It has evidently been left *in situ* after all the surrounding portions were destroyed by denudation.

At Itababo island the first beds of sandstone make their appearance in an altered condition. They are extremely jointed, of a white colour, and have the quartz grains composing them quite clear and transparent, and very angular. The felspar cementing the quartz grains is pure white with small irregular iron-stained particles scattered throughout it, and also contains small specks of micaceous iron. Where first met with all signs of bedding have been completely destroyed by the metamorphic action, but a short distance on a slight indication of bedding is observable, which becomes more confirmed as the distance from the trap dikes increases. East of the Comuti mountains there is a fine development of thin-bedded, reddish, fine-grained sandstone, the strike of which is S. 55° E., and W. 55° W., with a dip of an angle of 20° in a southerly direction. It is slightly metamorphosed and extremely jointed, and has a bed of jasper interstratified with it. Half a mile further on there is a perpendicular dike of greenstone, 32 feet wide, intersecting the sandstone at right-angles to its dip without disturbing it, but indurating it for a short distance from its walls.

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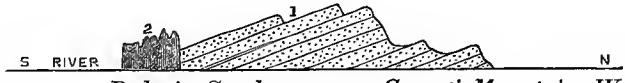

Greenstone Dyke in Sandstone near Cumuti Mountain, West.

1. Sandstone. 2. Greenstone.

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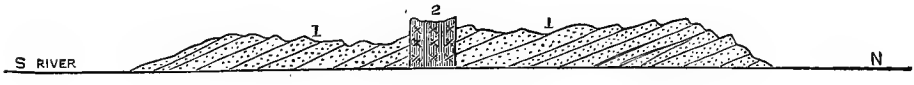

East.

1. Sandstone. 2. Greenstone.

At the base of the Camuti mountains, on the river's edge, the thin-bedded sandstone is seen with a bed of greenstone lying conformably upon it. This rock continues to the very top of the mountains, where it forms a perpendicular face of rock 160 feet high, making a total thickness of 1,100 feet. In many places on the mountain it shows lines of rude stratification, which are nearly horizontal. At its junction with the sandstone the latter is converted into a greenish hard compact rock without the lines of bedding having been obscured, or the small scales in its lamine at all altered. The deductions to be drawn from this are that at a period subsequent to the depositions of the sandstone the trap was forced up from beneath through large fissures both in the sandstone and in the neighbouring granite, and spread out over the surface in a huge mass some 1,100 feet thick. The sandstone preserves its dip in a southwardly direction as far as it can be traced till it entirely disappears near the Cuyariwaha cataracts. Many trap dikes pierce it from the Comuti mountains to this point, and the dikes continue beyond for some distance.

From a point below the Ouropocari cataracts, as far as the Pishani island and rapids, there is quite a different set of rocks to any hitherto mentioned, which are of a greenish gray colour, and are composed of crystals of felspar and quartz, in a felspathic base. In a few instances the felspar crystals are much rounded, and the rock then resembles an extremely altered conglomerate. The contained crystals of quartz are clear, glassy, and irregular in form, and the felspar regular and of a white colour. The base or matrix is of a grayish colour, with small crystals of hornblende scattered throughout it. At the Pishani rapids this rock contains reddish crystals of felspar as well as white. Beyond this it seems to pass gradually into syenite, and from that into granite.

The huge massive Achramucra rocks are composed of granite, traversed in places by quartz veins which contain opalaceous quartz. One of these veins is three feet wide, but does not extend far. Granite and syenite constitute all the rock masses appearing from this to the Rappu cataracts, near which there is a curious granite rock, of a coarse crystalline structure, which is composed of the usual granite constituents, contained in a fine-grained felspar and mica base.

From the Rappu cataracts to the mouth of the Rupununi river there are no rocks to be seen, and both banks of the river are composed of gray alluvial clay. The Rupununi river alluvium also (up to Pirara landing) is composed of the same clay, varying only in colour here and there, where it is yellow and mottled, reddish and white. In some places beds of impure ironstone and iron-cemented pebble beds replace the gray clay. Not far up from its mouth, on the south bank, there are exposed thin beds of soft red and gray micaceous shale, dipping south-east at an angle of 30 degrees. It is evident on examination that this red shale belongs to the red sandstone strata that occurs at Comuti, on the Essequebo river.

Below the mouth of the Anourimé inlet, a short distance, a mass of syenite is exposed in the river, and is connected with the Anourimé hills, which are composed of a hard reddish syenite.

There is a large quartz vein on the north bank of the inlet which dips south at an inclination of 20 degrees, and runs east and west. It is 20 feet in width, and much stained with oxide of iron, but, as far as I could see, does not contain any metals.

The ironstone before-mentioned appears bedded in many places along the river, and is most extensively developed at Karinambo. It is usually cemented together by oxide of iron. In many places large water-worn blocks of quartz and sandstone are regularly scattered throughout it. At Karinambo the base of the iron beds is hidden by the water, so that their thickness is unknown. They extend horizontally for 200 yards, and show 10 feet vertically, being covered with a grayish clay soil. What renders these beds different from the other exposures of the same rock is their jointing, which gives them a columnar appearance.

The soil on the Rupununi savanna varies much. In the lowest parts of the plains it is of a black colour and contains much vegetable decomposed matter, and on the higher or undulating portion of it is poor and gravelly.

The Annai mountains are composed of a pinkish syenite, very compact and hard, containing but little hornblende. There are two conical hills of bluish gray quartz near the above mountains, which appear to be the remains of a wide and extensive lode of this mineral.

The whole of the level and undulating savanna, from the Rupununi to the Ireng, and onwards to the foot of the Pacaraima mountains, is composed of gray alluvial clay, in which are beds of friable iron-cemented gravel, forming the highest ground, as well as occurring in the lowest portions of the river banks. Between the undulations are recent alluvial bottoms of black vegetable clay or loam, which are very fertile. The soil on the other portions is of a reddish clay, containing much sand and black shining pebbles of ironstone, derived from the waste of the ironstone beds. The banks of the Ireng river, at the season when I visited it, were some 20 feet high (the water being extremely low), and composed of gray and iron-stained alluvial clay.

At the foot of the Pacaraima mountains, at the Unamara river, there is a vein of white quartz, and adjoining it are hills of quartz similar to those at Annai. Between the savanna and the Unamara river there is a high ridge extending east and west, composed of granite intersected with greenstone dikes. In one part of this there is a patch of mica schist, the surface of which, as well as of the surrounding granite, is strewn with quartz blocks and pebbles.

The next ridge to the northward is composed of a different kind of rock, which continues with slight lithological changes and modifications from this to the edge of the sandstone escarpment on the Sacaouta river. This rock—a quartz porphyry—in its com-

monest form of occurrence is composed of white crystals of felspar and clear crystals of quartz in a greenish-gray felspathic base of extreme hardness. It usually contains crystals of hornblende of small size scattered throughout. It appears to be in regular layers of great thickness, some of which are massive and break with a conchoidal fracture, while the others are schistiform, and split with a vertical, coarse, slaty cleavage. This rock sometimes becomes more schistose in appeacance and of a slightly foliated nature, containing thin layers of mica. In it are numerous veins of quartz of various thicknesses, from a few inches to two and three feet. As the parent rock disintegrates, the quartz is liberated and washed down the mountain sides, forming large mounds and low hills in the valleys below. Traversing the porphyry are also large dikes of greenstone, similar to those seen in the granite and sandstone before mentioned.

Passing from the valley of the Unamara river to the northward, the whole surface of the hill is covered with blocks and angular pieces of quartz of all sizes, with patches of the porphyry jutting up here and there amongst them in the form of upright tabular masses and irregular obelisks. These latter occur over the whole extensive area occupied by this formation. At the second pass,

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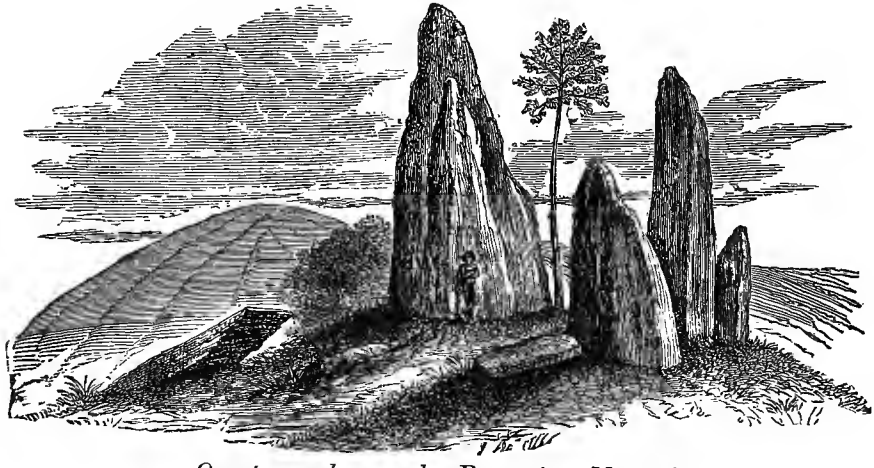

Quartz-porphyry rocks, Pacaraima Mountains.

near the Conewyutelli river, beds of compact structure occur, and in the valley below the schistiform beds are met with, while on the mountain side between both types are exposed, one resting upon the other.

I examined the quartz veins as thoroughly as I could under the circumstances while on the march, but could not discover any traces of gold in them. Travelling quickly, as I then was, so as to ensure a successful journey, every moment was precious, on

account of the little food in this district to be procured for my party, and without which my explorations of the country as far as Cotinga river would have to be abandoned. Therefore from want of time I was unable to do more than make a cursory examination of the quartz along the route.

Between the Conewyutelli river and my camp of the 28th February the porphyry retains its schistose or slaty character, but varies slightly in its structure. For instance, it is syenitic in one place, though of the same greenish gray colour; in another spot it has more quartz crystals in it; while in a third instance the crystals of felspar diminish in number and are very minute. Dikes of greenstone are seen between the above-named river and the Curawaka. In crossing from the valley of the Curawaka river to the next valley a number of low ridges are crossed, formed of the porphyry, which (though its main features are still the same) is syenitic, and the crystals of hornblende lie in irregular vertical planes, coinciding with the rude cleavage. On these ridges are two veins of quartz, and the whole country around is covered with the same mineral.

The undulating land of the Cumparuyamo river valley is formed of quartz, gravel, and blocks, more or less water-worn (showing that they have been carried down the river from the east), resting on the porphyry, which contains a large quartz vein close to the village. This vein I examined thoroughly, and it appeared to be quite barren.

In the bed of the Sacaouta river there is a greenish jointed rock resembling a clay slate.

On the north side of the valley of this river is the escarpment of the sandstone formation; near its foot large boulders of an altered coarse reddish conglomerate, composed of white quartz pebbles in a hard sandstone matrix, lie strewn about. This is the same sandstone as that seen at the Macrebah and Peiamah falls on the Carubung and Mazuruni. I examined the escarpment on the mountain to the west of the Marakang river, and found at the base a greenish bedded rock dipping north, with greenstone dikes in it and small quartz veins. Upon this came the conglomerate and a whitish quartz ore sandstone, occupying a vertical height of 600 feet, with 300 feet of red and yellowish sandstone upon them. These last-mentioned beds have been disturbed and curved, and are thin-bedded. This is the only place in the district where I observed any such disturbance in the sandstone beds.

Continuing up the valley of the Marakang river, the stratigraphical arrangement is as follows: thin-bedded gray, yellow, and pinkish sandstone, lying upon thick beds of hard white sandstone and conglomerate, the general dip of which is eight degrees, but varies from five to ten, and with a strike of north-west and south-east, dipping in a northerly direction.

Not far from the Karakanang river there are low rounded hills of white and pink argillaceous sandstone, the surface of which are covered with quartz crystals. They are the so-called Crystal

mountains, and extend from this into Venezuela. The soil on the surface of these hills is reddish and clayey, and covered with iron gravel and pieces of quartz. The crystals are of various sizes, seldom exceeding two inches in length, and are of different degrees of purity, passing from transparent to milky and white opaque. Their form is the usual hexagonal pyramid. Their angles are sharp and well-defined, showing that they have not been transported far, but come from the cavities of the sandstone in the immediate neighbourhood. Crossing the Karakanang river, a green-bedded rock like that at the base of the sandstone series appears, and from that on to the village all is greenstone.

The mountains to the north-west of the village give an excellent section of the sandstone, which is as follows:—

1. One hundred and fifty feet of dark green shaly rock, resting on granite and greenstone.
2. One hundred and seventy-five feet of red slaty sandstone.
3. One hundred and seventy-five feet of extremely hard white quartz sandstone.
4. One hundred feet of coarse pebbly conglomerate.
5. Two hundred feet of pink and gray interbedded argillaceous sandstone, soft and friable.
6. One hundred and fifty feet of red ferruginous sandstone, containing thin beds of jasper.

This gives a section of 950 feet of sandstone beds, dipping nearly N.N.E. at an angle of 5°.

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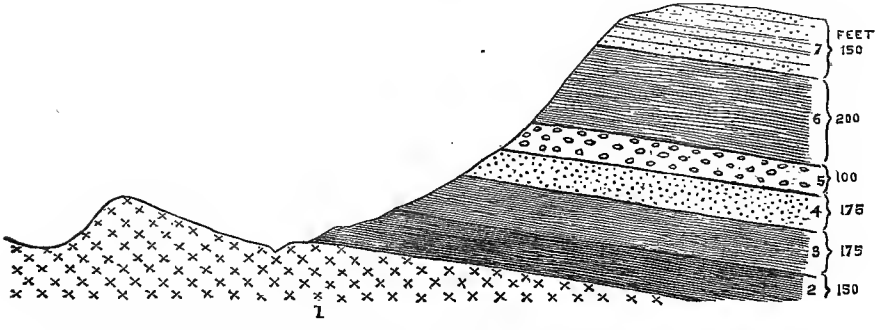

Section of Sandstone Beds upon Greenstone Layer, near Karakanang, Pacaraima Mountains.

1. Greenstone. 2. Green slaty rock. 3. Shaly sandstone. 4. Quartzose sandstone. 5. Conglomerate. 6. Argillaceous sandstone. 7. Jasper sandstone.

The hills rising beyond the upper course of the Karakanang show the white argillaceous sandstone, which here has small round water-worn pebbles or quartz scattered irregularly throughout it. Upon this come beds of hard jasperous sandstones, of red and purplish tints. Beyond the Peepee river to the Cotinga is all reddish, thin-bedded, fine-grained sandstone, containing jasper, and dipping to the N.N.E. at an angle of 5°.

The falls of Orinedouke on the Cotinga river are formed of jointed red sandstone. From this to Roraima mountain is all

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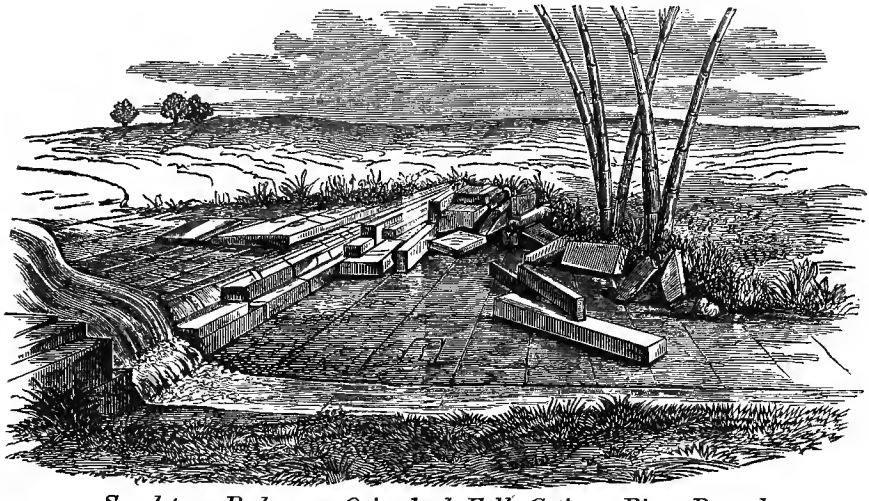

Sandstone Beds near Orinedouk Fall, Cotinga River Branch.

sandstone, thin-bedded and argillaceous in places, and thick-bedded and jasperous in others. In the Weaumou river the sandstone contains thin beds of green chert. Waetipu mountain is formed of horizontal beds of light yellowish-gray fine-grained sandstone.

At the foot of the sloping portion of Roraima a hard dark gray diorite appears and continues up to the highest points to which I ascended, and almost as far as the foot of the mural precipice.

To the west are undisturbed beds of grayish sandstone, while above both these and the trap comes almost 2,000 feet of white and yellowish-white hard thick-bedded sandstone. It is difficult to understand exactly the true nature of this trap rock, as to whether it is a huge dike forced up through the sandstone, or a great layer of trap rock upon which the sandstone was deposited. Not having time to search for and examine the junction of the two, it is impossible to say positively; but though there has been no disturbance of the beds around, I think it probable that, like the Comuti mass before mentioned, it is a great layer in the sandstone.

With regard to the age of the sandstone formation it is impossible at present to speak, not a single fossil belonging to either the animal or vegetable kingdom having been obtained from it; so that to say that it belongs to one epoch more than another would be extremely hazardous. All that can be said is that it is of more recent formation than the schistose rocks before described in other reports, and than the great development of quartz porphyry to the south of it, upon which it rests in part.

At Mora village on the edge of the mountains, at the elbow of the Rupununi river, the rocks are of a reddish kind of syenite

which continues to the Cawulibar river. Tracing this rock up the valley towards the mountains to the north it passes into a massive reddish rock which contains small trap dikes and is of jasperous nature. The mountains to the north themselves are composed of the same porphyry before described as occurring from Enamonta to the Sacaouta river. On the north side of the Yacali river valley, on the top of the mountains, the sandstone beds are clearly seen lying almost horizontally, from which some blocks have broken loose and rolled into the river below. Further on in the valley to the north the hills are all composed of syenite and granite.

Many dikes of greenstone run through the porphyry. Not far beyond the Uorora river the mountains are all formed of syenite, with the porphyry at the top forming their crests. There is also a large conical hill, some 300 feet high, one half of which is white quartz or covered with white quartz, the other half being porphyry. At the base of this hill to the north is granite for a short distance. Across from the Ireng river to Quango village all is prophyry and syenite, with greenstone veins in the latter. In the Shapaouta valley there is a large vein of quartz, and in the route from Itabay to Cawulibar village there is reddish syenite with greenstone dikes, and the gray porphyry with quartz veins.

REPORT No. 6.

Observations made on an Excursion extending from Georgetown to the Mapuri Rapids on the Rupununi, thence to the Mappi near the northern base of the Camuku Mountains, and thence up the Essequebo to King William the 4th Cataract.

By JAMES G. SAWKINS.

1869.

Saturday, September 4th.—Took barometrical observation before starting from the wharf at the penal settlement at 9 a.m.; crossed the river to Bartica, where we made arrangements for payment of wages to some of the men I intended to send back before I returned myself. After a heavy shower had passed over, we got under way, and reached a little settlement called Agatash, where we stopped, the tide falling. The rise and fall of the tide at this place is from two to three feet.

September 5.—Ther. at 7.39 a.m. stood at 75 degrees, at 2 p.m. 85 degrees. The land on either side of the river is low, the banks not being more than 20 feet above the river.

September 6.—About 6.30 we got under way. Our course was south, varying from 10 to 40 degrees east. A few islands and islets were reached by 7.40 a.m., all partially under water, like the banks of the river on both sides. These islands are from one fourth to one mile in length; the deepest channel is on the western side. There is a sand bank opposite Agatash that prevents vessels of over 200 tons ascending the river. At 11 a.m. we stopped for breakfast. Soon after we passed a dike of greenstone, then at about a mile south a dike of a grayish trap with iron pyrites, and about a mile further up the river another dike of a similar rock without pyrites. At Cumaka Serima gray granite somewhat gneissic occurs, and the river is divided into a number of islands. At 3.30 p.m. we arrived at the foot of the first cataract, over which the boats had to be hauled by means of ropes; we encamped on a sand bank on the west side of one of the numerous islands with which the river is studded.

September 7.—Started at 7 a.m.. The granite appears here in large bold masses, sometimes showing the lines of scaling or peeling like an onion; at others a decided gneissic structure, a

piece of which I observed tilted by the force of the river, presenting as clean and smooth a surface as a piece of slate with sharp pointed edges. The river being swollen 10 feet above the mark it was when Mr. Brown ascended it in January last, many of the rocks are now covered that were then exposed. The whole space occupied by the falls or cataracts are either granite proper or members of the granitic family. At 5 p.m. we reached the "still water" above the falls. A heavy thunder storm passed over us at 2 p.m., and it was still raining when we encamped at the first place a landing could be effected, just below Gluck island.

September 8.—There are several islands in the river, but neither rapids, falls, or cataracts during to-day's progress, and not a rock to be seen in any part of the river; shallow and large sand deposits occur at the points in the turns of the river. A very heavy storm passed over us between 2 and 3 p.m., with strong wind. We encamped at 5 p.m. on a sand bank on the west side of the river. Mr. Brown was taken ill and unable to proceed.

September 9.—Remained encamped all day. Towards evening Mr. B. got better. The heat at mid-day was overpowering, although the thermometer stood only at 97 degrees.

September 11.—Started at 7.30 a.m., passed the Arissaro hill; breakfasted near the foot of it, where there are some granite rocks. A little further up the river a trap dike crosses it.

September 12.—Started about 7 a.m. At 9 we passed the spot at which I was last March, when I walked from the Demerara river.

September 13.—Started as usual, between 6 and 7 a.m. Saw no rocks until we reached the rapids of Cumaka, where the granite appears with quartz veins traversing each other, of a quarter of an inch to two inches in width; also detached blocks of hornblendic rock superposing, but the rapidity of the current prevented a close examination. Soon after we entered smooth water, most of the rocks being covered by it. At Acuramalalli rapids the trap rocks rise a few feet above the present surface of the water. We encamped on the south part of an island just below the Curanucu rapids, where greenstone trap and hornblende rocks produce obstructions in the river.

September 14.—Under way by 6.30 a.m., and between 7 and 8 we passed the rapids of Curanucu and examined the different rocks in the small channels through which our boats were drawn. After surmounting these obstructions, we passed over smooth water, and then another rapid at the base of Buhuri-Bunacu island, but no rocks were to be seen in passing. A little above this we came to the great cataract of Waraputa, where the granite extends across the river, some of which is very dark from the quantity of black mica it contains. There are veins of quartz of a few inches diameter, and syenite, much in the same manner as that at the Ororu Malalli falls on the Demerara river, with which it is in all probability connected.

September 15.—After passing the first rapid by hauling the boats over by rope and hand, we came to a collection of granite rocks, all having a scattered and confused position, detached from each other, some large ones resting on smaller; to one of these the name of Paiwori Cayra is given from its resemblance to the vessel in which the Indians preserve their favourite liquor, Paiwori. This development of granite extends over a large area, presenting such variations as are usual, with small quartz veins, gneiss, syenite, and dikes of greenstone.

September 16.—The whole day has been occupied in getting over a succession of rapids that were rushing and pitching over beds of granite and dikes of trap that traverse the river, which, being high, compelled the pilots to seek and conduct our boats through "holes," as they term the small branches or overflows of the river. We encamped a little above the falls of Etanimé on the western side of the river.

September 17.—Started at 6.20 a.m., and after taking an observation of barometer and thermometer, the Taquiari mountains came in view in the distance. Here is the first place where sandstone is seen on the east shore, then trap, then a fine-grained greenstone; these appear in dikes traversing the river, producing falls and rapid water, but the country hereabout is much more open than what we passed over yesterday. The Taquiari mountains are about 800 feet above the river, which runs along their base, where the rocks are composed of greenstone. There is a singular separation at the south-east termination of the mountain. A large pyramidical structure stands out from a somewhat similar one that makes the terminal connexion of the mountain; this has weathered into three distinct pieces of rock, resting on broad bases one above the other. At each junction there is a separation, and as at these junctions the weathering of the rock has been greatest, each piece has assumed spherical or elliptical forms; and as the difference in size of the three pieces is proportionate with the form of the Indians' large water jar of the same name, "Taquiari" has been assigned to it. We encamped at night at the foot of the Cuyariwaka falls on a very nice piece of dry ground.

September 18.—Started at 6.20 a.m. Had some difficulty in finding a place where we could get the boats over the falls of Cuyariwaka. The river being high the stream ran too fast for the men to pull the boats against it, consequently we had to drag them along by the aid of ropes and branches of the trees which overhung the river. After getting over these falls we entered "still water," that is, the river unimpeded by rocks, but still flowing at the rate of one to two miles per hour. The banks on both sides of the river are very low, corresponding to that above the Ororu Malalli falls on the Demerara, the whole of which, I suppose, would be flooded by a rise of 10 feet above the present level. Proceeding up the river the banks are composed of a whitish clay, or more generally coloured yellow by iron. Before reaching the large pond of Tambicabo, there are some rocks above the surface, in the middle of the river, of altered sandstone, making

it appear like flint. About a mile above the abandoned site of post Arinda we encamped and remained over Sunday, September 19th.

Monday, September 20.—Made an earlier start than usual, 6.15 a.m. As soon as we reached the middle of the river the hills of Taracai came into full view. We soon passed them, having smooth water before us with low undulating alluvial banks on both sides that extend apparently for many miles back from the river. At the falls of Ouropocari there are some very curiously water-worn rocks; parts of them appear porphyritic, and others like an altered conglomerate. They are much grooved by atmospheric agencies, and are resting on rocks of inferior size, leaving a space beneath them sufficiently large for travellers to hang their hammocks. Dikes of altered rock occur here. A little below the falls on the west side of the river is a block with some Indian writing on it. We encamped at the falls of Orotoka.

September 21.—Started at 6.15 a.m. Passed over a series of rapids and falls until 10.30, when we reached the last of the rapids, taking breakfast in the midst of what is known as Groote falls. Barometer at 7 a.m. 29·760, temperature 78°. About noon came in sight of the Maccari range, but soon lost sight of it again by the numerous islands that intercepted the view. At 5 p.m. we found considerable difficulty in finding a place to encamp.

September 22.—Started at 6.40 a.m., a little later than usual, on account of the heavy shower that fell early this morning. It was 9·45 a.m. before we reached the south point of the long island on which we encamped last night. At the south end of this island there is a very picturesque view of the mural end of the Maccari mountains; it has all the appearance of the sandstone mountains of the Mazaruni river; the bold escarpment forming the termination presented a bold picture. At 3 p.m. we reached Pishani falls, where the boats were hauled over the rocks; the passage chosen for this operation was on the western side, that on the eastern being considered too dangerous for any boat to attempt getting over. After these difficulties were surmounted we came to smooth water.

September 23.—Started at 6.20 a.m., and by 7.30 we had passed the Pishani falls, where the rocks still present the character of altered sandstone. At the upper part of these falls these rocks are of much finer grain. On the east side of the river between the islands granite rises to the surface and covers a considerable area. A little above this the river opens, and a long stretch is seen to the south-west, where the granite again rises to the surface, besides other rocks of that family.

September 24.—Started at 6.10. Thermometer, 79°; barometer, 29·370. Smooth water before us, with granite rocks appearing above the surface; then quartzite, then granite again; banks of the river very low, composed of yellowish clay or sand. The map does not agree with the course we are going westward. A long reach in that direction occurs opposite the inlet of Aruan, from which a very high mountain is seen bearing W. 10° N.

Smooth water continued the whole day, but no distant land rises above the forest that grows on the river banks.

September 25.—Started at 6.30 a.m. A fog overhung the river; smooth water, low banks, no rocks to be seen. At 9 a.m. arrived at the mouth of the Rupununi and went to the Carib village of "Apotrie" on the Essequebo, just above the Rupununi, to obtain cassava and any other fresh provisions we could; also to divide our provisions into four lots, and make up the accounts of the men whom we intend to send back from this place.

September 26.—Wrote letters to his Excellency and others to send by the two luggage boats that return to her Majesty's penal settlement to-morrow.

September 27.—Paid the two crews that returned to-day to the settlement and provisioned them for the voyage. A division was then made of the stores—one portion to remain here, one for the crew of Mr. Brown's boat, and one for the crew of my boat, the cassava for our crews not being ready we were detained.

September 28.—By the time the boats were reloaded and early breakfast prepared, and all things paid for, we left the landing of Apotrie and proceeded up the Rupununi river. About 2 p.m. we came in sight of the Makarapan mountain, the highest land yet seen on this or the Essequebo river. The banks of the Rupununi are low, seldom rising over 10 feet above the level of the water; the river is about 300 yards wide; no rocks are seen; a yellowish or red clay, with very little sand, forming the low and unpicturesque confines of the view.

September 29.—Barometer, 29·750; thermometer, 78°. Low clay banks continue and the forest trees diminish until they appear like mere bush. Two conical hills appear, bearing W. 10° and 20° N. A very sensible change is perceived in the atmosphere, not in temperature, but elasticity or tenuity; probably due to the proximity of the savannas. Where the river runs west we had a view of the Makarapan mountains. We breakfasted near the inlet of Anourimé and encamped at the mouth of the Rewa river, where Mr. Brown joined me soon after.

September 30.—Having given Mr. Brown directions to proceed up this river and the Quitaro, a branch of it, and meet me at the Carib settlement, at the mouth of the Rupununi, on the 18th November, we wished each other a pleasant voyage and parted. It was 6.35 a.m. before we got under way, my object being to ascend the Rupununi as high as I could in my boat, and then cross to the Takutu river, which forms the boundary line between this colony and Brazil. Barometer, 29·700; temperature, 75°, at 7 a.m. During the whole day not a rock could be seen, nothing but white, yellow, and red clay banks that sink occasionally until both become swampy. We had to encamp in one of these low places where there was a large pond close behind.

October 1.—Barometer, 29·660; thermometer, 80°, at 7 a.m. The land very low on each side of the river, only a few inches or feet out of water; no rocks to be seen. About 2 p.m. we arrived at Cotton creek, close to which the great savanna of the Rupununi

opens out to a magnificent extent, presenting a view highly picturesque on a large or panoramic scale. The horizon is bounded by mountains at greater or less distances from west to north, with trees distributed in park-like disposition; a cluster of high trees forming a group, or a lone tree here and there with a long belt at the base of a mountain, in varied tints of bright and olive green. Blue mountains cap one another until lost in the atmosphere. I took a series of angles, noting the position of every peak of prominence, in the hope of obtaining their names, which none of my crew could give me. We encamped just below Curassiwaka creek.

October 2.—Started at 6.20 a.m.; barometer, 29·630; thermometer, 76°. We came to that point of the river that appears to have recently cut through the open savanna, as only a few low bushes are growing on the low banks over which the hills and mountains of Annai are seen. The river is running here faster than it does below; I should think fully four miles per hour. No rocks seen to-day. About 10 a.m. we arrived at the mouth of Quartanie creek; sent Peterson to the Indian settlement near this to purchase bread and provisions as soon as possible. He returned at night, having made arrangements to have the provisions early on Monday morning. After a long walk on the savanna I returned to my boat to dine, when I found the smell arising from the creek unbearable, and compelled me to have my boat moored in the middle of the river, in the hope of obtaining a breeze from over the savanna, and freedom from the annoyance of the mosquitoes. It was all in vain, for neither I nor my men could get any sleep.

October 3.—Early this morning I walked to the house of the interpreter (Henry). The scenery is truly beautiful. No park in the world could exceed its natural beauty; yet on examining the soil, sand and stiff clay, almost as hard as brick, and the coarse wiry grass that grows thereon, I felt convinced that the natives were compelled to go to the mountain sides for such land as suited their mode of cultivation of cassava, ground provisions, &c. &c.; but for pasturing cattle nothing could exceed the advantages of these savannas with such abundance of grass and water, with groups of trees here and there that offer shelter from the midday's sun, and the higher parts of the undulations as resting places at night. In sight of these advantages it is difficult for anyone to conceive why there is not a head of cattle to be seen, while the neighbouring savannas, extending into Brazil on the south and Venezuela to the north-east, are covered with cattle that are bred as articles of commerce, and as I am informed sold in the market of Georgetown.

October 4.—The provisions were brought by daylight and paid for in negotiæ. By 7.40 we started on our upward course. Barometer, 29·720; thermometer, 82°. The banks of the river low, composed of yellow and mottled clay. Walked over the savanna after breakfast to take angles and make observations; found the map at variance with them.

October 5.—Started at 6.30; thermometer, 78°; barometer, 29·720. Soon after we approached hills, some of which are covered only by grass, others partially, with small stunted trees on them, while an adjoining hill beyond is densely covered with forest trees. The river was falling faster than usual at 8.30 a.m.; rain commenced about 4 p.m.; obtained the first sight of the Canuku mountains to the south of us. From the hills of the Pacaraima range, through which the river has made a passage, I obtained several specimens of the rocks, all of which are very silicious, and appear most like an altered sandstone, bearing lines of stratification of black, green, and purple colours; in some specimens there are round grains, others a foliated structure with curved markings; it might, from its exterior appearance, be mistaken for slate, and more of a stratified rock than any other. This place is interesting as it differs from the monotonous series of granite that has accompanied our investigations so far into the interior of this colony.

October 6.—A cold foggy morning; thermometer, 75°; barometer, 29·610. Low clay banks, with ponds of water just within and beyond the banks, that appear to be ever changing the course of the river. About 8 a.m. we passed Bononi creek, which was nearly dry and choked with fallen timber, so that only woodskins or bark canoes can ascend it, and that only in the rainy season. At 10 a.m. we arrived at the landing to the village of Waimatae, where I attempted to walk into the interior, but after going through a portion of the forest I came to a large pond that intersects the path, and prevented my reaching the village. The river runs here about two miles an hour, so that we made little progress to-day. It has altered its course near where we encamped by cutting off a bend; it has thrown down the trees that grew on the bank, prostrating them across the old channel, and cut down the opposite side, where at present the bare bank presents a perpendicular bluff of 6 feet above the water.

October 7.—A bright morning; temperature, 78°; barometer, 29·630. The banks of the river are covered by timber, so that the savannas are not seen from it. Where there is a pond or small watercourse it is generally fringed by trees, showing that by irrigation the land of these savannas would be susceptible of cultivation. The Rupununi becomes narrower here and runs with greater velocity, so that our progress to-day was slow and irksome. At 9 a.m. we reached the landing of Karinambo. I walked to the village, which is situated on a slight rise in the savanna, around which, during the rainy season, the land is covered by water. The surface is sand, clay, and gravel, so also a little higher up the river, where beds of ferruginous clay were observed, in which hydro-oxide of iron is cemented like cellular lava, or cinders from an iron furnace.

October 8.—Started at 6.25; thermometer, 76°; barometer, 29·640. Before reaching Wai-ipokara or Morooca, the landing place of Pirara, there is on the west side of the river a bed of ferruginous clay overlying a recent coarse conglomerate; the

pebbles are all laminated in structure, although worn round by attrition. Stopped to breakfast on the east side of the river where the savanna connects with some woodland. I walked to the savanna, but found the grass nearly as high as my head, and a haze between me and the Canuku mountains so dense that I could not obtain a distinct outline of them. The clay banks on the east side of the river being 10 feet high, and still more on the west, we found considerable difficulty in finding a suitable camping place.

October 9.—Started at 6.15 a.m. Thermometer 76°, barometer 29·620. Clay and sand banks continue. A ferruginous concrete occurs on the east side of the river, forming protruding shelf-like stratum from the bank, on which quartz and sandstone pebbles are collected. The banks of the river became thickly wooded as we approached the falls of Curutoko, about three-quarters of a mile above the abandoned mission of Urua creek. These falls are produced by two dikes of basalt that traverse the river N.E. and S.W. On these dikes the ferruginous concrete is seen about four feet in thickness. The surface of the basalt is very highly glazed by the same metallic deposit of iron and manganese that covers most of the rocks in the rivers of this colony. The river here becomes still narrower, and the banks more densely covered by forest trees, so that I seldom got a sight of anything beyond them. The banks are composed of clay or sand. Some recent changes in the course of the river occur here; portions of the banks have fallen, carrying with them the trees that were growing on them. Sand banks projecting from the shores, and large trees lying across the river, now became more frequent; and as the width of it is not more than 70 feet from bank to bank, progress was slow and uncertain. We encamped on one of the sand banks, and soon after a heavy thunderstorm passed over us.

October 10.—Passed a very disagreeable day on the sand bank. The thermometer in the shade was 96°, and not a breath of air moving. At 7 a.m. thermometer 78°, barometer 29·655.

October 11.—Thermometer 78°, barometer 29·650. Cloudy; a heavy dew fell last night. Sand and clay banks continued. The Waralli mountains appeared above the trees to the S.S.W. shortly after we passed their base, where there is a bed of gneiss, forming a point in a bend of the river, on a line with the axis of the mountain. About two miles above a fine granite occurs in large masses. A continuation of pointed hills, clothed with heavy forest, came into view at almost every turn of the river, but even these are so similar to each other that they become monotonous. Granite appears again and again, first at a small stream, then in the centre of the river; large boulders occur at the base of the mountains; sand and clay form the banks of the river.

October 12.—At 7 a.m. thermometer 78°, barometer 29·600. We passed round the point of a hill composed of gray granite, and soon after the river expanded and became so shallow that the boat struck on the sand and rocks several times. I ascertained at a Wapisiana village here that I would not be able to ascend the river much further without I wished to remain until the next rainy

season, as the water was falling very fast, and already lower than usual at this time of the year. This I regretted very much, as it prevented the carrying out of my plan, of crossing south of the Canuku mountains to the Takutu. Encamped just below a village on a sand bank on the west side of the river.

October 13.—The river became so very shallow that before 8 a.m. this morning the crew had to get out and lift the boat over the sand bars twice. Thermometer at 7 a.m. 80°, barometer 29·580. About 9 a.m. I contemplated returning on account of the difficulties that presented themselves, and taking a different route over land, by which I could reach the northern base of the Canuku mountains, and the Takutu river that forms the boundary of the colony; for to continue hauling the boat over so many rocks and sand banks, with the river falling so very fast, would be hazardous. At 10 a.m. we came to a large trap dike that traversed the river. There was not more than six inches of water on the sharp edge of two openings through which the boat could pass; to get over it would involve considerable loss of time, as we should have to unload and reload, and perhaps before an hour repeat the same operation. I therefore at once resolved to return to the Pirara landing, where I knew there were tracks that would lead me to Nappi, and other points of the Canuku mountains. Our rate of motion became very different as soon as the boat was put about. By 5 p.m. we reached the place we encamped on the 12th.

October 14.—Thermometer 75°, barometer 29.560. Before 7 a.m. we passed the house where we breakfasted on the 12th, and where we spent last Sunday. We encamped at 4.30 p.m. At 5 p.m. we heard a very loud noise, which sounded like that of a large cannon; such reports are frequently heard by the Indians, who declare they proceeded from the mountains. I heard such reports while on the Mazaruni river, where the Indians have the same ideas regarding them. Sir R. Schomburgk speaks of them. I cannot account for this phenomenon, but suppose it is caused by some electric agent in the rarefied atmosphere that pervades the higher lands in these districts.

October 15.—Thermometer 78°, barometer 29·590. On arriving at the fall of Curutoko we had a narrow escape from wreck or drowning. When we came to this fall Captain Peterson thought he could shoot the centre of the cataract, and directed the boat to that point through the rapids. When just at the edge of the fall the bowman saw a sunken rock, which, if we had come on with full force, would have dashed our boat to pieces. All hands, at the word from the bowman, sprung into the river in order to check the boat, which they were fortunate enough to do, and by the aid of ropes carried her to the only passage, where she was gradually lowered to the basin below. While the men were getting their breakfast this morning, I took a walk to the savannas lying between the Rupununi and Rewa, to obtain a view of the Canuku range, and drew in the outlines of the most remarkable points and their relative bearings. At 3.30 we arrived at the Pirara landing

"Wai-ipokari," from which there are paths leading to the interior. I immediately sent the interpreter and another man to Captain Pasico the Maccusi chief. I then took a walk to where the remains of two houses are, one burnt, the other abandoned; from that point I obtained a fine view of both the Canuku and the Pacaraima mountains.

October 16.—My object in sending the interpreter to Pasico last night was to obtain some men to carry the provisions I should require, besides the tent, hammock, &c. The necessary packages were accordingly arranged so as to be ready, and the boat put under shelter. Barometer 29·600, thermometer 86°. The interpreter returned this afternoon, stating that Pasico was too ill to come himself, but that he would send me a guide and carriers early to-morrow.

October 17.—The crew objected to walk across the savannas without native sandals or shoes, as they call them, that are made from the Ita palm. A native in a few hours made nine pairs, for which I paid him.

October 18.—The Indians having arrived and arranged the packages of salt fish, rice, &c., we started at 7 a.m. The view from this spot is very extensive, and possesses that peculiar beauty which great extent and distance always give to the landscape. The grandeur here consists only in the aerial perspective, not in any particular object; here and there are seen a belt copse, or a stunted tree on the brow of a hill, and the distant mountains were enveloped in mist. We continued walking until near 10 a.m., thermometer 95°, when we came to a large pond, and as there was said to be no other water for a long distance I ordered the men to prepare breakfast. Some of the crew found the exertion of walking too great for them, and had stayed behind to rest. By 4 p.m. we arrived at the village of Quartata. The whole route was composed of clay, sand, and gravel, which on the edges of the watercourses becomes cemented into a hard concrete or conglomerate, so also around the pond where we breakfasted, and at the base of all the undulations. The walking was very severe to our feet. Our stock of cassava being low, by waiting over to-morrow the people of this village promise to prepare some for us.

October 19.—Waited to get the cassava for the men, and Ita palm shoes for them. Quartata consists of seven or eight houses, containing an equal number of families, who appear to have very little in the immediate vicinity to depend upon; but like most of Indian tribes in this colony they chose one place for residence and another for cultivation.

October 20.—Having procured sufficient bread we started at 6 a.m., expecting to go direct to Nappi, but I soon learnt that a portion of the carriers, three women and three boys, were not going on with us, that they had been sent by Pasico to take me to his house or village, but no further, and that he would appoint other men to go with me to Nappi. We took a short cut to the eastward, and through a swamp, over which I was carried by men in a hammock. The Ita palm sandals I put on this morning in

consequence of my feet being swollen were worn into holes, so that it was now little better than walking on bare feet, and extremely painful. About 3·30 we reached the house allotted to me in the village. I obtained from Pasico the information I required through two interpreters, and obtained two guides for the Sawara-auru river, a tributary of the Takutu.

October 21.—Finding myself incapable of walking I sent the most intelligent man in the crew with two guides (whom Pasico sent early this morning) to the Takutu river, with such instructions as would insure the faithful performance of my object. Although my feet were still sore I was desirous to go on, if it was but a few miles, but on reconsideration I determined to remain till Monday, when I hoped the interpreter would be well enough to go on. I had during the day a long conversation with Pasico about the vicinity.

October 23.—Thermometer 98° in shade. At 4 p.m. I took a walk round a part of the hill that was broken away to examine the strata, and had a full view of the Canuku mountains, the perpendicular structure of the sides of which shows plainly the difficulties to the explorer. I also went to the pond, the water in which when disturbed becomes white from the beds of white clay that lie below the red and yellow clays on the surface.

October 25.—Started at 6.30 a.m. on the track to the Nappi mountains. The surface is composed of hard red, yellow, or white clays, with ironstone gravel, except in the swamps, where there is black vegetable soil and white clay. These swamps extend over a great portion of the country, now filled more or less with water, but by January or February they become dry. As there was but one house in the vicinity of this place, where we were compelled to encamp from the inability of some of the men to proceed, I had my tent put up between two trees on the savanna.

October 26.—Long before daylight I was disturbed by tormenting mosquitoes, and glad when daylight broke; then I called all hands, and by 6 a.m. we were on our way. I stopped to breakfast under some trees, and soon felt unwell; fever came on with great violence and severe headache, so I determined on not going any further to-day. Thermometer in shade 102°, in sun 128°.

October 27.—I had a little rest, but woke with considerable pain in head and right side; took such remedies as I had, which relieved me a little, but felt quite unable to move. I therefore sent some of the men to the top of the mountain, or as far up as it was possible for them to get, to bring me pieces of all the rocks they could find *in situ*. These men returned at sundown, and on examination I found the rocks were generally gneiss, varying only with granite or syenite, exactly like those I had previously examined on the other portion of the range, and in the river. I found myself again with burning fever during the afternoon, which made me think that if I became seriously ill my chances of recovery would be very slight, and considering it would be more advisable to beat a retreat, I engaged four men to accompany me, and if necessary to carry me in a hammock.

October 28.—Before dailight a heavy shower of rain commenced and continued until 12 n. Fever soon came on, which I tried to break by walking, but that becoming very painful to me I was occasionally carried in a hammock. About 5 p.m. we arrived at a village of four houses, one of which was vacant and allotted to me. Pain and anxiety continued until about 8 a.m., when the fever passed off.

October 29.—Passed a restless night. Walked as far as I could, and was occasionally carried in a hammock, but in great pain the whole day. We reached Carinacru about 1 p.m., the temperature in the sun 123°.

October 30.—I was determined to strive my utmost to reach the boat, as I felt my life depended on my getting at medicines I had there. I walked about two miles before I would consent to take to the hammock. The heat before 10 a.m. became oppressive, and when we stopped to breakfast it was 123° After breakfast I continued walking until near 1 p.m.; feeling then nearly exhausted I got into the hammock, and arrived at the belt of forest that fringes the river. I then began to recover a little under the shadow of the trees, and again commenced walking, reaching the landing at 2.20 p.m.

October 31.—The Indian guides and carriers were paid off, and everything being satisfactorily settled they went back to their homes. Thermometer 98° in shade. I became much worse about 2 p.m., and suffered intense pain.

November 1.—Feeling better I determined on returning. Of the geology of the Canuku mountains and savannas there is very little to interest the explorer. Where the range is cut through by the Rupununi river, gneiss, granite, and basalt, or greenstone, as dikes or eruptive rocks that have passed through the two former, occur. Along the northern slope there are many bold escarpments of granite extending over acres of surface, several of them barren of vegetation, and perpendicular, where the rocks are cleft from the summit 800 or 1,000 feet, at the base of which abuts the debris that for ages and ages has been accumulating. Over all this fragmentary portion there is a heavy growth of forest trees. The general aspect of the savannas is that of an extensive and in some directions boundless plain, with a few cashew, acacia, and other bushes dotting the surface. The men I sent to the Takutu returned with rocks of the same character from the extreme western limit of the Canuku range as I had seen on its other portion.

November 2.—We arrived at Annai landing about 4 p.m. Fever still continued on me. The river having fallen considerably since we passed up, I observed a bed of the ferruginous concrete exposed on the east bank.

November 3.—Waited for provisions I directed to be made for our return.

November 4.—Cassava bread and other provisions having been brought by the Indians, we started, and arrived near a river west of the Makarapau mountain, near some long white clay banks.

November 5.—I observed the river had fallen about 8 feet since I went up a month ago, but there were few rocks exposed by its fall; the only ones to be seen were clay, sand, or ferruginous concrete. The clay is commonly white and porous, and the sand yellow. We arrived at the mouth of the Rewa about 4 p.m., where we encamped.

November 6.—A very severe thunderstorm passed over us this morning soon after midnight. Continued passing alluvial clay banks until we came to the Arumé mountain. To ascend it we had to enter a large pond or inlet, near the head of which rocks appear, which at first I took for an altered sandstone; but from several specimens collected from the base to the summit, the crystals of felspar, opalaceous quartz, and hornblende are more distinct, forming a compact and pretty coloured syenite. A little further down the river a fine view of the Makarapau mountains was obtained. We arrived at the junction of the Rupununi with the Essequebo at 3.30 p.m., and soon after at the landing of the village of Apotree, where we encamped.

November 8.—Finding that I could go up to King William the Fourth falls in five days, I thought there was time to go there and back by the 18th, the day appointed to meet Mr. Brown at this place. The course up the Essequebo from this point for some distance is east. The trees on the sides of the river are magnificent when compared with those on the banks of the Rupununi, but whether this is not due to age appears to me questionable. At 10 a.m. we came to a dike of basalt with lines of five crystallized sides standing up in columnal structure, this being the first place where I have met with this rock in the colony. A short distance above there is an abandoned Carib village (Musara), where granite of gray colour rises. The hill above, on which the village was, is composed of decomposed granite. The course of the river now turns south-eastwardly; on the east side the banks are composed of white clay, and the west are low and swampy. The trees on both sides diminish in altitude. A red granite occurs about three miles further up the river, and white clay banks on either side.

November 9.—Thermometer 79°, barometer 29·800. Banks of the river low on each side, occasionally rising a few feet above the surface of the water, composed of white clay or sand. About 8 a.m. we passed the inlet of Masaetaitouriu, at which point gneiss appears; again further up, at the next inlet, Primos, a gray granite rises just above the level of the water. Here I landed on purpose to find the path which leads to the Corentyne river. Continued our course up the river, examining every rock that appeared above the water or on the banks, which in most cases was granite. There is no object to attract attention or to note a marked feature in this monotonous river of dark water and high forest trees reflected on its surface. We encamped on the west side of the river during the night.

November 10.—Thermometer at 7, 82°, barometer 29·800.

Our course was south 20° west, then more westwardly for a short distance. Two dikes of gray granite cross the river, forming small rapids. At 9 a.m. we arrived at Puambo island, which is formed by alluvium deposited on red granite, and ascended the eastern channel, the western being crowded by large blocks of granite. South of this island, about three fourths of a mile, there are some troublesome rapids, over which the boat had to be hauled, the rocks being so numerous as to render the passage very intricate. The island of Paumbo is much larger than represented on the map. The granite dikes disappear soon after passing the rapids, when gneiss follows for some distance, succeeded by a very dense hornblende rock, after which the river becomes deeper, and a long stretch of smooth water opens out to view, both banks of the river being covered with a high forest.

November 11.—Thermometer 78°, barometer 29·740. Scenery like yesterday, high trees on clay banks that rise from 6 to 12 feet above the river, occasionally the boughs of the smaller trees touch the water; deep reflections on the surface, like those on a black glass; rocks blackened by a metallic deposit projecting a few feet above the surface, most of them gneiss. At 3 p.m. we came to an island about one mile long, with rapids on both sides of it. We ascended the western channel, which was the broadest, but much filled with granite rocks. The rapids continue further up the river. About a mile beyond an island we encamped.

November 12.—Temp. 78°, bar. 29·720. We soon after found the river covered with foam, which appears to accumulate during the night more than in the day, and then came to more rapids, that continue some distance. The first dike forming the rapid of this series is a dense hornblendic rock with iron pyrites; this is followed by gneiss with crystals of garnet. This rock extends over a large area, but the garnet crystals are small and fractured. At 3 p.m. we arrived at the foot of King William 4th's cataracts, which is a succession of rapids, from 100 to 500 feet apart, closely interspersed with rocks of gneiss and granite, in which veins or layers of quartz are interstratified with mica and felspar. These rocks also present different colours of red and gray, and where they are weathered a light brown. Their surfaces are not so thickly coated with the metallic deposit like "black lead," as Humboldt describes the rocks to be in this section of the world, and as they generally are further down the rivers of British Guiana. I encamped at a small island a little below, where there is a sandbank extending from it. The river is divided into several narrow rocky streams, and each branch so encumbered with rocks that I saw no possibility of passing them, and as I could not prolong my stay advantageously I determined on returning without delay.

November 13.—At 6.30 I started on my return to civilization. I commenced at the falls this morning a map of this portion of the river, because I consider that furnished us incorrect and defective.

November 14.—We descended as far as the place we encamped on the 9th.

November 15.—It rained for three hours during the night. Thermometer 75°, barometer 29·750. We started at 6.25 a.m., and at 4.30 p.m. arrived at Apotrie.

November 16.—At the landing of Apotrie I waited the arrival of Mr. Brown, and gave orders for more cassava, yam, &c.

November 18.—Had my boat arranged ready for starting. Rain at 2 p.m. About 4 Mr. Brown arrived, he and his crew all well.

November 19.—We did not get off until 7.45, and arrived about 4 p.m. at "Pavian Hole," having passed the rapids of Rappu without difficulty.

November 20.—Started at 6.20. Granite rocks that were under water as we went up now appearing above the surface. We arrived at the rocks and falls of Achramucra at 9.50 a.m. Passed the Pishani islands and rapids between 2 and 3 o'clock p.m., and encamped near the Maccari mountains.

November 22. Thermometer 78°. Passed numerous islands in smooth water until we got down as far as the Maccari rapids. I went out of the usual channel to examine the base of the mountain of Maccari, which is nearer to the river at this point than any other, where we found porphyry of rather a reddish colour. About 9 a.m. we came again into the main stream, and reached the great fall of Oropocari by 4 p.m., where the boats were unloaded and their cargoes carried to the lower part of the island, on which we encamped. A very heavy thunderstorm passed over us soon after dark.

November 23. The boats were lowered by rope and hand over the falls and brought into the cove where the cargo was deposited. As soon as they were reloaded we started. There are here some very curiously fluted rocks reposing on others of less size, the fluting or channelling being the result of alkaline water that has fallen from trees under which they lie, while the same rock in the river is not so channelled but has a smooth surface. The fluted rocks are about 40 feet in circumference and repose on much smaller ones, as we often see granite rocks similarly placed, producing rocking stones; there is also a space beneath them large enough to shelter several persons.

November 24. It was so cloudy that the hills of Taquari could not be seen. Temperature 78°. We ran down the falls of Cuyariwaka, and in a few minutes after the more dangerous one of Curibiru, then that of Akawana, which is even worse and of greater extent. About 1 p.m. we ran down the Haiawah cataract, where it was so rough that we shipped a good deal of water. The next cataract was the Yucuribi, where we found greater difficulties than at any of the previous ones; our passage over it was effected unloading the boats twice and carrying the loads over the rocks. This operation occupied some time, so that we did not get to the base of the cataract until 4.10. Encamped as soon as we came to an appropriate place.

November 25. Soon after starting we arrived at the Twisinki

falls, which were ran down, as it appeared to me, very recklessly. Soon after we came to the great falls of Habacuyaha, where the boats were lowered by ropes, during which I made a close examination of several rocks I had seen but superficially when ascending. The mass is generally granite, but mixed up with it is gneiss, petrosilex, diorite, &c., &c. At 1 p.m. we reached smooth water, and continued on it until 3.30, when we reached the head of the great Waraputa. On reaching the foot of these falls it was nearly dark, and we encamped. Rained very heavily.

November 26. It was 6.40 a.m. before we started. The rain continued until 8.30. At 5 p.m. we encamped near the path end, over which I walked from the Demerara river in February last.

November 28. Stopped at the village Paramuru, opposite to which there is another called Flat Rock; remained at the landing of the former the whole day, the crew having friends and relations living there. Several showers of rain fell during the day.

November 29. Started before 6 a.m. and passed the last set of cataracts before 8.30 a.m. We arrived at Bartica Grove about 3 p.m., and at the "Settlement" soon after. By steamer three days after we arrived at Georgetown.

Physical Features.

After proceeding up the Essequebo river as high as 4° 20′ latitude, near the cataract of Achramucra, or rocks that impede the river there, a depression of land is observed dipping south, and the banks of the river become gradually lower and lower until they are submerged. During the time the rivers are in flood the Essequebo rises some feet above its banks, when a large portion of the country becomes inundated until the close of the rainy season. By a rise of 30 feet most of the country between the Maccari range of mountains north of the savannas and the north base of the Canuku range must be overflowed to a great extent, as the highest hills on the savannas do not exceed 60 feet above the banks of the rivers, consequently the water that accumulates annually during the rainy season attains to lacustrine dimensions, and in the depressions that are lower than the rivers the water remains throughout the year.

The lowest part of the depression on the north of the Makarapau mountain appears to be about the Cuma Kiya and Anourimé inlets, and on the south between that mountain and the Annai range, about the Taraqua inlet, but the barometer gave the lowest part of this great depression at Bononi.

The magnificent forest trees that grow on the banks of the lower Essequebo gradually disappear on approaching the savannas, and are replaced by a low scrub resembling the growth on a promontory of the sea coast. This peculiarity is not confined to the river courses, for the savannas are only here and there dotted with dwarf trees, excepting in the depressions where water has accumulated and been detained each year, as will be described hereafter.

Savannas.—The savannas are not seen from the river until the Essequebo is ascended as far as the 4° of latitude, where it receives the water of the Rupununi from the west; it is the latter that intersects the great savanna that lies between the Pacaraima and the Canuku mountains. It is first seen from the Rupununi river, near Cotton creek, a little to the S.W. of that conspicuous and beautiful mountain the Makarapau, which rises between 3,000 and 4,000 feet above the savanna, forming a bold and terminal point to the Maccari range. The peculiarities of the savanna in many respects are like those of the prairies of western North America the pampas of South America, and the llanos of Venezuela, to which I entertain little doubt they are connected; but they appeared to me to resemble the Darling downs of Queensland more closely, as the grass not only holds supremacy over the flat lands, but passes over hill and mountain. The trees and bushes have been extirpated as though the hand of man with axe, compass, and line had directed it, the demarcation being so beautifully defined on the Annai range of mountains, where some are perfectly barren of everything but grass, while the others are clothed by a luxuriant forest.

The geology of these savannas is very clearly defined on the alluvial plains, consisting of only three distinct stratified post-tertiary rocks, resulting from the disintegration of the adjacent mountains, *i.e.*, clay, sand, and below the sand a ferruginous concrete or hydro-oxide of iron, which in process of time becomes hæmatitic. The surface of these savannas is undulating in elevations and depressions from 5 to 30 feet; the highest rise I found to be 60 feet. These hills are covered with "black shining pebbles," a ferruginous gravel, which lies on the sunburnt clay.

There are many of the depressions that expand over an area large enough for lake-like deposits of water, and as many of these depressions are deeper than the bed of either the Rupununi or Takutu rivers, the water remains in them throughout the year. Other depressions occur, but not of equal depth, that become dry. These, when surrounded by trees, are used by the natives for cultivating maize, yams, cassava, sugar cane, &c., instead of using the slopes of the mountains for that purpose. There is another feature of these savannas like the Darling downs of Queensland; it is the grouping of a small number of different trees, over an extent of land, sometimes over not more than an acre or two, at others extending nearly a mile; these groups of trees are not confined to the depressions where alluvium has collected, but, on the contrary, are more frequent on slight elevations and on the sides of the depressions. The Ita palm (*Mauritia flexuosa*) becomes one of the most prominent trees on the flat open swamps, rising to the height of 50 or 60 feet; this tree is used by the natives in various ways besides making rope of the fibres and strong drink from the fruit; the bark was used (by the men I employed to carry my luggage and provisions across the country) as sandals to protect their feet from the sharp gravel with which the savannas are

covered. I found walking over these savannas very fatiguing, and when the thermometer was 125° to 130°, without a breath of wind, the heat was almost insupportable both for myself and the men.

Savanna Mountains.—The savanna mountains are more general in the Pacaraima than in the Canuku range, but more especially near Annai; these mountains present a striking feature in the landscape on one side of the range; without any conceivable cause portions have nothing but grass upon them, while other parts are densely covered with fine forest trees. The sharpness of the division between the two makes them appear like highly cultivated fields of grain. Sometimes these areas of apparently cultivated land cover the portion of a hill that is sheltered from the moisture brought up by the prevailing wind during the rainy seasons. Other hills and mountains are entirely covered by grass, and the neighbouring ones with forest trees of great height. It is difficult to account for this caprice of nature, as the soils and the rocks are alike, and the inclination of the mountain sides the same in one as in the other.

Mountains.—In ascending the Essequebo river, like most of the others in British Guiana wherever there are rapids, cataracts, or falls traversing them, some hills or mountains are generally seen in the line of strike to the dike of rocks that forms the obstruction. These hills and mountains on the confines of the Essequebo gradually increase in elevation until they reach the Maccari range, that trends from the south-west to the north-east, as most of the granite dikes do. At Pisani Pisani rapids a fine mural end presents itself, on the east of the river, as a cliff about 1,300 feet in height, which appears to be due to the eroding action of the river. At the base of the rock is porphyry, and forms several patches that are seen in the river. Some few miles to the east of Arrasuca there is a long sloping hill of syenite, the base of which is approached by an inlet bearing the name of Arumai; the height of this is about 520 feet, and it lies at the base of the great Makarapau.

The Makarapau is a more beautiful object when viewed from the south than the north, as it rises out of a perfect level, without any object to obstruct the view of its precipitous sides; whereas on the north and weather side there have been many landslips, which lessen the boldness and magnificence of this splendid mass of granite. There is a conical hill to the N.W. very like a sugar loaf, similar to one seen on the Mazuruni river, and named by the Indians by the same name, "Arrasuca," or Sugar Loaf. Makarapau is connected on the west with the Maccari range, curving round from the N.E. to the S.W.

A few miles south-west of the Makarapau are the Annai mountains. The peculiar features of the Pacarima range are such as not to be forgotten. They belong to those hills and mountains of the savanna district, and are capriciously clothed with savanna

grass or forest trees. On the north the savanna extends to the base of the Makarapau, on the south to the great Canuku range.

From what I have previously said it can be seen that I pushed my way up the Rupununi river, beyond a Wapisiana village, for the purpose of examining the south as well as the north portion of the range, but the low state of the water in the Rupununi river prevented my going further than 3° 20′ N. latitude, 59° 10′ W. longitude.

The passage up between the different heights was varied and frequently picturesque, particularly so where there are three conical peaks, called the Waralli mountains, where the plant, from which the Waralli poison is extracted, grows. The grandest view, however, is that of the Barukutuauari mountains, which rise, I should think, over 2,500 feet above the sea, as my barometer gave me for the height of the river at the foot of the Makaparima 513 feet.

Being obliged to return for the reasons before stated, I pursued my downward course with the greatest rapidity possible, and arrived at Wai-ipukari.

To reach the northern base of the Canuku range from this it became requisite to walk about 48 miles, the track being very crooked, on account of the swamps that were impassable.

At this distance the whole range of mountains from east to west presented one uniform intense blue colour, or as Darwin says of those seen from the Pampas, a beautiful "French gray, with some blue in it;" but on approaching it the inequalities are seen and boldly defined, as the sun in its decline produces sharp lights and shadows on the perpendicular and projecting surfaces. Here and there a cascade washing the well-worn sides of the already polished granite, gneiss, or syenite is seen.

Between the Nappi mountains and that adjoining it to the S.W., there is a bold stream that falls over a perpendicular height of several feet, and then runs north, uniting with other springs that issue from the base of this range, forming the Nappi river, that generally maintains in the dry season a depth of three feet.

To ascend these mountains to their summits is extremely difficult, on account of the perpendicularity of their sides, more particularly on approaching the mural surface. The profile of many of these mountains present the relative angles of roof and chimney.

Many of the roof-like sides are covered with forest trees, but the chimney-sides are barren of any vegetation, excepting some moss and air plants. Some of these mountains have been partially ascended, but there is so little cultivable soil to encourage the Indian settlers, that they are generally considered as unproductive and uninhabitable. To the west of Nappi there are two conical hills that form picturesque outliers. I could not obtain the names of these hills, but from the top of either the course of the Takutu can be traced for a considerable distance.

At the western termination of the Canuku range the mountains

gradually diminish, quite unlike that of the Maccari, that terminates with the Makarapau.

During two months of the year the surface of some rocks in the Pacaraima range shine with a dazzling brightness that may be seen for 50 miles. This is due to the sun's rays striking on the moistened surface of the rock. I witnessed this effect after a fall of eight hours rain on Ilamikipang.

To describe the geological limit of each formation, as it appears above the surface of the rivers, would require much time and occupy that of my readers uselessly. I will therefore condense, in as few words as possible, a list of those rocks comprised in the extent of country over which I have passed, and place them stratigraphically, so that the relative position of each may be understood.

A. *Alluvium.*—Alluvium is the soil formed of particles worn off rocks by rain and water, and re-deposited as sand, clay, and gravel, that forms the river banks and low flat lands. The base of the inland savanna is of undobbtedly alluvial or lacustrine deposits, but of much greater age than that now occupying their surface; but what that age is I am unable to determine, as no animal or vegetable remains have been met with to settle so interesting an inquiry, and as the alluvium is formed from the disintegration of Azoic rocks, we can only expect to find recent deposited fossils.

B. *Concretionary Iron Ore.*—This substance assumes different forms under the varied influences to which it is subjected, and to their duration. It is frequently found forming beds intimately combined with clay, presenting a uniform brick-red colour, and at others with white or yellow clay presenting a mottled appearance. The iron ore sometimes as gravel, at others in concretionary masses, with round, hollow, or tubular separations filled with clay and particles of sand, due apparently to a process of segregation which lies below the clay, and by continued concentration forms hematite or brown iron ore. On the savannas it frequently occurs on the surface in the form of gravel, with black shining exterior. The cause of this is explained by the clay and sand beds overlying the gravel or concretionary iron ore having been washed off.

It is in these formations the greater portion of the gold obtained from Caratal in Venezuela is found, which I suggested as my opinion prior to that fact being known to me. (See my report on the Cuyuni river, 1868.)

C. Sandstone and Conglomerate.

C. The next in order of succession of the rocks observed in this colony is a quartzose sandstone and conglomerate of great thickness, composed entirely of milk-white water-worn pebbles of quartz cemented compactly in a silicious matrix. This conglomerate is found at the base of the stratified series. These sandstones appear to extend over larger areas than the conglomerates, and under varied conditions, from metamorphic agency.

D. Schists.

D. The next rocks that appear are schists, or those of a slaty structure, the uppermost of which is a grey clay slate only observed on the Cuyuni near the supposed boundary of the colony. Below this series are some talcose schists, found only in this vicinity and upper part of the Mazuruni, near the Carubung creek; these are followed by mica schist and gneiss, which, as well as the granite and syenite, have been pierced by porphyries, greenstone, and other plutonic rocks, that have passed up through lines of separations or weakness, during a period when the granite was at a depth beneath the sea, and beyond all influence of our atmosphere.

It will be seen by reference to my journal that all the rocks collected on the rivers and mountains of Essequebo, Rupununi, Nappi, and Takutu are either granite, syenite, gneiss, basalt, conglomerate sandstones, or alluvium, showing how few families of rocks exist from the shore of the Atlantic to the 3° of latitude in this colony.

My inferences, therefore, are that no metallic deposits or veins exist to give encouragement to any mining enterprise, nor is it possible under the present condition of the colony a geological survey can be executed with the minuteness that other countries more accessible have been surveyed by myself and colleagues.

REPORT No. 7.

Geological Report on the Rewa and Quitaro Rivers, and the Country between the latter and the Rupununi.

By CHARLES B. BROWN.

1869.

CONTENTS.

PART I.

DESCRIPTION OF ROUTE.

ON the 29th of September 1869, we reached the mouth of the Rewa river, a tributary of the Rupununi, just 28 days after leaving the penal settlement, and on the following morning I commenced the ascent of this river in my small bateau with a crew of seven men and an interpreter.

Before starting Mr. Sawkins instructed me to return in time to meet him at the Caribise village of Apoterie, at the mouth of the Rupununi, on the 18th of November.

The Rewa being a rapid stream our ascent was slow, and we therefore did not reach the Quitaro river till the 7th of October. Arriving on the 12th instant opposite Ataraipu rock I spent two days examining it and the neighbouring hills. Proceeding on our journey we reached the furthest point attainable for boats (of the size of mine) on the 16th October, at a landing place from which a path led through the forest to the savanna. We were fortunate enough to overtake a party of Indians travelling homewards, who guided me to Ataraipu and afterwards to their landing. From this, on the 18th, they conducted me to Maturuwow village, on the

savanna, and served as guides and carriers during my subsequent land journey.

At this village I organised a walking party, consisting of my eight men together with seven Wapisiannas, all carrying loads of provisions in packs. Taking a southerly course we commenced our journey, and reached Carawaimintow mountain on Saturday the 23rd. I devoted the following Monday to an examination of a portion of it. There being no path leading from this place eastwardly or southwardly through the dense forest, I was obliged to take a course in a south-west direction towards the head of the Tahuta river, a small branch of which we reached (about the second parallel of north latitude) called the Tahutuwow.

On the 28th October we encamped on the Rupununi river, at a spot where it was reduced to a mere brook, not more than 5 feet wide and 18 inches deep. From this spot my homeward journey commenced, and it was with feelings of regret that I turned my back upon the south; but the time allowed for the journey (11 days) having been expended, there was no help for it but to return. Recrossing the Rupununi we took a path which led northward to a village called Parerabaton, near Mount Tomboro, at which we had stopped for a few minutes on our way down, and there rested on Sunday the 31st. Striking off in a north-north-west direction without a path we travelled for two days and reached the village of Maturuwow, from which we had started.

I then paid a visit to Shea rock, and continued north to the Catoorareow river (a branch of the Rupununi), returning to the Maturuwow village on Sunday November 7th. The following day we walked out to the landing where we had left our boat, having been travelling overland for 21 days. One day was occupied in preparing the boat for the return journey and in packing away the provisions in it, and on the next we started down stream.

When we reached the mouth of the Rewa I ascended it for one day till we came to the foot of some cataracts, where we spent Sunday the 14th. We turned back once more on the following morning and descending this swift running river, reached the Caribise village, our appointed rendezvous, on the 18th of November.

Leaving this place on the following morning in company with Mr. Sawkins we started on our return journey down the Essequebo river, arriving at Georgetown on the 2nd December, after having been away just three months.

PART II.

Physical Features.

1. *Rivers and Streams.*—The Rewa river lies between the 58° and 59° of west longitude, and runs from 3° 30″ north, in a northwardly direction to the fourth parallel of latitude, where it empties itself into the Rupununi river. Its general course is about south-

south-east for over 30 miles, then south-west for 16 miles, and finally south-south-east again as far up as I went. It is an extremely tortuous with a rapid current. At its confluence with the Rupununi it is 95 yards wide, and where joined by the Qultaro it is 55 yards. From the latter spot it runs its entire course through a low level country. At this season of the year the river is about half full of water, and the clay banks are 10 feet above its level. There are lines of sediment upon the tree stems and leaves deposited by the water during the recent rains, which are now 10 or 12 feet above its present level. The water is of a brown muddy colour from the earthly particles in suspension, but last year (when low) at its mouth the water was of a brownish black.

As the river winds and twists about the water keeps continually cutting deeper into the concave curves and building up clay beds on the opposite convex curves, thereby producing different features on either side. The banks of the concave sides, from this wearing process and their stiff plastic nature, are kept even and perpendicular; while the banks on the opposite sides slope gently into the river from some distance back and form shallows at their edges on which grow low shrubs and trees. There are numerous sand beaches and banks usually seen at sharp turns where the current sweeps rapidly by, allowing the sand to settle in the backwater or eddy, while the lighter clayey materials are carried on and deposited in other places, thus keeping up a great natural sorting process.

There are also inlets or ponds in many places joined by narrow channels to the river, with or without small brooks running into them. They have been old portions of the river's course long since abandoned, the water having cut through bends and taken straighter courses, leaving them to silt up. The whole surrounding country is covered with forest, the growth of which is not so luxuriant as that on the Essequebo river, nor is the undergrowth so dense.

The tributaries of the Rewa are the Porto and a nameless river (100 feet wide at its mouth) on the east side, and the Quitaro, Morewow, and Mashiveow on the west, together with numerous small brooks all along its course. Of these the only one of any importance is the Quitaro, a fine navigable river for boats for a considerable distance up, and clebrated for its Brazil-nut groves, and for its being the highway to the "far famed" Ataraipu.

The Quitaro is 44 yards wide at its junction with the Rewa, and exactly the same witdth at the highest point upon it to which I went. The scenery and general characters of this river differ very slightly indeed from that of the Rewa. The chief variations are lower and more irregular banks, a more rapid run of water, and more numerous sand banks and beaches. Then again it passes through a more mountainous tract for some distance, and in the vicinity of Ataraipu masses of rocks cross it, forming rapids and cataracts, which become very numerous the higher up one goes, until the passage is completely stopped for anything but small corials. It has numerous tributaries, but the only four worthy of notice are the Pobawow, Coomacowrie, Bunow, and Totohwow. The first-mentioned is a fine deep stream 72 feet wide

at its mouth, and somewhat interesting from the fact that a large grove of Brazil-nut trees (Bertholletia excelsa) grows in the forest on its banks. The Totohwow is a good-sized river, navigable for small corials. It is one of the chief branches of the Quitaro near its source, and runs along the northern foot of the Carawaimintow mountains. All the other rivers met with during my land journey are not of sufficient size or importance to require any description.

2. *Mountains.*—Five days journey up the Rewa the first hill is seen on the east bank, and on the eighth and ninth days some conical hills, amongst which is Ranidekeur, are passed on the west bank. These hills form the eastern termination of the great chain of the Canuku mountains, reaching from the Takutu to the Rupununi river, and extending to this spot. They do not seem to continue beyond this to the eastward.

Foremost amongst the mountains of this portion of British Guiana comes that singularly shaped rocky peak of Ataraipu, long since pointed out as a great natural curiosity. It is one of a group of conical hills with massive rock summits, situated on the south-eastern extremity of a long granite range on the western side of the Quitaro river.

Ataraipu, from where it is first seen, presents the form of a great solid rock pyramid, curiously striped and groved, rising from the top of a conical tree-covered hill of nearly equal altitude, but viewed from the bare side of Coomacaba mountain all its pyrimidal form is lost, and it assumes an irregular massive shape, having a spur jutting out from its northern face. What it loses in form when viewed from this spot it gains in grandeur, and as one gazes upon it he naturally thinks of the unnumbered ages that it has stood in this dreary solitude, and of the great natural forces that have been at work in forming this most wonderful structure.

Two of its neighbours, Omadekeur and Calishadakeur, are equally wonderful rocks, though not of so great a size or of so strange a form.

As there is much interest attached to Ataraipu as a natural curiosity I will describe my journey to it. Taking provisions for two days, and guided by a Wapisianna Indian, our party started from the Quitaro river at an early hour on the morning of the 13th October. Soon after starting we crossed a small creek running eastwardly, then over a low ridge and across another creek. There was no path, and the bush being very dense, the men had to clear a way with culasses through the thickets. We then began to ascend a gradual incline until at 3½ miles from our starting point we came to the crest of a ridge of granite lying south-west and north-east, and having a steep escarpment to the north-west. The height by aneroid was here 573 feet, being 216 feet above the river. In front of us to the north-west, about three miles off, stood two huge bare masses of rock with tree-covered bases, having a smaller conical hill between them; the one on the right was easily recognised as Ataraipu mountain. Behind it came an undulating forest plain, reaching north for some eight miles, which was succeeded

by a range of dark-looking massive mountains, extending east and west as far as the eye could reach. About half a mile due east of us the ridge on which we stood terminated in a huge bare granite rock called Calishadekeur.

After gazing with delight on the novel and striking picture before me I descended the escarpment into the valley below to a good-sized stream called Ataripuruwow, 415 feet above the sea, at the foot of the southern slope of Ataraipu. We then ascended gradually for a considerable distance over a rough country, thickly strewn with blocks and masses of granite. A little after mid-day we reached the foot of the rock itself by scrambling up a steep ascent amongst large granite blocks, and were 857 feet above the level of the sea, at the place where the forest ends and the smooth bare rock rises, at a steep angle some 600 feet higher. At this spot the inclination of the rock's side is at an angle of 70° with the horizon, and as at all sides it rises at a very slightly lower angle all attempts to scale it would be useless.

We then crossed from this and clambered up the bare side of Coomacaba rock to a height of 910 feet. Being there not more than 300 yards from Ataraipu, and at a higher level than its tree-covered portion we had a most magnificent view of it, as well as of the country to the N.E., E., and S.E. It has but one horizontal joint near the top, and a slanting split near the base. The other lines upon it are grooves and hollows, the result of atmospheric action. It is covered with a purplish and gray vegetable growth, similar to the mould plant, growing separately and in somewhat regular vertical bands down its sides, the former in the water grooves and channels, and the latter covering the exposed convex ridges between. We camped for the night a little before dark at the stream in the valley below, and next morning retraced our steps to Calishadekeur ridge, and climbed up its peak with great difficulty. From its summit (1,150 feet high) I was able to take observation of the surrounding country, especially of the portion which I was about to examine.

We then made our way out to the boat again, arriving at the river's edge about 4 p.m. next day. After having been encamped for about an hour we were startled by a loud report, resembling the discharge of a 32-pounder cannon, heard from a distance of a half a mile. It sounded in the direction of Ataraipu rock, and woke up numerous echoes amongst the neighbouring hills. There was no sensible vibration of either the earth or air produced by it. At the time the sun shone brightly, not a cloud was to be seen in any portion of the heavens, and a deep stillness pervaded the atmosphere. This is the third time that I have heard these sounds, once near Merumé on the Mazuruni, at Achramucra rocks on the Essequebo, and finally at this place. It is extremely difficult to hazard a conjecture as to the nature and cause of these strange sounds.

Carawaimintow mountain lies between the Totohwow river and the main source of the Quitaro river. It is of a long narrow form, averaging 1,200 feet above the sea, and is completely covered with forest.

The Wassarie mountains, seen from a distance, appear of great height, and trend in a S.E. and N.W. direction, forming the boundary between Brazil and this colony. They are well wooded, and stand in a most desolate uninhabitable region, unapproached by a single Indian path.

Tomboro, Shea, and Otonani are three huge elongated masses of bare rock situated in different parts of the savanna. Shea is not more than 12 miles from Ataraipu in a W.S.W. direction, whilst Tomboro and Otonam are away some miles to the southward. These three rock masses are portions of six irregular granite ridges which lie W.N.W. and E.S.E., varying in height from 20 to 1,200 feet, and lying almost parallel to Ataraipu range.

3. *Savannas and Plains.*—The whole country through which the Essequebo river runs, from the fourth parallel to its mouth, is one vast forest-covered plain, from which (here and there) small isolated hills, high massive ranges, and clusters of mountains rise like islands from the ocean. The same description is applicable to the country through which the Rewa and the Quitaro rivers wind from their sources to their mouths. The part covered with forests extends westward some 15 miles from the river almost to Shea rock, and there is replaced by savanna. From this the line of the forest edge curves round to the north in one direction, and then almost due south in the other, close past Watuticaba, then it sweeps away to the south-west, towards the head of the Rupununi. All to the east and south of this line is forest-covered plain, and all to the west of it is bare open savanna. This land is slightly undulating in most places, and were it not for its covering of trees would be simply a portion of the great savanna with which it is continuous. The level of this plain at the mouth of the Rewa is 205 feet above the level of the sea, at the landing on the Quitaro it is 415, and near the Carawaimintow mountain it is 895 feet.

The great savanna extends from the edge of the forest above described westwards to and beyond the Takutu river, the boundary line of the colony. In its northern portion, from the foot of the mountains beyond Shea and Vivitow to Tomboro, there is little level land, except along the rivers courses, but is principally undulating country crossed in a N.W. direction by low ridges and hills. The height of the savanna at Maturuowow village, near Shea, is 590 feet, and at the Rupununi head 745 feet above the sea level. Along the small watercourses are swamps with long grass and rows of stately Ita palm trees, the latter growing with great regularity. Upon the swellings or rising grounds are scattered trees of a stunted-looking sort, having knotted stems and rough leaves, together with a coarse grass. Along the Rupununi river and its branches, such as the Awaraweow, Cobanawow, &c., there are broad belts of trees on both sides.

Near the head waters of the Rupununi and a branch of the Takutu river, not far from the second parallel of latitude, there is a small savanna some 8 or 10 miles long having an average height of 900 feet above the sea.

PART III.

Descriptive Geology.

1. *Alluvium.*—The alluvial deposits of this portion of the country are of three ages, viz.:—

(*a.*) Recent alluvium.
(*b.*) Fluvatile clay and loam.
(*c.*) Valley gravels.

(*a.*) The recent alluvium is composed of a black clayey loam, containing much vegetable matter, it is sometimes replaced by a reddish yellow clay. It occurs on the sides of the small rivers and streams on the savannas, and at the convex side of the curves of the large rivers. In the former position it is of a dark vegetable nature, and produces an abundance of fine grass upon which the savanna deer feed, and which would be capable of supporting herds of cattle.

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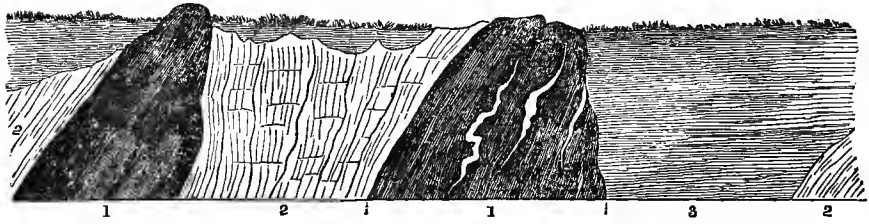

Section of valley gravels and fluvatile loam, Quitaro river savanna.
1. Granite. 2. Valley gravels. 3. Fluvatile loam. 4. Alluvium.

(*b.*) The fluvatile clay and loam is an arenoargilaceous deposit of considerable thickness, and sometimes contains beds of hydro-oxide of iron. It is usually of a yellow colour (but is sometimes a gray) with no visible lines of bedding, except in one place, where undoubted marks of false bedding can be clearly traced. It usually is a continuous mass from top to bottom, looking as if it had been deposited in one bed of from 14 to 20 feet in thickness at one time. Not a pebble or rock of any sort is to be found embedded in it, nor does it contain any portion of stems of trees, and is derived from the waste of the granite or gneiss rocks. The general surface of this alluvial deposit bordering the large rivers is comparatively level, and in the long rainy season is covered with water by the rising of the rivers above their banks. The hydro-oxide of iron occurs in beds in a few spots on the Rewa river in thick horizontal or slightly inclined beds. When horizontal it is vertically jointed and columnar, when inclined the jointing is wavy and resembles false bedding. I have described the occurrence of this deposit before on the Rupununi river and savanna in a former report, and will but make a suggestion now regarding its origin. It appears to me to have been formed at the mouths of old branch streams, at the point where their iron-saturated water joined this river in its

ancient course (when it was depositing all this extent of alluvium), and there chemically precipitated. This is now occurring at the mouths of small streams at the present time, where near their outlet the pebbles are all becoming coated and agglutinated together by the hydrated oxide of iron.

(*c.*) The valley gravel is of post-pliocene age, and consists of a thick deposit of yellowish clay, containing blocks and pebbles of quartz and also iron oxide. In one place near Curawashinang village, on a slight eminence, there is a great accumulation of a fine white sand belonging to this deposit. The soil on this valley gravel where covered with trees, though exceedingly sandy and poor looking, produces nevertheless fine corn, cassava, yams, sweet potatoes, plantains, and sugar cane. In places where it is of a reddish clayey nature it is extremely productive. At Tomboro I saw some corn growing on this kind of soil, the stalks of which were at least 12 feet in height. The soil everywhere is poor looking, light, and sandy, and contains much oxide of iron in small round pellets, yet, strange to say, one portion of it supports a forest of ordinary sized trees, while the other is part of the open savanna, covered with sparse coarse grass, and a few species of scattered stunted trees of the genus Curatella, &c. In nearly all the places where I have emerged from forest to savanna, the edge of the former is abrupt, the trees as it were forming an even wall, and not extending beyond a certain line. Thus we see on the same deposit, without any apparent cause, a sudden change from productiveness to comparative sterility.

The quartz blocks on the surface are of various sizes, colours, and textures, and some pieces contain accessory minerals, such as schorl, mica, &c. Some blocks are three feet square and some are angular, while many are water-worn.

2. *Sandstone.*—Four miles up the Rewa river there are beds of a friable purplish sandstone, containing minute scales of white mica, exhibiting false bedding and laying in an almost horizontal position. The alluvium of the banks obscures their extension north and south, so that it is hard to make out their true position with certainty; but I believe them to belong to the great sandstone deposit of the Pacaraima mountains.

3. *Mica Schist.*—True mica schist is largely developed in the bed of the Totohwow river, near the foot of the northern slope of Carawaimintow mountain. It there consists of friable beds of a brownish colour.

4. *Ferruginous Schist.*—Between the edge of the granite near Cotoewow village and the Carawaimintow mountain, the only rock to be seen (with the exception of the mica schist above mentioned) is a ferruginous schist. This rock is in places of a granular texture, sometimes it is compact, and always of a reddish gray colour. On the side of Carawaimintow it becomes a ferruginous schist of steel-gray colour and bright metallic lustre, containing a large percentage of micaceous iron. This rock greatly resembles the Itabirite of Brazil.

5. *Gneiss.*—The first gneiss is met with just three days journey up the Rewa river, near the Mashiveow river, from which it continues southward to the cataracts on the Quitaro, a little beyond Ataraipu, and not far past a cataract called Ataraipuru-Wanamaric. Its eastern and western extension could not of course be ascertained from this. On the way to Ataraipu, at a mile and a half in, the gneiss ends abruptly, and is succeeded by granite. Where first met with it is very much decomposed, its constituents, with the exception of quartz, being much disfigured by decomposition. It appears along the river sides, in many places under the alluvium, or rising in hills through it in the form of rounded masses, or in horizontal beds.

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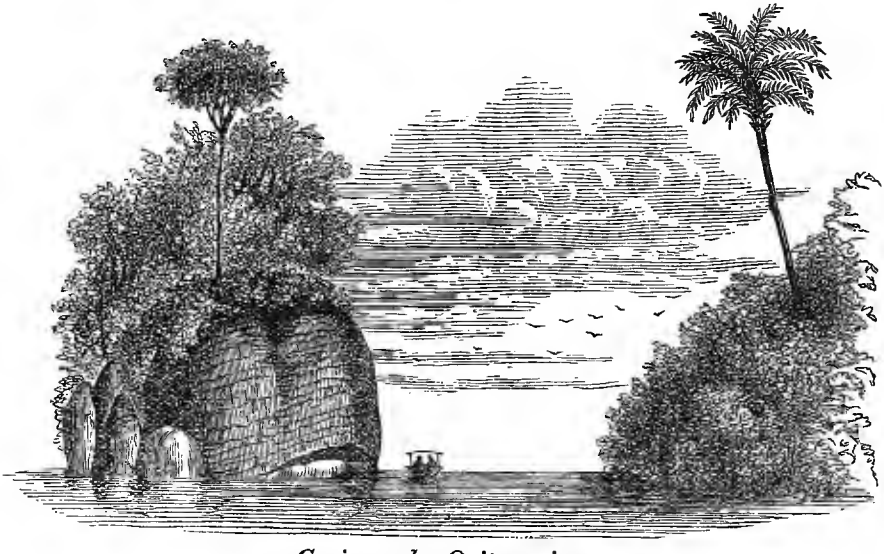
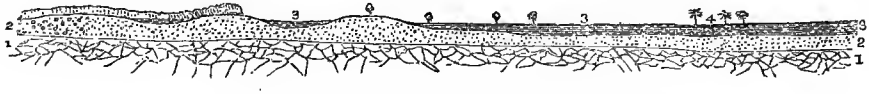


Gneiss rocks, Quitaro river.

Not far from Ranidekur mountains there is a massive bed of blackish jointed quartzose rock in the gneiss, which contains small veins and patches of crystalline quartz. In three places on the Quitaro the channel of the river is divided by large rocks of gneiss, some 30 feet high and 30 feet in diameter.

No. 10.



Weathering of gneiss, Quitaro river.

1. Gneiss. 2. Decomposing gneiss. 3. Alluvium.

In many portions of its masses the gneiss becomes schistose, passing almost into mica schist, and more rarely into a granitic gneiss. It often contains small veins of very coarse granite, which penetrate it in all directions, but nests of quartz are rarely seen in

it. The usual form of the gneiss when not bedded is that of large foliated central bosses, with less hard jointed folds resting upon them, of a more micaceous constitution, and slightly decomposed. These hard central bosses exhibit their twisted foliated texture on weathering so plainly that it can be seen from short distances. Frequently, when the bedding is clearly defined, the foliated mineral structure is observed to be almost at right angles to it. In one place there is a large development of gneiss in beds of great thickness, dipping east at an angle of 5°, and jointed vertically into columns of great size, of a fine crystalline texture, but does not contain veins of quartz.

About two miles up the Rewa above its junction with the Quitaro, there is some fine-grained gray micaceous gneiss, which appears to be overlain by a layer of coarse white granite. This gray gneiss, like similar beds at Ranidekeur mountain, contains crystals of red and black garnet arranged in parallel lines, and iron pyrites in small specks. The varieties of gneiss met with may be thus briefly enumerated :—common, fine-grained, granitic, micaceous and Porphyritic gneiss.

6. *Granite.*—This rock is met with on the Rewa, close to the spot from which the first hill is seen, and again past the mouth of the Quitaro, a quarter of a mile up. In the first instance it assumes the form of a great dike crossing the gneiss, and in the latter it appears to be a boss covering a very large area, having been thrust up through the gneiss. It is of a light gray or white variety, with coarse texture. These are the only two places where isolated granite areas occur. Adjoining the boundary of the gneiss to the southward of Ataraipu (as described under the head of gneiss) comes a great area of granite extending southwardly to Carawaimintow, and westwardly to the Rupununi river. The granite of a great portion of this area is of course covered by alluvium, but is at no great depth below it. In a similar manner, portions of the area occupied by the gneiss are also covered by alluvial deposits. The granite forming Ataraipu rock, Omadakeur, Calishadakeur, and the surrounding hills, is of a whitish colour and extremely hard. The quartz and felspar in it are white, and the mica is dark greenish black. On the gradual slope from the Ataraipurruwow river to the foot of Ataraipu rock, the whole surface of the ground is covered with blocks and great angular masses of granite, some of which are 40 feet square. On the western face of Ataraipu there are a few small veins of coarse granite, looking of a lighter colour than the rest of the rocks when viewed from a short distance.

In the Quitaro river amongst the small cataracts where the gneiss ends and granite begins, the change in form is immediately perceptible, smooth round blocks of granite taking the place of the flat wavy looking gneiss rocks. In the forest between the landing and Maturuwow village on the savanna, granite juts up through the alluvium of a similar kind to that on the Quitaro river at the cataracts.

The granite of Shea and Tomboro and all exposed between

these two places is the same as that of Ataraipu. Some granite occurring beyond Tomboro contains quartz veins and is of a gneissose texture.

About three miles north of the village of Cotoewow, the granite appears to end, and is not seen from this to Carawaimintow, to the point to which I ascended. The edge of it, as it curves away to the south, is met with at a distance of two miles west of the same village. It continues for a short distance east of the little savanna, and is then covered by alluvium, and does not occur at the surface again till some six miles east of the head of the Rupununi river. From this it does not appear at the surface again till half way between the village of Irribisinow and Mount Toboro, but in the beds of the Rupununi and its branches near Waripuow village it is seen underlying the alluvium.

Shea is an enormous mass of solid granite rising 490 feet above the surrounding savanna, and being over half a mile in length. At its western end a grove of trees has gained a footing, and a few shrubs and wild fig trees are clustered in a hollow near its highest point. The granite of which it is composed is similar to that of Ataraipu. Half way up its south side there is a most curious shelving cave, about 40 feet wide, running back some 20 feet, and its floor is covered with a finely divided dusty loam of brownish colour, varying in depth with the inequalities of the rock from a few inches to two feet. Scattered through this loam are the bones of deer, turtle, and fish, and some fresh-water shells of the genus Ampullaria. The Indians living on the surrounding savanna from time to time go up to this cave and remain there for a night or two, and the bones spoken of are the remains of their repast on these occasions.

From the top of Shea rock, looking in a south-south-east direction, a huge conical bare rock, apparently granite, is seen far off in the distance. It is close to the Essequebo river (I was informed), and is called Cobarara mountain. From Shea northwards to the chain of mountains crossing from the Rupununi to the Quitaro, all is of granite formation. Vivitow mountain, viewed from a distance, is similar to Shea, and is composed of granite.

7. *Intrusive Greenstone.*—On the Quitaro river, 8 miles due east of Ataraipu mountain, there is a broad vertical dyke of porphyritic greenstone, most probably of porphyritic diorite. The crystals in it are small, and the rock is of a dark greenish colour.

Another large dyke of the same rock occurs on the Catoorareow river, a branch of the Rupununi, north of Shea village. It may possibly be the western extension to the same dyke; it runs east and west.

A jointed, compact, greenish dyke of igneous rock occurs near the mouth of the Poto river, on the Rewa, lying north-west and south-east. One set of its joint planes is inclined so regularly that it resembles lines of stratification, it is however a vesicular diabase, and the circular cavities are lined with minerals, such as quartz, actinolite, calcopar, and a green mineral, all in minute quantities.

Iron pyrites in small quantity is scattered through it, and I observed also a little native copper.

PART IV

Economic Geology.

In all this district examined there does not appear to be any mineral of sufficient value or in such quantities as to be ever turned to account. I have repeatedly washed in likely-looking spots for gold, but was never rewarded by finding a single grain. At the same time, if there is any mineral discovered hereafter over this district it will be gold, for there is a strong mineralogical resemblance between the savannas here and the plains at Caratal in Venezuela, where gold is now being worked. If a few excavations were made in favourable localities in the alluvium of the savanna, this question could be soon settled.

All the garnets I have seen have been small, but a protracted search for large and valuable ones might be successful. Some quartz blocks on the savannas near Shea are opalaceous and could be used for jewellery. Building stones and road materials are in great abundance.

REPORT No. 8.

Geological Report on the Central Portion of British Guiana.

By Chas. B. Brown.

1870.

CONTENTS.

PART I.

Physical Geology.

On Wednesday, February 2nd, 1870, I started from Georgetown for the purpose of making a journey into the interior of the colony, in order to examine the geological structure of that vast extent of country lying between the Essequebo, Rupununi, Ireng, and Mazuruni rivers.

I was detained for seven days at the Penal Settlement, while my boats were undergoing some necessary repairs, and left that place on the morning of the 10th. Proceeding up the Essequebo with two bateaux and 14 men, we reached the mouth of the Potaro river on the afternoon of the 16th. At its mouth this river is about a quarter of a mile wide and contains dark coloured water. We had the good fortune to meet a large party of Partimona Indians, near the mouth of the Potaro, who were going in "woodskins" to the Demerara path in order to cross over to the Demerara river, two of whom I induced to return to act as guides.

As the Potaro runs through a portion of the country I had to examine, I determined to ascend it if possible, and cross over by land to the Siparuni and Burro-burro rivers. We therefore turned up it, and next morning arrived at a large cataract, which unfor-

tunately stopped all further progress. This cataract, called Tumatamari, is between 5 and 6 miles from the Essequebo, and the difference of level between its top and foot is 20 feet. It is produced by a great igneous dyke crossing the river obliquely in a north and south direction, and forming low ranges of hills on both banks, which rise some 60 feet above the river. There is a rocky island in the middle of the cataract, dividing the water into two great channels; the one on the north side contains the greater portion of water which rushes over with such force, that it would be impossible to haul a boat up at any time. That on the south side falls some 8 feet at first and then rushes down an inclined plain, shallow and rocky. The water in the river was rather low at the time, and spread out into various small channels on the south side amongst the rocks. The captains of the boats examined the full width of the cataract, but could not find a spot up which to haul them, the absence of vegetable growth on the rocks (a remarkable peculiarity) and their angular shapes, rendering it impossible. They also examined the path round the fall made by the Indians to carry their "woodskins" over (a distance of about 300 yards), and finding that it led over a steep hill reported unfavourably on it also. The Indian guides who live on a branch of this river told me that it would take them four days to go up to their village and bring down woodskins for me; they further said that there were more bad falls higher up. Seeing, therefore, the time that would be lost waiting for "woodskins," and the great difficulties to be encountered, I abandoned all hopes of ascending further under the present circumstances.

Making up my mind to ascend the Siparuni river, and, if possible, cross from the head of it to the head of this river, I turned down stream to the Essequebo, and then up to the mouth of the Siparuni, where we arrived at 8 a.m. on the 22nd. This river contains dark-brownish water, and is about 100 yards wide. Proceeding up it we soon reached a small cataract which delayed us a little, and at 2 p.m. passed the mouth of the Burro-burro river, coming in from the south-south-west, which divides the water pretty equally with the Siparuni. We found the river high from recent rains, while, as before stated, the Potaro was extremely low, and both rivers drain portions of country not very remote from each other. The banks were only some 6 feet high above water, as a rule, though of course they varied in some places.

At mid-day on the 23rd we reached a small cataract 2 feet high, and 2 miles further on came to a very large sloping cataract, 10 feet in height, which we ascended with difficulty. We had no Indian guides, so that the name of falls and branch rivers were unknown to us; consequently, when on the 24th we came to a fork of the river, we were unable to decide which was the Siparuni and which the branch, and therefore took the one to the right hand. From this on, the branch we followed was full of rapids, and diverted into small channels by numerous islands. One cataract which we passed was of considerable size, and the boats had to be unloaded and hauled up. After that the men were obliged

to work all day in the water with the tow rope, fo that from 12 noon to 5 p.m. we only went a distance of 4 miles. The water was turbid and high, and we greatly feared that if the rain ceased it would drain off quickly and leave us up there.

During the night of the 25th the water fell 18 inches, so I deemed it advisable to go on for half a day, and then return. From 6 a.m. to 9.30 a.m. we made only three miles on account of the numerous rapids and cataracts, and passed a high hill on our right hand; coming to a fall, part of which was over 3 feet perpendicularly, the other portion divided off by an island was sloping but very shallow. We were able to proceed only a quarter of a mile farther, when a large fall completely stopped us. I there ascended a small hill on the right hand to examine the rocks exposed; after which we returned down river, and such was the force of the current that by 4 p.m. we reached the fork of the river, and turned up the left-hand branch. After going a short distance, we saw that it kept its full width, had no islands or rapids, and was in fact the Siparuni river.

Not far up we passed a continuous range of hills on the east bank of the river, ranging from 300 to 500 feet in height, above the general level of the country, which here averages 300 feet above the sea.

We had rain nearly every day after leaving the settlement up to this period, and found that the Siparuni was rising, its water in this part being almost up to the level of the top of the banks. The trees along the river's sides in its upper course are extremely high, and all the surrounding vegetation is dense and luxuriant.

On March 1st, we came to another fork, and again took the branch to the right, it being the larger of the two. Next day we had a long rapid to contend with, occupying at least half a mile in length of the river; the overhanging branches of trees on one side had to be cut away, and the boats to be hauled up close in shore by their tow-ropes, which occupied us the whole forenoon. From this on the river narrows very much, and many large trees have fallen across it from side to side, most of which lying under water we could just pass over them without the boats touching. We ran some risk in proceeding further, for if the water fell a little these trees would have to be cut through; in that case, as they are extremely hard, it would be no easy task and would waste much time.

Early in the morning on the 4th we came in sight of a high mountain range having a perpendicular face of rock to the north which I judged to be 1,500 feet in height. After this we passed several isolated mountains, and almost every long reach of the river disclosed other mountain ranges. In the afternoon of the same day we reached the highest navigable point on the river, all further progress being barred by a fall of six feet high, composed of sharp angular rocks, having a very slight slope, and no depth of water between the rocks in which to haul the boats.

All the way up this river we expected to meet with Indian villages from which to procure guides and provisions for the land

journey, but were disappointed. There were numerous signs of Indians having travelled up or down very recently, and also of their having travelled frequently, for there were numbers of old camps, and the rapids and cataracts had well beaten paths round them. I had no other course left to pursue but to return, ascend the Burro-burro river, and from the head of it cross over to the Potaro. This I knew, if it could be accomplished, would show me more of the country than in crossing from the head of this river.

The Siparuni runs a very tortuous course, winding from Maringdouk Falls, first south-east, then north-east, east-north-east, north, and finally east-north-east to the Essequebo.

We were three days getting down to the mouth of the Burro-burro river, and on the morning of the 9th commenced our journey up it. My boats not carrying sufficient stores for the three months' consumption, I was obliged to leave part at the penal settlement, and now sent back one boat, the "Waramambo," for it, giving the crew orders to ascend this river on their return till they met with us. Continuing our journey with one boat we met two "woodskins" containing six Macusi Indians, who told us that in one day's journey we would come to their village. We met with a few small rapids, and found that the river was falling rapidly.

A little after mid-day on the 11th, we arrived at the village landing, and walking a mile inland came to the village of Marepowta. There were only three men there and two of them were ill. The owner of the place promised to guide me up the river, if I would wait two days till two men and his son, whom he expected, came; to which I had to consent. At the village I learnt the names of the falls on the Sipuruni and of the two large branch rivers I had seen.

On the second day the expected people arrived, and on the third we started, the Macusi Indian and his little boy going in a woodskin to act as guides. The banks of this portion were well wooded with mora and greenheart.

We reached a fork of the river in two days' journey from Maripowta, and took the branch on the right hand in order to get woodskins at a village there. This is called the Siparie-paru, the other being the continuation of the Burro-burro. The river narrowed rapidly as we ascended, and many soft wood trees which grew on both sides spread their branches to the middle of the river, almost blocking it up, so that we had to cut our way through them in many places. We had also had to cut through five large fallen trees called "Tacoobas" which delayed us considerably before we finally arrived at the village landing, where we had to remain for one day to get the four woodskins which I hired fitted with new bush-rope ties and bark caulking. Next day we descended to the junction of the Siparie-paru and Burro-burro, bringing the woodskins down also, and landing all our stores, made a permanent camp. Selecting the food required for the use of the men and myself, we placed it in the "woodskins," and leaving two men in charge of the boat and stores to await the arrival of the "Waramambo," we started up the Burro-burro the same afternoon.

My party now consisted of four boat hands, the interpreter, cook, and Macusi guide.

The river from this on became very small, and the number of fallen trees lying across it, under which we had to pass and wind amongst, impeded our progress considerably.

The following day we passed a high mountain on the south side, and at the same time another on the north.

At 10 a.m. on the 21st we passed the mouth of the Surama, a small branch of this river, coming in from the south, near which the banks of the Burro-burro become high, and there are a few sand beaches at its bends. A quarter of a mile beyond the Surama we came to the landing of a Macusi village bearing the same name and went to it. It is prettily situated in the midst of a beautiful undulating savanna, about three miles from the landing. Along the greater portion of this river, from the Siparie-paru there are groves of a small kind of bamboo lining its banks and hanging in festoons over the water's edge. This change in the vegetation opens up the river, relieving it of its usual gloomy aspect when overhung by tall trees.

From this place I sent back three woodskins, with a man in each, to the batteau to bring up provisions, while I went on with four men as far up the river as possible. After going four miles we came to a number of huge granite blocks, almost shutting up the passage of the river, the water running through narrow channels between and beneath them, which being too narrow for the two "woodskins" to pass through, they had to be carried over a distance of 20 yards, while each article forming the load was handed from man to man across with great difficulty. At noon the guide was taken very ill, and being unable to go on we all had to encamp.

The following day we continued our journey amongst mountains on either hand, and came to the first cataract, called Cartchieparu, near the mouth of a branch river of that name. During the remainder of the day we passed four more cataracts, before arriving at a village landing place. This is the furthest point that can be reached in "woodskins" at this season of the year, the number of small cataracts beyond and the shallowness of the water preventing further progress.

The next day I walked to the village of Archiecullock, so as to examine the structure of the hills along the path. This led in a westwardly direction near the river for a short distance, and then struck across the hills to the north-west. The first ascent of 400 feet was very precipitous, then it became more gradual until at the village the height was 900 feet above the sea. A fine view was here obtained of the valley of the Burro-burro river, looking west, which is narrow and closed in on both sides by densely-wooded mountains. All the surrounding country is composed of similar mountains.

We returned to the landing in the afternoon, and the following evening got back to Surama village landing, finding the men whom I sent back for provisions already there.

The Burro-burro is a comparatively straight river, and runs a general north-north-east course from its source to the Siparuni.

The next day (26th) I went a short distance up the Surama creek and found it too narrow and with not sufficient depth of water to enable a "woodskin" to go far up it, and returned to Surama village, at a height of 305 feet above the sea.

On Monday the 28th I again sent down three men with three large "woodskins," in which were stowed three smaller ones, to my boat, to bring up supplies and men from the "Waramambo," which I expected would by this time have arrived in the river below. At the same time I started off with a guide, the interpreter, and my cook, to explore the country between this and the Rupununi river at Annai. Leaving Surama village, we went in a south-westerly direction over an undulating savanna surrounded by forest-covered hills on all sides with the exception of that to the east, where the wooded plain reaches to the Essequebo river. Rising from this great plain are four high isolated mountains in a line between Makarapan and Maccari mountains. Looking from north-east to north-west, a wild, rough, mountainous country, clothed with dark green foliage, meets the eye, and to some would bear a rather monotonous, unpleasing aspect. But glancing from this to the cheerful little savanna at its foot, with an Indian village prettily situated in its midst, one perceives how nature can bring extreme types of scenery together, the wild and the peaceful, without the dark character of the one marring the still beauty of the other, but by which both are rendered pleasing alike. We soon passed over the savanna and into the forest beyond. Crossing a small river called the Perparu, a tributary of the Surama, we passed through the village of Poropo, and going in a more southerly direction to the Paracooba river through another village reached a third Indian place, called Paloureouta, at 4.50 p.m., after 7½ hours' walk.

Next morning, at an early hour, we started in a southerly direction, and crossed some low ridges forming the watershed between the Burro-burro and Rupununi rivers. Early in the forenoon we emerged on a fine savanna surrounded by grass-covered hills, lying east and west, through which the path led westwardly out to the head of the Rupununi savanna, and then in a south-east direction to Annai village, where we arrived in the afternoon.

We left Annai next morning, on our return to Surama, and, proceeding in a north-east direction, passed through a gap in the hills, and came to a savanna extending eastwards. Passing over some low ridges in a northerly direction, in the forest, we crossed the Cuyariye river, now only a chain of water holes, and ascended several ridges, the highest point of which was 650 feet. At 2.30 p.m. we struck the path between Surama and Peropo, and at 5.30 p.m. arrived at the village of Surama.

The succeeding day I went to the landing, getting there just as the "woodskins," containing stores from the "Waramambo," and 11 men arrived. As all the stores could not be brought up, I sent back two hands in a "woodskin" to fetch the remainder, and set

all the other men to work to make "cartouries" to carry their packs in for our land journey. The palms from the stems of which these are made were very scarce about there, and much time was taken in searching for and getting them.

The next day (April 1st) the men had all their cartouries made, and on the 2nd, the "woodskins" having returned, all the stores were packed up in loads of 25lbs. each, and one assigned to each man. I had some difficulty in procuring guides, but succeeded at last in getting three Indians who would take me as far as they knew the path, and then return.

On Monday morning, April 4, at an early hour, we started on our journey with the intention of travelling on foot from this to the Ireng river, and passing to the west of the heads of the Burro-burro and Siparuni rivers in a northerly direction, to reach the Potaro river and descend it. I would thus be able to examine both geologically and physically a large tract of country which I believed to be totally unknown to all except Indians.

My party consisted of 11 of my own men, the interpreter and cook, and three Macusi Indians. Taking the same path as I had done in going to Annai, we reached Peropo village, where I got another Indian to accompany us, to relieve some of the men who were carrying extra heavy loads. We passed over some low ridges after leaving the village, and through two villages, coming to a fourth on the Taramu river at 3.30 p.m., where we put up for the night. The country passed over next day was at first comparatively level, and covered with trees of the usual thin growth observable in savanna groves. The path then led westwardly up the valley of the Taramu river, almost to its head, about 775 feet above the sea. By 9 a.m. we had crossed this river five times, and then began to ascend gradually, where it became a mountain stream full of rocks and pebbles. At 2 p.m. we came upon a small savanna bounded by bare hills, which we crossed, and ascended a rough, forest-covered hill, and along its level top, till at 4.30 p.m. we camped near a small water-hole at a height of 1,225 feet.

Leaving camp at 6.20 a.m. next day, and descending a steep, rocky mountain side, we came out upon a small level savanna, surrounded by grass-clothed hills. I soon recognised the place, having crossed it on the way to the head of the Mora river last year. After two hours' walking we came to Itabay village, and after procuring some provisions, went on again in a westerly direction, camping for the night near the valley of the Uorora river. Next morning before breakfast we walked up the valley of the Uorora, and ascended the steep mountain side, a sharp climb of 1,500 feet, and found ourselves at the village of Quonga. We were detained there all the afternoon, waiting till the chief men of the village returned from their fields, in order to induce some of them to guide us on, our present guides not knowing the path beyond this.

Having procured two men, we started on next day down the mountain to the river in the valley below, then along a path, from valley to ridge, over a fine open country, through which flowed a good-sized stream, named Carapowta, a branch of the Ireng, and

then onwards in a north-north-west direction to the village of Cara-cara, where we arrived at 4 p.m.

Next day I left the men at the village, and went on with the interpreter and three Indians belonging to the village to the Ireng river. Leaving the village, the path led south-west over a mountainous savanna country near by a mountain called Wyetipu, some 3,000 feet high, near which flowed a stream called Mataparu. Crossing this, we ascended a very steep, wooded hill, and on down to the Ireng beyond, coming on it at a fine fall called Carona. It consists of a number of cataracts formed by the water rushing down a large rocky slope over huge broken blocks to a large dark pool below. There was very little water in the river but in the rainy season it must be of considerable size. It spreads out amongst rocks to a width of nearly 200 yards, and on both banks are high wooded hills. The level of the river is 500 feet at this spot, and the hills rise 500 feet more. It took us four hours' quick walking to get there and the same time to return.

On Monday morning (11th) I sent six hands on their way back by the path we had come to the Burro-burro, to take the two bateaux down to the Essequebo, and then on to Tumatamari cataract on the Potaro. I gave orders for them not to leave the mouth of the Siparuni till the 20th, in case we should be unable to get beyond the head of that river, when I would be able to descend it, and join the boats there.

I then continued my journey with a party of seven of my own men and three Indians, one of the latter being a man from Cara-cara village as guide. We proceeded in a north-east direction up a steep mountain all covered with forest. Hitherto we had fine weather, but on this forenoon a light misty rain was driven before the north-east wind, which loaded the trees and undergrowth with moisture, making the walk very wet and disagreeable. On the top of the mountain (2,180 feet high) there was a large field of cassava belonging to the Cara-cara village people, where there was a hut in which we were forced to take shelter from the inclemency of the weather for a time. Descending some 400 feet from this, we came to the Awarapearu river in a valley below. This river runs into the Ireng, and passes not far to the westward of Cara-cara. Crossing this valley up a gradual slope, all in forest, we came at 1 p.m. to the village of Coniapeur, and continuing down an extremely steep mountain side to a level forest-covered plain below, came to the village of Tarawa at 4 p.m., on a large stream of the same name. Our course from the Awarapearu was almost due north.

Looking from the village in a north-north-east direction, a considerable extent of country is visible from the forest around the houses having been cut down, disclosing a flat-topped range of savanna mountain with a steep escarpment. Not far from Tarawa, on the following morning, we came out of the forest upon a fine mountainous country, disclosing most extensive and magnificent scenery in every direction, of that grand and varied description upon which one's eye could never tire resting, and of which no

pen could convey an adequate idea. Away in the distance, in the direction of Roraima, were mountains of all shapes and forms, some with sloping peaks, others having truncated tops and flat table-shaped summits of a delicate cobalt-blue colour from their great distance. Then heaped up, and packed one behind the other in strange yet beautiful confusion, came mountain after mountain; between these and the foreground stretched in front of us was the valley of the Ekilebar river, lying east and west, and opening to the Ireng river valley a few miles to the west, while beyond it came the great flat-topped range (spoken of as being seen from Tarawa village) called Tawailing, now looking so close that I imagined that a walk from this spot across the intervening valley to the top of it and back would only consume a few hours, but the Indians assured me that it could not be done in one day. The Ireng valley can be traced for some distance coming in an east-south-east direction. I cannot imagine a finer view of mountain scenery, nor one with more varied tints and richer colours than the one here displayed.

The Indians said the Roraima could just be seen from the highest part of Tawailing. About 500 feet of the escarpment of this latter mountain is composed of a perpendicular face of white and reddish white sandstone beds. In the direction from which we came the dark masses of mountain are all covered with trees.

Two small villages relieved the deserted appearance of this valley. We stopped a short time at one of them named Quarquia for shelter from the rain. This village is 1,335 feet above the sea, and from it the path descends into the Ekilebah valley, and traverses it due north to the foot of the sandstone escarpment, 1,004 feet above the sea. This we reached late in the afternoon, and resting a short time pushed on up the mountain side, to try and reach the village above. After a climb of an hour's duration, we got to the village of Mowarieteur, right on the brink of the mountain in a most exposed situation, having ascended just 1,085 feet in that time. Night had almost closed in as we got there, and the wind blew strong and cold upon us heated as we were by our fatiguing climb.

This mountain is separated from Tawailing by a deep gorge, cut out by the Ekilebar river.

Half an hour's walk on the following day beyond Mowarieteur brought us to a large village named Owenteik, where my Indian guides left me, they having agreed to come thus far not knowing the country further on. The people of the village wanted me to remain until the chief man of the place returned he being away hunting. As I would not hear of this delay, they tried to throw all sorts of obstacles in my way, such as the great difficulties of the route to the Potaro, and of the immense distance to that river. After about two hours' delay and much talk I at last induced three men to carry the loads of the men who were going back, and act as guides to the next village.

Owentick is about 150 feet higher than the last village, and being situated on the open mountain, a fine panorama of savanna

country is unfolded before one, ranging from west to north. The chief features in this scene are an extensive undulating plain, surrounded by mountains on all sides, and traversed by the Ekilebar river. The surrounding sandstone mountains add greatly to the beauty of this picture by the pure white red or pink of the faces of some of their cliffs.

After leaving this place our course lay east-north-east down the mountain to the great plain below. We had to wade across the Ekilebar river in some shallows near a pretty fall, and then continued along the plain for a great distance till we came to a Macusi house, called Encaco, late in the afternoon.

Passing westwardly to the next village occupied only half a day, and was over an extremely rough open country, our walk terminating at the foot of a high tree-covered mountain. Here again I had to wait for a long time to make arrangements for men to accompany me on, and as I got a large quantity of cassava here, I wanted four Indians to make up my full number, as those I got at Owenteik were going back. None of the people of the place could come they said, as they were going to travel down the Siparuni river, and cross over by Akaiwanna path to the Demerara river; but the chief man sent on to a village close by and got some men to come over and promise to go with us. These went back to their village to get ready for the journey, agreeing to take us to the Potaro river, starting on the following morning.

It was 11 a.m. before they eventually came. After starting we proceeded along a terrace formed by some sandstone beds, and cut up by small watercourses, which run down from the mountain on the left. This terrace soon widened out into an extensive table-land as we passed the end of the mountain, and then became covered with forest. That night we reached a village called Elechiliqua, and took up our abode in one of the houses for the night.

Next morning we started at an early hour, and the path led almost due north up an ascent which was (by aneroid) 2,800 feet above the sea. At 10 a.m. we crossed a small stream called the Saranieparu, which, much to my delight, was said by the guide to be a tributary of the Potaro river. At 3 p.m. we came to the edge of the mountain, and were just 3,135 feet above the sea. From this spot glimpses of a large valley lying north-north-east were obtained. We had been walking in forest all day, and as far as could be seen all the valley and mountains on either side were well wooded. Descending to the Emoy river at the foot of the mountain we camped.

The next day—Sunday 17th—we continued on our journey close along the Emoy river, and then on along the Arnick, of which the former is a branch, to a rising ground, having walked in a northerly direction all day. On the top of the rising ground we emerged upon a small undulating savanna, covered with high coarse grass, and at 4 p.m. we came to a large village, most prettily situated near a grove of graceful Parapee palm trees. My first inquiries were as to whether we could get woodskins on the Potaro

river to go down in and was answered in the negative. Then the guide arranged with the villagers to send a man to the next village, which was a day's journey from this and close to the Potaro itself, to see if they had any. We required some cassava bread to be made, and so had to remain at the place for it, and for the man who went to the next village to return.

From Taiepong (the name of this village) looking west, a long distance off, a high mountain range is seen, then comes a gap, and beyond a flat-top mountain, having a precipice to the north, off the end of which is a high peak. The flat-top mountain is called Salieng, it bears north 64° west from this. Ayangeanna mountain is hid by the high mountain range, and its position as pointed out to me bears south 80° west from this. The sources of the Mazuruni, Potaro, and Ireng are supposed to be in this mountain. The whole of the Taiepong savanna is surrounded by sandstone mountains, not rising very high above it. I regard this tract of country as a rough table-land, of an average level of 1,900 feet above the sea. Looking north-west through a gap in the mountain, an escarpement facing north-east of this table-land appears, the foot of which is on a level with a second plateau, on which runs the Potaro river.

I could get no satisfactory answers to my questions as to the number of days it would take us to descend to the mouth of the Potaro. Some said six days, others ten, whilst all agreed in the statement that a very large fall, above which we would have to leave our canoes and walk to a village below to get others, would delay us considerably. I consulted my men as to the feasibility of making a raft out of pump or other light wood on which to float or pole down the river in case there were no "woodskins" to be got.

We had now been some days out of salt provisions, and were living almost entirely upon cassava bread, owing to the great scarcity of game in the immediate neighbourhood. To go back by the way we had come under such circumstances meant starvation; to go on by raft if no "woodskins" could be procured would certainly be easier work than walking for hungry men; so the proposal of raft making was favourably received. Just before dusk, however, on the evening of the 19th, the messenger returned with the good news that there were "woodskins" at the village he went to. But as there was a great drinking festival going on, he said it was no use for us to go there, as we could come to no arrangement with the people till all the drink was finished. A man who returned with the messenger we sent on offered his services as guide down the Potaro to Tumatamari Fallo, where I expected to meet my boats. He spoke very fair English, and gave much information regarding the rivers and mountains of the surrounding district, together with their names.

He said that the Potaro had a very large fall not far up from this which effectually stops all further navigation in woodskins, and that there are paths leading to the Upper Mazuruni, Ireng, and Potaro heads from village to village.

On the 21st we left the village of Taiepong; walking westwardly we crossed the river Arnick, and at 3.30 p.m. came to an Indian house close to the Potaro river, at which we remained for the night. The whole day long the rain fell sometimes as a heavy downpour, sometimes as mist, making the ground sodden, the trees dripping, and the small streams swollen and turbid. More miserable and uncomfortable work than walking under these conditions cannot be imagined.

Early next day we went up a branch of the Potaro called Enapowou to the village where we were to get the canoes, and found a large assemblage of people, many of whom were partially intoxicated; they told us that on the following day we could have the "woodskins" but must wait till then. We were obliged to submit to this arrangement and wait till the following morning, when the canoes being ready and brought to us, we were once more afloat and with the stream in our favour descended rapidly all day.

Our food, consisting of cassava bread only, was served out all round, and each person ate his share when he pleased, which saved the time and trouble of having a general breakfast and dinner hour.

We had four small woodskins and one small corial, manned by my seven men and three Indians.

The river at the place from which we started was about 100 yards wide, and full to overflowing from the recent rains we had experienced. The water in it was of a dark brown colour. The forest lining the sides of the river was dense, but the trees were not so high as on the borders of the Essequebo river.

Here and there on the long reaches of the river high mountains are seen to the west, north-west, and south. The river at the place from which we embarked is over 1,400 feet above the sea, and this is the average level of the forest-covered table land before mentioned as the second plateau. Making a good day's journey we camped late in the evening about one mile above the great fall, the roar of which was distinctly heard.

Owing to the delay in sinking the "woodskins" in a small creek we did not get started till 7 a.m. next day, Sunday 24th, to walk round the great fall to the village below. Coming out on a small open savanna of a most rocky barren nature, we traversed it for nearly a mile before we came opposite the portion of the river containing the fall. The morning was cloudy and a heavy dense mist rose whirling above the edge of the precipice in the direction of the spot from which the heavy thudding roar of the fall sounded. As this mist rose above the edge it was caught by the north-east wind and blown over the place where we were, falling in the form of light rain upon us. I at first took it to be a rain squall, but soon saw that it was produced by the fall itself.

Passing through a low bush and over great square blocks of conglomerate, we emerged at the very head of this most noble fall. Here was presented a sight I never expected to behold and one that my feeble pen never can describe. Imagine a large river some 100 yards wide, and having an average depth of nearly 20 feet, emptying itself over the face of a precipice of about

900 feet in height into a great basin below in one clear white mass, and you can form some idea of the grandeur and magnitude of Kaisteur fall. Away from this leads a deep and narrow valley, lying north-east, in which the river runs smoothly and peacefully after leaving the turmoil in the foaming cauldron below.

Glimpses of the river in this valley are here and there obtained looking like silver bands midst the dark green foliage of the neighbouring forest. The end of the valley which has been cut back by the river, in the same manner in which it is still being cut back, is open, and the great forest plain of the Essequebo river is faintly seen in the distance.

Behind the falling water there is an enormous cave filled with mist, in and out of which through mist and spray large black swallows dart and circle.

To obtain a full view of the face and foot of the fall other than to lie flat on the rocks and look down over the precipice is impossible, for the heavy impenetrable mist before spoken of prevents one from seeing anything, if he went along the precipice edge on the west, further than some 30 yards from the fall. I now speak only of the time of day that I was there, from 8 to 10 a.m., when these conditions were in force. Perhaps later in the day the sun has power to turn part of this mist into invisible vapour, and so reveal more hidden beauties.

The dark green foliage of the forest on the river, and clinging to the bluffs of the valley's side, the pinkish and gray colours of the sandstone rocks on the right of where the water passes over, and the clear brown of the water as it turns the edge suddenly changing to dead white, are contrasts of colour which give extraordinary beauty to the scene.

As the water passes down it seems to move in masses, ever downwards, but never able to effect separations in the mass. Thus a downward movement which singularly draws one's gaze with it is produced, rendering a near approach to the precipice both difficult and dangerous unless in a reclining posture. Looking down on the river at the edge of the foam, where it regains its usual peaceful character, it looked like a small channel that one might almost jump over, so far down is it.

Making a slight sketch and examining the rocks occupied two hours. I never felt before that the want of ordinary food was such a hardship as when I tore myself away from this spot. But to delay here not knowing what distance we had yet to go before reaching the boats, and with but little cassava bread to live upon, was dangerous in the extreme; I had no choice but to push on and get as near the foot of the fall as I could. We therefore continued on the Indian path which led north-east through the forest, down the steep mountain side, and arrived at the river below at 3 miles from the fall.

I took the height of the top of the fall above the sea level with an aneroid barometer, and found it to be 1,375 feet, and the moment I got to the river, as just mentioned, I again took the altitude and found it to be 375 feet above the sea. This makes

the difference of level between the top of the fall and this place exactly 1,000 feet.

Now looking from the top down the river to this landing place, I could see no falls whatever, and the valley looked almost level. The Indians, however, say that there are some cataracts, so in giving my estimate of the height of the fall I allow 100 feet for all cataracts and inclines between the foot of the fall and this landing, which leaves about 900 feet for the height of the fall. These measurements I give as the result of my short and hurried investigations, and as such they must be regarded until future explorations determine them with accuracy.

Finding no "woodskins" at the landing the men went on to the village to get some, and returned with five at dusk. This was done because our hammocks, spare clothing, &c. could not be carried over at a branch creek between this spot and the village, across which the men would have to swim.

Next morning we went down to the village some four miles on, where I succeeded in getting two good "woodskins" large enough to take us all, and one small one for the guide. We had to remain here for the remainder of the day to get cassava bread for our further journey. The people would only promise to make a little as they were all going to take a long journey and required all they could make for themselves; of what they already had I could not induce them to part with a single cake. Thus I was obliged to give up all hopes of getting back to the foot of the fall to verify my measurements.

Next day we proceeded down stream and crossed two falls, named Waratu and Amutu, the first 3 feet and the second 20 feet high, over which the water falls almost perpendicularly. At both of these there is a "portage," and the woodskins and loads had to be carried over by the men. The length of the latter "portage" is 300 yards. From the village down to Amutu fall both sides of the valley in which the river lies are bounded by high sandstone cliffs and bluffs, which have gaps in them formed by branch streams, these latter form some beautiful cascades in their downward course over the cliffs.

In a few places in coming down, the upper part of Kaieteur can be seen from the river, but a bluff to the east of it hides the greater portion.

On the 27th we were delayed two hours in carrying the "woodskins" a quarter of a mile round a succession of small falls called Pacutou, and at 10 a.m. we came to another "portage" one mile in length, which took the men till 4 p.m. before the three "woodskins" and their loads were carried over. This "portage" clears a succession of falls named Cobanatout. We did not go far after loading the canoes again before we camped.

The following day we started very early and passed the mouth of a large river coming in from the north called Auriebrong. Far up this river the guide told me there are some large falls, and I strongly suspect that they, as well as the one far up the Potaro (before mentioned) will prove to be fine large falls.

At 10 a.m. we drew near to the Tumatamari cataract, and easily recognised it; landing at the end of the path we abandoned our "woodskins" and hurried over. Reaching the river below we saw on the opposite side at a fine sand beach the two bateaux and the men encamped close by. On our hailing them they joyfully responded and quickly brought the boats over, in which we all crossed to the sand beach, and were soon snugly in camp.

I felt truly thankful for having got with my party safely through the difficult journey I had undertaken, and reached my boats again. These boats had waited longer for us in the Siparuni than I ordered and being very short-handed had only reached here on the 25th.

We left the Potaro on the 29th, and descending the Essequebo, now swollen to within three feet of the highest point it ever attains reached the penal settlement on the 3rd of May.

I left the settlement on the 5th, and coasting down along the eastern shore of the river reached Leguan on the following morning, and arrived at Georgetown in the afternoon.

PART II.

Descriptive Geology.

1.—*Alluvium.*

The alluvium of this portion of the country has been formed at three recent periods, and may be divided into three deposits, viz.:—

(*a.*) Recent alluvium.
(*b.*) Fluvatile clay or river loam.
(*c.*) Valley gravels.

(*a.*) The recent alluvium has been formed, and is still being deposited, at the bends of the rivers and streams, and is therefore liable to changes in colour and texture from the different kinds of detritus contributing to its formation. Thus it is often reddish and yellow as well as dark-brownish black. This latter variety is the commonest and is often seen in the savanna valleys. It is usually of a fine texture and of an argillaceous composition.

(*b.*) The fluvatile clay forms the large plains through which the Potaro, Siparuni, and Burro-burro rivers run. Adjoining the Essequebo ond extending up to the Tupuru river on the Siparunie and the Surama on the Burro-burro, this deposit is composed of a stiff grayish clay, which in places changes to a yellowish or mottled red and yellow colour. It forms a gently undulating country. Beyond the points above mentioned it attains a slightly higher elevation, but is of the same structure.

The area occupied by this deposit is very extensive, and its slightly undulating surface is covered by a luxuriant forest vegetation.

(*c.*) Valley gravels. The Surama savanna and all the level tract between it and Paloureouta village, as well as many portions

of the valleys in the savanna mountain district, upon the quartz-porphyry, is covered with this deposit. It is composed of a yellowish arenaceous clay, containing blocks and pebbles of quartz, and is exactly similar to that on the Quitaro savanna. A coarse grass grows upon it in the open country, and it is not very fertile, in portions covered with trees; there are many places where the oil is extremely productive.

These three deposits have been fully described in the 7th Report, so that there is no necessity to repeat what is there stated.

2.—*Sandstone Formation.*

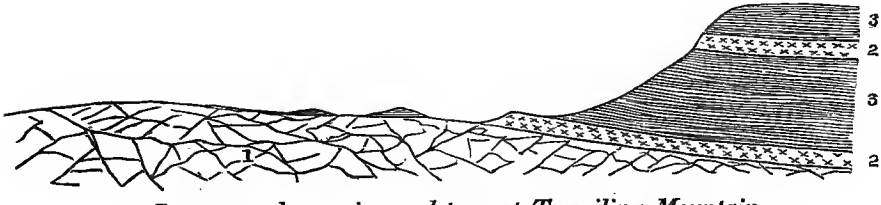
The boundaries of this formation in the portion of country here described are laid down on the geological map.

On the Takutu river, a branch of the Siparuni, beds of altered purple sandstone appear dipping north-west at an angle varying from 10 to 20 degrees. There is also a small isolated tract of light green chert, divided by jointing into small rhomboids, which is very similar to the beds of chert in the sandstone near Roraima. It appears to dip east at an angle of 5 degrees and I have no doubt belongs to this formation.

Between the village of Taramu and Itabey there are on a hill top blocks of rocks much resembling the sandstone, which are of a reddish yellow colour. Beds of sandstone occur on the mountain between Itabay and Quonga village, and also between the latter and Cara-cara. Again the upper portion of the Waitipu mountain, close to the Ireng river, not far from Carona fall, is composed of horizontal beds of sandstone forming an outlier.

In the valley of the Ekilebah river in that portion of its course traversed, after passing through the great gorge in Tawailing mountain, large blocks of the coarse pebble conglomerate (from this sandstone formation) lie strewn about at some distance from the foot of the escarpment which this great deposit always presents as its outcrop. Some of these have no doubt been washed down the mountain side, but many of the masses are *in situ;* and there constitute the base of the rocks of this period. Further on comes the sandstone escarpment below the village of Mowarieteur, where 1,085 feet of this formation are exposed. The beds dip due north at an angle of 5 degrees. Tawailing mountain west of this has a terrace of sandstene beds of 500 feet vertically, then comes its sloping portion, in which is a layer of greenstone.

No. 11.

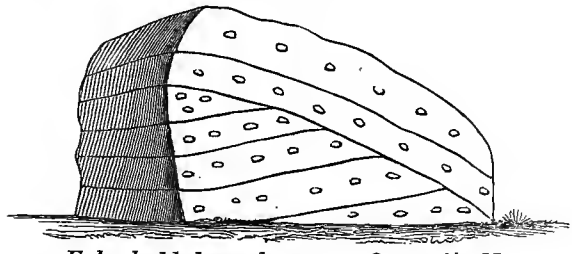


Greenstone layers in sandstone at Tawailing Mountain.

1. Quartz-porphyry. 2. Greenstone. 3. Sandstone.

On the top of the mountain at Owenteik village there are great square weathered blocks of coarse boulder conglomerate, exhibiting most marked and curious false bedding. This rock is of a pale

No. 12.



False-bedded conglomerate, Owenteik, V.

pinkish colour and continues for 100 feet down the hill; then comes hard beds of reddish standstone dipping north at an angle of 7 degrees for about 300 feet, and then appears a conglomerate again down to the level of the Chilebah river, of a thickness of 324 feet, making a total section of 724 feet. On the north side of the river, in the savanna, there is a group of these conglomerate beds which are jointed vertically in a curious manner and show some local disturbance. All the low hills and low ranges of hills on the western side of the savanna valley are composed of sandstone of various colours, viz., gray, white, pinkish, and red. The path led close past the foot of a range of low cliffs, the face of which had lately broken away disclosing a snow white patch of sandstone rock, which was visible at a great distance. Some dark red beds overlie these white ones, just beyond Encaco. Around this village this formation is represented by a development of very friable pinkish sandstone.

Passing west from this the sandstone is interstratified with red shale beds, which must occupy a considerable thickness of strata. These are overlain near Jackiquocki village by the hard, red, and white sandstone beds, which form a mountain facing east, and rising very steeply with a terrace of 200 feet above the river running at its foot, formed of a set of horizontal beds of hard red sandstone. They now cover the flat surface of the terrace on which the village stands, and at the edge of it they have been left piled together like a fortress, while the part behind them has been denuded.

Past the end of the mountain just spoken of the sandstone forms a flat table land partially of open country and partially of forest. The sandstone here is of a coarse texture and whitish colour, and contains many interbeded waterworn pebbles. It continues to the head of the Emoy river forming there a mountain 3,000 feet high, facing north.

The valley of the Emoy and Arnick river is composed of the white sandstone beds. Taiepong savanna near these two last-named rivers, and between them and the Potaro, is composed of white coarse sandstone and conglomerate, which is covered with white quartz pebbles from the decomposition of the latter.

Owing to the height of the water in the Upper Potaro river, at the time I descended it most of the rocks on its sides were covered so that only in one or two places I was able to examine them; they were all sandstone. Lying to the west of the Kaieteur Fall, at the little savanna there, the sandstone conglomerate forms almost horizontal beds of rock strewn with waterworn quartz pebbles. These same beds form the head of the fall and it is owing to their great hardness and the comparative friability of the sandstone underlying them, that this great work of nature has been produced.

There is no doubt but that this fall was at one time 10 miles to the north-east of its present position, and has during the lapse of vast ages cut its way back to its present position. Down the mountain side to the river below the whole distance is composed of whitish and reddish sandstone, containing scattered quartz pebbles. Below Kaieteur the river is a succussion of deep pools, which being full of water hid most of the rocks. In mid-river opposite the village below the fall the sandstone makes its appearance, and the edge of the table land on both sides of the river's valley is composed of horizontal or very slightly inclined beds of sandstone.

At the fall called Amutu the sandstone ceases, and the north-eastern extension of this great formation is obtained, ending abruptly with high bare precipices, and tree-clothed slopes.

The chief lithological characters of the sandstone formation may be thus briefly enumerated, viz., the base is composed of extremely hard cherty dark green beds of altered rock, the stratification of which is still preserved. Upon this comes hard beds of quartzose sandstone and conglomerate, often obliquely laminated, but of no great thickness, and then a series of white, red, pinkish, and gray friable sandstone beds, occupying many hundred feet vertically, being interstratified with beds of red shale. The highest portion is composed of interstratified gray sandstone and conglomerate. This formation presents a thickness of 1,200 feet at its southern outcrop, and 3,000 feet at its northern.

The minor divisions of the sandstone may be collected into two groups, an upper and a lower. The upper consists of 1,500 feet of gray sandstone and conglomerate, and the lower of white, pink, and red sandstone interstratified with red shales of 900 feet in thickness. Further westward at Roraima, as before stated, we have almost 2,000 feet of the upper and 1,000 feet of the lower division.

Most of the sandstone beds contain water-worn pebbles of white quartz and red jaspar scattered very irregularly and sparingly through them; even the soft white and pink beds contain these small round pebbles.

The conglomerate beds are composed of water-worn blocks and pebbles of quartz, cemented together by quartz and felspar grains of the same pinkish gray material as constitutes the sandstone. Generally they are so hard that when a block splits apart, the embedded pieces of quartz split evenly in two also with the frac-

ture. Both the upper hard sandstone and conglomerate exhibit false bedding in a most marked degree.

There are few beds of breccia on the conglomerate.

This formation overlies the quartz-porphyry and is intersected in numerous places by igneous layers.

The dips are invariably regular and gentle, and in the district now being described contortions are nowhere to be found. The angle of dip is usually from 5° to 10° from the horizontal plane. Indications of great faults are observable, but owing to the dense forest covering in those places they cannot be traced.

I was unable to discover any fossils whatever in the sandstone beds. In one piece which I procured there are circular discs, but in them no structure is visible. Some of the shale beds exhibit slight markings, which I am inclined to think are merely accidental. One small specimen shows the cast of some inequalities produced in a shale bed by a substance scraping over it when it was in a soft state just after deposition. It is, therefore, impossible to arrive with a degree of certainty at the geological age of this formation, but I think that one is justified in considering it to have been formed at the opening of the secondary period, and to be the equivalent of the new red sandstone of Europe.

This opinion has been arrived at after a close investigation of its lithological characters, which in some measure agree with those of the Bunter division of the Trias.

The sandstone is seen in different localities resting on quartz-porphyry, greenstone, granite, and metamorphic rocks.

3. *Quartz-porphyry and Felstone.*

This rock comes next in descending order to the sandstone, and occupies a large tract of country lying along the Essequebo, Potaro, Siparuni, and Burro-burro rivers; it also forms the greater portion of the Savanna mountains, between the latter and the Ireng river. Its outlines are marked upon the map.

Under this heading I have ranged three similar kinds of rocks, from the fact of their occurring in the same districts and passing one into the other. These are quartz-porphyry, hornblende, porphyrite, and felsite or felstone.

The first of these is composed of a compact matrix of felspar of a gray, black, or light greenish colour, containing imbedded crystals of felspar and quartz. The crystals of felspar are usually well developed, and of different colours, from white to light green and red. The quartz crystals are small and usually of rounded compressed forms, and of clear or opaque varieties. They are sometimes of a light yellow colour. In the greenish varieties, which are most frequently met with, the crystals of felspar are often only partially developed, and are in little round patches of a white colour, which passes gradually into the greenish matrix.

The fracture is smooth concoidal where not affected by the atmosphere, but where decomposition has commenced it is uneven, and the surface of the rock to some depth becomes soft and

assumes a white colour. On the Takutu, for instance, and also on the Siparuni beyond the Tupuru river, portions of this rock are decomposed for some 2 feet from their surface, becoming converted into a hard white kaolin, with the quartz crystals remaining unaltered. On the Burro-burro the porhyry occurs in two places, of a greenish to almost white colour, with clear crystals of quartz, arranged in the white variety in short wavy nests.

In the vicinity of granite or syenite the crystals of quartz die out, and the scattered hornblende crystals become more numerous, and range themselves in vertical planes and clusters, and so pass into hornblende-porphyrite.

These rocks have a vertical tabular structure, and have a tendency to split in long slab-like flakes. One of these flakes that I measured was 6 inches wide, 8 inches deep, and 4 feet long. They are irregularly jointed, and also extremely hard and durable. They contain nests and veins of quartz, but no other accompanying minerals.

On the Siparuni river, 3 miles from its mouth, the greenish quartz-porphyry, similar to that at Ouropocari cataract, on the Essequebo, is seen at a small fall, and the same rock occurs on the Potaro, at the island near its mouth. Not far below the Maringdouk fall on the same river, a very fine variety of the quartz-porphyry occurs which has reddish crystals of felspar in a black matrix together with black quartz crystals.

Opposite the Tupuru river mouth there is a development of the third variety of rock, viz., felsite. This rock differs from the quartz-porphyry in having no crystals contained in the felspar base or matrix.

Near the old village of Amo the granite passes gradually into the hornblende-porphyrite and then into quartz-porphyry. From the landing above this to Archiecullock village, the hornblende-porphyry forms the whole of the hills, and is composed of white crystals of felspar and green crystals of hornblende in a gray felspathic base. On the Taramu river there is much of the black variety of quartz-porphyry, containing but few quartz crystals; while onwards from this to Quonga both the greenish variety and the horblende variety form the whole rocks appearing at the surface. From Quonga to Cara-cara village the mountains are all formed of hornblende-porphyrite. The Carona falls on the Ireng river are also composed of the same rock, in which the felspar crystals are of a reddish colour; it is there jointed at right angles, and breaks up into regular cubes. Between this and Cara-cara village the quartz crystals again appear in this rock, to the suppression of the hornblende. From Cara-cara to the sandstone outcrop at Tawailing mountain, the whole country is formed of quartz-porphyry.

At Pacutou fall on the Potaro river there is a development of hornblende-schist which contains small veins and nests of quartz. The quartz-porphyry appears below Tumatamari cataract and also below Cobanatout falls.

Owing to the height of the water when I descended this river (Potaro) most of the rocks were hidden from view.

The surface of the country presented by the quartz-porphyry is usually extremely rough and picturesque, being composed of rough ridges and mountains, with huge masses of rock protruding therefrom of tabular shapes, and with jagged pinnacles.

On the plain of the Essequebo river this rock has been planed down, no doubt by marine action, and forms undulating tracts covered with forest; but in the elevated districts where no trace of this is observable it forms a rough grass-covered country, interspersed with patches of forest, presenting fine pictures of wild scenery.

Strewn over this porphyry are patches of quartz blocks and pebbles, most of which are but little water-worn. They have probably been derived from veins in this rock, and belong to the valley gravel deposit.

This porphyry is of plutonic origin, and has never been found of a later age than the Permian epoch.

4. *Gneiss.*

Gneiss occurs in only two places in the district; these are near the mouth of the Siparuni, just above its junction with the Burroburro. It is there associated with granite, and is similar to that on the Quitaro river, described in a previous report.

A small development of hornblende rock occurs not far from this gneiss.

5. *Granite and Syenite.*

Granite becomes a surface rock in only three places, viz., just below the Pacutou falls on the Siparuni, at Surama, and between Itabay and Quonga.

In the Surama district it is the northern extension of the same rock from Makarapan. It is in all three areas of a grey variety of rather coarse texture, having white felspar, dark green mica, and colourless quartz. In the Surama area there is also much syenite associated with it which is also of a coarse texture, and the minerals composing it are white felspar, clear quartz, and green hornblende.

Between the last-named place and Annai the syenite is traversed by dykes, and pierced by bosses of greenstone.

6. *Igneous Dykes and Masses.*

In many portions of the districts surveyed these rocks have pierced through syenite, granite, gneiss, mica schist, and quartz porphyry and form layers in the sandstone, and point to periods of great igneous activity over these areas. From the diversity exhibited in the texture, &c. of these rocks in different localities, it is difficult to regard them as all of one age. Some are contemporaneous with the porphyry, and others more recent.

The difficulty of distinguishing the various kinds of felspars contained in these rocks, whereby they may be separately determined, renders it impossible to classify them properly without examination.

Greenstone or diorite of a porphyritic texture is the commonest form under which they occur. Thus over the quartz, porphyry, and sandstone areas this rock is chiefly seen as dykes many feet wide, and as mountain masses at the head of Emoy and Arnick rivers, and at Comudi mountain on the Essequebo.

All the localities where dykes occur are marked on the map, and a few of them may be here enumerated. The cataracts of Tumatamari and Maringdouk are composed of a coarse crystalline greenstone. Not far from Cara-cara village to the westward there is a large dyke of greenstone, and a larger is seen at the sandstone outcrop at Tawailing mountain. At the highest point of the mountain, before descending to the Emoy river, the coarse greenstone rock there exposed is of grayish colour and of extreme hardness.

The soil on the surface of these rocks is of considerable depth, and always of a red colour from the sesqui-oxide of iron in it. It also contains round concretionary pellets of iron clay, and the whole is derived from the decomposition of the rock itself.

PART III.

Economic Geology.

There are no minerals or metals of any economic value in the portions of this district that I have traversed, as far as I can discover.

Some of the beds of sandstone are admirably adapted for building purposes, but their distance from the coast is so great that it is a matter of doubt whether they will ever be of any value.

REPORT No. 9.

Geological Report on the district bordering on the Curiebrong, Ireng, Takutu, Rupununi, and Upper Essepuebo Rivers.

By Chas. B. Brown.

1871.

CONTENTS.

PART I.

Physical Geology.

I left Georgetown on the morning of the 3rd of September 1870 in the Revenue cutter, and arrived at the penal settlement on the evening of the 4th. At that place I was delayed two days in getting crews for my boats and making other preparations for the journey. On Wednesday, the 7th, I left the settlement with two new bateaux manned by 16 men, carrying stores for three months' consumption for one boat's crew, and two months' supplies for the other, and commenced the ascent of the Essequebo river for the fifth time. Landing near Arissaro mountain I ascended and explored a portion of it, which occupied one part of a day, and then resumed my journey, reaching the Potaro river on the 14th, and Tumatamari cataract a few hours later on the same day. The river below the cataract was very much lower than it was on the 29th of last August, while above it was some 4 to 5 feet lower. The south side of the cataract contained no water, the whole river now precipitating itself by three channels over a succession of steps on the north side. Upon my first visit to this cataract in February 1870 I noticed the absence of all water plants usually seen growing upon the rocks of cataracts, but now observed that a small *lacis* was growing upon the rock surface under water or those that had

been lately covered by the river. My object in again visiting the Potaro was to proceed up its tributary, the Kuriebrong, for the purpose of examining the great fall on that river, which the Indians had assured me was as high as the Caieteur.

During the afternoon of the 14th I had all the requisite stores for three weeks' consumption packed up, and the crews, 12 men in all, told off for the provision boat "Ataraipu" and the woodskin, which we had hidden near this cataract in August last. The "Ataraipu" is a strongly built boat, 28 feet long and 5 feet wide, with Mora timbers, and yellew silver bally planks. With a staunch boat like this, and the experience that we had gained in ascending large cataracts, we had little difficulty next day in hauling her up empty in a passage in the middle channel. By 3 o'clock in the afternoon of the same day we entered the mouth of the Curiebrong river and ascended it for some six or seven miles before the approach of night compelled us to camp. This river was low, and had its channel obstructed by sand shoals covered with a coarse light green reed-like grass which produced numbers of small rapids.

On Friday, 16th, we reached the Indian village where I had been in August last, and found the owner in readiness to act as guide onwards to the fall as he had promised. He agreed to meet us above the cataracts next day by taking the path across whilst we followed the river. Leaving the village we regained our boat, turned a quick bend in the river to the north-east, and came to the foot of the first cataract, at which place the river ran with great force being narrowed by massive syenite rocks to about 30 feet in breadth. Round the next bend, northwardly, we came to the second cataract, a much more formidable one than the first, being 3 feet in height and having a steep slope; there we had to unload the boat, convey the stores over the rocks, haul up the boat and reload above. Next came some rapids, and then a sloping cataract 4 feet in height and only 20 feet wide, the water rushing over with such force that we were compelled to place skids amongst the high rocks, and after transporting the load to haul the boat on these across, a distance of 13 yards. This cataract was succeeded by numerous rapids, where the rock sloped evenly to the water's edge and enabled the crew to tow the boat along for a considerable distance. The course* of the river there was north-north-east, and the next bend was still more to the eastward; there we met the fourth cataract which we ascended, and not far on came to the fifth.

Next day we resumed our journey, and our course was south for a short distance to a cataract composed of four steps, having a total height of 10 feet. There we found a portage, along which the stores were conveyed and the boat taken up in the water, but skids had to be used in two places. After this the river turned to the east, then north, and we passed the seventh cataract just where the river

* These and subsequent courses refer to the direction of the river in ascending it, and not to the direction in which the stream flows.

bent round to the westward. Beyond this we encountered one cataract and three rapids, and reached the landing at the upper end of the path before spoken of, meeting our Indian guide late in the afternoon. When I came to this spot in July last, I walked over this portage in less than an hour, and it now took us nearly two days of hard labour to follow the bends of the river round to the upper end of the same path, combat with eight cataracts and many rapids, and only gain in a straight line a distance of two miles. The forest trees on both banks of the river from the head of the cataracts onwards are low, and resemble somewhat the stunted growth of savanna bush, as no tall mora trees are to be seen.

During the whole of the following Monday we had smooth water to paddle against, and only one long rapid, but on Tuesday (20th) in the forenoon we came to a high cataract, called Mona by the guide, produced by a great mass of greenstone which completely obstructed the bed of the river, reducing it to two narrow clefts that one could jump across, and through which the water ran with great force. There we had to proceed as hitherto, by unloading, placing skids and carrying everything over, and thus were delayed considerably. The river above Mona cataract was still and pond like for about 1½ miles, and then came a succession of five cataracts, in granite rock, at each of which the boat had to be unloaded and hauled up as usual, and at the last, skids had again to be used. Not far beyond we passed a small cataract, at the foot of which in the strong current the woodskin in which were the guide and his companion got swamped and went to the bottom. Above this cataract there was a village prettily situated at the end of a bend of the river where we landed and took up our quarters for the night. Wherever cataracts occur in this river, it becomes extremely narrow as before stated, but when still water is reached above them, it is found to open out to its full width of 80 yards.

The next day (the 21st) we hauled up four small cataracts and three rapids produced by grass covered sandbands, through which the river ran in narrow channels choked with grass, the roots of which gathered the sand and mud, forming a kind of dam. At 3 p.m. we reached the landing at the foot of the table land, from which a path leads up to the Curiebrong river at the head of the fall and there encamped, after examining the river as far as we could get beyond. There the foot of the mountains comes close to the river, and its bed is so studded with enormous boulders of conglomerate that all further progress by water was completely prevented.

On the following day we started to walk to the top of the fall at 8.30 a.m. along the path used by the Indians of the district. This path was extremely rough and led in the forest up a steep slope westward for some distance, then southward along the hillside for a mile or two, and then westwardly again up the mountain, at an exceedingly steep angle, to the top of the table land. From the edge of the table land, at a height of 1,200 feet above the sea, there is a splendid view out of the mouth of the valley between the table land mountains, disclosing an immense forest-covered

plain as far in a north-east direction as the eye can reach, traversed by a low ridge running south-east and north-west, together with a few isolated hills scattered here and there. This ridge crosses the Curiebrong river at Mona cataract. After pausing a time to enjoy this view, we continued our walk for about two miles in a south-west direction, and emerged from the forest at the junction of the Amailah and Curiebrong rivers, just above the fall, and at a spot facing the course of the latter river. The bed of the Curiebrong there lies in a north-westerly direction, and is joined by the Amailah river coming from the west-north-west; it turns abruptly in an east-north-east direction, in a line with the mouth of the latter river. Looking up the Curiebrong from this spot there is no water to be seen, only a long slope of flat conglomerate beds, dipping slightly in a north-west direction, with a step or break here and there, and with a slight anticlinal curve, giving the centre of the bed of the river a higher position than the portions on each side. These rocks are covered with the dry withered remains of a large and beautiful water plant—a common inhabitant of such localities—and are cracked and channelled in various directions by the water, which, now that the river is extremely low, only rushes through these to the head of the fall, or lies in deep pools and basins amongst them. The greater portion of water runs close to the western side, and mingling with the water of the Amailah river, turns abruptly eastward in a deep and narrow channel having the same direction as the latter river, and arriving at the eastern side of the Curiebrong, falls over a step of rock 27 feet in height and 24 feet wide, continues down a sloping channel of similar dimensions for a distance of 100 feet and is then precipitated over a perpendicular precipice of 144 feet in height, with great force, falling on the corner of an enormous slab of conglomerate. The water falls with a curve in the usual inverted rocket form of a fleecy white colour, and coming in contact with the rocks below, shoots off in various directions, producing a small cloud of mist, entirely disappearing amongst the immense blocks of conglomerate down a steep inclined plane to the level of the river below about two miles off, having descended from a level of 1,280 feet above the sea to that of only 100 feet. The edge of the top of the fall is quite straight and is 110 feet in width. In the rainy season it attains much greater proportions, with regard to breadth and volume, than at present, and then I imagine must almost cover the blocks in its bed below its foot and present a very grand sight. At two or three other places along the full width of its top edge small rills of water that have traversed subterranean passages pour over and add greatly to the picturesque appearance of this fall. One of these near its extreme northern side, the main fall being on its southern, pours in a column of about 8 inches in diameter through a circular aperture in an overhanging slab, and has an exceedingly curious appearance. This aperture has been produced by a hard block settling in a slight depression on the surface of the spot, and grinding through a space of some two feet or so by a circular motion communicated to it by the

running water. Hundreds of these circular holes and basin-shaped cavities are to be seen in the beds of rock above the fall some of which are from 8 to 10 feet deep, and over 5 feet in diameter, and still contain the remains of the blocks that have cut them in the shape of small boulders and pebbles at their bottom. After taking all the measurements of the fall with a line and tape, I descended with little difficulty to its foot, and followed the bed of the river downwards for a considerable distance, climbing over and under the confused heaps and blocks of rock. After exploring that portion I returned to the head of the fall, and camped in the forest near its edge late in the afternoon.

This fall is called Amailah by the Indians, after the river of that name before mentioned, but the word has no particular signification. A particularly atrocious spirit is said by the Indians to reside under the fall whose form is that of an eagle.

The perpendicular faces of rock and the blocks in the river's bed below the fall are of course void of vegetable growth, but all around, where trees and shrubs can gain a footing, they are seen of the densest growth, luxuriating in the moisture that arises from the spot. On the north side at the foot of the fall there is a small low cave into which I crawled with two of my men, but owing to the darkness we could not see its full extent. A small flock of the same large swallows as are seen at Kaiteur fall, find a roosting place here also.

I was extremely disappointed at the small vertical dimensions of this fall, having put full confidence in the Indian account of it as related to me in July last, on the Potaro, never dreaming that their estimate of the comparative heights of two objects would turn out so absurdly disproportionate. That this is not a great perpendicular fall like the "Kaieteur" may be accounted for by the fact of its not containing a sufficient body of water to pound up and carry away the very hard and conglomerate rocks which it has cut through, and which form a bed 100 feet in thickness. When it first cut into the gorge for a few miles it cleared away this rock as it cut downwards, but from that, up to its present position, it has been filling up its bed with great boulders.

After two days spent in exploring we left Amailah on the morning of the 24th, and descended the mountain to where we had left our bateau, got everything on board and commenced our return journey to Tumatamari. We landed at a village close to the Warerie river, and from it had a fine view of the table-land mountains, disclosing a ravine to the westward of that of the Curiebrong, which the Indians said was the head of a branch of the Semang, one of the tributaries of the Mazaruni river. At 6 p.m. we reached a village just above Pacutou cataracts, and remained there for the night; and on Sunday the 25th went on a short distance to the village of Patamong, where we remained till Monday morning.

The 26th, 27th, and 28th, with part of the 29th, were spent in descending the Curiebrong and Potaro to Tumatamari cataract, where I remained for three days awaiting the arrival of Mr. R. G. Pollard, who was to join the expedition for the purpose of

making collections of Natural History for the Museum in Georgetown. As, however, he did not appear at the end of that time, we continued our journey to the Essequebo river, and proceeded up it to the Carib village of Apoterie, a mile beyond the mouth of the Rupununi river, which we reached on the afternoon of the 13th.

On Friday and Saturday (14th and 15th) I was engaged in making arrangements for sending back my provision bateau, in trying to procure a competent interpreter of the Taruma language, and in making preparations for my journey up to the sources of the Essequebo river. The Brazilian half-breed who had been my Wapisiana interpreter during my Quitaro journey in 1869, was sent for, but was unable to come; so his place was taken by the captain of the Caribs who had some knowledge of the Wapisiana language. As the Wapisiana Indians go from the Quitaro river across to the Cuyuwini and so on to the Tarumas to traffic with them, we felt sure that the latter tribe would be able to understand our interpreter, and as it turned out, they did so in some measure.

Early on Monday the 17th, I sent back the "Ataraipu" with her crew of seven men to be paid off on her arrival home, and gave instructions to one of them—George Cameron—to proceed to town for supplies. Having calculated the time it would take to return, I made an agreement with the crew to re-hire on the 9th November, to bring up the stores procured by Cameron, so as to meet me in the second week of December at or below King William IV.'s fall. At 8 a.m. on the same day we continued our journey up the Essequebo with one boat and a crew of eight men besides the Carib interpreter. The river has a sharp turn to the eastward a short distance beyond our starting point and gradually curves more to the northward, continuing in that direction for about eight miles, when it once more assumes it usual direction of north and south, inclining to south-south-east. At 5 p.m. we camped at the mouth of the inlet Masae-taitourou, on a low narrow neck of land. The day was dull and cloudy with slight showers in the forenoon, and this gloomy weather, together with a foreboding of the difficult journey before us, exercised a depressing influence over the spirits of our little party—now reduced to 10 individuals in all—as we paddled against the strong dark waters of the Essequebo, under the gloomy shadows of the grand old trees lining its banks. Before us looming in the distance of imagination was King William IV.'s cataract, which had hitherto effectually barred the progress of all explorers, both native and European, with an exception in the person of Manarowah, a Carib chief, and a few followers. This man, nigh 100 years ago, lived near Murray's cataract and made war on the neighbouring savanna tribes, in order to obtain prisoners to sell as slaves to the Dutch living on the sea coast. He accordingly once made a journey up this river for that purpose, and succeeded in reaching the Taruma country, where he obtained a number of slaves; but such were the difficulties he experienced in ascending that he returned by the

Cuyiwini river, and down the Quitaro rather than descend by the way he went up. This information I derived from the Carib interpreter, himself a descendant of Manarowah and bearing his name. The Carib Indians inhabiting the village we had just left had lived there for many years, but not one of them had ever been as far up as King William IV.'s cataract, and their knowledge of its existence and formidable nature was derived from the tales of a Carib who accompanied Sir Robert Schmoburgh in 1836 to that place and turned back with him. Added to this were the traditions of great falls existing beyond King William's cataract handed down from Manarowah's time.

The succeeding day we made good progress, and camped on the extreme northern point of Paumbo Island. On the 19th we encountered some rapids between that island and the mainland, which delayed us for some time in towing up the boat. Two days more hard paddling against a strong current brought us almost to the foot of Murray's cataract, the first on this portion of the river. During the second day's journey, from the river near a small island a view is obtained of the first hill to be seen on this portion of the river.

On the morning of the 21st we began the ascent of Murray's cataract, by hauling the boat with but little difficulty up one of its numerous side channels, and reached the top at 10 a.m. This cataract consists of a succession of steps of a foot or two in height each, over which the water runs amongst rocks and small wooded islands for a distance of about 300 yards; above it the river's current does not run with much rapidity, and the water is deep and pool-like. From this place onwards the river's course is not correctly laid down on the map, and there are three large cataracts amongst numerous islands, none of which are noticed on it. At the first of these we had to unload the boat, haul it up, carry over the things, and reload above, but at the others we passed up sloping channels.

The scenery of this part of the river is very pretty, for it widens out amongst islands, rocks, and rapids, and low hills of conical shapes line its margin on either hand, relieving the level nature of the forest-clothed banks.

Starting at an early hour next morning we came immediately to the foot of another cataract, and had to lighten the boat before hauling it up, after spending much time in searching for a good channel for that purpose. None of my men, nor the Carib interpreter, knew anything of the river, but had to look for the best channel as we went along. We passed up a second cataract, and came to a bend of the river lying due east, opposite to which was a conical hill with a bare rock summit. From this the river turns S.S.E. for about two miles, and contains four small cataracts in that distance. Two small streams, one on either hand, enter the river just at the end of this bend, and low hills lie close to both banks; then the river turned about S.S.W., at the far end of which reach we saw King William IV.'s cataract before us, a narrow but high band of white foam, having a most formidable

appearance and bounded on both sides by low hills. At 3.30 p.m. we arrived close to the fall, as close as the broken water and waves would permit the boat to go with safety, and landing on the right-hand side walked amongst the sloping rocks from its foot to explore it. We had a smooth surface of gneiss rock sloping at an angle of 40 degrees to clamber along, on a hill side where the footing was extremely precarious before we reached the level of its top; and then, to my great disappointment, I saw at a glance, that it was inaccessible. I saw an immense volume of water rushing madly down an inclined plane—some 200 yards in length—leaping in quick succession over four great steps, having a total height of 24 feet, with such fearful force that no boat could even approach its foot without being dashed to pieces on the rocks by the waves and eddying water. Not a chance was given of carrying the boat on land past this obstruction, for it was bounded on both sides by hills of massive rock which come to the water's edge steep and smooth, and are there flanked by great irregular blocks of gneiss 20 feet or more square. About a quarter of a mile before reaching this we passed a channel or arm of the river on the western side, which we did not fail to observe, and which now offered us our only chance of getting up. We, therefore, ran down the stream, and turning into it, soon came to a similar fall to the one we just examined, and knew it was produced by the western extension of the same gneiss ridge which here sloped abruptly to the water on its western side, but on its eastern had some large flat rocks, where we could obtain a footing to carry the boat over. It also is bounded on both sides by hills about 300 feet in height, the one to the east being on an island. We landed on the island side, and saw that though of almost equal height to the other fall, the body of water rushing over was by no means so great, and that in one or two places we could take advantage of the water itself to pass up the boat. Having spent much time in the examination of this spot, and arranged our plans and the line we would follow, we again descended the river a few hundred yards to a fine sand beach to camp, and spent the Sabbath beyond the deafening roar of the cataract.

At an early hour on Monday 24th, we commenced work, and all hands were soon busily engaged cutting long poles for skids, placing them on the rocks, and then lashing them together with "bush rope." The load was then carried piecemeal over one half of the way, so far as a footing could be obtained; and then the boat hauled up the first step of six feet, on skids at an angle of 40°, then over the second in a similar manner. The third step shallowed on our side and formed a deep bay in the rocks where we were able to haul up the boat. At its top the rock formed an almost perpendicular wall, where the men could not carry anything, but could barely pass alone, so everything had to be put on board again, and the boat towed up to the last step. There the process of unloading, dragging up, and reloading was again gone through, and by 2 p.m. we had the pleasure of finding ourselves at the top of King William IV.'s fall. The four steps of this give a

total height of 20 feet by aneroid, the first being the highest, down which the water rushes with great velocity. The whole set occupies a length of 200 yards of river, and is about 60 yards wide. At the head of all there is a small rocky island around which the water lies in a great pool, bending round to the eastward, and joining the main channel a short distance above the top of the cataract. At the junction there is another small cataract, at the end of the large dividing island, which gave us some further trouble before clearing it. The river above is in one channel, and bends round to the south-west for about half-a-mile, then turns south-east and east-south-east for one mile, running this course with a rapid current, being narrowed in so exceedingly by gneiss rocks that in one place it is not more than 50 yards in width; beyond it widens somewhat and is full of rocks and rapids. At 4.30 p.m. we came to a succession of cataracts and camped for the night, having done a hard day's work.

Next morning on exploring the place we found that at the head of these four cataracts the river bent round almost at right angles to its course, and we therefore cut a track across the neck of land on the south side, carried the load over, and then returning hauled the boat up with great difficulty and loss of time. Before reloading we went on a short distance in the empty boat, and found, to our dismay, that we were at the foot of an exceedingly high and curious cataract, which would evidently give us an immense amount of labour before we could succeed in getting beyond it. This cataract is produced by the river passing over a mass of steep gneiss rock (lying S.S.E. and N.N.W.), of 50 feet in height, and running in part of its upper course, almost parallel to the deep and narrow channel, bounded by walls of rock at its foot, in which the whole body of water of this great river then rushes in a torrent, reduced to a width of only 30 yards. The face of this is nearly a mile in width, but is occupied by water, only in narrow cascades here and there. These are 50 feet high, 11 in number, and are of exceeding beauty. Dense masses of foliage cover the intervening spaces unoccupied by the water, and the effect produced by the white foaming cascades bursting out here and there amongst the trees is exceedingly curious. The upper channel slopes more and more to the north-east till the last one ends with a leap of only 20 feet or so, while the lower channel has its head a mile on, in the opposite direction, with about the same elevation above the river. The farthest cascade but one is the widest and highest, and over it the water leaps and tumbles in sheets of white foam amongst the black rocks, and rich green, yellow, and brown water plants growing upon them, and all is overhung by dark green vegetation of varied shades, forming a most beautiful sight. After examining it thoroughly we saw that our only chance of getting above was to cut a path or track through the forest from the foot at the corner of the bend on its western side and drag the boat over. We were all the afternoon examining the place, and in doing so climbed up the face of the middle of the fall, in the bush, and found that we could see nothing of its top beyond, the view being

hidden by numbers of small tree-clothed islands, amongst which the water ran in narrow channels over rapids and cataracts.

On the following morning we followed the edge of the river till we came to still water above all the islands, and felt sure that we were above the head of the fall. We then selected the gentlest sloping ground, marked a track along it to the place where we camped, and from it cut a wide path back to the head of the fall. By 5 p.m. we had finished cutting all but 100 yards of this portage.

Next day we finished cutting the road, laid down skids all the way, and placed bridges over two gullies, after which I measured the distance and found it to be just 40 chains = $\frac{1}{2}$ a mile.

On Friday the 28th, early in the morning, we hauled the boat out of water, and commenced our laborious task; some hauled on the tow-rope, whilst the rest pulled by the gunwale, and so guided her along. On the level or slightly inclined places we got along well enough, but where the land rose at all abruptly, we had great difficulty in moving her foot by foot. In this manner we succeeded in getting her across and launched in the river above by 9 a.m., at a height of 90 feet above the level of the spot from which we had started at 6 a.m. We then returned and carried the load over, article by article, which occupied us till 3 p.m., each man making six journeys.

By 3.30 p.m. we were once more on our journey up stream, in still water amongst large and small islands, where both sides of the river were studded with low hills, averaging some 300 feet in height, and of conical and ridge-like forms. At 5 p.m. we camped on a small rocky island in the middle of the river where its course was easterly, and from which beautiful spot I watched a splendid golden sunset repeated by reflection in the still dark water around. This scene and the death-like stillness of the place produced a pleasing but utter sense of loneliness when reflecting upon our isolated position, cut off as we were from the world by the two great barriers we had so recently passed.

Everyone now felt sure that we had no great obstacles before us, and began to look out for signs of old Indian encampments; but great was our disappointment when we came next day to a number of small cataracts and rapids in the forenoon, then had a portage for our luggage 200 yards in length in the afternoon, and finally camped in the evening at the foot of a great cataract, somewhat similar to that which we passed the day before. We examined it on the following day (Sunday 30th), and selected a course up which to take the boat. This great cataract has three channels coming in a southerly direction, passing over a steep open rocky slope at an angle of 20 degrees, with a total fall of 40 feet, which after emptying themselves in the river at its foot, rush away at right angles to their former course. The first channel is small, the second wide and passing amongst a spread of bare rocks, and the third, at the head of the bend, is narrow, but contains the greatest quantity of water.

On Monday 31st we hauled the boat up in some of the small

channels, at times in water but more frequently on the *lacis* covering the rocks, often up a steep slope at an angle of 40° to the horizon, and returning, carried the load up a distance of 300 yards, which occupied us from early morn until 11 a.m. Scarcely a mile above this we encountered two more large cataracts; the second being 6 feet in height necessitated our transporting the boat over the rocks, and at both we had to unload everything. The last of these had numbers of rocky islands along it, and some immense blocks of gneiss rising up from it to heights of 15 and 20 feet. That night we camped at the foot of a somewhat similar cataract. It would be a mere repetition of what has been already written were I to describe each day's work, toiling up cataracts and rapids, so I will content myself with merely recording the number that we encountered before we reached the mouth of the Cuyúwini, where I knew that all our troubles of this nature would terminate. It took us 7½ days' journeying before we reached that river, and during that time we passed up 16 cataracts and seven rapids. On the fifth day we passed the mouth of a large branch river, 20 yards wide, coming in from the westward, and on the sixth day passed the last cataract, one of 10 feet in height, in five steps, with a long slope. In one great cataract we were obliged to paddle across a channel just above a steep step. In doing so, the boat's head was turned round too soon, and in an instant we were swept backwards down it, and had it not been for the great skill with which the boat was managed by the bowsman and steersman, we must inevitably have been dashed to pieces on the rocks below. But taking advantage of the turning water at the foot of this step, the boat was guided just in the nick of time out of the rushing water, and we were luckily saved. The river in this part is very beautiful, and the enormous gneiss rocks scattered through it are exceedingly strange and picturesque.

Early in the forenoon on the 9th November we reached the mouth of the Cuyuwini river, and were on a portion of the Essequebo that had been explored and mapped by Sir R. Schomburgh, he having come in 1836 from the Quitaro savanna down the Cuyuwini river, and on up this river to one of its sources, choosing this route in order to avoid King William IV.'s Fall. Four miles beyond the Cassi-Attae rapids we found an old encampment which had been made within the last few months. This was the first trace of Indians that we had met with since passing Murray's cataract; with the exception of some old broken pottery near a large fall below the Cuyuwini river, marking an ancient encampment. Above the Cuyuwini river the Essequebo is 138 yards wide, and from that on to the second parallel of N. latitude it remains pretty nearly of the same width. From the last cataract, below the Cuyuwini mouth, the river is broad, and runs very sluggishly, and is bordered by a growth of tall forest trees covering the whole surrounding level country. Its banks are high, and it has numbers of small branch rivers.

On the 12th we came to Yucanopito cataract, and from a bend of the river just below it obtained a view of the Amuccu mountains,

bearing south 45° east, very lofty, and well wooded. A short distance on we came to a large Indian plantation covering many acres of ground, on a low hill side on the east bank of the river, and shortly afterwards came to a landing place where some corials had recently been built. We walked to the village, a few hundred yards back, and found it deserted, but evidently only for a time, as all the large cooking utensils, &c. were there, and the houses were comparatively new. We therefore concluded that the people had gone up river to hunt, and continued our journey, passing in the afternoon another provision ground.

Next day we passed the mouth of the Kassi-kityu or dead river, at an early hour, and observed that it was almost as large as the Cuyuwini. From this onwards the river begins to narrow rapidly, and has small inlets on either side at intervals, on the edges of which grows the Awarri palm. South of the Mataruki river there is a cataract which is not marked on the map, and the courses of the bends of the river are not very correctly laid down. In the afternoon we came to a second village, but found no people there, and camped not far beyond at the Marourona river.

Resuming our journey next day, we passed the Caniyu rapid, and came in the afternoon to another small rapid, at the top of which we saw two Indians in a corial just preparing to run down, but who, upon seeing us, turned their boat, and disappeared behind some rocks. Rounding the next turn in the river, we came to their village, situated on the east bank, and landed at it. There were 14 Indians there, inhabiting two houses, and belonging to the Taruma tribe, who were exceedingly timid at first, but soon became assured of our pacific intentions. My interpreter spoke the Wapisiana language very imperfectly, and they did not speak it well themselves, so I was unable to get much information from them regarding the surrounding country.

On the 16th we passed numbers of small rivers coming into the Essequebo, and of course above each it became smaller and smaller, the banks lower, and the sides swampy, with numerous inlets and ponds. At a spot where we arrived late in the afternoon the river had cut a new course across a bend, almost entirely deserting its former bed, and lying across this was a large dead tree, half immersed in the water, effectually barring our way. These dead trees, called Tacoobas, are of an extremely hard wood, and often 3 feet in diameter near their base, so that it occupies a long time to cut through them with the axe. We were therefore obliged to drag the boat along, in the old channel, over sand banks and shallows.

Shortly after mid-day on the 17th we came to a fork of the river where its waters appeared equally divided, and took the branch to the left, which proved to be the Caneruau or Ouruow river, near the head of which the Woyawais Indians live. At 3 p.m. we came to a landing place at the end of the path leading to the Woyawais country, where the river was so completely blocked up by fallen trees as not even to allow the passage of small corials, and from which the Indians are obliged to walk onward through

the forest. Here the river is again divided into two channels, both 13 yards wide, one 10 feet and the other 6 feet deep. We returned to the main river, and ascending it a short distance, camped for the night.

We did not proceed far upon our way next morning (the 18th) before we came to numbers of fallen trees lying across the river, which had to be cut through, and after removing several of these we reached a part of the river where it began to divide into channels, amidst a low, swampy tract of country. At 9 a.m. we came to a place so choked up with fallen trees, that we could not go any farther without immense labour, and I deemed it advisable under the circumstances to return. The width here was 18 yards, and the greatest depth 7 feet 6 inches, the deepest part being near the middle, and the water shallowing rapidly on either side. The altitude by the standard barometer was 828 feet above the sea level. The river was falling a few inches every day, and was about half full of water; consequently in the driest season of the year at this spot it must attain much smaller dimensions. Branches of trees almost met across above our heads, and the river guava grew thickly in the water near each side. No Indians ever travel up this, the main river, but only go up the branch to the landing spoken of.

When I left the Carib village at the mouth of the Rupununi, I had determined, if possible, to ascend this river as far as it was navigable for my bateau, and then to return by the same route when that end was accomplished. This had now been done, even beyond my expectations, and I found myself at a distance of 528 miles by the river's course from its mouth at Tiger island, and in 1° 19′ 30″ north latitude. The lithological character of the country here held out no promise of its containing any useful minerals or metals, and it would have been a mere waste of time to have prosecuted my researches further in this direction. I had some thoughts of visiting the Woyawais country by walking from the Canerua river landing, but as that would necessitate our return to the Taruma village at Onoororo river for a guide and provisions, and a long pull back again—besides, part of the journey being out of the colony, in Brazil—I gave up the idea. Moreover, a long stay up here was rendered dangerous by the probabilities of the swelling of the river in the "short rainy season" then close at hand, whereby all retreat would be cut off at King William IV.'s fall by a rise of water of even a few feet in height. These reasons, and a wish to examine a little of the Casikityu river compelled me to return without loss of time, consequently at mid-day on the 18th we turned about, and with the current in our favour made good progress during the afternoon. Early next forenoon we reached the Taruma village at Onoororo river and purchased by barter a stock of fresh provisions, and then continued our descent.

On Monday 21st I ascended a hill 430 feet high, not far from the Caniyu rapid, to have a view of the surrounding country, but as it was flat-topped the trees with which it was clothed completely obscured the view. I had some of them cut down, and climbing a

standing one had a fine view of the country to the west-south-west. There were two high ranges of mountains rising from a level or slightly undulating forest country in that direction, neither very lofty, but steeper faced on the south than on the north, and the second one came from the direction of Mount Wassarie. There was a small savanna to the south-west, not very far off, but all the rest of the country was covered with vast forests. Descending to the bateau we continued our journey down stream, camping late in the evening near the Casikityu river. Next morning we turned up it and spent a little over one day in exploring it, but coming to some difficult rock obstructions 15 miles up we returned to the Essequebo and continued our homeward journey. This river as far as we ascended it has a general course of due west, running east, and is some 50 yards wide at its mouth. In passing the lowest Taruma village we called in and obtained a few more provisions, and the same night reached a spot within a mile or two of Bubumana rapids.

On Monday 28th we passed the mouth of the Cuyuwini river, which cannot be more than 90 yards in width, and on Tuesday entered a channel leading through numerous islands at the head of the great cataract which we passed on the 8th instant in ascending. This part was divided into steps separated by intervals of smooth water. We camped late in the evening at the foot of the second step, having had to lower the boat down by the tow rope. This side of the river was not so open as the one we hauled up at, all the rocky islets being close together, and in part covered with a growth of low trees and shrubs. We ran down the remaining portion next day at some risk, as the steersman and bowsman knew nothing of the channels they took, except by viewing each from above to see if there were sunken rocks in them. In the afternoon we reached the great cataract at which we had camped on the 6th, and ran down part of it in deep zig-zag channels, with the load in, shipping a large quantity of water.

On Thursday the 1st of December we came to the top of the cataracts which had given us so much trouble in ascending, and had at most of them to unload, and lower or run the empty boat down. From the long straight reach of the river, near the third parallel of latitude, there is a high, bare, conical hill to be seen bearing south 80° east, about four miles off. The following day we ran and lowered down a number of cataracts and rapids below our old camp of November 1st. In one cataract we ran down a very deep channel, where the water poured through in a solid mass without breaking, at an angle of 40°, and having a vertical height of 6 feet. At another, the last we ran that day, there was only one channel to take, which had a large rock just under water in the middle of it, and was extremely dangerous, as the water glanced from the rocks on either side, and passed directly over it, so that the difficulty was to keep the boat from striking upon it. There was no way of lowering down, as it was bounded by steep rocks, and the small channel in which we hauled up was now quite dry, the river having fallen considerably. By the great skill of both

bowsman and steersman, the boat was run down successfully, but in spite of their combined efforts it touched the rock causing no little anxiety amongst us at the moment.

We passed the great cataract of the 31st October by unloading and lowering down, and reached the top of Manarowah fall on Saturday evening (the 3rd). I went to the edge of it in the main channel and saw that on the south-eastern side it is formed of two great steps, 20 feet high each, with level pools at their foot, and beyond comes the last fall of 50 feet. We spent Sunday at this spot, and had a few things carried across the portage in the forenoon. The water was 2 feet lower at the top, and 3 feet lower at the foot of this fall than when we came up.

By 10 a.m. on Monday 5th we had everything across the portage to its foot once more, and I again visited the front of the fall in order to make a sketch and examine the rocks. Carrying the load over the next portage we took the boat round and found the cataracts at the bend exceedingly steep and dangerous, owing to the water at their foot having fallen at least 4 feet since we went up, and after much trouble we got down them. That evening we arrived at the head of King William IV.'s fall, and camped at the small island just above it.

On Tuesday, 6th, we got the boat and remaining stores down to the foot of the cataracts, but not without some difficulty and delay, for owing to the draining off of the water at its foot to a depth of some 5 feet, the last rocky step was rendered higher and we had to make an entire new arrangement of skids. Proceeding on our journey, we arrived at the east bend of the river, near the bare conical mountain before mentioned. Landing, with some of the men provided with cutlasses for clearing the way through the dense and tangled undergrowth of the forest, we struck off for the mountain, and with great difficulty found it. Climbing its precipitous side, which for about 200 feet from the top was void of forest trees, and consisted of solid gneiss rock, clothed here and there with patches of penguins and shrubs, we had a fine view of the surrounding country from its summit, at a height of 700 feet above the sea. This disclosed a portion of the great plain through which this river runs, coming from the south and flowing northward, with a great tract of rough mountainous country to the westward, and an extensive plain to the eastward stretching away as far as the eye could reach. There is a dead level tract with only one ridge rising in it to the north-east, close the position of the Berbice river. In this plain, therefore, the three rivers, Essequebo, Corentyne, and Berbice, have their courses, lying almost parallel to each other, and without any apparent dividing ridge between them. The plain to the north is bounded by the great range of mountains from Makarapan to Maccari, which can just be discerned faintly with the naked eye, and the range from Wenkobat across the Corentyne river. Amongst the mountains to the south-west there is a high three-peaked range, very similar in appearance to Mount Saeraerie on the Takutu savanna, and on the south-east, some 15 miles off, there is a high

range at the sources of the Berbice. Every portion of this extensive tract of country is covered with a dense growth of forest trees, without a single savanna to be seen. The rain fell for a time when we were going in, and made the bush most disagreeably wet on returning, and it was quite dusk before we regained the boat and camped.

By 1 p.m. on the 7th we reached the foot of Murray's Cataract, having run down some cataracts and lowered down others, which occupied all the afternoon. Much to my dissappointment we did not find the beateau "Ataraïpu" at the foot of this as we expected, but on the following day, as we were breakfasting, it made its appearance to our great joy, for besides bringing a stock of provisions, it bore some news from the outer world. The cause of their not meeting us higher up river, as I had calculated upon, was owing to a few days' delay in waiting for Mr. R. G. Pollard, and consequently they had not left the settlement till the 14th of November instead of the 9th. During the afternoon we came up with a corial containing three caribs, who had been sent up by the villagers of Apoterie in search of their captain, our interpreter, and had brought provisions for him. They were on their way back, having been as far as the foot of Murray's cataract and not meeting with us had concluded that we had been lost or killed. We reached the Carib village near the mouth of the Rupununi in the afternoon of the 9th, where I had the pleasure of being joined by Mr. Pollard, the gentleman whom I had expected to have met in September last at the mouth of the Potaro.

On Saturday the 10th, I paid off the interpreter, had the boats loaded with the new stores, and at mid-day started up the Rupununi river for Karinambo village, which I intended to make my future depôt for provisions whilst I explored the Cotinga and Takutu river districts. We found the Rupununi pretty low and did not reach Karinambo till Saturday the 17th; here we landed all the stores, carried them up to the village, and stored them in one of the houses. The following Monday (19th) I again sent back the provision bateau with nine men to be paid off, giving Cameron orders to return once more with a load of stores, leaving the settlement on the 1st day of February. The surplus stores remaining, after my boats had been deeply laden, were left at this village under the charge of the same Indian who had taken care of a similar lot on the occasion of my journey to Roraima in January 1869.

Arriving at Pirara landing on the following evening, we landed the stores and camped, and next day walked to the village of Aring-wong on the savanna about 3 miles off, to see about a place in which to store our extra supplies during our walk to the Takutu river to get corials, there being none to be got on the Ireng river. In the height of the great rainy season, in June and July, corials can be taken up the Morooca and Quatata rivers, then over a portage of half-a-mile into Lake Amucu, and from that down the Pirara river into the Ireng, but at this period of the year the lake is dry, and the rivers too low for the purpose. I got leave from

the headman of the village to put my things in a house there, and then sent to Carenacru village for Macusis to come and help to carry them in and guide me to the Takutu river. I went with some men and examined the mouth of the Awarricurru river, to see if we could get a corial into it, and so take advantage of a large pond to transport the things as near to the village as possible, for we had almost two months' supplies with us to transport which with carriers would be a long and difficult job. We found the water very low, and the passage obstructed by small fallen trees and branches. Next day we took a corial round to the place and cut our way up to the pond, a distance of about 2 miles. This we accomplished by 10 a.m., leaving the corial in the pond opposite to and not more than half a mile from our camp, to which we walked by a path. The Macusis, 12 in number, had arrived when we returned to camp, and these, together with my eight men, during the afternoon carried one-half of the stores over to the corial. In two journeys on the following day the remaining stores were transported to the corial, and in two trips of it they were carried to the upper end of the pond, not far from the village. My bateau was moored in a small creek mouth in Wai-ipukari pond at Pirara landing, and the corial send down the Awarricuru to the same place.

On Saturday 24th we had all the things carried to Aringwong village, and placed in a house there in safety, and then we had each man's load, 18 in number, prepared for our journey to the Takutu river. The next day being Christmas-day we remained at Aringwong, and on the succeeding day started on our journey. The party consisted of Mr. Pollard and myself, 8 of my men, and 10 Indians. Since our arrival on the savanna the atmosphere had been very hazy, and the distant views thereby rendered indistinct, but on this day the air was remarkably clear, showing the fine and bold outlines of the distant Canucu and Pacaraima mountains in strong relief. There was no breeze whatever, and the heat of the sun was intense. We reached Carenacru village and remained at it for the night.

During the night a Macussi Indian arrived from a village between this and the Takutu and reported that the Brazilians from Fort St. Joaquim had crossed the Takutu, and were on their way to Carenacru to capture the people for slaves. The story was such a plausible one that we believed it at first, but on our arrival at the Takutu we learnt that the whole thing was a pure fabrication.

Leaving Carenacru next day we walked in a south-west direction, over the undulating savanna, without any shelter from the sun, to a large alluvial flat through which the Camoa river runs. Coming to a high savanna again, of hard red clay soil, dry and sterile, we soon reached the village of Curiealike-cher, and after breakfasting there, continued our journey at noon, coming to the village of Curienucra soon after. Leaving this we descended a small declivity into a broad alluvial plain, at far side of which we crossed the Nappi river, the bed of which was quite dry, and then

crossed a small branch of it which contained water in pools. These two rivers are lined by broad belts of trees for a distance of about 200 to 300 yards on each side. Emerging from the bush we rose a slight elevation to the undulating savanna again, and came almost immediately to an untenanted village, at which we put up for the night on account of its having water close by and our inability to reach any during the remainder of the afternoon, the distance to it being so great.

Resuming our journey on the following morning at 6 o'clock, we reached a small village by 9 a.m. where we breakfasted, and then crossing a strip of level alluvium in south-westerly direction, came to another village at the foot of the Canucu mountains. From this the path led in a westerly direction along a level alluvial tract, which lying low and being shelted from the slight breeze was exceedingly hot. The rays of the declining sun, slanting in our faces, and the radiation from the parched ground, bare and sandy in many places, added greatly to our discomfort and made the walk almost unbearable. In the afternoon we struck the Macumucu river, a fine stream 10 yards in width, but shallow, flowing swiftly towards the Takutu, and lined by narrow belts of trees at which we rested for a short time enjoying the delicious shade and cool water. Shortly after leaving this spot and skirting the river we came to a Wapiriana village at 4 p.m., and remained there for the night.

Early next morning we reached the village of Yarewah, on the east bank of the Takutu river, having crossed the Macumucu river on our way. I there hired three corials, all I could get, to travel on the Cotinga river in, though they were in bad repair, and would require some caulking and mending. I paid off nine of the Macusi Indians and sent them back, keeping only two. The Takutu river, opposite the village, is very broad and full of sand shallows and beaches, being wider than the Rupununi at Annai and containing whitish water.

On Friday, the 30th, the corials were prepared for their loads and the owners paid for their hire, the bargain being that I was to have the use of them as long as I wished and then return them. At 9 a.m. we left Yarewah village and descending the Takutu soon passed the mouth of the Macumucu, at which place the river was so shallow owing to its great width that the corials had to be dragged on the sandy bottom every here and there. Between the sand shallows the water was lying in deep pools of a greenish white colour. Beyond this for a considerable distance we had deep water till a bend in the river turning south-east was reached where sand and gravel shoals set in. At 5 p.m. we camped on an extensive sand beach, not far from the Macupura river mouth, and on the Brazilian side of the river which was some 200 yards in width, whilst the water of the river occupied a space of not more than 20 yards. In the rainy season all this sand is covered with water and is then the bottom of the river, many feet under water. We reached the junction of Takutu with the Ireng, coming in from the north at 2.30 p.m. on the following day, the 31st of

December, and turned up it. The Takutu is a wide river with high perpendicular clayey banks, and as it runs through an open savanna country, the tops of these are clothed with grass having trees only dotted here and there along its margin either singly or in small belts or groves.

The Ireng river contains much more water at the junction than the Takutu, though from bank to bank its width is not so great. It drains a portion of the Pacarai-ma mountains, and, therefore, its water is of the usual dark brown colour of all the rivers whose courses do not lie entirely in savannas. Its banks were 30 feet high where we camped in the evening, on the last day of the year, and spent the following day, Sunday, January 1st, 1871.

At 3 p.m., on Monday 2nd, we reached the mouth of the Pirara river, turned up it for about one mile as far as the corials could go and camped. The Ireng was rising rapidly at the time owing to the winter rains in the Pacaraima mountains. Leaving all the surplus stores under cover of an awning, and securing the corials well, we left camp at 6.30 o'clock next morning and took the path which leads across the Pirara and Nappi rivers to Quatata, a village two miles to the eastward of the deserted village of Pirara. We reached this place in the afternoon after a walk of 21 miles, and remained there for the night. I engaged all the serviceable men in the place to carry stores for me from Aringwong to our corials on the Pirara river for the Cotinga journey, and went on next morning to Aringwong village. In the afternoon I sent all my men out to Pirara landing with Mr. Pollard to take him down in the bateau to Karimambo, he having determined upon stopping there till my return from the Cotinga in order to make collections, which he found could not be done whilst travelling.

On Friday morning (6th) 11 Quatata Indians came and got their loads of provisions (rice and fish) weighing 30lbs. each, and went on with them to their place. A little after mid-day my men returned from Karimambo and we all started on our return to the Ireng river, stopping that evening at Quatata.

I left Quatata at 6 o'clock next morning with my seven men and 21 Indians, and taking a path leading almost due west over the undulating savanna crossed the Pirara river high up its course at 8 a.m. Leaving the narrow belt of alluvium on its opposite side we came to undulating savanna, then crossed a ridge near a large grove of trees and descended a gentle slope to the great level plain which extends to the Ireng river. We struck a bend of the Pirara river at 10 a.m., and after two hours spent there started on due west without a path and reached our corials at 3 p.m. I paid off the 19 Indians last hired, and they returned to their homes. It took us the whole of the following day to repair the corials, caulking splits and seams with oakum made from a piece of rope, and nailing on their top planks.

On Tuesday, 12th, we started early and soon reached the Ireng river, which having swollen some 2 feet in height since we came up was running very rapidly and assisted us greatly so that we reached the Takutu at 1 p.m. and turned down it. This river is

called the Takutu on Schomburgk's map, but the Indians call it the Ireng, and I certainly think that it is properly the continuation of the Ireng. The greenish-white water of the Takutu at the junction formed a narrow strip only a quarter of the width of the river at the time while the Ireng water of a brownish colour occupied the remaining portion. The Takutu just below the junction is 200 yards wide and very shallow. Like its upper part it has extensive sand beaches at all the bends, is bounded by perpendicular cliffs 30 to 40 feet high, and as it likewise passes through open savanna country the tops of the cliffs are covered with grass with here and there a single tree or small grove. At 5 p.m. we camped on a great sand beach near the Somena river, and next morning continued our journey under sails made of a canvas hammock-awning for one boat, two blankets for another, while a tree branch served for the third. The general course of the river, lying in the direction of the trade wind which blew here with great force night and day with occasional short lulls, favoured the use of sails, and assisted by the strong current we soon reached the mouth of the Cotinga river. This large river comes in on the north side having a width of about 200 yards—the Takutu at this spot being over 400 yards—and contains a brownish turbid water running very rapidly. There are but few sand beaches along it so that it more nearly resembles the Ireng, and its clay banks are of a variety of shades of gray, from nearly white to reddish gray.

On Thursday, the 12th, we camped near Wanakara mountain, and on Friday (13th) we passed the mouth of a large stream called the Murawai, beyond which were the Aratiari rapids. These were rather formidable owing to the lowness of the river, and they extended over a distance of 300 yards amongst many large rocks. It was here necessary to unload in two places, and it took us an hour before we cleared them. Late in the afternoon we passed the Mauitzie river, and soon after came to a set of rapids, not marked on the map, extending over a distance of 400 yards and camped at their foot.

The succeeding day we hauled up these rapids through small channels amongst rolls of granite rocks lying east and west. All this portion of the river is incorrectly laid down on the map, and few of the cataracts and rapids occupy their true position thereon. We passed up Worokoi-marari cataract late in the afternoon and camped at the foot of Warara-sararu.

The savanna there is dotted with small trees and covered with fresh green grass, upon a slightly undulating surface. In the vicinity are some very picturesque masses of bare granite rock, of enormous sizes, rising above the surrounding level country, and in the distance beyond, to the north, are seen the grand ridges and peaks of the Pacaraima mountains.

On Monday, 16th, we hauled up Warara-sararu and over the large rapids above coming to the foot of Mikang-yepatori rock, one of the granite rocks seen as above-mentioned the day before. This rock is over 300 yards long, and is elevated in a great roll 100 feet above the savanna. From the top of it, the western end

of the Carucu mountains can be faintly discerned at a distance of 40 miles to the south-east, all the intermediate country being a vast tract of almost level savanna. In the afternoon we passed the Zuruma, a tributary of this river, of almost equal size, and at 5 p.m. reached a large cataract formed by great masses of granite, in an eastern bend of the river, close to and south of mount Pirawai, where we camped.

Hauling over the cataract on the following morning, we rounded the bend to the north, amongst large granite rocks strewn all over the river's bed, and passing some rapids below the end of Mikangpati mountain came to a cataract at that place. The banks of the river still retained their high perpendicular character, and were fringed with grass and scattered trees. We met six Wapisiana Indians in the afternoon who gave us much information about the Indian villages beyond, and stated that they lived not far from this near Tuanu-sararu cataract. That night we camped at the foot of that cataract, and before dusk were visited by a party of 20 Indians.

On hauling up this cataract next day we met with many rapids and small cataracts, before reaching the mouth of a small river called the Wirina, where we landed at 4 p.m. We met some Indians who told us that we could not get much farther up the river in our corials. I therefore went to the village to see if I could procure men as carriers for our journey, and to make inquiries regarding the route. Learning that we could only go one day's journey on the river and that there was no other good place to leave our corials I decided walking from this place onwards.

I went to the village next morning, had all the stores carried to it and deposited in a safe place, in one of the houses, and the corials secured in the river mouth, in a shady spot. This village called Tamarchellie, is situated on the savanna close to the base of the mountains to the north, and half a mile east of the place where the Cotinga river debouches from them. I there tried to secure the services of six men, but could only induce two to promise to come. Two Indians came over from a neighbouring village and promised to go with me, one of them acting as guide. My object was to make a long journey across the mountains either to the Meruné river a branch of the Mazaruni, or to the vicinity of Ayangcanna mountain, so as to explore either of those regions.

On Friday the 20th, the two Indians came as they promised, but after distributing the loads to my nine people and these Indians, there were three loads left. Not one of the people of the village would come at first, though their head man did his best to persuade them, but after much trouble we induced three to accompany us. At 8 a.m., all being ready we started,—my party consisting of 14,—and soon reached a spur of the mountains, not far from Piatzang rock. Over this we walked amongst large granite rocks, and in an hour and a half descended into the valley on the other side, coming to the Waiquah river, a branch of the Cotinga running west. Continuing our journey we passed a small village

and came to the one at which my guide lived, not far from the site of the old village of Torong, where Sir R. Schomburgk once had his head quarters. This place is situated in the extensive valley of the Cotinga and Waiquah rivers, and is surrounded on all sides by mountains. I made enquiries regarding the paths and found that there was none to the Meruné river in English territory, excepting the path by which I went to Roraima, a track leading from this to it near Saca-outa river. As we would have to go almost to Roraima, and then strike off for the Meruné, I gave up the idea of taking that route, owing to the length of time required for it, and the fact of its being chiefly over-ground before explored. I therefore made up my mind to take the path to the Sacaouta river, and crossing the old path strike across for the head of the Mazaruni, if possible, exploring the country as long as our provisions held out, and then returning. With great difficulty I induced the guide to take me that way, he wanting to cross the Cotinga near the village, and take us through Brazilian territory.

Starting early next morning in a northerly direction, we reached the Cotinga there a rapid stream with its bed impeded by rocks, rapids, and cataracts. We then followed a faint track up the valley of the Cotinga along the level portion at the base of the mountains to the east, and at 4 p.m. reached the spot where it emerges from a narrow gorge, coming from a direction at right angles to its course in the valley beyond. At this place it is joined by the Cumparu river, a large tributary on its eastern side which winds through an extensive valley, almost continuous with the one up which we came. Proceeding a short distance along the river, we camped at 5 p.m. in a small grove of stunted trees, on its edge, and close by a large water-hole, in its rocky bed. At this season of the year these large mountain streams contain but little water, which percolates slowly through the water-worn blocks and gravels of their beds, and therefore water can only be obtained in their deepest parts. During the day we crossed numbers of small streams coming down the mountain sides on the east, and emptying themselves into the Cotinga, and our course was east-north-east.

Though the next day was Sunday, it was necessary to continue our journey, so we followed the Cumparu river for a short distance, then turned into a branch valley with a steep ascent at its head in which was a small stream, and reached the top of the gorge through which it came at a height of 1,065 feet above the sea. On the top we came upon an undulating valley in which the same stream wound about, with a slightly inclined course, and camped in a grove of trees near by it at 10 a.m.

Our course next day from 7 till 10 a.m. was about north-north-east, along the same undulating valley, and across some low ridges to the Saca-outa river, then from that on we went in a north-east direction to the foot of the sandstone escarpment. Near this we crossed the path along which I went to Roraima in 1869, and beyond crossed the escarpment through a pass, 1,672 feet above

the sea, and one mile to the eastward of mount Cumararing, the one I ascended at that time, on Sunday, January 31st. To the west of Cumararing mountain, the sandstone capping the mountain forms a round bluff called Pacaranga, and a long terrace named Elesia, while to the eastward of this is a high mountain rising higher than its neighbours, called Matarouca. From the top of the Cumararing pass we obtained a magnificent view of mountain scenery, all grass covered like the country we had passed over, and with a long massive flat-topped mountain in the distance to the north, conspicuous for its height amongst the rest called Toobabourome. All these mountain ridges trend east and west.

The guide pointed out a large river passing across the end of the valley we were looking down upon, where there was a set of cataracts, and said that it was the Ireng. On my former visit, from the top of Cumararing mountain I saw the river, but none of my Indians were sure that it was the Ireng, though they thought it was, and I then considered it to be a branch of that river. From the position of the Ireng on the map so far to the eastward of this (28 miles) it seemed impossible to me that it could be that river, but I was now assured of the fact. At Quarquia village on the 9th of April last I was close to the Ireng river almost due east of this, so that it must bend from that place towards the west running a considerable distance nearly east.

Descending from the pass we reached the bottom of the valley beyond at 3 p.m., and turned eastward to an Indian house to spend the night in, as the afternoon was dull and cloudy, and threatened a heavy rain storm. From that place I walked to the Ireng, a distance of half a mile, and found it to be over 100 yards wide and running very swiftly, with its water of a blackish-brown colour. The Indians there told me that it turns north-east at the back of Mount Matarouca, and then runs a long distance—which I estimated at six miles—in that direction, for they showed me a village on a ridge to the east-north-east, close past which they said it ran and then turned south again.

Starting early next morning we crossed the valley and ascended the mountain on its northern side, gaining a height of 1,580 feet, then down into a narrow valley across a small river, and up the mountain to the same level again. In this way we proceeded crossing three deep gullies with small streams in them running into the Ireng river near by. Passing the last of these the path came out on the Ireng, and led along its brink for a mile to where the river bends away to the eastward running west. Soon after leaving it we crossed a ridge and descended gradually to a village called Tacara-erimone, close to a small river named Iringwatong. We continued our journey from this across a wooded ridge for three miles or so, and came into open country again at a village on the southern side of the Wailongteur river, where we remained for the night.

The weather all along had been favourable to us, but the further north we went the more it began to change, and on this day many rain squalls were seen passing over different parts of the sur-

rounding mountains. We were obliged to remain at the village all the following day (the 25th) whilst the people prepared some cassava for us, it being necessary to procure all the food we could, as we were told that we would not meet another village for some days. Rain squalls kept passing over the place all day, and everything wore a bleak and cheerless aspect. I procured a guide and two men there to take the place of the Tamarchelle Indians, who would go no further, and then visited different places about during lulls in the rain.

Starting early on the 26th we soon came to the Wailongteur river and ferried all the men's loads over in a long narrow canoe, which had to be used with the greatest caution possible to prevent its upsetting, while most of the men swam over. This river is deep, about 30 yards wide, and contains blackish water. The path beyond led through the forest bordering the river for about a mile, and then out upon the open country, and across an undulating plain to a mountain escarpment, which rose to a height of 1,900 feet above the sea, the plain at its foot being 1,480 feet. From the top of this ridge the view of the next great undulating plain and the mountains beyond was very grand and extensive, but owing to the mist driven before the wind the outlines of the very distant mountains were rendered indistinct. All the country was grass covered, with groves here and there lying in the hollows and gullies on the mountain sides, and lines of Ita palms growing along the rivers and streams. To the north, some 8 miles off, the great Toobabouromé mountain bounded the plain, and behind came another and higher flat-topped range called Toobakeng, which appears to me to be to form the same table-land escarpment as Peepee-eping, and was once continuous with Roraima and Waetipu. To the east beyond the Ireng river were smooth rounded ridges curving from east to north-east. This great plain narrows to the west, and ridge after ridge of smooth mountains spreads away towards the south of Roraima.

The valley of the Ireng river crosses the end of the plain on the east, and its gap, where it emerges from the great mountains to the north, is clearly defined. The course of the Karnang river winding over the plain is distinctly visible by the row of beautiful palms growing on the swampy lands adjoining it, and it can thus be traced coming from Toobabouromé mountain, and running due south towards the point of view, then about four miles off turning suddenly east, and flowing to the Ireng river. Lying on the far side of the mouth of the Ireng gorge is a high mountain similar to Toobakeng mountain called Chenabieping.

A curious feature in this view—and one seen everywhere amongst sandstone mountains—is the great natural terracing of the mountain slopes, which conveys the impression to one's mind of water having once stood at different levels along their faces. But this has not been the case, for it has been produced by subaerial denudation, the hard layers of rock forming perpendicular faces, and the soft beds forming level or slightly sloping planes between. The almost horizontal beds of sandstone dipping

north, and showing their strikes from this, adds to the regularity of these markings on the landscape.

From the top of this ridge the descent was gradual for about 4 miles to the Kanang river, at a level above the sea of 1,598 feet. At mid-day we crossed this river at some rapids, where it widened out to about 100 yards and shallowed some 300 yards above a high fall. The rains having flooded this stream it ran with great force over a flat sandstone bottom, smooth and slippery, and over waist deep. The deepest part, however, took me to my armpits, and it was only by the assistance of one of my men that I could keep upon my feet. Each man carried his load upon his head across, and all were got over safely, with the exception of one load, which fell into the water, the man carrying it having been washed off his feet by the force of the stream.

From the opposite side we walked over the undulating plateau in a north-east direction for an hour, and gained a point from which I could see Mount Zabang, to which I took a bearing by compass of south 75° west. This dome-shaped mountain, a most conspicuous landmark, has been placed on the map by Schomburgk, who passed near it on his way to Roraima, and its position, I suppose, has been determined with accuracy. This bearing then would make the position of the spot from which it was taken considerably to the west-north-west of Ayangcanna mountain, when by the Indian account we could not possibly reach that mountain in less than 10 days journeying to the northward. In the afternoon we came to the Ireng river, having walked in an easterly direction to it, and came out at a spot commanding a fine view of this river and its valley, where two sets of great cataracts were seen occupying more than a mile in length of the river's course. On the opposite side of the valley, on a high bluff, there was a number of Indian houses, which gave an appearance of life to the beautiful, though deserted, country around us. Descending to the foot of the upper set, I made a sketch of them and examined the place. It consists of three perpendicular steps, at intervals of 100 feet or so apart, constituting a total height of 50 feet; while the second set is somewhat similar, and of about the same height. The river at the upper cataract spreads out to a width of 120 yards, and the hill side on its western bank is thickly studded with trees, which do not occupy any great space, merely fringing the spot. The steps are very regular, and the dark brown water pouring over them becomes white as snow, and passes on both sides of a small wooded island. We remained at the fall all night and took shelter in two small "banaboos" erected by the Indians, who come there to collect a species of *lacis*, called "Ouyah," which grows upon the rocks.

Early next morning, at daybreak, the air felt extremely cool, the thermometer standing at 69°, and the river water at a later hour indicated the same temperature. We followed the same path back for a short distance westward, and then took the main path northward, descending to the valley of the Ireng

once more, at a small river where the guide searched for and found a small corial in which we crossed over—six at a time —to the opposite side of the Ireng. It here appeared to be 70 yards wide, and very deep. We followed the bank of the river in a northerly direction across a number of gullies, in which ran small brooks, coming down the hills to the east, and falling into the large river. In the afternoon we reached a village where the path northward ended and the forest-clothed country began, and here we were obliged to remain for the night.

In passing Toobabouromé and Tobakeng mountains I observed that they were continuous one with the other, and form part of the same escarpments of the high plateau. On the side of Toobakeng, facing south, there is a large sloping fall seen at a distance of some 8 or 10 miles, which shows like patches of snow upon the dark mountain side amongst a grove of trees which lines the river.

Our last guide resigned his post at this village, but first obtained corials for us to proceed in up the Ireng river. All the information we could obtain there was to the effect that we would have to go for some days in these corials, and then get a path onwards. The Ireng in this position of its course is narrow, but runs with great velocity, and at the time was rising rapidly from the daily rains in the mountains.

Next day, Saturday 28th, the rain delayed our starting till 11 a.m., at which hour we left the village landing in three corials of wretched construction, and just large enough to contain the whole party, 12 in number, and our provisions. These corials were merely hollowed out logs of wood with sharpened ends, but not spread out amidships as is usually the case, and though of great length were only just wide enough to enable one to sit down in them. They rolled from side to side at each stroke of the paddles so alarmingly that it required great steadiness to keep them from upsetting. We passed four villages on the left-hand, all about a quarter of a mile apart, and at 5 p.m. reached the landing of a fifth on the right-hand, at which we landed and spent the night.

We spent Sunday 29th at this village, and I obtained much information regarding the river above and country beyond from some Indians who had lately come from a village at the head of the Mazaruni river. From them I learnt that it is but four days' journey from this village of Waipah to Enapowow on the Potaro river, but five days' journey to the Mazaruni in a northerly direction, and five days also to Ayangcanna mountain. They also said that the head of the Mazaruni is somewhat to the north-east of Ayangcanna, in a large savanna, and that the Ireng head is to the west of that mountain. They also told me that the rivers and swamps between the landing on this river where the corials would be left, and the Mazaruni river or Ayangcanna mountain were now quite impassable, and would be so for a month to come, and that we would not be able to go to either place. I therefore determined to go on as long as our stores held out, though our

salt provisions were nearly out at the time, owing to our not having been able to procure either fish or game in the district.

We started at an early hour in our corials on Monday the 30th and found the stream running in this part with even greater velocity than it did lower down. Not far on we passed two villages, where the people told us that we could not go much further on account of the swollen state of the river, and some of them accompanied us in their corials for a short distance to a long set of rapids and cataracts, at the foot of which we were obliged to leave our corials, and walk along a path on the west bank for a distance of a quarter of a mile to a village above them. At this place we could only get two corials, therefore I was obliged to leave four of my men there and go on with the rest. At 4 p.m. we came to a second set of rapids (after going only $1\frac{1}{2}$ miles against the strong current) which we could not stem, nor get any footing so that the men might haul the corials up them, and were obliged, under similar circumstances to the last stoppage, to land at a village below them. Heavy rain fell during the afternoon, and the night was cool and misty.

We remained at the village all night, and got an Indian next day to guide us on by a path which he said he knew but was seldom used, the Indians never travelling when the river was in flood. When in its ordinary state they propel their canoes with poles, keeping in the shallow parts of the river, and so stem the strong current. The Ireng runs at this place in a narrow valley, bounded on both sides by high steep sandstone mountains, all clothed with dark green forests, and resembles greatly the valley of the Potaro river below its great fall.

Our guide led us along a mere track through the forest in a northerly direction, not far from the river, mostly through swamps and across small streams (just where they joined the river) now all full of water; two of these were so deep that we had to fell a tree across each to walk over on, but all the others we waded through. We also crossed the ends of two spurs of the mountain, coming down between the streams. Whenever we came to the river's edge it was seen running with great force, and broken by rapids and small whirlpools. The rain of the previous evening had made the trees and undergrowth along the path so wet that it was like walking in a shower to pass through them. At 11 a.m. we came to a village in a fern-opening, and leaving it soon after crossed a high spur and descended to the level of the river again. Beyond this we crossed four streams, wading over one, and coming to a village in a large clearing early in the afternoon. There our guide said we would have to remain till the next day, as we could get no place further on to shelter us for the night. On inquiry the village people said that we would be able to get on, in part of a day, as far as the river was navigable, and then have time to visit the large fall there named Orindouie and return again at night.

As we had now got almost as far as we possibly could go without a fresh supply of provisions, I gave up all hopes of getting

beyond the falls just mentioned, and determined to return from it on the following day. We had fought hard to get even this far, but our difficulties and delays had been very great, and coupled with this was the unfavourable season of the year, and the fact of my not having been able to obtain a sufficient number of carriers in the first instance.

The mountains upon both sides of the river's valley all the way up are from 1,000 to 1,500 feet higher than the level of the river, and are the edges of an extensive table land. We had two heavy showers of rain during the day, and a drifting succession of black misty clouds continually passing over the mountain tops. The village houses being small and overcrowded I was obliged to hang my hammock under a small shed, only partially roofed, which leaked badly.

Leaving the village on the following day, February 1st, accompanied by a number of Indians, we did not go more than a few hundred yards before we came to a large branch creek, over which we were conveyed in corials, then walking a short distance through the forest along the river, came out opposite a village, and the people bringing over corials ferried us across. At this place we got corials, even more crank than those we had endured hitherto. Though the stream ran strong, yet it had nothing like the velocity of the portion below, where the slope of the bed was greater, and we were able to make progress against it. At 10 a.m. we came to the landing, immediately after passing the mouth of a large branch called the Suquabie river, and from this we walked up a hill in a northerly direction for some distance through the forest. We then turned westwardly and came out on a small fern-covered savanna to the head of a beautiful waterfall in 40 minutes after leaving the landing.

The difference in level between the foot of the fall and the landing, a distance of about half a mile, was by aneroid 253 feet, and from the top, looking down the river, there was a second fall to be seen of about 30 feet in height. The difficulty of approach to its foot renders accurate measurements impossible, but from all the data I could collect, I estimated the height of the fall at 213 feet. It is not perpendicular for its entire height, but has three steps on its western half, the last being down a succession of beds of rock almost as regular as a staircase. Its westwern portion is more regular, and there the water falls perpendicularly for 162 feet (measured with a line), and then slopes onwards. There is no deep pool at its foot, but a shallow slope of foaming water, amongst huge rocks for a distance of about 300 yards, and then the water is narrowed in, and falls over a perpendicular height of 30 feet as above mentioned; from this it has but a slight descent to the landing place, some 500 yards on. The width of the river just above the head of the fall is 56 yards. As the smooth dark water nears this it breaks into small waves with crests of foam for a space of 200 feet, and then sweeps over in a curve caused by the impetus it receives in passing down the slope. The water turns to whitish foam as it passes over, and falls in the usual inverted rocket form,

beating with great force below, and spouting upwards in clouds of spray.

Owing to the precipitious nature of the rocks on the side where I was I could not descend to its foot, but had to content myself with sketching it from an opening about a quarter of the way down, at a sloping place on the eastern side. The mist rising from its foot takes a fixed course and blows in a south-east direction falling on the open slope spoken of. Here the tall Argave also grows surrounded by high grass, shrubs, and mosses, amongst which the footing is at once difficult and dangerous. The river was in flood at the time of my visit, which greatly enhanced the beauty of the sight. The surrounding mountains are all of great altitudes, and form a wild-looking picture of forest-covered inhospitable looking country.

After spending 4½ hours there, we took a pathway leading west across the savanna, and came to a small village in the forest beyond. From this we followed a path leading in the same direction, and came upon the Suquadie river above its fall, a similar one to Orindouie. We took a corial and ran down to within 200 yards of it, and landed at a place where the river separated on either side of a large island. The path led on the island to a small rocky savanna, and came out at the head of the fall.

This being surrounded by trees (which grow under the precipice edge on the slope below, with their tops rising above it) is partially hid and only glimpses of it can be obtained here and there through the foliage. It is a sloping fall the top inclining at an angle of 55°, and the lower portion at an angle of 70°, and is not so wide as Orindouie, but somewhat higher, and is called Wantuànà. The fall on the other side of the island is called Wotowanda, at whose foot there is a deep pool of blackish water and corials can ascend to it, there being no rapids below.

On the flat hard rocks of jasperous sandstone, above Wantuànà, there are numerous carved inscriptions, known as Indian picture writing, which like all the other picture writings in various parts of the colony cannot be interpreted by the Indians of the present day, but are said by them to be the work of the Makunaima, or Great Spirit. The fact of there being open tracts at the head of these falls, as well as one at Kaieteur, in regions where there are no natural savannas is exceedingly curious, and these tracts must I think have been artificially produced by means of fire when in bygone ages an ancient people inhabited these spots.

Leaving Wantuànà fall we returned by the path we came, and took a track leading to the landing, where we arrived at 4.30 p.m., from this we descended in corials to the village we had left in the morning, running down stream with great rapidity, and getting there at 6 p.m. During the day the river fell 3 feet owing to the rains in the mountains beyond having ceased, but during the night we had several showers against which the shed that I was in was but a poor protection, and I was compelled each time to take down my hammock, put it under shelter, and sit down till they ceased. My position was then by no means an enviable one, exposed as I

was under the dripping thatch to the cold rainy wind that swept down the mountains upon me after all the fatigues of the day.

Early next day we left the village in corials and went down the place above the great rapids at which we had left our first corials and four of the party and walked overland to the lower landing. The water having subsided a little since we went up, the rapids above this were not so turbulent, and we ran down with great speed. Contiguing our journey we reached the village of Waipah, at which we spent Sunday, 29th January.

I heard of a large fall close to this, which the Indians said was very high and not far away, and though badly off for provisions, I thought it as well to make an effort to see it. Landing therefore we started inland by a path leading in an easterly direction up a valley close to a river not more than 20 yards wide and very shallow, and passing through one village we arrived at a second where we spent the night.

Leaving Waremapai, the second village, and going in a northerly direction, we came to a deserted village, from the open space around which I obtained a view of the fall. As I anticipated, it was rather diminutive compared to the great falls of this portion of the colony, and not being quite perpendicular as well I did not deem it advisable under the circumstances to visit it. I judged its height to be 400 feet and its width 20 yards; its crest is broken by rocks, and the water falls over in a thin white veil, bursting out from the forest on the face of the mountain about half way down its side. Some of the surrounding mountains have grass-covered summits and are devoid of trees.

We returned to Waipah village and descending in our corials very rapidly to the village from which we procured them paid with "negotiae" for their hire, getting leave to take them down the river to where we had crossed it on the 27th. We ran down two exceedingly rough rapids at great risk, and reached the spot above mentioned late in the afternoon, and took shelter for the night in a large palm-thatched shed.

Some rain fell during the day and the sun shone brightly during the afternoon where we were, but looking back to the high mountains I could see great black masses of rain clouds still hanging around their tops. The river was now 4 feet higher than when we crossed it before. In coming down in the afternoon, the water being very high, we could see the adjoining hills and sloping grass lands dipping gently to the water's edge, while here and there a single tree or a clump of wood grew close to the water, or dotted the hill sides. Here and there on them, patches of pinkish or red earth and rock was disclosed by old landslips, and everywhere the strange-looking parallel terracing was very observable. The great rounded slopes of these hills, with their dry watercourses or gullies, their grass-covered sides, and their shadows deepening in the declining light, the fitful gusts of the north-east wind hurrying over them, and above all the deep solitude that reigned around, formed as wild and deserted a picture of mountain scenery as could well be imagined.

Crossing the river on the 4th, we continued our homeward journey across the bare hills to the Karnang river. The rainy weather had, in this part at least, passed away, the day was calm and clear, and the surrounding views so grand that I often stopped to gaze around me at the beauties of hill and vale. The Karnang was much lower than when we crossed it before, so we waded it close above the head of the fall where it was shallowest. Coming to the top of the ridge north of the Wailongteur river, I remained there for over an hour to take bearings to the various mountains and sketch them. The top of Waetipu and part of Roraima was visible, but their lower portions were enveloped in a dense white mist. Cukuienam mountain, abreast of Orindouie fall, on the Ireng, from which we had come, looked further off than Waetipu. Descending the ridge we re-crossed the Wailongteur river, and coming to the village put up for the night. Here I procured some water from a small spring, which ran amongst large blocks of greenstone, and which had a slight mineral taste.

Next day (Sunday 5th) we continued our journey on account of the short supply of provisions remaining, and I had to embrace the last chance of examining some highly interesting geological developments, and make sketches of them as I went along. It was in this day's journey that I had such clear developments of great layers of greenstone rock interbedded with the sandstone spread out before me as to enable me to explain many difficulties in the geology of the country that had before remained obscure. I had seen sections before, showing the greenstone lying upon the sandstone, but had not been able to obtain positive evidence of the intrusive or contemporaneous nature of the former rock by finding a section disclosing the latter resting upon it, though I had long suspected that such was the case. In the afternoon we came to the village of Cumararing, and remained there all night. It rained very heavily about midnight, and continued for a long time, and as the house was only partially thatched it leaked exceedingly, forcing us all to unloose our hammocks, put them under shelter, and stand up most of the remainder of the night close to the walls of the house, where the leaks were not quite so bad.

Leaving this place next morning, I went to examine some rocks on a hillside to the north-west, and then joining the path at the foot of Cumararing pass, crossed over it, and down to the Sacaouta river beyond. Crossing this river, we struck off in a west-south-west direction, and after a long walk arrived at the Cumparu river, at a spot within one mile of Cotinga river, and camped, having accomplished the distance between the Ireng and Cotinga rivers in one day.

Next day we took a different path to the one we had come by, crossing the mountains instead of following the Cotinga valley. The walk was long and rough, and the path led down into the Waiquah village, through the old village of Torong to Terchellewan, where we spent the night.

On Wednesday the 8th we got back to the village of Tamarchelle, where we had left our corials and our surplus provisions.

We remained at the village the following day, to rest after our fatiguing journey, pay off the Indians, and get the corials ready for our voyage down river. Tamachelle is situated on a plain to leeward of high mountains, over which the north-east wind blows with great violence and seems to be deflected, striking the plain just at the village, and apparently threatening destruction to every house in the place.

On Friday 10th we started in our corials, and descended the Cotinga river very rapidly, arriving at the Takutu river at mid-day on the 14th. We were only one day's journey from the Brazilian frontier fort of St. Joaquim, and I deemed it advisable to visit it. I wished to see whether the savannas there were similar to ours, as grazing tracts for cattle, and also to procure some sugar for my men, their stock having been long since exhausted.

We reached the fort at 9 a.m. on the following day, and were most courteously received and hospitably entertained by the commandant, Snr. Manoel dos Santos Alreo. The fort is built of stone, and occupies a commanding position at the junction of the Takutu with the Rio Branco. There are two large cattle farms near by; one, called St. Bento, is on the opposite side of the river, and has over 3,000 head of cattle.

We left the fort at 9 a.m. next day (17th) on our return, against a strong current and head wind, so that our progress was very slow indeed, and we did not pass the mouth of the Cotinga till the next afternoon. We worked half of Sunday, and on the following Tuesday at mid-day turned into the Ireng river, reaching the landing in the mouth of the Pirara river at 1 p.m. on the 22nd. Securing the corials, we started at 2 p.m. to walk to the Rupununi, and at 5 p.m. we camped at a bend of the Pirara river.

Resuming our journey next morning (23rd) at an early hour, we reached Quatata village at 10.30 a.m., and went on to Aringwong village in the afternoon, where we remained for the night.

On Friday (24th) we went to Pirara landing, and taking my bateau, descended the Rupununi river to Karinambo village. My object in now returning to Karinambo was to meet my bateau "Ataraipu," that had been sent down for provisions, and which had, I supposed, already arrived, having given orders to Cameron to leave Bartika Grove on the 1st of February. These provisions were required for the remaining months of March and April, during which I intended to explore the country southward of the Canucu range, and between the Takutu and Rupununi rivers. The boat had, however, not arrived, nor did it come until the morning of the 6th of March, by which time our store of rice had completely given out, but we had sufficient salt fish to last for some time. The captain of the bateau informed me that the delay was owing to the height of water in the Essequebo river producing a strong current, and illness amongst the crew. My messenger, Cameron, had been stung at Twasinkie by a sting ray, and had been unable to come further than the Carib village at the mouth of the Rupununi.

On Tuesday, 7th, the "Ataraipu" started at 3 a.m. on her

return journey, to be paid off for the last time, and during the day we were engaged getting the necessary stores measured out for our further journey. At this place I had rejoined Mr. Pollard, who now determined to accompany me during the remainder of my journey, so we started up river in the bateau on the 8th, arriving at Pirara landing at 1 p.m. on the same day. I had nine loads of stores carried to Aringwong village, and sent the two Macusi Indians, who had been with me since December, to Carinacru village, to bring down 11 men to act as carriers.

Next day the Indians arrived, and we took the remaining provisions to Aringwong, had the boat moored safely in the inlet, and went to that village for the night.

On Friday 10th I sent two of my men and three Macusis, with their loads, across to the Pirara river, to take the corials we had left there down the Ireng and up the Takutu to Yarewah village, where I had hired them, whilst Mr. Pollard and myself started with five of my men and 15 Indians to walk to the same place, and from thence go on together. We passed through Umata village, taking a path more to the westward of the one we followed when we crossed to the Takutu in December, and camped at the village of Curewakiteur.

The following day, after crossing Nappi river, we struck our former path, and kept upon it to Yarewah village, which place we reached on the 13th. The forenoon of each day was cloudy, and consequently cool, but at mid-day the clouds dispersed, and the sun shone with great brightness, the heat and glare being intense. The Canucu mountains, viewed from this place, form a great group of high mountain ridges, lying east and west, varying in height from 1,000 to 2,500 feet, all covered with forests, excepting on places where the rocks are too steep and smooth for trees or shrubs to gain a footing. With their deep valleys, frowning precipices, and domes of purplish rock, they present a dark-looking, inhospitable tract of country.

We found that my people had arrived at Yarewah before us, with two of the corials, the third having been taken by Indians. In the afternoon we went up the river in a corial to see if it were possible for us to go on as far as Suwaraowra river by water, but we found the river almost shut up in three places by rocks lying across it, so that we were obliged to give up the idea, though I was very anxious to explore this part of the river, as Sir R. Schomburgk had mentioned the existence of gold in its sands.

On the 14th we started from Yarewah, and walked in the direction of Mount Ilamikipang, one of the peaks of the Canucu range, and came to a path leading south-west along the foot of the same range, over undulating savanna, crossing the dry bed of the Camu river. At 10 a.m. we reached the Coara-outa river, and breakfasted, having found some water in a hole in its bed. Beyond this river, which was bordered by woods, we came in the open to a village, at which we had some delay in trying to procure a guide, but without success. The people, however, gave us directions how to proceed, and we went on a good path, leading at a distance of

about one mile along the foot mountains, till we came to the extreme western point of the Canucu chain. From this we turned more to the southward, without a path, and after going about two miles, camped at 4 p.m. in a clump of savanna trees, close to some small deep ponds. Saeraeri and Cursato mountains could be seen from this at a great distance off to the southward.

On the following morning we started at an early hour and crossed the Suwaraoura river, a wide but shallow stream, and turning westward, passed through a stunted growth of trees for a considerable distance, coming to a Wapisiana village, in open savanna, called Berkutone. From this place we walked to the Takutu river, a mile and a half off, and taking a corial with seven men, descended the river for a considerable distance past the Suwaraowra mouth to wash for gold. The river was exceedingly low, the actual body of water flowing down above the sands of its bed being not more than 10 feet wide and 4 inches deep, nothing in fact but a succession of large waterpools, between which the water passed over shallows of the above dimensions, in some places produced by rocks, in others by sandbanks and gravel beds. Owing to the great delay caused by having to drag the boat over these shallows we did not get very far, and at 4 p.m. came to a steep cataract beyond which it was useless to go. There I commenced washing the sands and gravels for gold but without success, and then camped.

Next day we turned back and ascending the river slowly washed for gold in numerous places, and got back to the landing in the afternoon. We rejoined the men left there, and then went back to Berkutone village, and on by a path in a southerly direction to a village called Rumatokoke, where we remained for the night.

Leaving Rumatokoke, we went southwardly over the level savanna to the vicinity of Tatat mountain, crossing at mid-day the Scabunk river, and passing on the way through three Wapisiana villages. At another village, within a mile of the Takutu, and close to Tatat mountain, we remained for the night. During this day's journey we traversed the level land bordering the Takutu river, and to the eastward of us the savanna assumed a more undulating character. There was a number of small conical hills rising above the plain in a few places, with the high Cursato group to the south-east, and the splendid pile of Saeraerie Mountain with its four peaks to the eastward, which relieved the monotonous level of the plain. Behind us, growing fainter and fainter in the distance, were the great Canucu mountains, covered with dense forests, whilst all the surrounding country (with the exception of the small conical hills) was dotted only here and there with small trees and shrubs. In this day's walk, a distance of about 20 miles, we had scarcely any breeze, and the sun in the afternoon was exceedingly hot.

Early next morning I went to the Takutu river, distant about half a mile, its bed was full of rocks and its water scarcely running and covered with a thin scum. By 10 a.m. we reached a large

village two miles south-west of Cursato mountain, and leaving all the loads and most of the men took a guide, and walking to its foot, ascended it along a steep and rocky path leading up its southern face. This track led straight up the mountain, amongst the small stunted growth of trees with which the whole is clothed, whose leaves, now parched and withered by the drought and heat, afforded us but little protection from the merciless rays of the afternoon sun.

Arriving at the top in 40 minutes after leaving the foot we came to a small rocky patch of grass land from which a magnificent view was spread out before us. Here, at the height of 1,300 feet above the sea level, and 1,060 feet above the savanna, was a grand bird's-eye view of the country, ranging uninterruptedly from south-east to due west presenting a great undulating savanna country, with a few isolated mountains rising from it. Amongst those not far off were Pinniyette and Mammette to the south-east and Rhati to the south, with Viruette mountain lying out at no great distance, in the foreground. Away in the south-west beyond the Takutu river were groups of high mountains just discernible in the hazy atmosphere in the direction of Tauarutu range. The savanna below from the foot of the mountain as far as Viruette formed a dead level plain, with but few trees upon it, and spreading southward around the isolated mountains it became fainter and fainter in the far distance till it seemed to fade gradually into the atmosphere. One or two bends of the Takutu, showing strips of glittering water, were seen and a small forked branch not far from the village we had left formed a dark serpentine line shown by the green trees lining its edges. The light yellowish savanna, with its patches of bright green grass, in places where it was shooting forth afresh the dark green bands of scattered trees in the distance and in patches on the mountains, the purplish cast of the rocks exposed on the nearer mountain sides, the faint blue of the distant mountains, and the bluish hazy atmosphere and sky, formed the various tints of this fine picture. Not a living thing was to be seen, and not a bird even flitted amongst the trees about us, but everything seemed to have hidden from the afternoon sun. Scarcely any movement of the air was felt, and here and there near Mount Rhati, and in the direction of Tauaruta mountain, the smoke of burning savanna grass, set on fire by Indians, curled high and straight into the air. Whilst watching and enjoying this scene, spread out as it were at our feet, some dark clouds gathered near Mount Viruette, and presently torrents of rain fell from them in a circular patch, having a diameter of about one quarter of a mile, and lasting only for a short time, passed away to the westward.

Descending the mountain soon after, we returned to Cocobean-arruwow village. The view also from this place is exceedingly pretty, looking eastward with a fine extensive level foreground covered with a carpet of grass, and studded here and there with low scattered trees, then comes a low range of tree-clothed conical hills, and the massive pile of the Cursato mountain, forming a

middle ground, while the distance is made up of clusters of mountains of round and conical forms growing fainter and fainter till lost in the distance.

At this village some Indians were making salt from a grayish earth, procured from a spot not far from the village having a strong saline flavour. This they mixed with water and placed in a large funnel-shaped gourd, having a plug of grass in the bottom, through which the water after taking up the salt in solution slowly filtered. The water was then boiled down and a dark fine-grained salt obtained.

On Monday the 20th we started from the village at 7 a.m. and took a path leading almost due east along the level land at the base of this cluster of mountains passing the southern side of Cursato, and to the northwards of Duruau. We passed one stream, a branch of the Scabunk river, in which there was no water visible, but turning to the hill close by, at its source, the water was seen bursting out amongst large blocks of granite. At 4.30 p.m. we crossed the last low granite ridge to the eastward and came upon undulating savanna, beyond the whole group of mountains reaching at 5.30 p.m. the village of Pinniyettinow where we put up for the night. Here the Indian guide who had brought us from Rumutukoke village resigned his post, not knowing the country further south, and we procured a Wapisiana to take his place. One of the Macusi Indians of the party having sprained his ankle, could go no further so he determined to return, and five others informed the interpreter at the same time that they also would go no further. Thus we lost the services of six carriers, but as we had no power to detain them, there was no help for it. We had consequently to leave five loads of provisions at this village, and go on with our party reduced to 16 carriers.

We left the villiage early in the morning (21st), crossed the head of the Suwara-owra river which rises in Pinniyette mountain, and preceeding over undulating savanna crossed the Macudood, a small branch of the Rupununi, coming to the end of Mount Pinniyette. Just beyond this we crossed a river called the Rahwow, a tributary of the Takutu, and some distance on another river. At 5.30 p.m. we reached a small river, called Mepitewow, and finding two small water holes in its bed camped at them for the night. We had followed a path leading due south all that day. From the end of Pinniyette a low ridge runs south-south-west, and is succeeded by numbers of similar ridges, lying almost east and west, with level tracts between out of which rise groups of granite rocks of dark blackish colours from a vegetable growth upon them. The country passed over was all dry and parched, the grass brown and withered, and with very few trees anywhere to be seen. From the last ridge we crossed in the afternoon a fine view of undulating savanna with parallel ridges lying east and west was obtained, with Tomboro mountain far away in the south-east and Tauarutu mountain in the distance to the south-west. During the night we had a heavy rainstorm

accompanied by thunder and most vivid lightning, the rain lasting till 8 o'clock next morning.

Our course from this on next day was in a direct line for Tauarutu mountain across two good sized streams, branches of the Takutu, one called Cauaruwow and the other Comatawow. The guide took us to a village where as he thought we could get information as to a track across to Cow-urua on the Rupununi river, which I wished to visit; arriving at the place we found only the remains of recently burnt houses situated on a rising ground three miles from the Takutu and 12 miles from Tauarutu mountain. We thereupon turned eastward and walking without a path came to one of the rivers we had crossed in the morning, though away to the eastward of the crossing and there camped.

Leaving camp next morning (23rd) we did not go far before we met a path leading in a south-east direction which we followed and eventually came to a village beyond a river called the Casowedie. Getting information there regarding the route to take, we set off again across country due north-west over an undulating tract, and came to a river close to a village late in the afternoon where we camped. As we came along in the afternoon from a ridge top, I had a fine view in the direction of the Quitaro, savanna, and with pleasure recognized many distant landmarks, such as Tomboro and Carawimintow mountains, which I had explored in the autumn of 1869.

Next morning (24th) we went to the village close by and then westwardly without a path to a large branch of the Rupununi, called Tawaiwow, and then on past Cau-urua, an old deserted village, along a good path near the Rupununi in a northerly direction to the vicinity of Mount Patighetiku. Turning down from the path to the Rupununi, we camped on its edge for the night. The river where we camped was some 30 yards wide, and the water was lying in pools, and apparently not flowing at all. Its banks were 15 feet high and lined with a belt of bush on each side.

Starting at 7 a.m. next day, we followed the path we had left the day before for about one mile past Mount Patighetiku, and then turned north-east without a path to the Puruarawow river. This river had water only in pools amongst large granite rocks, was only 15 yards wide, and is a tributary of the Rupununi. There we came upon a good path, and followed it in a west-north-west direction, crossing the Camaikariba river and then the Suwara-owra. We came soon after to the village of Catunariba about one mile to the west of Pinniyettinow village, at which we had left some provisions on the 21st, and for which we now revisited the place, just arriving in time, our last supply of vegetable food having been finished that morning. We went on to Pinniyettinow and then returned to Catunariba, where a good Indian hut being placed at our disposal, we remained all the following day (Sunday 26th).

Replenishing our empty packs with fresh provisions, we continued our journey next day along a path over beautiful undulating savanna, in a north east direction, towards the great Canucu

mountains. Up to this time, since leaving Karinambo, the weather had been very fine, with a few exceptions, but now as the regular rainy season of these regions approached, it gave signs of breaking up, and on this day we had heavy showers of rain. We came to a village called Daruwow, and learning that we could not reach Cabarooda village till the next afternoon we remained there for the night. We went down to the Rupununi river, not more than one mile to the eastward of the village, and found the water lying only in still pools, between which we could walk over on rocks and gravel banks without seeing a drop of water. This village is just four miles to the south-west of Mount Tarucupani, and the view from it to the Canucu mountains is extremely fine. The southern face of the Canucu mountains is not clothed with the same dense forest covering as on the north, but is studded with large areas of grass land some of which are upon their very summits.

We left Daruwow at 7 o'clock next day and walking over a level plain crossed by two low ridges came to the Rupununi at 8 a.m., over which we passed dryshod on the large rocks. Beyond the river we crossed another alluvial plain near the far side of which ran the Catua-owra river coming all the way from the valley behind Shea rock and running into the Rupununi close by. Then we went on over another gap in a spur of the mountains across a third extensive level alluvial plain, and round a conical hill of gneiss on its eastern side to a village which we reached at mid-day.

Going on to Cabarooda village we learnt that there were no corials there small enough to go down river in, owing to the water being so very low. We went to the river (a distance of only $1\frac{1}{2}$ miles) at the far side of the valley, close to the dome-shaped mountain of Burkutuayari, and there found the river very low and apparently blocked up with masses of rock, between which the water was lying in pools. There was a corial there, but it was too heavy and large to drag over such obstacles as sandbeaches and rocks. After a great deal of trouble and loss of time we found that we would have to go by a path to a Macusi village a few miles on, and there try and get canoes.

Therefore, next morning we started on, and entering the forest, with which the whole country was now clothed, came after $1\frac{1}{4}$ hour's walk, to the village, situated close to the river where there was but little level land the mountains closing in on both sides. Here there was a large bateau 20 feet long and very heavy, which was of no use on account of the river being nothing more than pools and little channels of water amongst sands and rocks. The Indians of the place said that we would have to walk down the bed of the river to a large creek on the left hand from which onwards the water was deeper and where corials could be obtained. Procuring a guide we started northwards, the path leading through some bush for a short distance and then along the sand beeches in the bed of the river. Every here and there we had to wade from one sand point to another, the water reaching

often to our knees, but sometimes being only about 3 inches deep and not more than 2 feet wide. In one or two places there was nothing but sand, the water evidently percolating through it, and in these places the centre of the river bed was some feet higher than the parts near each bank. At a few deep places where the water was lying in ponds we had to walk in the forest for short distances and come out on the river where the sands set in again. After a most fatiguing walk in this manner, chiefly through light yellow sand in which the foot sank to the ankle, and from which the radiation of heat was most intense and the glare distressing, we came at 5.15 p.m. to a river called Peropoko, where corials were to be obtained and camped. All the way down the mountains come here and there close to the river on either side, and are in high ridges trending east and west. The river's bed is about 50 yards wide, and is lined on both sides with heavy forests. We found two small corials near this river and secured them.

Early next morning (30th) we walked to the village and obtaining some provisions came by another path to the river a little lower down where there were a number of small corials. Two of these we hired and three we took, the Indians saying that they would come down to Pirara landing and take them back. In these we continued our journey down the river which now contained just sufficient water to admit of our small corials being poled, paddled, and dragged along, and to prevent us from walking further on the sands. In the portion of the river travelled over during the afternoon the water became very shallow, owing to the river widening out and running over wide sand areas. At these places the men had to wade and drag the boats along. Many old trees and branches which had fallen into the river lay across the deepests parts and necessitated our hauling the corials in shallows round them. That night we had some heavy rain accompanied by a strong breeze, which continued up to a late hour next morning.

Next day (31st) we passed the mouth of the Mapara river coming from the last mountain valley, which being swollen by the late rains added a good body of water to the river, so that we had no more shallows to drag over. We experienced two showers of rain, the second being exceedingly heavy, and falling late in the afternoon, we therefore landed and camped on a sand beach close to Camarapa river. After passing the Mapare river the mountains end, and the river flows through a forest-covered plain.

At mid-day on Saturday, April 1st, we ran down the Urua rapids, and in doing so one of the corials, containing five Macusis, upset through bad management.

Near Cutoka river, on the east bank, the forest ceases, and a narrow tract of savanna sets in, occupying the river's edge almost all the way down to Pirara landing, while the west bank is clothed with trees from the Canucu mountains quite down to the same place. We had frequent showers during the day accompanied by strong gusts of wind. At 5 p.m. we reached Pirara landing and camped.

On Monday, 3rd, we started with 10 men for the purpose of visiting a salt deposit which exists near the Ireng river, and passing once more through Quatata village got as far as the Carebongteur river. Next day we crossed the Nappi at its junction with Pirara, and reached our destination at noon; then I examined the place and returned to the Nappi river for the night.

We got back to Aringwong next day, and the succeeding one, accompanied by all the Indians who had acted as carriers during the journey, descended in the bateau and corials to Karinambo. I then paid off all the Indians in negotiæ for their services and they all returned to their homes. A party of Wapisianas came down for the corials that we had made the journey from Perapoko river in to take them back as they had promised.

We rested one day, packed our things in the boat, and on the 18th left Karinambo on our homeward journey, camping that night at Mora river, at the foot of the Pacaraima range. The water in the Rupununi stood almost at the same height as it did when we ascended it in December last. It would appear that when this part of the river falls during the dry season to a certain height on its banks, it keeps that level pretty nearly, during the dry weather only rising a few inches after a fall of rain in the Canucu mountains, and then subsiding to its standard level again. Mr. Pollard informed me that in the month of January the river became swollen with water to within some 3 feet of the level of its banks after about three days' heavy rain in that district.

On Wednesday 12th we came once more to the Essequebo river, and landed at the Carib village for a short time. The Essequebo was in flood, and the Caribs told me that it had been so ever since we went up the Rupununi.

The information I got from them regarding the Berbice river was that the path to it had not been used for such a number of years that it had become overgrown with bush, and that no Indians lived on that river for a distance of five days' journey down it below the old path. I determined however to go across to it, and so we started up river accordingly, reaching the spot from which the old path led, at the mouth of Primos inlet, the following afternoon. We had experienced constant showers of rain every day and night since the 9th, and this night proved no exception to the rule.

As the rain did not cease until 7 o'clock next morning we did not get started till 8.30 a.m., and then taking two days provisions with us commenced walking due east by compass. One of my men went in front, and following close, I directed him by compass bearings how to keep, from time to time. The other men coming behind had cutlasses and cleared the path thus marked out so that we would have no difficulty in finding our way back. We crossed a swamp wading in shallow water, and then a low level tract of country, well wooded with high Mora trees and strong undergrowth (without any change of level) till 11 a.m., when we came to a second swamp, where there was the source of a small

stream running east. The forenoon was cloudy, with no rain, but the undergrowth was loaded with moisture from the rain of the previous night, which made the clayey ground soft and sticky. We went on over the same level forest country, crossing three creeks. At the third the land became firmer, and rose a little, and then sloped gradually to the Berbice, at which we arrived at 5 p.m., having been 6½ hours walking across. The Berbice was there about 40 yards wide, and its water was turbid and high, but running sluggishly.

Early next morning I had a group of trees cut down, and a mark placed on a tree, in order that when I ascend this river I can recognise the spot, and so determine my true position. At 7.30 we started on our return to the bateau, having given up all hopes of going down the river, there being no corials or woodskins to descend in, and following the track we had made reached the Essequebo in five hours. On regaining our boat there we started down stream, and arrived at the Carib village at sunset. The river had risen 5 feet since we went up, that is in four days, and was now within 8 feet of its highest mark, and some 10 feet higher than it was in December last. On the way back from the Berbice river we had a little rain, but the next day it ceased, and the weather cleared a little.

On Monday, 17th, we commenced the descent of the Essequebo river, and reached the part of the river opposite to Maccari mountain at 9 o'clock the following morning, and taking a compass bearing to its western end landed on the east bank. We commenced cutting a track towards it, according to the course, but made very poor progress, owing to the thickness of the undergrowth, composed chiefly of a tall plant resembling a Bromelia, whose long cutting edge leaves entwined in front and above our heads, and had to be cut through before we could proceed. We only cleared a track of about one mile in length by 4 p.m., and returned to the camp.

Resuming the same occupation next day the same difficulties presented themselves until we reached the foot of the mountain and began to ascend it, then the undergrowth as is usually seen consisted of young trees which sprout up three or four feet high from the seeds which fall from the surrounding forest. At noon we commenced to ascend gradually for about a quarter of a mile, then we came to the foot of a steep and rocky ascent, which continued for some distance with an easy and short slope on top, then up another abrupt rise, with a gentle slope above, to the face of a precipice of sandstone. This perpendicular face of rock was 150 feet high, and inaccessible at this spot, so we made a detour along its foot for a short distance to a deep gully, up which we got a footing and climbed by holding on to the trees and shrubs growing amongst the loose blocks of rock till we came to a second perpendicular face of a rock which was also inaccessible. From the end of the mountain at this level we had a fine view of the country, ranging from south to north-west. We once more followed the edge of the perpendicular face of rock upon a narrow ledge to

where the upper part of the gully intersected it, and up the gully to the third and last face of rock, where a narrow ledge led out to the point of the mountain which we followed. Gaining this spot we found an accessible place, and clambered up it to the top, finding ourselves on the summit of Maccari mountain at last. Here at a height of 1,270 feet above the sea the trees were stunted, and growing thinly together, and we obtained another splendid view in the same direction as the first.

I observed that the range of mountains from Makarapan does not come within more than 8 or 10 miles of the river, and curves more towards the northward than indicated on the map. This range terminates in an exceedingly high massive mountain at the south-eastern base of which are numerous small conical hills. We left the top of the mountain at 2.45 p.m., and descending rapidly through a heavy shower reached the Essequebo at our camp at 5 p.m.

On the 20th we continued our homeward journey, and next day at mid-day landed at the foot of Cumuti mountain. Ascending it to the Comuti rock I took bearings to the mountains which lie in ridges nearly north and south between this spot and the Demerara river, and which have not been placed upon any map. A heavy rain prevented my exploring the top of the ridge, so I was compelled to return on the following day for that purpose.

On my way up in the early morning I visited the look-out at Cumuti rock, and witnessed a singularly beautiful sight. In looking down upon this in fine weather you gaze upon the tops of forest trees far below, spreading like a green carpeting away to the horizon eastward, relieved here and there by bands of sparkling water in the numerous channels of the great river. Now all was changed, and a dense sheet of white mist covered the face of the whole country, obscuring the sun, then a little way above the horizon, whose rays lit up the fleecy mist till it resembled a sea of molten silver.

We proceeded along the ridge for a long distance, but the forest was so dense that I could not obtain a satisfactory view to enable me to see whether this group of mountains is continuous with part of the sandstone table land. Descending the mountain to the camp we went a little way down river, and camped on an island where we spent Sunday the 23rd. The rainy season appeared to have thoroughly set it, and heavy showers were frequent both night and day, with the river rising steadily. Owing to the great height of the water we were able to evade some of the most dangerous cataracts through channels amongst islands where the boat was lowered down by its tow rope. These channels are called Itaboos, and by them we passed Yucaribi, Etanimé, Owspart, Habacuhaha, Twasinki, and Haiawah cataracts, only running down Pacutout and the great Waraputa cataract. When we reached Cumparu river, nearly opposite to Curi-curi point, on Tuesday 25th, we entered it, went up a few hundred yards, and camping got things prepared for a walk to the Demerara river.

The rain delayed our start till 7 o'clock next morning, and on

the way we stopped for two hours at a small stream, so that it was 3 in the afternoon before we came out upon the Demerara river at an old deserted wood-cutting place. The land over which the path led was low and swampy, adjoining the Essequebo for a short distance, and then it became more undulating, with some ridges from 100 to 200 feet above the level of the river. On the way we crossed three good-sized streams, and at almost three-fourths of the way across we emerged from the high standing forest upon an open tract, where numbers of dead trees, fallen and erect, are to be seen blackened and charred by fire. This is called the "Burnt Ground," and it continues to within a mile or two of the Demerara along the path. Amongst the dead trees clumps of small trees and shrubs, some of them 20 feet in height, of quite a different growth to the original forest having sprung up, leaving large areas almost destitute of vegetation, save a common coarse fern and a few bunches of grass on the arid white sandy soil. This devastation of primeval forest has been caused by a fire, which must have spread during some remarkably dry season, many years ago, as is attested by the height of the after-growth.

Next morning we left the Demerara river at the Cumparu stream, and walked back, during a heavy rain, to the Essequebo at the other Cumparu river (without stopping on the way) in 4½ hours. The path is exceedingly tortuous, and must be a quarter longer than a straight course from river to river would be.

We left the Cumparu in the afternoon, and running down all the lowest set of cataracts in the river, reached the settlement on the evening of the 29th, and waiting four days there for the contract steamer, returned in it to Georgetown on the 4th of May.

PART II.

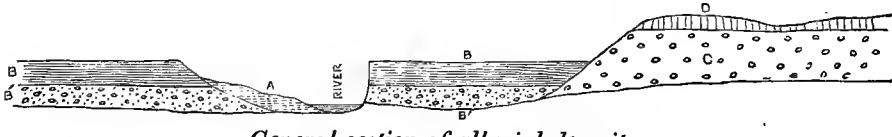
1. Alluvial Deposits.

From more protracted investigations of the alluvial deposits of the savannas than I had hitherto been able to make, I have been led to arrange them under the following heads :—

Recent period. { *a.* Loam, sand and gravel beaches of rivers.
b. River loam.
b′. River gravels.

Post-pliocene : *c.* Valley gravels and clays.

No. 13.



General section of alluvial deposits.

A. Recent alluvium. B. River loam. B¹. River gravels. C. Valley gravels. D. Iron oxide.

a.—Loam, sand, and gravel beaches of rivers.

Under this heading is placed the black clayey loam deposited by small branch rivers on the savannas, the small patches of recent alluvium at the bends of some of the large rivers, and the extensive sand and gravel banks exposed in the large rivers that traverse the savannas. The quantity of alluvial matter deposited every year by the rivers, when in flood, is very considerable, and I had opportunities of obtaining the thickness of this, deposited in three places very remote from each other during the last rainy season. These were on Potaro river, below Tumatamari cataract, on the Upper Essequebo and Takutu rivers. At Tumatamari this coating of baked mud on the rocks and sandbanks was in places 6-10ths of an inch in thickness. On the Essequebo river, below Primos inlet, it was 3-8ths of an inch thick, and composed of a dark clay, with minute particles of mica and sand throughout it, thoroughly baked by the sun. On sandbanks in the Takutu it was in some hollows 2 inches thick, and had small bird tracks, raindrops, and impressions of leaves upon it.

On the savanna, between the western end of the Canucu mountains and the village of Berkutone, there is a superficial coating of light sand, which is blown into small ridges by the wind. It is the result of the washing away of the clay with which it was mixed by the rains. The undulating country between the Demerara river and the Essequebo traversed by the Cumparu path is covered with a light white sand.

Great sand beaches and gravel banks occur in the Takutu river, both above and below its junction with the Ireng, and also on the Ireng and Cotinga on a smaller scale. On the former river some of these sandbanks are one or two miles long, and some 200 to 300 yards wide, occupying the greater portion of the bed of the river. Amongst the white quartz pebbles of these gravels, some of which are from 2 to 3 inches in diameter, are pebbles of flint, hornstone, and reddish and yellowish quartz. In the sand amongst the gravels are small garnet crystals and magnetic oxide of iron grains, which proves that they are derived from the disintegration of the gneiss of the Canucu mountains. In the lower course of the Takutu the gravel beaches are made up of every variety of common quartz, great quantities of red jasper, small agates, and black botryoidal quartz. In the Cotinga and Ireng also jasper pebbles are very common, and have been washed down from the sandstone formation of the Pacaraima mountains.

At the heads of the Camoa and Nappi rivers, not far from the Canucu mountains, there are fine broad level tracts of recent mud-like alluvium, and similar deposits are situated in all the depressions in the savannas. Upon the surface of the river loam on the level savannas there is sometimes seen a soil of dark loam from 18 inches to 1 foot thick, which has gradually been deposited by yearly floods.

b. River loam, and *b'. River gravels.*

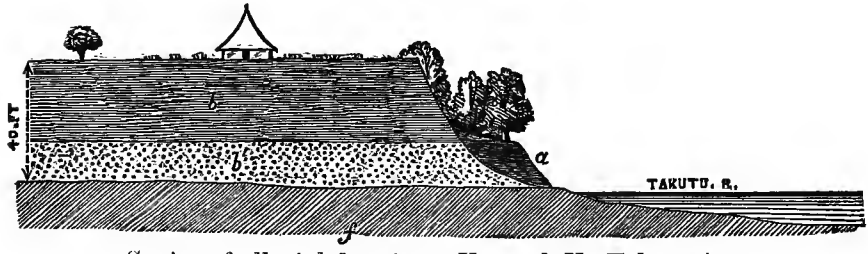
The river loam forms the upper portion of the great tracts of alluvium deposited by the large rivers of the colony, whilst the river gravels (*b'*) lie beneath it, and form the lower portion of the same great deposit.

The area occupied by this in the lowlands of the country is exceedingly extensive. On the Essequebo the banks of the river are formed of this loam, but its lower portion is not seen. On the Cotinga and Takutu rivers, however, where sections of these beds are exposed in their banks of 30 feet in height, the homogeneous loam is seen resting upon the gravel beneath; and where the base of the latter is visible the upper portion exceeds the under in thickness.

I will now give a detailed description of these deposits as they occur in different districts. A dark-coloured alluvium of an arenaceous nature occurs near Colomeh river on the Curiebrong, but is of the usual yellowish loam in other portions of the river. A short distance above the great portage on the Curiebrong river there is a set of gravel beds similar to those seen on the Mazaruni at Camacousa. These form a thickness of 20 feet above water, but their base is hidden, and they are composed of loosely cemented gravel beds of different textures interstratified with layers of loose sand, all stained of a dark brown colour, and showing false bedding. The pebbles in them are very slightly waterworn, and some are quite angular.

The banks of the Essequebo river, from the mouth of the Rupununi up to Murray's cataract, are composed of grey and yellowish arenaceous clay of homogeneous structure, and beyond this, as far as I went, where the banks were not formed of rock or of recent alluvial clay, this same loam extended. In some places it becomes almost pure white, and then contains a large proportion of Kaolin, being derived from the decomposition of granite and felsitic rocks. In one place, some miles below the Ouruow river, this clay assumed a bright pinkish or reddish-pink tinge, and contained a large proportion of finely titurated silver-white mica.

No. 14.



Section of alluvial deposits at Yarewah V., Takutu river.

a. Recent alluvium. *b*. River loam. *b'*. River gravels. *f*. Red shale.

Not far below the mouth of the Macumuca river, on the Takutu, upon the evenly planed surface of the red shale, just above the level of the river water at the time of my visits, rests the river gravels and loam deposits, exposing a vertical section of 30 feet in height, composed of two equal portions, the lower of coarse sand, and the upper of gray loam of homogeneous structure. Amongst the coarse sand in one place there occurs a layer of fine white sand, and above it a layer of more argillaceous materials, exceedingly firm, and stained with tin coatings of iron-oxide. Irregular patches of hydrated oxide of iron occur frequently. The banks of the Ireng river opposite our camp of January 1st gave a perpendicular section of 30 feet composed of arenaceous loam, the lower parts of which are partially consolidated. The lower portion is of a red and yellow colour, and is impregnated with oxide of iron, whilst the upper is of a yellowish colour and finer texture.

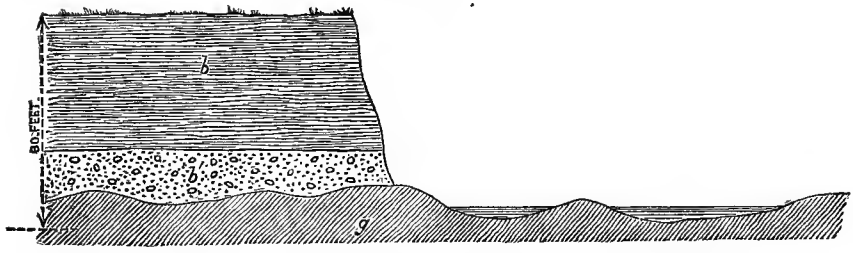
Irregular masses of clay impregnated with hydrated oxide of iron are frequently seen in many places, and especially where water laden with salts of iron in solution is seen trickling through the loam and sands, and depositing the oxide as it becomes exposed to the air.

There are no divisions into layers or beds except between the lower and upper portions, and this is irregular and not clearly defined. Not a trace of bones, shells, or vegetable remains can be discerned anywhere in them.

In the mouth of the Pirara river, about one mile up, there is a spot where the river has cut away some of the grey loam and left a curious development of hydrated oxide of iron standing in rough and jagged pinnacles, some of which are hollow and funnel shaped. These are composed of angular grains of quartz sand cemented by iron, and are exceedingly hard and have a stalactitic appearance. They have been formed by the percolation of water saturated with salts of iron through the loam and sand.

Some curious beds of leaves are shown in a section of the gravels and sands on the lower Takutu river not far from its junction with the Ireng ; they are in false bedded layers of from 2 to 4 inches each having a total thickness of about 2 feet, and are seemingly but little changed in composition since they were deposited. Pieces of wood thoroughly decayed and blackened occur amongst the leaves and are very friable, whilst in the gray clay above them there are scattered leaves and casts of the cylindrical stems of some plant. The scattered leaves when dry peel off the clay leaving clear impressions. The bank there has fallen down, and in some degree disguised their true position so that it is difficult to say whether they belong to this or a more recent deposit. Not far up the Cotinga, from a bed of gravel cemented by hydrated oxide of iron, I obtained an impression of a leaf the leaf itself having been destroyed.

No. 15.



Section of Alluvial Deposits near the month of the Cotinga River.

Scale 10 feet to $\frac{1}{2}$ an inch.

b. River loam. *b'.* Partially consolidated river gravel and sand. *g.* Decomposing gneiss.

Near the Murawai river, a branch of the Cotinga, the river gravels rest upon gneiss rock, as consolidated sand beds, with the gray loam on top. Higher up the Cotinga sections of the same deposits forming the banks of the river show the gravels cemented firmly together by white clay with the loam in two portions of grayish and yellowish colours. The gravels are always false bedded and often contain large angular or slightly worn blocks of quartz. The materials composing this deposit on this river have been derived from the disintegration of the granite and quartz-porphyry of the Pacaraima mountains. Beds of hydrated oxide of iron are seldom seen on the Cotinga river beyond Wararasararu, but the whole deposit is often of mottled red colours from the percolation of iron-saturated water through it. Above Tuanusararu no gravel beds occur, and the alluvium ends at the base of the mountains, the river coming out of a narrow gorge bounded by rocks.

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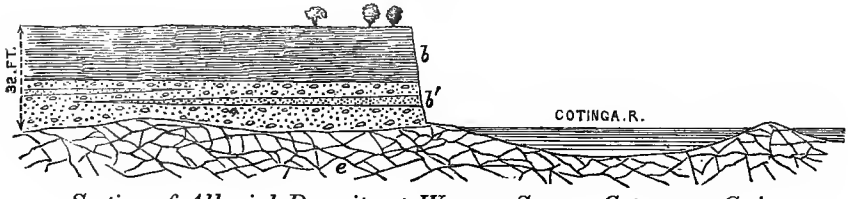

Section of Alluvial Deposits at Warara Sararu Cataracts, Cotinga River.

b. River loam. *b'.* River gravels. *e.* Granite.

On the Wailongteur river the alluvial deposit seen is of reddish and mottled clay 20 feet thick belonging to the river loam.

The banks of the Suwara-oura river are composed of a reddish yellow arenaceous loam, 15 feet in thickness, resting upon gneiss rocks and of a homogeneous structure, not a single pebble being seen in it, though quantities of gravel are now being carried along its bed by the stream. Between Dahdaad and Cocobean-arruwow villages there is a great level plain many miles in extent of river

loam, and this deposit forms the greater portion of the savanna along the Takutu river from Suwara-owra river southward as well as along the Rupununi river in its course south of the Canucu mountains. The Rupununi in its course through these mountains is bordered also by the same deposit of a gray colour which also forms its banks in the savanna to the north.

The tract of country between the Berbice and Essequebo rivers, and from the Essequebo to the foot of the Maccari mountain is composed of the river loam of a yellowish colour.

All the great level tracts of country bordering the Ireng are composed of the same alluvium which has been deposited by that river. Everywhere in the large rivers where the bank on either hand is being washed away this loam and consolidated gravel form almost perpendicular faces.

Saline Efflorescences.

On the surface of the river loam within 200 yards of the Chewow river, a branch of the Pirara, and at a distance of five miles from the Ireng river, there is one of those places where salt is obtained from the surface of the ground by the Indians. At this spot there are numbers of small bare patches of ground of a grayish colour amongst the surrounding grass-covered alluvium which are incrusted with salt.

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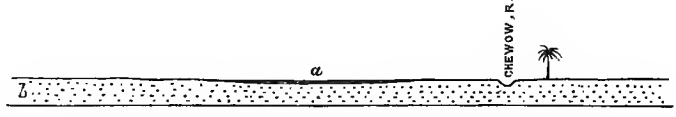

Salt Efflorescence on Alluvium, Ireng savanna.

a. Salt patch. *b.* River loam and sands.

On examining these I found a layer of grayish-brown dusty soil an inch thick caked on top into a slight crust having a strong saline taste and composed of an earthy substance containing fine crystalline particles of chloride of sodium. Below this comes a coarse white sand to a depth of 30 inches (as far down as we could dig) which does not contain a particle of salt to the taste. This sand at a depth of 1 foot is moist and mixed with sufficient gray clay to cause it to adhere together when pressed in the hand. These salt patches occupied only a space of 100 yards by 50, and beyond this area not a particle of salt was to be found. On the surrounding surface there is a thin sort of dried-up vegetable coating which shows that the land there is inundated during the rainy season. The Chewow river was very low at the time of my visit, and contained water (without the slightest brackish flavour) in small dirty pools in its bed full of lilies and rushes. Near the head of this river there is another salt patch, also one near the Ireng not far off, and a third on the Pirara river to the north-east.

The guide informed me that after every rainy season, when the country becomes dry and parched, the salt comes out on the sur-

face and is then very pure and white, and in greater quantity than at any other time. When removed by the Indians it continues to form, and the portion taken away is soon replaced. The Indians gather it, mix it with water, strain and boil down the solution obtained and get an impure salt which they harden by heat.

C.—*Valley Gravels and Clays.*

This ancient alluvial deposit occupies very large areas of the savannas, and amongst the savanna mountains of the Pacaraima chain. In the former localities it forms an undulating country rising from 70 to 100 feet above the level of the river loam deposit, whilst in the latter it occupies different levels along the valleys of the rivers of those districts. It is of a much greater age than the preceding deposit; its base resting usually at a higher level.

The great stretch of savanna between the Canucu mountains and Karinambo village on the Rupununi where this deposit occurs forming the watershed between the branches of the Essequebo and the head waters of the Rio Branco, is composed of red and gray clays, with beds of hydrated oxide of iron forming the crests of all its ridges. But south of the Cursato mountains, and near the Rupununi to the east of them, these iron beds are never seen, and instead of red and yellow clays we find quartz, gravels, and blocks with grayish clay.

On its surface between Aringwong and Carenacru villages there are some water-worn blocks of sandstone, and between the former place and Curewakiteh village where iron beds were exposed they contained a few quartz-pebbles and pieces of water-worn sandstone. On the high ground near Pirara landing in the iron beds there are pebbles of quartz and sandstone, and going westward towards Quatata village, at about two miles from it, there are water-worn pebbles of sandstone. Beyond this to the Ireng river there is noly one spot where small pebbles of sandstone are to be seen, and these are accompanied by quartz pebbles. These quartz pebbles and blocks have I think come from the sandstone formation, and point either to the former existence of sandstone along the course of the Rupununi, or to a great change in the river system of this district, when rivers from the Pacaraima mountains, probably the Ireng, traversed this portion of the country now occupied by the Rupununi.

From Pirara landing, on the Rupununi river, to the Canucu mountains, the surface of this deposit is composed of a stiff reddish clay, containing iron pellets. Between the Macummucu river and the base of the Canucu mountains at Mount Ilamikipang, a layer of iron oxide is exposed containing quartz pebbles. A short distance south of Chipedarinow village, an isolated ridge of iron cemented clays and pebbles occur, not far from the Takutu river. Near the old village of Pirara the surface of the valley deposit is of a bright red loam, which, when baked by the sun, is extremely hard.

Beyond the last granite ridge on the Coarawow river there is a great stretch of undulating savanna of red loam and quartz gravel with quartz blocks, and scattered on the surface of the latter are

very curious brown pellets of iron, one-fourth of an inch in diameter. From Cau-urua old village up to Patighetiku mountain, the path leads along the edge of the valley gravels, and there they are 30 feet higher than the river loam, and composed of quartz gravel and waterworn blocks, derived from the quartz-schist. Here it is very observable, that the branch streams of the Rupununi river have produced the present contour of the surface of the savanna, after it had been modelled by the main river.

In the Waiquah, Cumparu, and various other river valleys in the Pacaraima mountains there is a thick deposit of partially rounded quartz blocks and pebbles, most of which have been brought down by the rivers and deposited at different levels.

Before leaving the subject of recent deposits it may not be out of place to mention that I have examined these in many places for gold, by aid of the washing pan, but without success. As it has long been reported that gold was found in the Takutu river, I washed its sands and gravels, as well as the base of the alluvium of its banks, in many places for that metal, both below Yarewah village towards the Ireng, between the western end of the Canucu mountains and Suwara-oura river, and on a branch stream called Coarawow, some 3 miles from the Takutu river and 12 miles from Tauarutu mountain, but without finding a single grain. By these washings a large proportion of magnetic iron sand and garnet crystals was obtained, but nothing of any value.

2. *Sandstone Formation.*

During this journey I had opportunities of examining the sandstone formation on its northern escarpment at Amailah fall, on the Curiebrong, as well as its southern edge at Cumararing mountain, and of a large portion of its surface, exposed between the upper portion of the Ireng river and the latter place.

I will proceed to describe the Ireng area first, and then the Amailah sandstone afterwards; as in the former district the sections are much clearer, owing to the open nature of the country, and there the association of trap rocks with the sandstone is more clearly revealed.

Journeying northwards from the sandstone escarpment at Mount Cumararing, the outcrops of the different sandstone beds are crossed, presenting good sections, and a fine opportunity of studying their sequence.* As before stated (Report No. 5) the crest of Mount Cumararing is composed of beds of sandstone dipping north, and these have been eroded by a small branch stream running into the Ireng, producing a large valley, on the northern side of which we again find the base of this formation. The basement beds are composed of a series of quartzose sandstones, jointed and compressed, lying upon a greenish felsitic rock of exceeding hardness, which is apparently bedded irregularly and rests in its turn upon quartz-porphyry. This felsite contains a sort

Diagram No. 16.

of concretionary structure, like dark coloured patches of the same substance, in horizontal positions in it. Upon the quartzose sandstone lie coarse massive beds of sandstone-conglomerate, dipping north at an angle of 8°, and having a greenish-white argillaceous bed on top. The relative thickness of these beds cannot be ascertained, but the whole exposed in the face of the hill together does not amount to more than 200 feet.

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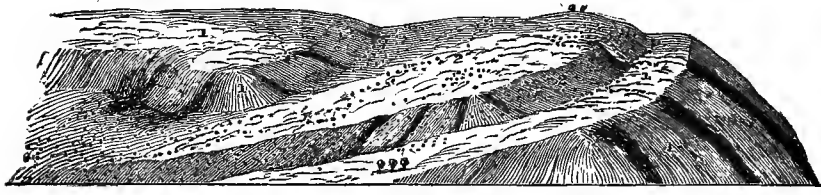

Greenstone Layer in Sandstone North of Cumararing Mountain.

1. Sandstone. 2. Greenstone.

From the top of the second ridge, 1½ miles north of this section, there occurs a great layer of diorite interstratified with the sandstone, of about 300 feet in thickness, and is identical in composition with that of Cumuti and Roraima mountains. This rock is a coarse crystalline-granular compound of white felspar and greenish-brown hornblende. Although the true contemporaneous or intrusive nature of this greenstone is most plainly shown, as before stated, still the actual junction is so disguised by subaerial denudation and decomposition, that it is quite impossible to say positively whether it is of the former or latter nature. I had previously seen the actual contact of these rocks at Cumuti mountain (Report No. 5), where the greenstone rests upon the sandstone, but not any section in which the sandstone rested upon greenstone, showing the contact. North of Karakanang village I observed a dark, slaty, green rock resting upon the greenstone (Report No. 5), and possibly it is a shale altered by contact with the greenstone. This then would give the greenstone an intrusive character. North of Cumararing, however, I traced the sandstone overlying the greenstone to within a yard or two of their junction, and found that the former was not altered in the least degree at that distance from the point of contact.

Not far north of this there is a true eruptive dyke of a different kind of greenstone, which must intersect the last described layer of igneous rock, and is evidently of a later orgin. It is about 50 yards in width, lying in a E.N.E. and W.S.W. direction, and can be traced for a long distance by its line of dark coloured blocks of rock, and the patches of bright red earth, which result from its decomposition. It evidently has an inclination to the north, for it has suffered from a fault which has lowered one side and given it the appearance of a side throw, for a distance equal to its own width. The sandstone on either side of this dyke is not altered apparently, and its bedding is not in the least disturbed, but dips north as

before, at an angle of 8°. Against it comes a soft, friable, whitish sandstone on the north, and a hard jointed conglomerate on the south.

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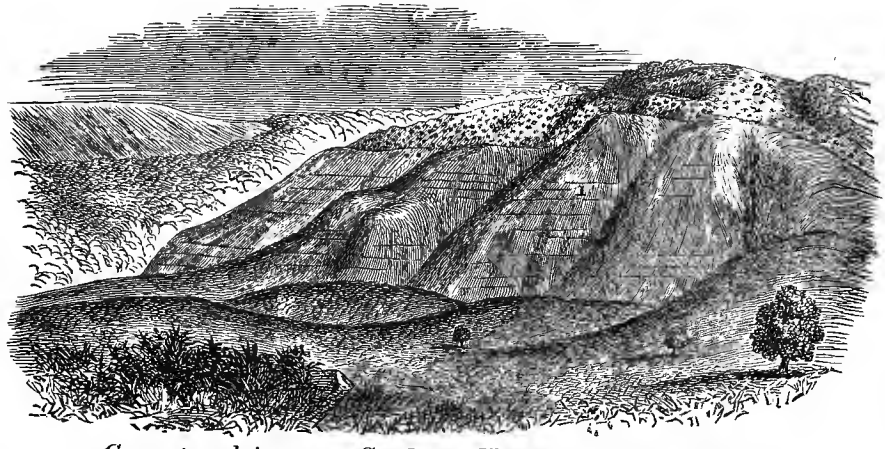

Greenstone lying upon Sandstone N.N.E. of Tacara-erimone V.

1. Sandstone. 2. Greenstone.

The sandstone continues for $1\frac{1}{2}$ miles beyond this dyke, and forms a low escarpment, some 300 feet in height, upon which the base of a second great layer of greenstone rests. The beds here dip gently north at an angle of 5°. At this place again the actual contact is disguised by detritus that has fallen from the hillside. This bed is exposed at the surface for a distance of $2\frac{2}{3}$ miles, which with a dip of 5° to the horizon, gives a thickness of 1,000 feet. On the side of the great slope, from the top of the last-mentioned escarpment down to the Wailongteur river, there are great blocks of this greenstone in the form of rounded, weathered, and split masses, covering its upper eroded surface. It is a similar greenstone to that of Cumuti rock also, but not so coarsely crystalline. This greenstone can be traced to the bed of the Wailongteur river, in which it forms large masses, and on for about one quarter of a mile to the edge of the forest, which lines the river, where it is overlain by beds of yellowish thin-bedded shale, dipping north, and forming an undulating tract of country to the fort of the next escarpment. The face of this is composed of outcropping beds of gray and pinkish soft sandstone, with here and there, every 20 feet or so vertically, a hard bed of sandstone, of a reddish colour, and with interstratified bands of white, grayish and banded beds, of a flinty looking siliceous rock. On its very summit some layers of red jaspar are seen, which may correspond with those seen on Karakanang mountain top. If so, this greenstone is continuous with that of the above district, and probably also with that of Tawailing mountain to the east. The sandstone containing the jaspar is of a soft white or pinkish colour, with layers of minute rounded quartz grains in some parts of it.

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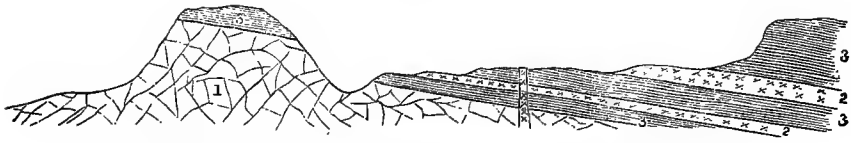

Greenstone Layers in Sandstone at Cumararing Mountain.

1. Quartz-porphyry. 2. Greenstone. 3. Sandstone.

Taking the sections just described from Cumararing mountain, the base of the sandstone, we have a total thickness of 4,800 feet of sandstones and shales, containing two great interstratified layers of greenstone, one of 300 and the other of 1,000 feet in thickness.

All the way down from the top of the escarpment, north of Wailongteur river to the Karnang, the soft reddish friable sandstone beds form the surface of the ground and have in the valley below an almost horizontal position. Farther on in Toobaboromé mountain, the dip is in a south-westerly direction, at a very slight angle showing an entire change in the lie of the beds. The horizontal beds, with jaspers strewn all over their surface, cover the whole plain to the lower falls of Orindouie on the Ireng, where there are beds of exceedingly hard fine-grained silicious sandstone containing layers of red jasper. The sandstone continues, lying almost horizontally along the Ireng with jasper beds on top as far as a point due west of Toobakeng mountain. Journeying up the Ireng from this in a corial but few rocks are to be seen, and these are all sandstones as far as Camouta rapids, where a third layer of greenstone occurs, occupying a distance of one quarter of a mile of the river. Some two or three miles to the south-west of this, on the Chemapeur river, I saw some beds of bluish-black thinly laminated crystalline rock which I take to be a trap. It is laminated parallel to its bedding and resembles an altered shale. One slab of this rock in the bed of the river was adhering to a block of conglomerate of a friable nature, composed of pebbles of various rocks in an earthy cement.

The upper fall on the Ireng river called Orindouie is produced by beds of red sandstone containing pebbles of quartz, which dip a little to the south of west, at an angle of 5° to the horizon. These beds are jointed vertically in two directions, and at the foot of the sloping side of the precipice, on the eastern side, they form rows of jagged pinnacles. The top beds of Wantuánà are composed of thin bedded jasperous sandstone, containing beds of red jasper and are almost horizontal.

In the face of the great table land at Amailah, on the Curiebrong river, we have again associated sandstone and greenstone; but here, as in most other cases of the kind, in a country densely clothed with vegetation, and subjected to the disintegrating powers of a tropical climate, all minor geological details have been obscured or completely hidden by debris and forest. On approaching the foot of this great escarpment, at a distance of about one mile from the Colomeh river, a small tributary on the west, the granite rocks

terminate, then comes a tract of one quarter of a mile in width in which no rocks are to be seen, but which I believe to have been the sandstone outcrop, now obscured by alluvium, and after this we have a coarse crystalline greenstone, precisely similar to that at Cumuti mountain, with its horizontal bedded structure very prominent.* Upon this, at a height of about 400 feet on the mountain side, comes the sandstone formation, which consists of red and white coarse sandstone with coarse conglomerate on top, occupying a vertical distance of about 800 feet. The junction between the trap and sandstone is completely hidden by the great blocks of conglomerate which have fallen from above, together with the loamy detrital matters derived from the sandstone beds and the dense foliage. This layer of greenstone, 400 feet in thickness, is very coarsely crystalline, having large semi-transparent crystals of hornblende of a brownish colour, in a crystalline base of white felspar, most probably anorthite.

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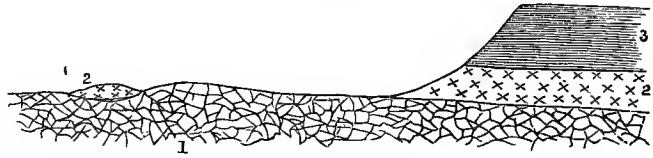

Greenstone Layer at Amailah on the Curiebrong River.

1. Granite. 2. Greenstone. 3. Sandstone.

The precipice over which the Curiebrong river precipitates itself exposes a section of the sandstone formation at the top of the great table land of 171 feet in height. This is composed of thick beds of hard, coarse, pebble-conglomerate for 101 feet, overlying 70 feet of thin-bedded sandstone and shale, arranged in alternate layers of thin red shale and gray sandstone, of various thicknesses, from one-eighth of an inch to two and three inches. Against the foot of this section are enormous blocks of conglomerate, which have fallen from the beds above and obscure all below.

The thin sandstone beds contain surfaces exhibiting most perfect ripple marks, from small narrow wave-like ones, to those wide undulations produced by strong currents; also well-developed sun cracks and casts of rain drops. Here then is evidence of a shallow water deposit, where there was a flow and ebb of tide which was succeeded by a great deposit of coarse conglomerate, containing pebbles of quartz, jasper, and trap. I examined the thin-bedded sandstones very closely, as far as I was able, for bird or reptile tracks, but without success, only observing upon one slab a cast bearing an indistinct resemblance to a track, but which could not be depended upon.

Just beyond the mouth of the Colomeh river at the foot of the Amailah gorge, the first blocks of conglomerate are met with, and

* Diagram No. 19.

the river's bed is there almost filled with them. Both on this river and on the Potaro, before reaching the mouth of their valleys, no detached blocks of this conglomerate or sandstone are to be seen, proving undoubtedly that they have all been destroyed in the river's bed before reaching the open plain. There are two detached mountains to the north of the sandstone escarpment near by which are sandstone outliers.

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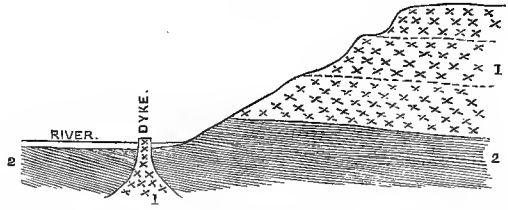

Greenstone Layer upon Sandstone, Twasinki Mountain.

1. Greenstone. 2. Sandstone.

At the base of the Twasinki mountain there are 50 feet of white sandstone beds, dipping in a N.W. direction at an angle of 30°, upon which lies 770 feet of the same coarse greenstone as is seen close by at Cumuti. This greenstone is in three great layers, presenting steps facing towards the east on each of which is a talus of red clayey earth, and the crest of the ridge is capped with a thick layer of impure hydrated oxide of iron. From finding similar layers on all the greenstone hills, I imagine that they are derived in part, if not entirely, from the decomposition of the surface of that rock.

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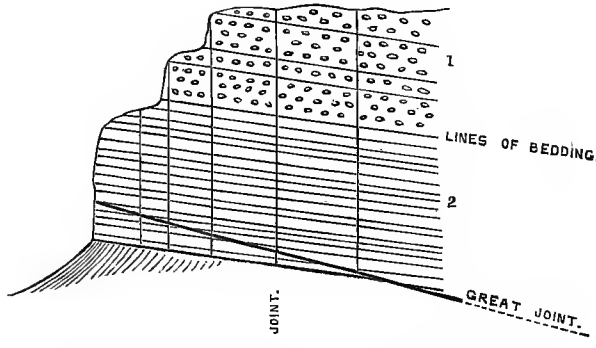

Sandstone Escarpment, Maccari Mountain.

1. Conglomerate. 2. Sandstone.

The long narrow range of Maccari mountains has its upper half composed of sandstone, of this formation, having a total thickness of 620 feet. It is first met with at a height of 520 feet on the mountain end, and rests upon the quartz-porphyry, but a huge mass of reddish clay and blocks of sandstone hide their junction.

It is divided into two equal portions, the lower of fine grained red sandstone, in beds varying in thickness from two to six feet, and the upper of coarse whitish pebble-conglomerate. The sandstone portion is jointed vertically and displays false bedding in a marked degree. One great joint is seen near its base at an angle of 12° to the horizon, cutting across the bedding in a most curious manner. The lowest beds have layers of white quartz of spindle shapes embedded in them, and also circular spots of a lighter colour than the mass of the rock itself, with plates of white mica in their laminæ. The pebbles in the conglomerate are of white quartz, either scattered irregularly throughout the sandstone, or in some cases forming the whole mass of the rock. The cementing material of the quartz grains and pebbles is a white clay, in very minute quantities, and is sometimes wholly wanting. The perpendicular faces of sandstone are covered with a white lichen, and the sloping portions with moss and shrubs.

At Yarewah village, and again near the mouth of the Macumucu river, in the bed of the Takutu, there are beds of a purplish or dark-brown shale, containing layers of silver-coloured mica scales and black irregular stains of oxide of iron, with a sort of conchoidal fracture. These beds dip in a due south direction, at an angle of 5° to the horizon. They resemble some of the beds of the red sandstone, but like similar beds on the Rupununi river, their true position cannot be easily determined.

Though I searched carefully for fossils in the shales and sandstones I was unable to find anything whereupon any dependence could be placed. On a large block of sandstone in a brook close to the Ireng river, above the lower Orindouie fall I obtained a specimen of coarse fluted rock singularly like the cast of a *Sigillaria*, which had been washed down from the mountains to the east.

I went to see a "shining substance" in some rocks northward of Cumararing mountain, guided by an Indian of the village, who had informed my interpreter of its existence. He took me to a mass of gray sandstone rocks on the side of the hill that had fallen from a precipice near its crest, and then began to search for the block in which he had seen it but without success. We all spent a considerable time in searching amongst these rocks but could see nothing. This sandstone was in blocks and slabs of a gray colour and coarse texture with thin layers of scattered specks of oxide of iron and white mica. There was nothing like a vein or any indications of gold or other metals of value.

I have not yet sufficiently examined the various sections which I have got recorded in my notes of the beds or layers of greenstone associated with the sandstone formation to enable me to arrange and correllate each one at present, and as it will necessarily occupy some time, it will be left for a future report. The determination of their true character, as to whether they are intrusive on the one hand or contemporaneous on the other, cannot be accomplished until the whole has been thoroughly examined. All that can be said at present is, either that these eruptive rocks

have burst up from beneath, and been forced out in great layers between the sandstone beds at different times, or that they have been ejected during the time that the sandstone was forming in the bed of the ocean and thus came inter bedded with it.

One can form some idea of the activity of the igneous action exerted during the epoch of this sandstone formation when he considers that the out-crop of these traps can be traced around an area of 150 miles in length and 50 miles in breadth. The immense denudation that has taken place since they became surface rocks may be inferred when we view the many distant isolated tracks of greenstone all of which have evidently formed at one time a continuous layer.

Though there is no data whereby the Geological age of the sandstone can be determined in the absence of Palaeontological evidence, still it is evident that its association with greenstone layers betokens an extreme age. From its lithological characters its containing these inter-bedded greenstones, and having rippled-marked surfaces on some layers, it closely resembles the new red sandstone of Connecticut, U.S.

Mica-Schist.

At the portage of the first cataracts at the Curiebrong river there is some partially decomposed schist with thin quartz veins and strings. Between Yiemah and and Apanachi rivers there are some perpendicular beds of a gray argillaceous rock, full of square cavities, from which some mineral, most probably iron pyrites, has been dissolved.

Near a portion of the Essequebo river where it takes a great bend to the south not far from Rock Danigo, and south of the month of the Cuyuwini river there is a small hill of mica-schist, descending to the river's edge. It has its foliation vertical, is jointed irregularly with the slope of the hill (an angle of 50 degrees), and again more regularly jointed at right angles to its foliation, so that it breaks up into elongated rhombs. Thin lines and swellings of quartz occur here and there in it. Besides these there is a large quartz-vein 2 feet 6 inches wide lying across the river of a pale amber colour, which does not appear to contain any minerals or metals. I examined it thoroughly and washed in the sands accumulated below it and obtained a good quantity of magnetic iron sand but no gold.

There is a small development of chlorite-schist on the Cass-kityu river on granite.

4. *Hornblende-schist and Hornblende-rock.*

A patch of hornblende-schist occurs at the granite ridge edge, on the southern side of the shallow valley of the Mepitewow river.

At the Casowedie river there is a long low hill, partly covered with trees, and ranging N.N.E. and S.SW. which is composed of a highly crystallized dark green hornblende rock. It is a quarter of a mile in width, and appears to be an eruptive mass in the

granite of this region. This seems to extend across country to the Rupununi river at Mount Patighetiku, which rises about 300 feet above the savanna and is entirely composed of the same rock. On its surface there is a thick covering of red clay, producing a marked contrast in colour, with the yellowish clay upon the granite. It is very coarsely crystalline, and decomposes to some depth on each block or exposed mass, producing red oxide of iron.

Just above Paumbo island on the Essequebo river, there is a development of rudely bedded rocks, composed of finely crystalline green hornblende and white felspar, which has a slight though irregular parallel arrangement of its mineral constituents.

5. *Gneiss.*

At a small river some 10 miles above Paumbo island, in the Essequebo river, there is a beautiful mass of gneiss of a dark colour and close wavy texture, full of large elongated and compressed crystals of pinkish felspar. About two miles beyond this crystals of garnet make their first appearance in this rock but as the gneiss is much weathered on the surface, the garnets are partially decomposed.

The gneiss at Murray's cataract and onwards to King William IV.'s fall is of a coarse gray variety, containing quartz nests and garnet crystals. Its planes of mineralization are in most cases vertical, and the rock appears to be cleaved, breaking easily parallel to them. Some masses resemble granite in their mode of weathering, and have flat or rounded forms, but still the planes of foliation are nearly vertical, they break up into irregular squares on the top surfaces of which the foliation is seen very highly developed in all forms of contortion.

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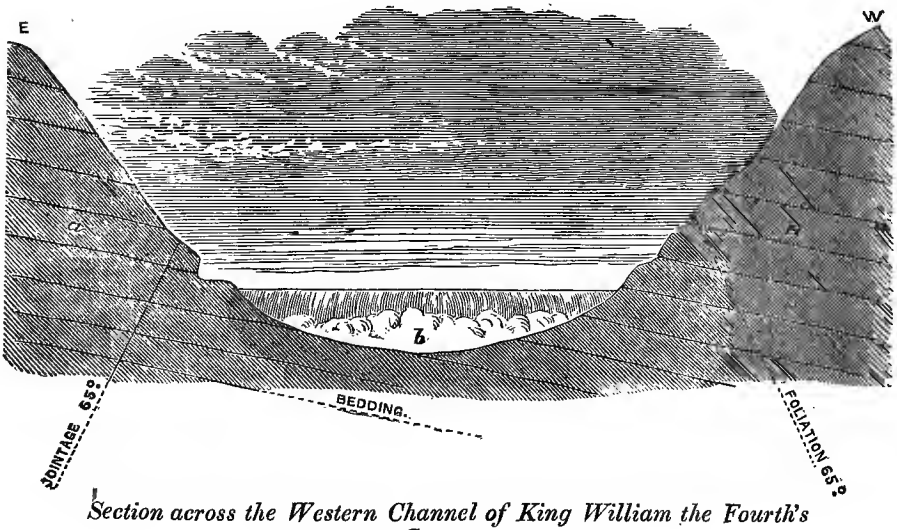

Section across the Western Channel of King William the Fourth's Cataract.

a. Gneiss. *b.* River.

The gneiss of King William IV.'s fall is massive and has the wavey foliation inclined at an angle of 65° to the west, the cleavage or joint planes at about the same angle to the east, while a rude sort of bedding is nearly horizontal, or inclines also the west. The rock has broken on its bedding and jointage or cleavage planes, and thus produced smooth sloping surfaces of rock on the western side of each channel and jagged steps on the eastern. This rock is of a gray colour and coarse texture, and contains immense quantities of garnet crystals in clusters arranged in lines. It is impossible to obtain any good specimens of these crystals owing to those that can be broken out by the hammer being in a state of partial decomposition. Some small veins of felspar and quartz traverse the gneiss of the western fall and contain small quantities of black mineral resembling pitch-stone.

I observed that in the bends of the river the planes of mineralization are almost vertical, and lie in the same direction as the course of the river in many places, but are chiefly east and west. Between Mararowah and Pamu cataracts there are numbers of rocky islets and detached masses of gneiss rock rising in some instances from 15 to 20 feet above water.

Ordinary gneiss forms all the rock masses in the river and on its banks up to the third great fall, at which I spent Sunday October 3rd, but there it changes to a syeintic gneiss, its mica being replaced by hornblende, and all its garnet crystals having disappeared. The strike of the foliation at this fall is nearly east and west, whilst lower down at Manarswah fall, it is about south-east and north-west.

Some two miles south of the third parallel of north latitude, the gneiss becomes granitic for a short distance, and at a large cataract beyond it assumes a porphyritic texture, having a green mica, and enclosing larger crystals of white felspar. From this place to the mouth of the large river coming in from the west, all the country is composed of the ordinary gray gneiss, without garnets, which occurs every here and there as detached masses in the river's bed, in curious forms, exhibiting most extensive degrees of contorted foliation. (See sketch on next page.)

In some places it is extremely compact or schistose, and of a dark colour, in layers between common gneiss. Some of the detached masses above alluded to are 25 feet in height and 20 feet in diameter.

I observed that on those rocks that are very high, their upper portion is of purplish colour, from a *lichen* growing upon them, the bottom edge of which forms an even but not horizontal line, showing that it cannot be the edge of the level of the water in the rainy season. Below this comes a zone of gray *lichen*, the bottom of which is evidently the high-water line of floods. Their upper portions, down to the end of the purple band, are grooved and channelled similar to those blocks now partially disclosed by the washing away of the alluvial banks. From this I infer that the river is there re-occupying its ancient course, and that these great blocks have been at one time surrounded by alluvium up to

the edge of the purple band, and like those on the river's edge and in the adjoining forest, have had their grooves and channels

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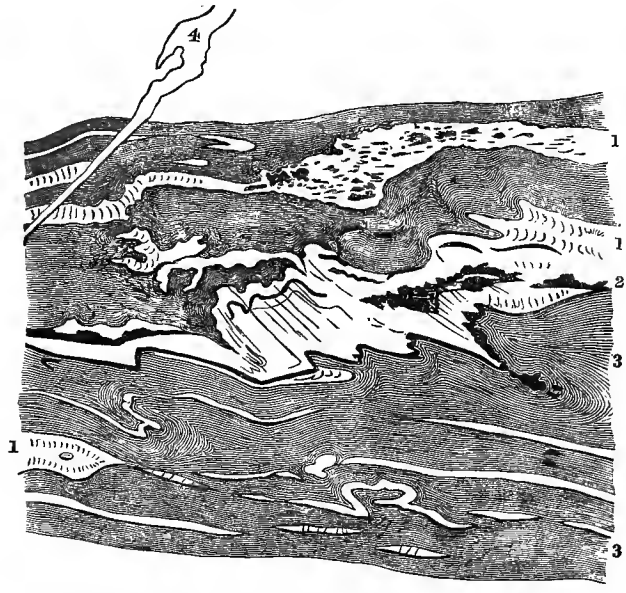

Patch of Gneiss 2 feet square, Upper Essequebo River.

1. Coarse white quartz and felspar.
2. Purplish felspar with a little mica and quartz.
3. Fine-grained felspar and mica.
4. Granite vein.

cut by the rain water falling from the trees that then grew around them.

About half a mile east of the large river before mentioned the last exposure of gneiss is seen, before coming to the granite development, and it is there of exactly the same texture as hitherto indicating no change whatever. Gneiss occurs again before reaching the Cuyuwini river beyond the masses of granite, and there in one spot contains a mass of quartz-schist. Beyond the granite, near the Cuyuwini river mouth, there is a wide tract of country composed of gneiss, which ceases at the mica-schist, some distance below rock Danigo, and does not occur again till a little distance past the Taruma village at Onoororo river, where there is another wide band.

Near rock Danigo there is a coarsely foliated rock close to a mass of granite composed of a greenish quartzose rock, intimately blended with mica, and having lines of white mica crystals in parts as well as bands and felspathic layers. These decompose readily, leaving the bands of quartz sticking out, in plates an inch thick, beyond the edge of the rock. In the great bend of the river, below the exposure of mica-schist, there is a junction of granite and gneiss, in which is seen a boss of fine-grained whitish granite,

with a shell of coarse gneiss on top, amongst which, and chiefly in contact with the granite, are fine foliations of mica. A coarse vein of granite ran across the former rock.

The isolated hills to the east, between Murray's and King William IV.'s cataracts are of similar gneiss to that in the river adjoining.

Gneiss occurs from a short distance up the Cotinga to the mouth of the Mauitzie river, generally in a very decomposed condition. In one place near Mount Wanakara it is seen in rolls, lying N.E. and S.W., and having a vertical foliation, trending N.W. and S.E. It contains garnet crystals. A little beyond the mouth of the Zuruma river gray gneiss is seen, resting upon granite rolls, and having a vertical foliation and cleavage, but none is found to the north of this.

Great flat masses of gneiss, with large felspar crystals, are exposed in the Suwarraowra river bed, as well as in the Takutu to the eastward. I examined the rocks of the Canucu mountains on their north-western side at mounts Quariwaka, Ilamikipang, and Curatawuiburi, and found at the first place clear developments of common gneiss, at the second a somewhat similar rock, but more nearly resembling gneissose granite, and at the third the same rock as the latter. In the last two positions the rocks contained small garnet crystals, large glassy crystals of felspar, and had a decided parallelism in the arrangements of their mica crystals. I therefore placed them under the head of gneiss.

At a place not far north of Dahdaad village, where a chain of deep ponds of water most clearly marks out an ancient course of the Takutu river, rocks of gneiss of a porphyritic character occur in isolated patches, and resembles those seen in the Takutu, near Suwara-owru river. They extend to the Takutu to the westward, and their foliation has a strike of nearly due east and west. A low ridge south of Cursato mountains is composed of gray gneiss with a small vein of quartz in it. A short distance beyond the greenstone rock, between Catuanariba and Daruwow villages, there is a ridge of a most curious rock, which has a greenish colour and is much decomposed on its surface. It contains a great quantity of grayish silica, a little felspar, and fine crystals of mica. Besides this it is studded with partially decomposed crystals or clusters of crystals of small garnets, which gives the whole a rusty appearance. This rock appears to be intermediate in composition between quartz-schist and gneiss.

One mile east of Daruwow river, vertically foliated massive rocks are exposed, of common gneiss, and this is the first development of that rock met with coming north. From this on, with the exception of two low ridges of quartz-schist off the end of Tarucupani mountain, the only rock to be seen down to Perapoko river, is gneiss. One of the spurs of the mountain jutting out westwardly from the main mountains, not far south of Cabarooda village, is a bare mass of this rock shaped like a great dome, with two flat-topped wings branching north and south from it, and their bases clothed with vegetation. It is some 300 feet in height, and

has a graet crack in the masses north of the dome, which is almost vertical, and about a foot wide at the top.

The gneiss exposed in the Rupununi river near Cabarooda is extremely foliated and contains a large percentage of quartz in layers and nests, and veins of quartz-schist. The whole mass of the Canucu mountains is formed of gneiss and granitoid-gneiss, through which extremely hard rock the Rupununi has cut a deep and wide valley to the plain beyond, and at the commencement of this plain near the northern slope of the range at Mapare river, the last gneiss rock is seen.

There is a black quartzose rock with reddish and white crystals of quartz, like that seen near Ranidekeur mountain on the Quitaro river occurring in the gneiss not far below Perapoko.

Igneous Dykes and Masses in the Gneiss.

Near the mouth of Mauitzie river on the Cotinga, there is a dyke of greenstone 30 feet wide, crossing the river in a N.E. and S.W. direction; and there is a small trap dyke in the bed of the Rupununi, some 4 or 5 miles above Aripai river.

A short distance below Watawarie inlet, on the Rupununi river north of the Canucu mountains, there is a patch or roll of a hard, green, finely crystalline, trap rock, with here and there small circular cavities, containing kernels of foreign minerals. Descending further to the rapids above Urua village I again saw this same rock very extensively developed, and having at the latter place a horizontal layer some 3 feet thick, of amygdaloid the vesicular cavities of which were filled with three minerals besides having a little iron pyrites scattered in specks throughout. The cavities are circular and lined with dark green crystals, inside of which is an opaque white mineral, and frequently when this is absent, crystals of calcspar. Besides these kernels there are large cavities lined with botryoidal forms of the same white mineral. The surface of this rock is smooth and covered with a black polish from the action of the water upon it, is irregularly jointed, and weathers in onion-shaped balls here and there, as well as in irregular polygonal pieces. The amygdaloidal portion is massive, and without jointing, and forms a curved bed without any actual division between it and the compact portions above and below; the only difference being that the cavities are more numerous along an almost horizontal zone, and die out gradually above and below. The full thickness seen of this layer is 15 feet. The same rock, with cavities in it, is seen a few hundred yards down the river forming a small rapid; and just below the site of the old mission of Urua it occurs without cavities, and its horizontal surface is marked by splits, dividing it into irregular vertical columns. This rock is evidently a diabase containing an amygdaloidal layer, which has been forced up through the gneiss, and spread out either amongst it or upon its surface.

6. *Quartz-schist.*

The first massive rock met with in ascending the Cotinga river is quartz-schist. It occurs in gneiss, but as only about 20 yards of its width are visible, its mode of occurrence is not clear, and it appears to be interbedded with the gneiss. It is of a dark grayish black colour principally, but changes horizontally to white and brownish-white colours, in bands. It is a coarsely foliated rock the direction of which is in an almost vertical plane, lying in an east and west direction. Coinciding with this is a set of well marked jointing or cleavage planes, whilst another set of joints is almost horizontal, and a third inferior set runs vertically at an acute angle to the first, so that the rock breaks up into irregular rhombs of great size. This rock is chiefly composed of quartz

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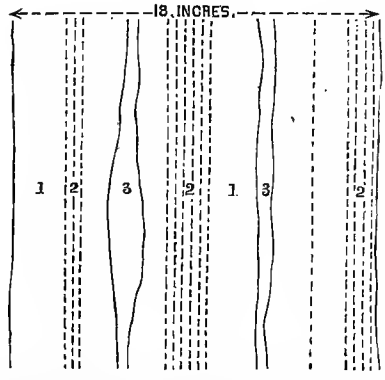


1. Blackish quartz with chlorite and mica scales.
2. Lines of decomposed felspar, chlorite, and iron py rites.
3. White quartz rests and banks.

associated with small plates of specular iron mica and chlorite, arranged in laminæ, and more or less intimately blended throughout the mass. When thoroughly mixed with the quartz it gives it a dark grayish-black colour, and when scattered in thin plates throughout it gives a greenish-brown tint to the whole. The quartz has a granular structure and a vitreous lustre, and is extremely hard. Where its foliations are free from the colouring minerals the quartz is then of an opaque white variety, banded with clear colourless sorts of the same mineral. It also contains some decomposed felspar crystals and a few specks of iron pyrites.

About one mile above this development in the river's bank there are sections of this same rock much decomposed, and they may be continuous with each other; but owing to the great denudation produced by the river, the connexion cannot be traced.

Some seven miles north of the Cuyuwini river on the Essequebo, there is a mass of quartz-schist, protruding in a wedge-shaped

form into the river from the gneiss for a distance of some 50 feet, and terminating in a point. It is jointed in all directions, much iron-stained, and portions ef it are of a granular texture. Some parts contain plates of chlorite, mica, and specular iron more or less intimately blended. In parts the quartz is of a vitreous lustre, and there the greenish colouring being thoroughly diffused, the rock assumes a very curious appearance. Where the specular iron forms lines in foliæ it decomposes leaving the hydro-oxide in its stead, and this it is that gives the surface such a rusty appearance.

Near Dahdaad village, in the gneiss, there is another small development of this rock containing small cavities (from which I imagine the specular iron has been dissolved) filled with a white clayey material.

White quartz-schist occurs *in situ* rising above the alluvium of the undulating savannas in many places to the west and south-west of Cursato mountain. One mass occurs not far north of Pinniyette mountain, and is surrounded by angular blocks of the same rock, resulting from its decomposition. The whole surface of the undulating savanna of the region is composed of these blocks in heaps, covered with but little soil, and they have been derived from the layers of quartz-schist occurring in the gneissose rocks, which exists at the heads of these rivers, Takutu and Rupununi, as well as from nests and veins in the surrounding gneissose granite. Every block of quartz exhibits a schistose structure in one part or the other by parallel lines from which crystals have been dissolved, but contains no mica or specular iron crystals. Similar masses are to be found south beyond Pinniyette mountain in three or four places, and blocks and boulders cover the undulating savanna around.

Far up the Coarawow river on the savanna a large boss of quartz-schist swells up and angular broken fragments of portions of it lie scattered around; this greatly resembles the quartz nests in the quartz-porphyry of the Pacaraima mountains.

It is probable that these quartz-schists occupy a position at the base of the gneiss and hence we have them lying in patches upon the gneissose granite of this region.

7. *Quartz-porphyry and Felstone.*

This rock makes its appearance in several places between Itawah and Apanachi rivers—branches of the Curiebrong river—and is of the usual kind, seen in other portions of the country before described.

Between the first set of cataracts on the Curiebrong succeeding a decomposed schistose rock of a bluish and sometimes greenish-gray colour, quartz porphyry appears, but contains a few crystals and continues down to the Essequebo river below Tumatamari cataract. It contains many trap dykes.

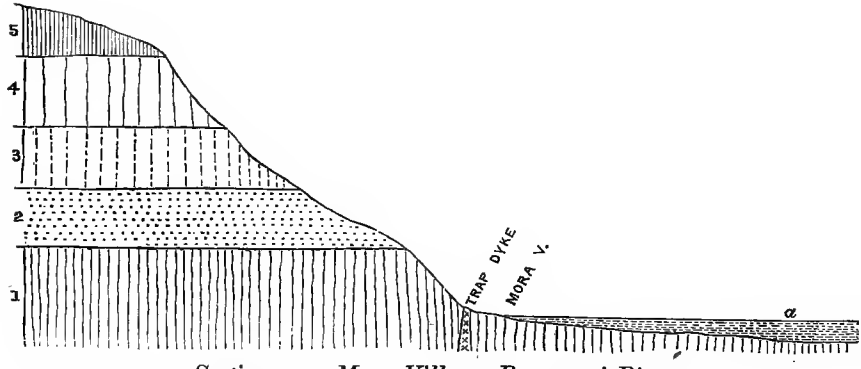
Just beyond the mouth of the Cassikitu river the granite gives way and is succeeded by quartz-porphyry. It is of a gray colour, is composed of crystals of felspar in a felspathic base,

along with green chlorite crystals in aggregations, and contains but few quartz crystals. This rock is alone seen in the river to a short distance beyond Canaiyu rapids where it assumes the appearance of a hornblende phorphyrite. It does not occur again till a little way beyond the mouth of the Camoawow river where it is of a gray colour and has but few quartz crystals.

A hill near Canaiyu rapid, 430 feet high, is composed of grayish-blue porphyrite consisting almost entirely of felspar crystals closely packed in a felspar base. In the Cassikityu river there is a tract of this rock which is succeeded by granite. The quartz-porphyry at Mikang-pati in the Cotinga river is of the usual greenish-gray colour, but contains few crystals of quartz. Just beyond the Waiquah river the quartz-porphyry sets in evideutly resting upon the granite to the south of it, and is of a felsitic nature containing small dykes of greenstone. On the low ridge, near Terchilewan village, in it is a pure greenish felstone, resembling a greenish slate, but having a conchoidal fracture. In the valley of the Cotinga river this rock contains small and large veins and nests of white quartz. From this valley to the sandstone escarpment at Mount Cumararing the mountains, ridge after ridge, are composed of this rock, of a very uniform composition, being of a dark greenish-gray colour with distinct crystals of felspar, and but few quartz crystals.

At Cumararing mountain the sandstone rests apparently on quartz-porphyry of an exceedingly decomposed nature, the junction is disguised and there is every appearance of a disturbance of the strata. It is white like kaolin, and crumbles in the hand setting free the quartz crystals. Between the quartz-porphyry and sandstone, north of Cumararing, there is a bed of greenish felstone.

No. 27.



Section near Mora Village, Rupununi River.

1. Foliated rock resembling petrosilox.
2. Quartz-porphyry.
3. Felsite with lines and veins of quartz.
4. Foliated quartz and felspar.
5. Compact felsite.

The whole of the ridges around Mora at the great bend of the Rupununi river, are composed of irregular layers of three forms

of rock, viz., quartz-porphyry, banded quartz-porphyry, and felstone. Commencing at the base of the hill behind the village we have a rock composed of thin layers of felspar and quartz extremely foliated in a vertical direction, then a band of quartz-porphyry containing quartz crystals, then felstone with quartz veins and lines, then banded porphyry, and finally a compact liver-coloured felstone. All these weather deeply on their surface to a pale cream colour. They seemed to be arranged in irregular layers occupying a vertical thickness of 700 feet, and have a sort of perpendicular foliage and cleavage, in some layers, while others are solid and massive. In the banded porphyry there are some curious concretionary forms, as well as beautiful foliated layers of different coloured felspar and quartz.

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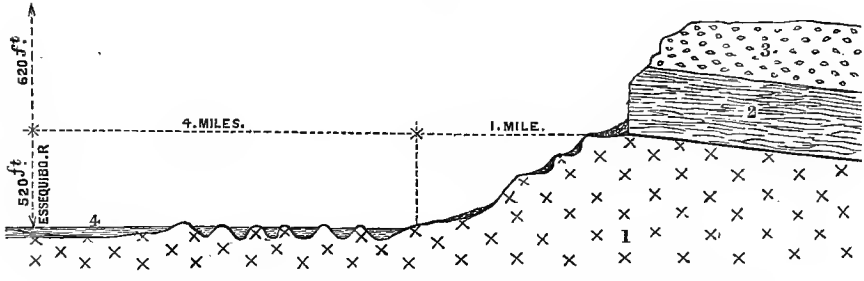

Section from the Essequebo River to Maccari Mountain.

1. Quartz-porphyry. 2. Sandstone. 3. Conglomerate. 4. Alluvium.

In six places between the foot of Maccari mountain and the Essequebo river narrow bands of quartz-porphyry protrude above the alluvium, forming ridges trending north and south, but only a few feet in height. At the foot of the mountain the same porphyry appears, and is seen *in situ*, and in large angular fallen blocks up to a height of 650 feet. In this distance it forms three irregularly shaped terraces, the first being much higher than the second and third, and the whole having an appearance of three great layers. A short distance down the third there are large blocks of red sandstone and sandstone conglomerate which have fallen from above, and these, together with a yellowish clay massed at the foot of the sandstone, hide the junction of the two formations. These terraces slope at angles of from 50° to 60°, and their tops have an inclination of 30°. This quartz-porphyry is of a greenish colour, with whitish or greenish white crystals of felspar in it, besides crystals or aggregates of greenish crystals of chlorite, but having no quartz in crystals. It is the same rock as occurs at Ouropocari with quartz crystals, and there is no doubt whatever about its lithological classification. Its surface is weathered in some blocks to a depth of three-quarters of an inch, and is of a white or rusty white colour, with pits from which crystals of felspar have been dissolved.

A small mass of quartz-porphyry exactly similar to that just described appears in one place only, on the path to the Demerara river, from Cumparu river on the Essequebo, and at a distance of not more than one mile from the latter stream.

The greenish rock before mentioned (Report No. 5) as occurring below Waraputa great cataract is probably a quartz-porphyry, impregnated with chlorite, crystals of quartz, and small veins of quartz. The felspar crystals in it are green, and can just be distinguished from the mass of the rock, while it contains some specks of iron pyrites.

Quartz Veins and Nests in the Porphyry.

At the junction of the Curiebrong and Potaro rivers there is a large vein or mass of quartz in which I could not observe any metals; it is jointed and ironstained, and appears to run at right angles to the latter river.

I examined a quartz vein above the first set of cataracts on the Curiebrong river, and though most promising looking, still I was unable to detect any gold in it. It occurs in three places where the river has cut across it, the first of which contains great quantities of iron pyrites in good-sized crystals, and the second and third besides this contain a black mineral in great quantities.

Between Terchilewan village and the spot where the old village of Torong used to stand there is a hill on the top. of which two veins of white quartz protrude above the surface of the ground, but which cannot be traced far in the direction of their line, which is east and west. They are in a much decomposed schistose-porphyry. I spent an afternoon in the examination of these veins, but could see nothing in them but thin scattered plates of specular iron with here and there small cavities from which the same metal has been dissolved. A somewhat similar vein occurs on the top of Cumararing mountain pass. In the Cumparu valley, protruding above the alluvium from the quartz-porphyry beneath, there are two almost circular masses of white quartz about 50 feet in diameter, and many similar patches are to be seen everywhere in the porphyry mountains, surrounded by angular and waterworn blocks of the same substance. From these are derived those low hills of rounded blocks and pebbles seen in the mountain valleys, and on the hill sides near the water courses of those regions. Some have the appearance of being in beds but most are in nests and veins. They seem to be entirely destitute of any valuable metals whatever.

Igneous Dykes in Quartz-porphyry.

Numerous trap dykes intersect the quartz-porphyry on the Curiebrong river in numbers of places between Mona cataract and Apanachi river.

To the south of the sandstone escarpment in the Saca-outa river valley there is a great dyke or layer of greenstone in this rock, and another well-marked dyke is seen some five miles south-west

of it, which is 50 yards wide, and can be traced by the eye for miles eastward and westward.

8. *Granite and Syenite.*

A great mass of syenite three miles wide, lying in an east and west direction, appears in the Curiebrong river not far from its mouth, and forms the first set of cataracts. The surface of this rock bordering the river and its bed is void of the usual iron polish, and above water in its stead has a gray and reddish *lichen* adhering to it.

One mile and a half above Mona cataract, on the same river, granite sets in, and is of a very coarse texture, having large crystals of felspar scattered throughout. These crystals are sometimes 2 inches long, of a pinkish colour, and have mica crystals in them. The rock itself is composed of transparent quartz, white and pinkish felspar, and dark green mica. It forms a surface rock to within one mile of the Colomeh river, not far from the foot of the sandstone table land, and in this distance keeps its coarse texture, and has small veins of quartz.

Tumune rock in the Essequebo river, beyond the mouth of the Rupununi, is composed of granite. In this upper portion of the Essequebo, at the mouth of a large river on its western side, granite suddenly appears in great masses of solid rock, of a coarse porphyritic variety, forming high rocky banks to the river for some distance, as well as protruding above water in different portions of the stream. For a distance of a few hundred yards between the granite and gneiss there is a strip of alluvium hiding their junction. This granite is of a darkish colour, and is composed of twin crystals of a dirty-yellowish felspar of about an inch in length (occupying the greatest portion of the rock), black mica, and but little quartz of a vitreous yellowish gray or colourless variety. As accessories it contains many crystals of garnet and a little iron pyrites. Where it first occurs it is traversed by veins of very coarse granite, containing crystals of white felspar of 2 or 3 inches in length, silver gray mica in plates an inch across, and white quartz. This granite is seen up to a short distance above the last great cataract in the river, some 12 miles south of its first exposure, but is not so coarsely crystalline, and contains quantities of garnet crystals. It assumes rounded forms by weathering, and is seen everywhere in the river's course, and on its bank, in great masses; sometimes for a bend or two the river may be clear of of them, and then beyond they are again met with, protruding in such numbers as to place a sort of barrier to the flow of water, thereby forming strong rapids.

Amongst the rocks I observed (as in many places elsewhere in this country) great splits which have evidently been produced by the action of the water and atmosphere, causing decomposition along lines of weakness, aided by an unequal resting upon rocks beneath.

Near the mouth of the Cuyuwini and just beyond it there is a second development of this rock, which is succeeded by gneiss; then comes granite again, as far as the mouth of the Cassikityu river. From a mile or two above the Caniyu rapid granite is seen again, as far as 2 miles beyond the Carocurihi river, where it is succeeded by gneiss, to a point a few miles beyond the Wapuau river, and there again it forms the only rock to be seen extending to the highest point upon the river that I reached. At the first Taruma field beyond the Yucanopito cataract, there is a very dark coloured rock exposed in a long roll, composed of dark quartz and felspar with black mica. Beyond the Cuyuwini there are blocks of granite in the river of enormous sizes.

In the first development of granite beyond the Cassikityu river, the granite is at first of a white finely crystalline variety, but soon passes into one of a coarser texture and darker colour. One mass of granite near the junction of the Ouruow and Essequebo rivers contains iron pyrites.

About 8 miles up the Cassikityu river the granite begins, beyond the quartz-porphyry, and continues as far as I went. It is at first of a dark variety, but soon passes into ordinary granite, and in one place contains green mica, a reddish felspar, and opalaceous quartz. In the first development beyond the Cuyuwini river the granite is coarse, and contains two kinds of mica of silver-white and greenish colours; also large crystals of felspar and elongated pieces of quartz.

On the Cotinga river at Aretiari cataract, it is of a coarse variety with greenish mica, and has coarse granite veins throughout. Beyond the Mauitzie river granite is again seen as a surface rock, and so continues to Pirawai cataract. The granite of Mikang-yepatori is exactly the same as that forming Shea rock and other ridges on the Quitaro savanna, and like them is quite bare of herbage, and outwardly of a purplish colour from a *lichen* growing upon it. It forms a great roll lying N.N.E. and S.S.W.

On a large patch of a slightly curved surface of this rock, in the river bed beside Mikang-yepatori, where the water rushes over with great force when the river is high, I observed the most curious and regularly formed ripple marks as are usually seen on patches of sand. This must have resulted from a wavey texture of the rock, giving it different degrees of hardness, so that the water wore it as described. I have repeatedly seen smooth polished surfaces, of a foot or so in diameter, on rough granite and porphyry blocks before, but not the polished ripple marking.

South of mount Pirawai the great granite rocks in the east bend of the river are much split, and have fissures running across them in various directions. Mount Pirawai itself is not a smooth massive structure like many of the mountains about it, but is apparently a pile of enormous angular blocks of granite, one particularly large block being situated near its top. Its broken condition is owing to decomposition and disintegration, and not to any violent disturbance producing ruptures.

Tuanu-sararu cataract is formed of gray fine-grained granite, with a slight disposition to a foliated structure. This rock, which occurs all the way to Pantsikameru cataract, is more or less schistose in parts, breaking up at times into spindle and tabular pieces, but not externally exhibiting foliation, and occasionally appearing in massive rolls. It appears to me to be a rock, intermediate in composition between quartz-porphyry and granite. Beyond the last-mentioned cataract common granite appears, and is soon after succeeded by the intermediate variety. The rocks thereabout have the black coating so frequently seen upon them, but which is not found of the same sort on any rocks further down the Cotinga river. This polish does not appear to me to be a deposit from the water, but the result of a chemical action of the latter upon the decomposing surface of the rock. A copper coloured rusty-looking polish is seen on some of the rocks in the lower parts of the same river.

The rocks forming the great ridge between the savanna and the valley of the Waiquah river, are composed of a whitish granite containing but little mica, which has quartz veins in it. This huge roll of granite is continuous with that at the Unamara river, and skirts the edge of the quartz-porphyry. Near the pass on the ridge there are two curious rocks, one called Piatzang, which is very large and tabular, and the other of a rounded form, and having a height of about 20 feet, is split vertically and horizontally into four divisions, all of which are weathering into spherical masses. On the northern side of the Waiquah valley a boss of the same granite appears through the porphyry.

Cursato mountain on the Takutu savanna is composed of granite of a slightly gneissose character, and has large glassy felspar crystals throughout it, similar to that of the western end of the Canucu mountains. Its sides are covered with blocks and masses of this rock, resulting from decomposition and subaerial denudation. The whole group of mountains between mount Cursato and mount Pinniyette are of a gneissose granite, containing quartz nests here and there.

East of Pinniyette are low ridges of granite, lying almost due east and west, which are situated one behind the other at intervals, so that in going south to the Coarawow river they are crossed at right angles, and are found to change gradually, until they quite lose all trace of a parallel arrangement of their mica. This granite is of different textures, sometimes coarse and at others fine, and its mica is usually green, changing sometimes to black. Some granite with opalaceous quartz of a bluish colour is seen near the Coarawow river.

In the beds of this and the Cumatawow river, the rolls of granite there exposed are of a coarse variety with black mica and glassy felspar crystals forming the greater portion of the rock. This granite occurs in ridges and isolated rock patches, protruding through the alluvial deposits of the savannas from the latter river eastward across to the Rupununi river south of Cau-urua, and

northward as far as a place midway between Catunariba and Daruwow villages. In the Tawaiwow river its component minerals are much crowded and compressed, the felspar crystals being slightly rounded. In the course of the Rupununi through the Canucu mountains there are two bosses of granite in the gneiss, one not far beyond Perapoko river, and the other near Aripari.

Close to the edge of the Berbice river, due east of Primos inlet on the Essequebo, there is a small tract of syenite-porphyry, which contains a dyke of greenstone.

Quartz Veins and Masses in Granite.

At the great cataract passed before arriving at the mouth of the Cuyuwini river, there is a curious low dome-shaped mass of quartz surrounded by granite, but as there are water channels completely enclosing it, its contact with the granite is not seen. It is of a semi-transparent variety, stained with iron, and much jointed and crushed, but contains no metals. It has a slight indication of circular jointing round a centre and is 30 feet in diameter.

Igneous Dykes and overlying Masses.

Arrissaro Mountain is composed of horizontal masses of coarse greenstone of a greenish gray colour. It has evidently been forced up in a molten state through the granite as attested by the great dykes immediately opposite its western end in granite rocks in the river, and then spread out over its surface to a thickness of over 650 feet, that being the height of the mountain above the level of the river.

In the Curiebrong river in the first set of cataracts, in syenite, where the river runs E.N.E. there is a great dyke of greenstone, part of a coarse and part of a fine texture. In a detached block of this rock there is a triangular block at its end, joined to it by a thin neck, produced by denudation, which has a most curious appearance. Mona cataract is composed of great coarse rocks of greenstone similar to that of Cumuti rock, and to the bedded rock at the Colomeh river under the sandstone. It lies in rude beds from 10 to 20 feet in thickness, and is most curiously fluted and grooved by water. It may have been at one time continuous with the Colomeh and Cumuti greenstone, and now owes its isolated position to extreme denudation.

Near the Urana river on the upper portion of the Essequebo river, there is a small dyke of greenstone, 2 feet in width in the granite, and it is the only igneous rock to be seen on the river from near Murray's cataracts upwards.

On the crest of the Cursato mountain there is a small dyke of greenstone, crossing a large mass or dyke of a coarser variety of the same rock; both are of greenish tints and extremely hard.

Not far from a small river, about midway between Catunariba and Daruwow villages, there is a ridge of partially decomposed

greenstone, and a similar one occurs in the direction of Saeraeri mountain. Some three miles north of this there is a low ridge of greenish rock, similar to the last-mentioned one, covered with a heavy red clay soil. On the side of this there is a large patch of dark-looking smooth rocks, covering about half an acre of ground, composed of fine specular iron ore. I could not make out whether it is a vein, or large deposit in the greenstone.

During these investigations I was unable to discover any minerals or metals of value. Other products coming under the head of *Economic Geology* such as building stone and road material, though in great plenty, are useless owing to their distance from the coast, and the difficulty of transporting them thither.

This concludes my observations on the Descriptive Geology of the portion of the colony recently examined.

REPORT No. 10.

Geological Report on the Corentyne River.

By Chas. B. Brown.

August 1872.

CONTENTS.

PART I.

Physical Features.

Having made all the necessary preparations for a long journey over the eastern portion of the colony, I sent my men two boats and stores by the schooner "Sophia" on the 29th of August 1871, with instructions to await my arrival at Skeldon in the mouth of the Corentyne river. Starting next morning by the overland route I reached New Amsterdam in the evening and next day went with Mr. E. King in his conveyance to the Benab and from that in the police boat to Skeldon estate.

On the morning of the 1st September my men and boats arrived in the schooner "Daylight," from New Amsterdam. The "Sophia" having had her foresail blown away was obliged to run into Berbice river and the men took passage in the "Daylight," which was on the point of leaving for Skeldon at the time. The sea breeze blew so strongly off Skeldon and in the long reaches of river southward of that place that it produced a short chopping sea in which my boats, if deeply laden, could not have lived. Consequently, I was obliged to hire a small sloop to take the stores to Oreala whilst I followed with the boats and their crews. The sloop got under weigh in the afternoon of the same day as the tide turned to run in, and we started in the boats about an

hour after. The Revd. T. W. Veness accompanied me, partly for the purpose of visiting the mission under his charge at Oreala. With a strong fair breeze and tide we made good progress, and at 10 p.m. reached a small wood-cutting settlement on the west bank of the river where we remained for the night.

At this place the river's bank is raised only a few feet above the ordinary high tides, and both sides of it are clothed with high forest trees, presenting the same appearance as the level tracts along the Essequebo, in its tidal portion. It also contains a number of low muddy tree-clothed islands.

About three hours' paddling next morning with the flood tide, brought us to Oreala mission and village where we remained for two days.

Near Apoacka river mouth, the low level coast alluvial land ceases and the Corentyne river winds past a slightly elevated tract of undulating country that rises to a level of 60 feet above the sea, and forms perpendicular or sloping cliffs for a short distance beyond Oreala. In two places below Oreala mission the cliffs are almost perpendicular from their bases having been washed away and are therefore void of vegetation disclosing fine sections. Where the cliff is sloping at Oreala it is clothed with tall trees, which only reach as far as its crest. Behind this comes a large tract of open country similar to the Rupununi savanna and having the same vegetation. Opposite the site of the Mission the river comes from the eastward, and between it and the high land lying N. and S. there is a tract of low level alluvium some 8 feet higher than the ordinary higher than the ordinary high tide level. This borders it as far as Siparuta where the river again passes along the edge of the high land. The trees growing upon this high tract are very different in size and appearance to the mora trees on the low land bordering the river and the couridas of the swampy lands below Oreala. They are chiefly of small stunted growths of Bartabally, Haiawah, Baracara, &c.

On Monday the 4th we left Oreala with the rising tide at 7.30 a.m. and at 10.30 a.m. reached the Siparuta cliffs. These are about 80 feet in height and similar to those of Oreala. The river there makes a great bend to the eastward,* then north for a short distance turning gradually to the eastward again, and then south-eastward as far as Apurn, where it changes its direction to the south-west, north-west, and finally due west to a point not far to the south of Siparuta at Parura river. We remained for the night at a small Arowaak village called Apurn, where the banks of the river were about 12 feet above the high tide march.

The tide being against us nearly all the forenoon of the following day and then only flowing for some three hours in the afternoon, prevented our accomplishing as great a distance as we had done on the previous days. We therefore did not get far beyond Kayaiwa cliffs before night set in. These cliffs are

* These and subsequent courses refer to the direction of the river in ascending it.

similar in height and composition to those of Siparuta, and are parts of the same high land.

On Wednesday 6th we had the current running strongly against us all day, the tide not reaching so far up as this (owing to the height of the river at the time), but only damming back the water, thereby causing it to rise a foot or two without checking its northward flow.

We met with the first rocks protruding above the surface of the water in the vicinity of the Matapi river, a amall branch on the east side, and in the afternoon the first hill or low ridge lying in an east and west direction, nearly opposite to Tomatai. Passing the mouth of the Cabalebo, a large tributary coming in on the east, the river bent suddenly round to the westward for a considerable distance.

The next morning Mr. Veness who had accompanied me thus far turned back in a corial which three Indians from the mission had brought up in our company for him. A short distance beyond Tomatai there were numbers of rounded rocks forming small rapids, while on the northern side of the river there was a low ridge, some 150 feet in height, lying east and west. Turning a slight bend, where the river alters its course from west to west-south-west, we came to some large rolls of granite, lying N. and S., forming two or three small islands. The river onwards for four or five miles was straight, and lying beyond it was a range of hills some 200 or 300 feet in height. At the end of this long reach there is an island some three miles in length, beyond which are numbers of very large rounded granite rocks forming the rapid of Baccacai.

The banks of the river in this part are some 10 feet above the level of the water, showing a gradual rise in the level of the country from the coast upwards. Later in the afternoon we came to the place where the river ran, through the low hills we had seen in the morning, and there its width was narrowed to about 300 yards, but widened again on passing through them.

Our course next day up to 11 a.m. was in a south-west direction, along a fine expanse of river with granite rocks of rounded forms scattered here and there in its bed. In a south-west bend we passed a large island called Tuwaballi, and early in the afternoon the islands of Caremalambo and Languana. Beyond the latter there is a small island with huge granite rocks at its northern end. This part of the river is broad and placid, with only a slight current, and is bounded by level forest-covered country, without a single hill or mountain to seen. That night we camped on a small island in mid-river, with long sand spits at each end, one running north-east and the other south-west, and both of considerable length. We passed a few isolated granite rocks next morning, soon after starting, and then over a long distance of wide river to a south-west bend, where it again narrowed considerably, and rocks and one or two small islands were to be seen. From Akalikatabo island to Temehri rock, near which we spent the following day (Sunday 10th), the river was so studded with rocks and

wooded islands that in no place could a view of its full width be obtained. These islands are chiefly composed of a clayey alluvium on rocky bases, with large loose rocks at either end, and amongst them the water flows smoothly and swiftly in various channels. Temehri rock is a large elongated, dome-shaped mass of rock, remarkable for a gigantic Indian figure engraved upon it.

We continued our journey on Monday the 11th, and soon came to a small cataract about a mile on, amongst rocks and islands, succeeded by two others interspersed with numerous small rapids in a part of the river lying in an east north-east direction. In three hours from the time of starting we cleared the cataracts and rapids, and gained still water above them, where the course was due south, and the river still studded with rocks. At noon we came to another rapid with smooth water above it, and with a few islands occupying a part of its channel. Beyond this the river's course was south-west for a considerable distance, and only one row of islands lined its western shore, while few rocks occurred in its bed.

Next day we traversed some wide southerly reaches of the river, and in the afternoon came within sight of the western part of the Wonotobo falls. At 3 p.m. we landed at the foot to explore them, and seek if possible some passage for our boats.

This is an extensive and beatiful set of falls, produced by the river passing over a granite step, lying in a north-east and south-west direction. The river is precipitated in three great and four minor channels, at various distances apart, all uniting in a large basin below of 4,954 feet in width, and about 400 yards in length. From the north-western corner of this basin the river narrows to 337 yards in width, and with a depth of 71 feet in its centre passes onwards in its course to the sea. Of the three principal places where the water rushes over the fall the western contains the greatest body of water, and running north-west at first curves round, terminating with a north-east course. It is a long sloping cataract, down which the water rushes in a foaming mass, leaping in waves over the rocks in its channel. Where it turns north-west it is joined by a small but steep cataract which crosses from the head of the middle fall. The middle fall has cut its way back for a distance of some 400 yards, whilst both the eastern and western fall terminate at the ends of the rocky islands which separate them. It is by far the most picturesque of the three, and is very nearly perpendicular. The eastern fall curves round from due north to west at its foot, being turned by a pile of rocks, beyond which lies a sand island. A small channel, about 50 yards in width, leads from the north-east end of the basin, curving from east to south-east for a distance of some 300 yards to the continuation of the falls to the eastward, which is composed of three great steps in two channels. Viewed from the basin the last 30 feet only of the falls is seen, amongst tree-clothed rocky masses, but by taking the level between the foot and the river, where we again embarked in our boats at their head, I ascertained the total height to be just 90 feet. The last rounded granite rolls,

producing the face of the fall, is flanked by great boulders and angular masses of the same rock, beneath which a large portion of the water finds its way down to the basin.

We were engaged on the five succeeding days in cutting a path and making a portage for the boats round to the head of the falls on the eastern bank, a distance of 62 chains and 80 links (three-quarters of a mile), over very rough ground.

In the forenoon on the 19th we continued our journey from the head of the portage in small channels, broken by numerous small cataracts, amongst rocks and islands. At noon we came to a large cataract where it was necessary to unload the boats. After passing this the tree-covered islands were not so numerous, though the granite rolls and isolated rock masses were more so, producing a characteristic view of the usual falls scenery so common on all the large rivers of the colony. The granite rocks were of all sorts of

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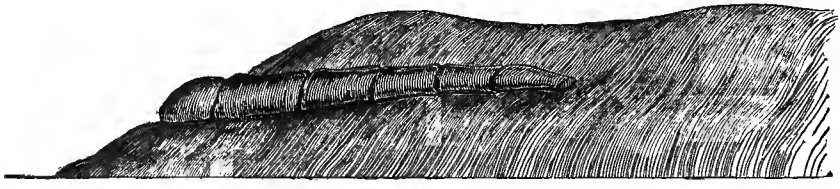


Weathering of Granite above Wonotobo Falls.

fantastic shapes, irregularly spheroidal being the most common. Many were much larger at their apex than at their base, and some were perched upon others in such positions that it appeared as if a slight push would easily displace them. The whole surface of the river was one scene of confusion of broken water and white lines of foam. The total width of the river is about three miles in this part, and its sides are lined by low hills of from 150 to 200 feet in height. During the afternoon we had to unload the boat twice at large cataracts, and camped at the foot of a third large one.

After combating with cataracts all the following morning, we succeeded in gaining the still water above them by 10 a.m., where the river ran placidly along amongst numbers of large islands. Early in the afternoon we passed the northern end of an island, where two large channels on the west joined the main stream, which was there some 300 yards wide. We skirted this island in comparatively smooth water, broken only by a rapid here and there, during the remainder of the afternoon till evening closed in, and we camped upon it.

The following day we passed the upper end of the island, which must be at least 8 miles in length, where the river bent round to the west for a short distance, and was obstructed by large rocks, forming a large cataract. Beyond this I observed three large channels running north, to the westward of the large island, and concluded that they were the ones which join the main channel, above the head of the falls. The river gradually resumed its

original southerly course beyond some large islands, being turned by a range of hills some 300 feet in height, and again spread out to a great width, amongst bare patches of rock. During the afternoon we were hauling up rapids and cataracts, and there was scarcely 100 yards of smooth water between each. Fortunately these cataracts, with but one exception, were long and sloping, and the boats were hauled up without being discharged.

Next morning we cleared this set of cataracts, and turning a short south-easterly bend of the river, traversed a long southerly reach, where the current ran with but little force, and large islands were numerous. The width in one place, where clear of these, I judged to be 600 yards. In the afternoon we passed up another set of high sloping cataracts, the rocks of which were of a dark brownish black colour, and the coating of iron oxide.

On the following morning the course traversed was due east for a couple of miles, and the stream was studded with islands; it then became south-east for a few miles, in a wide channel with numerous rapids, and but one cataract. Beyond this the river was smooth and ran with a very slight current, spreading out to some 500 yards in width, but still having a row of islands along its western side. I had no means of measuring it, so densely clothed were both banks with foliage to the water's edge, rendering the measurement of a base line an impossibility. As it contained huge rolls and masses of gneiss rock here and there, intermixed with small islets, it presented one of the characteristic views of tropical river scenery.

On Monday, 25th, we passed along a great southerly reach of some 6 miles in length, at the end of which there were some hills, with a peak of greater height than any we had hitherto seen. As we approached these hills, which were on the west bank, the river's course became clear of islands; and spreading out to a width of over a mile, its bed became studded with large rounded granite rocks. Here the river bent round to the south-east for some distance.

Next day our course was south-east, generally in channels amongst large islands, where small cataracts and rapids were numerous, the water lying in apparently still pools above each. On the rocks of these, where the water was most deep, were immense numbers of the large species of *lacis* with beautiful pink flowers. In small channels amongst these masses of plants (spread out for acres in extent) the water found its way, and upon them the footing for the men was exceedingly insecure, and the labour of hauling up rendered more tedious than usual.

On the following forenoon some low hills were seen, and soon after, on rounding a bend of the river, we came to the foot of the great cataract, which Sir R. Schomburgk has named King Frederick William the Fourth fall. The remainder of the day was spent in exploring the spot, and in searching for a good place, along which to make a portage. Selecting an even an comparatively slight line through the forest, on the east bank, where there was a gentle gradient, we marked out a path from the foot to the

top of the cataracts, and were occupied till the 3rd of October in preparing the portage, and getting one boat and stores over. The distance across was 61 chains (three-fourths of a mile), with a gradual ascent to a height of 80 feet in about half that distance, and a descent of 30 feet from that to the river above the head of the cataracts.

This singular set of cataracts very closely resembles that on the Essequebo river, immediately above King William the Fourth's fall. The main set is on a channel along the eastern bank of the river, where the greatest body of water rushes over in two leaps, in a northerly direction, into a channel lying north-east. There it joins the water that passes over the westerly falls, and is precipitate down a steep slope, with steps here and there, for a distance of three-quarters of a mile to the river below. The total height of the set is 50 feet, and the two upper steps are 15 and 10 feet respectively. The 15-feet fall is 50 yards wide and of great depth, the water running in a solid mass through a gap without breaking or showing any particles of foam for the first few feet, excepting on either side, where it comes in contact with the rocks. From its foot onwards the water is converted into a mass of foam, which surges and eddies in all directions with a deafening roar down the long rock-bound channel to its foot, where it heaps up a succession of angry waves.

On getting my boat to the head of these cataracts I sent back the luggage boat to Orealla for supplies, which I had arranged beforehand were to be sent there from New Amsterdam, by the 1st of October; and with the remaining stores continued the ascent of the river on the 4th. Before leaving I gave instructions to the captain of the luggage boat to come up as far as the place where we parted, and remain there till I came down river, it being my intention to follow the Corentyne to its main source, return to meet the luggage boat with the fresh supplies, and then explore a large branch, marked on the map as the Pani river. I should have preferred having the luggage boat to come higher up river to meet us, but was afraid if it did so, that we might pass each other amongst the numerous islands.

After leaving our camp at the head of King Frederick William cataract, we followed a good-sized channel on the western side of the river, and passed up a number of large cataracts and rapids, the course changing from south-west to south-east. Above these we had smooth water amongst large islands for some distance, and I found to my surprise that our course was still southerly, though from the distance we had come, if the map was correct, we ought to be travelling due east. I at first imagined that there must be some mistake in the map, but on finding next day that we were still going south and south-south-east, I concluded that we were on a branch of the Corentyne, that had been hitherto unknown.

The river was crossed by numerous barriers of rock, forming cataracts between large islands, for a considerable distance, and then for an equal distance became studded with small islands, amongst which the water ran with rapids here and there. Some

20 miles above King Frederick William fall the islands became less numerous, and both banks of the river could be seen at one time. In this distance we passed two large streams coming in on the west side, one being 100 and the other 50 yards wide. The first, joining amongst islands, we did not observe was a creek, till the temperature of the water proclaimed the fact, it being 5° lower than that of the main river. Below the second stream there was a number of formidable cataracts, near which we spent Sunday, the 8th. Low hills lined the river above this, and its width was about 300 yards.

The portion of river passed over on the 10th was more winding than hitherto, and as there were few islands in it, both banks could be seen. It also contained very few groups of rocks, and presented a fine broad uninterrupted surface, varying from 300 to 400 yards in width.

Next day our course was south-south-west against a strong current amongst large wooded islands to the foot of a set of rapids, produced by rolls of gneiss rock lying north-west and south-east, where the river spread out to a width of three-fourths of a mile: Above this we passed the mouth of a large stream on the east, of 111 yards in width, and from 6 to 15 feet in depth, joining the main river where its width was 277 yards, and depth from 8 to 14 feet. There its course became south-west for over 2 miles, and then west for a considerable distance, with low banks not more than 4 to 5 feet above the level of the water. The river from this on became more winding, but preserved a general south-west direction for some 30 miles, then it made a bend round to the north-east for a distance of 8 or 10 miles, and finally took a general southerly course for some 40 miles more, crossing the second parallel of north latitude.

There above a cataract a large branch comes in from the south-east, of greater width than the main river, but being shallower does not contain such a large body of water. The measurements of the two give a width of 126 feet and a depth of 15 feet for the main river; and 134 feet and 9 feet for the branch. From the mouth of the large river on the east side mentioned above, there are numerous small, and one large branch creeks to this river, and on the western side there are three large streams. In this distance also, there are only two cataracts and a few small rapids; and low hills approach the edge of the river every here and there. We followed the main river for three days after passing the branch, and in an almost due west direction, having to cut through a few "tacoobas" that had fallen across from bank to bank; and finally came to a row of massive rounded granite rocks, lying in a south-west and north-east direction across the river, which completely obstructed the navigation. The river had attained such small dimensions, and its water was falling gradually day by day, that I did not deem it prudent to follow it further, especially as we were quite at the limits of the colony in this direction. This I ascertained by meridian altitudes of fixed stars. There we encamped on the west bank of the river, at a distance of 410 miles

(roughly estimated) from the mouth of the Corentyne, for the purpose of making a land journey across to the Essequebo, to ascertain some estimate of the distance to that river, as well as the geology of the intervening country. Having no chronometers I could not determine my longitude, and by this trip across, hoped to be able to determine it roughly. The level of the river here was 670 feet above the sea.

On Thursday 26th we started, 6 men and myself, with provisions for a few days in packs, and each armed with a cutlass, for clearing the vines and cutting off the tops of small trees, so as to mark the route for our return. We came to the foot of a ridge shortly after starting, and traversed its side for some distance, at a height of 100 feet above the level of the swampy tract at its foot; and then descending to a small creek and manicole swamp, crossed over a ridge beyond, 300 feet high. We went entirely by compass, the men carrying their loads and cutting their way through the undergrowth of small trees, tangled vines, and bush ropes, as I directed them. Crossing after this a number of low ridges, and intervening manicole swamps, of soft iron-stained bog mud, we camped at a small rivulet, after 6 hours walking, at an exceedingly slow and tiresome pace.

During the two succeeding days we traversed a low swampy country, intersected with streams, some of considerable size, running in a northerly direction; and now and then obtained glimpses of a high mountain before us, the foot of which we reached late in the evening on the second day. The land passed over was low and undulating, the soil being a dark vegetable loam lying on a stiff yellow and gray clay. Fearing that our stock of provisions would not last if we went much further, I ascended the mountain next day (Sunday 29th), to get observations. Through gaps in the tree tops I got views of the surrounding country from east through south to west. To the north-west a mountain, one of the cluster we were on, shut the view, but a level forest-covered plain, seen far off to the south-west, was the one in which the Essequebo ran. A high mountain separated from ours by a deep gulley, hid the view to the north-north-west and north-east. These are the Amuccu mountains, and the one we were upon was 1,240 feet above the sea. Its sides are precipitious and covered with great masses of rock, one of which near the top was partially detached and fully 50 feet in height. The whole country from east to south-east and south to south-west, is a hilly tract of forest-clothed country, of vast ridges and domes one after another for miles and miles; all probably of about the same height, viz. 1,200 feet. The mountain close to us to the north is evidently very much higher.

Descending the mountain to our track we commenced our return walk, in order to obtain a larger supply of provisions. In 1 hour and 40 minutes walking from the foot of the mountain, we performed the distance that it took us the whole previous day to accomplish when cutting our way. This will give some idea of the almost impenetrable nature of the forest there.

The following afternoon we reached the boat, obtained 7 days'

provisions and got back to the Amuccu mountains at 9.30 a.m on the 1st of November. On the way back I climbed a ridge and had a glimpse of the country to the north, showing some low hills to the west-north-west, north-west, and north, not far off rising from an undulating forest-clothed plain. Our route due west took us along the foot of the mountains, parallel to their trend, and over a high spur that joined their southern flank with the mountains to the south. Beyond the spur the country was again of a swampy nature and intersected with rivulets. We got a number of views of the main range of the Amuccu mountains, which appeared to me to be at least 2,000 feet in height.

On the morning of the 2d we passed a tract of level country, for a distance of fully a mile where the surface of the ground was dotted with small hollows or pits, of various sizes and shapes in a most curious manner. These holes were usually circular, but often of elongated forms, and of from 4 to 6 feet deep each. The bottoms of some were hard, of others soft, and had no fissures. These pits covered a surface many acres in extent, that to all appearence is never wholly under water, in wet weather. The surface of the ground is a hard brownish grey arenaceous clay. Beyond these, for a considerable distance, the country is low and swampy and full of little hillocks and ridges of clay, as the above-mentioned part was full of pits. Passing this swamp we had good level country, in which ran a large stream in a southerly direction with high clay banks of reddish and yellow colours.

On Friday the 3rd our course led us over an undulating country at first which became ridgy, the intervals between each ridge being occupied by soft manicole swamps, containing small winding streams. The soil in these consisted of a black bog mud, upon a gray arenaceous clay and sometimes sand. The following day our journey was over a similar country where the ridges were higher and in greater numbers; and in the afternoon we crossed a large creek 23 yards wide running swiftly in a north-west direction. Beyond this we had more undulating land, and this as we proceeded became more and more level.

On Sunday the 5th we passed over a level tract which had evidently been recently some 5 feet under water, as inferred from the mud stain on the tree leaves, and conjectured that we were not far from the Essequebo; so pressing on with renewed hope, we had the satisfaction of reaching that river at 11 a.m., after a tedious and harassing journey. We came upon a part of it a few bends from the mouth of the Cassikityu river, where its banks were high and the water flowing sluggishly. We only remained for two hours on the bank of the river to rest, and then commenced our return journey with all possible haste. Having a well defined, though exceedingly rough, track to follow, we went along at a good pace, and reached our boat on the afternoon of the 7th. The distance traversed from river to river I estimated at 30 miles.

I measured the width of the river at our camp immediately below the granite rocks, and found it to be 74 feet wide, and 6 feet

in its deepest part, its current having a velocity of 1·73 mile per hour.

The explorations of this part having been completed, we started on our voyage down river to King Fredrick William's fall stopping at the first open sand beach for the purpose of procuring altitudes of stars for latitude. There I remained two nights for that purpose, and succeeded in getting good observations of meridian altitudes of a Eridani, a Cassiopeia, and a Pisces Australis, from the mean of which I obtained the latitude as 1° 49′ 55″ north. I failed in getting satisfactory altitudes of four other stars, owing chiefly to thin misty clouds, that from time to time passed across the sky. During the remainder of the journey down to King Fredrick William's fall I obtained the latitudes of our various camps.

On Saturday the 18th we reached the head of a large catatact which we passed up on the 5th of October; and next day in going down it we took a channel which led us more than two miles to the eastward, bringing us out at mid-day on a large river, apparently joining this in an easterly direction. This I at once concluded was the Corentyne river of Schomburgk's map, which we had missed by following the western side of the river after passing King Fredrick William falls. Running down it in a west-south-west direction for a distance of seven miles, we passed numbers of large channels of the river we had been up coming into it on our left hand, and at the western end came to the main channel by which we had ascended. During the afternoon we ran down a number of dangerous and difficult cataracts, and arrived at our old camp at the head of King Frederick William's cataracts, where we found the crew of the luggage boat awaiting our arrival.

Giving my men one day's rest we ascended the river with both boats to the branch river on the west spoken of above, and commenced our ascent of it. Our course was at first east-north-east for some distance, up numerous small rapids, then curved to the northward and eastward in a wide channel. Here two large islands abreast at a cataract—marked Goodall's on the map—divided the river into three channels. I purposely traced the south bank of the river to see if there was any communication between it and the other river, but found none. It is very evident from the map that when Schomburgk saw the large channels of the new river he imagined them to belong to this river, which he had descended, thinking that they branched off at Goodall's cataract. We passed up another cataract beyond on the 23rd, where the water was very shallow owing to the river spreading out so much, and came to smooth water above, where the river lying in one channel, bent from east to north and then to east-south-east. Then came a few islands, and a wide shallow cataract with a long slope of good height. At this place the river turned east for some distance, and then altered its course suddenly, coming from the south. This point is named Point Right About on the map, and the river has a comparatively

straight course from it for some 12 miles in a southerly direction.

Early in the afternoon of the 25th we came to a small branch on the west, occupying the place assigned to the mouth of the Pani on the map, but instead of being of equal width to the Corentyne at their junction as there marked down, I found it to be 23 yards wide and 7 feet 6 inches in its deepest part.* From these dimensions this river cannst have a greater length of course than about 20 miles, whilst on the map it is made to rise in the Amuccu mountains, and has a course of 125 miles given it, making it actually cross the position of the new river.

From this on to its junction with the Cutari the Corentyne has a winding course, sweeping round in great curves and keeping a general south-south-east direction for the entire distance. Here and there at long intervals it is crossed by rocks forming small rapids, and in two places large cataracts, one just below the Sipariwinni river mouth, and the other not far below the mouth of the Cutari river, called Sir W. Raleigh's cataract. In many places low wooded hills can be seen approaching its banks.

On December 1st we arrived at the foot of Sir. W. Raleigh's cataract, which is in two steps, one of 10 and the other of 6 feet, composed of coarse granite rock. In hauling up this next day we found a woodskin with three paddles in it, tied to the trees at the side of a small island, showing that a small party of Indians had been ascending the cataract when we arrived at its foot, and had been so alarmed at the appearance of two large boats that they had abandoned their things and fled. During the afternoon we encountered many rapids and came to a fork of the river, the branch on the left hand being the Curuni or Corentyne, and the one to the right being the Cutari. Of these the former appears the larger, but as the latter is marked on the map as the boundary of the colony I ascended it and came to a large cataract in the afternoon.

Continuing our journey on the 3rd we came to another fork, and took the branch to the right, it being the Cutari, and the other the Aramatau. The former at their junction is 146 feet wide and 19 feet in its deepest part; whilst the latter is 137 feet wide and 10 feet deep. We ascended the Cutari for five days, passing on the 4th day at noon the site of an old provision ground and village now overgrown with lofty cecropias, palm trees, and shrubs. This evidently is the place at which Sir R. Schomburgk embarked on his memorable descent of the Corentyne river.

From his reports to the Geographical Society it will be seen that in the year he attempted an ascent of that river, but was unable to get his boats past Wonotobo falls. Some years after he crossed

* On my return down river after the winter rains had added to their heights, I found the Pani river to be 30 yards wide and 10 feet deep; while the Corentyne close by was 186 yards wide having a uniform depth across of 15 feet, except in one place where it was 17 feet.

over from the Quitaro savanna, to the Essequebo near its source, and from that by the Capu and Wanamu rivers to the head of the Cutari, descending it and the Corentyne in woodskins, reaching the coast in safety after undergoing many privations.

From the 8th of November the long dry season began to break up, and we had frequent light showers from that time up to the end of the month, when the heavy rains set in, and the river began to rise steadily. On the night of the 7th of December the river rose 25 inches, so that it was in flood, its water being turbid and laden with sediment. All the rocks in the river were hidden, and its bank only a foot or two above water. Had it not been for this rise of water, we could never have gone so far up the Cutari as we did, and though we cut through a great number of "tacoobas" (fallen trees), yet we passed over a much greater number. We had also to cut through the branches of trees, that overhung the water in many places, meeting together in the centre of the stream. One of the last fallen trees or "tacoobas" cut through was 2 feet 9 inches in diameter. The river became very narrow being in one place where I measured it on the way up, along a log, only 64 feet wide and 9 feet 6 inches in its deepest part. The banks were low and the adjoining land swampy, being intersected with small branch streams. I could not ascertain the latitude of the furthest point reached, nor in fact any point on the river, owing to the rainy and cloudy state of the weather. I considered however from my sketch survey that we were only about 8 miles from the southern boundary of the colony, and the barometer showed a height of 700 feet above the sea.

During the night of the 8th the river fell 14 inches, and was rapidly falling, so I considered it better to descend whilst there was water enough, in case the rains ceased and the river subsided to its ordinary level, leaving us without sufficient water to float our boats, and thousands of tacoobas to cut our way through. We accordingly descended the Cutari, and arrived at the mouth of the Aramatau river on the morning of the 11th. We measured these two rivers at their junction, and found the Cutari to be 146 feet wide with a maximum depth of 19 feet, while the Aramatau was 137 feet wide and 10 feet deep.

Ascending the Aramatau for a day and a half, we came to a high set of cataracts where the river spread out in little channels over the face of a roll of rock. This river lies in a valley between low hills rising from 150 to 300 feet above it, its course is southerly. It was also falling so I did not deem it prudent to go any further, but remained a day at the cataract, in order to get an observation for latitude. The sun shone for a short time in the afternoon, and the sky became cloudy, but by 7 p.m. it cleared again and remained so till 10 p.m. during which time I procured a good meridian altitude of ⍺ Eridani which gave the latitude as 2° 6′ 26″ N.

On the 13th we turned the bows of the boats down stream, having completed all the requisite investigations in this quarter, and were glad at entering on this stage of our journey, not so much with the prospect of returning to the coast, as to get out of

these narrow, damp, and gloomy streams into the wide main river again, where we hoped to meet with finer weather. Arriving at the junction of the Cutari and Curuni rivers I measured the width and sounded the depth of both, finding the former to be 72 yards wide with a maximum depth of 17 feet, and the latter to be 75 yards, and maximum depth 14 feet.

The rapids below this are exceedingly dangerous, the river widening out and becoming so shallow that it was difficult to steer safely amongst the numerous pointed rocks. Below the Sipariwini river we found an Indian path, and followed it for a short distance, arriving at a small village, where there were no people, but as there were many articles of household use, some bows and cutlasses of Dutch manufacture, we concluded that the inhabitants had only gone away for a time. We also saw numerous old encampments, and some large locust trees that had been cut down and stripped of their bark.

On the 20th we arrived at the junction of the main channel of this, and the small channels of the new river, and measured its width and depth, finding it to be 138 yards wide with depths across varying from 8 to 28 feet. On reaching the main channel of the new river we found it to be 272 yards wide, having a depth from west to east varying from 6 to 30 feet. From these measurements it will be seen, that the new river is fully twice the size of what has hitherto been regarded as the Corentyne river, but which really is only a branch.

We crossed King Frederick William's portage on the 21st, and ran down the numerous cataracts between it and Enapogo, a spot some 12 miles above Wonotobo falls, spending Christmay Day encamped on an island near the 4th parallel of latitude.

From the foot of Enapago we made a land journey across to the Berbice river, cutting our way through the forest in a due west direction. We started on the 26th at 3.30 p.m and passing over a slight rising rocky ground at first, came to a swamp containing pools of water, covered with a rusty scum, and strongly impregnated with iron oxide at which we camped for the night. There was originally an old path from this to the Berbice but all trace of it has long since been effaced by the growth of trees upon it. The next and two succeding days we continued cutting our way through the dense undergrowth of the forest over a slightly undulating tract of country, and across numbers of small streams, some containing clear and others dark brown water. The subsoil was usually composed of white sand, and the soil in the vicinity of the dark water creeks was a bog earth, filled with matted roots, somewhat resembling a sort of peat.

On the 28th we passed at mid-day through a white sandy track, where the growth of forest trees was low, and of a different sort to the rest of the forest called by the Indians "Murie bush."

On the 30th at an early hour in the morning we came to the edge of the Berbice river, at a part where is was some 60 yards wide, and running with a very slight current. After resting a short time we turned about and made our way back to our boats on the

Corentyne, arriving there at mid-day on the following day, having taken just 8½ hours quick walking to accomplish the distance which I estimate at 16 miles. In walking over such a rough track as rapidly as possible, the delay caused by stepping and climbing over large logs and tree roots, is so great that it requires a great amount of exertion to keep up a speed of two miles an hour.

Late in the afternoon of the 1st of January 1872, we reached the head of Wonotobo falls, having run the great set of cataracts above them in safety, but at a very great risk,; and next day carried our boats and few remaining stores over our portage to their foot. We experienced a good deal of rain all the way down the river and on our journey across to the Berbice, so that I was glad to have the tent of my boat, which had been left there in September last, once more erected as a protection from rain and sun, having been just 3 months and 20 days travelling in an open boat, with scarcely any protection from the elements.

We left Wonotobo on the 4th and arrived at Apura village at 11 p.m. on the 6th taking up our quarters in an Indian house for then ight, and next day (Sunday). I spent one day at Orealla to re-explore the cliffs and savanna, and at 8 p m on the 9th left on my way to Skeldon, starting with the falling tide, and taking advantage of the cool of the night. We had a strong head wind with a drizzling rain about midnight and paddled on till the tide turned to run in, when we made fast to the bush in a sheltered spot, at 2.20 a.m. Fortunately the rain ceased as the tide washed and we all got a little sleep. At 7. a.m we continued our journey and reached Skeldon wharf at 11 a.m. There was only one schooner at Skeldon bound for Berbice, but it was too small to carry my boats, so I remained for three days at Skeldon House the guest of Dr. Leary, awaiting the arrival of a larger schooner, which was expected.

At Skeldon Mr. N. Winter and myself made a slight examination of a singular mound of sand, in which we found bones of animals and Indian pottery, clearly proving that it was the site of an ancient Indian village. He was fortunate enough to find a curious little image carved in a sort of Jade, which once was used as an amulet. Stone hatchets having been found there clearly proves that the original occupation of the place dates back to the stone period of this country.

On the morning of January 14th, I left Skeldon in the schooner "Daylight," with my men and boats, and arrived at New Amsterdam in the afternoon.

PART II.

1.—Alluvium and Fluvatile Loam.

The land bordering the mouth of the Corentyne river is composed of alluvium similar to that along the coast of the colony. This continues uninterruptedly along both margins of the river in

a southerly direction as far as Apoacka river, where it rests against the sand beds of the Orealla deposit. It spreads away east and west for many miles, forming an enormous tract of low-lying swampy country. Near the mouth of the river the surface of this deposit is below the level of ordinary high tides; while opposite Powis island, some distance up, it is a few feet above that level. At the head of the tide, at the time of my visit, its upper surface was at a height of 10 feet above the level of the water. In the immediate vicinity of the coast it is composed of layers of dark clayey loam and sand, but higher up the river it consists of heavy gray and yellowish arenaceous loam.

Beyond the sand beds to the river's sources, wherever it winds through level tracts, it has deposited the same gray clayey alluvium. This deposit varies slightly in its characters in different localities; for instance, along the river, from the upper end of Siparuta cliffs to Paruru it is of a yellowish arenaceous variety, the lower portion of which is a bluish clay very thinly laminated. Opposite Mawarli island its lower portion consists of white and gray clay interlaminated with thin layers of vegetable matter.

At the bend of the river to the south of the fourth parallel of latitude there is a horizontal layer of recent brecciate conglomerate and semi-consolidated sand, occupying a considerable area upon the surface of the granite. It is stained outwardly of a blackish colour, and has a slag-like appearance. This deposit is about 3 feet thick, and is hard only on its surface. On breaking it, the conglomeritic portion is seen to consist of small-sized water-worn blocks and pebbles of granite, particularly decomposed, and cemented by oxide of iron. The sand portion is made up of angular and worn quartz grains and worn crystals of felspar, cemented by oxide of iron.

On the new river, after passing the third parallel of latitude, the river's banks were not more than 5 feet above the level of the river, and are composed of a gray and yellowish gray argillaceous clay. In about the parallel of 2° 50′ north latitude there is a cliff section shown of from 20 to 30 feet in height, composed of red and yellow mottled clay below with yellowish loam above. The lower portion for some 10 feet in height is decomposed granite, and has some thin vertical veins of quartz and iron oxide. Upon this is a layer of angular pieces of white quartz, with 4 feet of gravel and iron oxide pebbles partially cemented together. Above this comes gray and yellowish sandy clay, which appears to be the river alluvium elevated to this position. To the southward this passes almost imperceptibly into yellowish loam, and from that into a fine white clay. This latter rests on an extremely fine pure white sand, containing spangles of white mica. Beyond this the bank dwindles down to the level of the water in a short distance.

Between the head waters of the new river and the Essequebo, in the numerous swamps bordering the small streams, the alluvium is of a dark colour, containing much vegetable matter. The tops and sides of the intervening ridges are covered with a heavy yellow clayey loam.

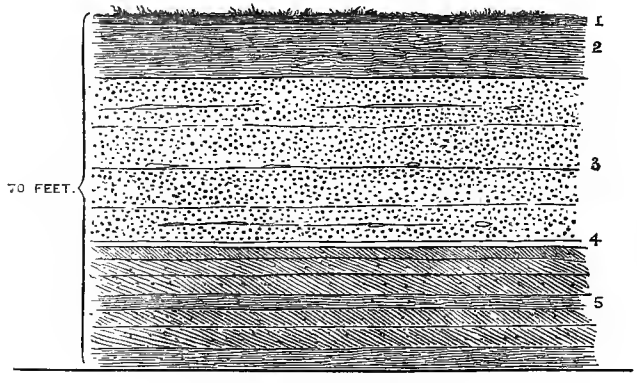
The alluvium forming the banks of the Cutari river is of a yellowish and sometimes grayish loam, and that on the Aramatau is precisely similar.

2.—Sand and Clay Deposit.

On ascending the Corentyne river as far as the mouth of the Apoacka river, one comes to the edge of an undulating tract of land raised some 60 feet above the level of the sea, forming a cliff along the river's margin, which continues up as far as Orealla. The edge of this high land is called the Orealla cliff, and the slightly undulating grassy plain extending westward for a considerable distance is called the Orealla downs or savanna. We again meet this same deposit forming the Siparuta and Kaiyiwa cliffs on the west bank higher up the river. It forms in fact a great tract of country between this and the Berbice river, stretching from the termination of the alluvium of the coast region southward to the high land, where the underlying rocks are raised to a higher level than the surface of this deposit in the vicinity of Wonatobo falls.

The structure of these beds is well shown in the three localities above mentioned. In the first or Orealla cliffs we find false-bedded layers of coarse white sand, of from 60 to 75 feet in thickness, lying in places upon irregular layers of an exceedingly fine white clay. This clay is slightly stained in lines and specks with red iron oxide. Amongst the loose and semi-consolidated sand beds are small lenticular pieces, of the same kind of hard white clay as at their base. About midway between the Mission landing

No. 30.



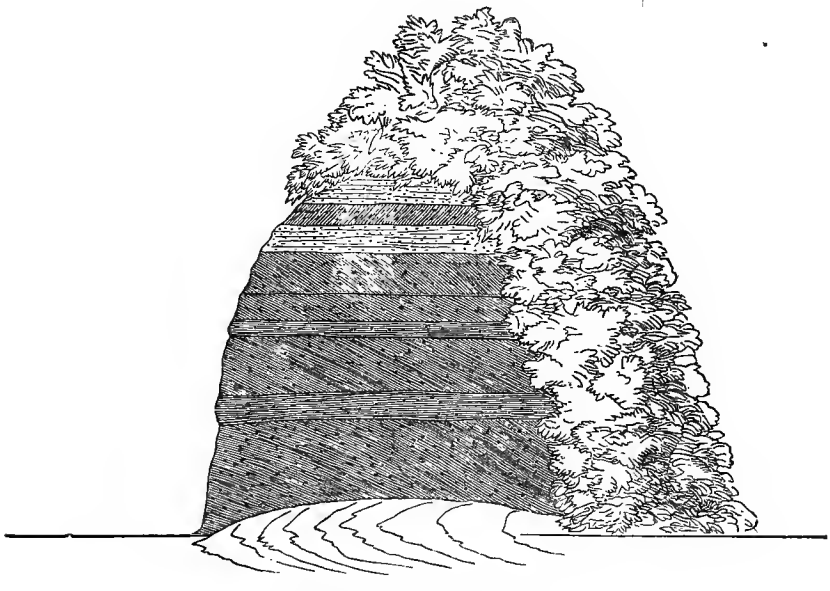
Section of Cliff at Oreala.

1. 1 foot dark soil. 2. 15 feet of red sandy loam.
3. 33 feet of white sand beds with thin seams of white clay. 4. 1 foot of white clay.
5. 20 feet of false-bedded coarse white sand.

and the main cliff, or perpendicular portion between high and low water mark, there occurs a bed of fine white clay, or Kaolin, having a slightly curved surface inclining towards the river. Its thickness cannot be ascertained, on account of its position under water, only 18 inches of it being exposed during low water of

spring tides. Measured along the shore, from south to north, this bed has a length of some 40 yards, of which only 25 yards is composed of true kaolin, the remainder being mixed with fine white quartz grains, which become coarser and more numerous northward, till in the distance of a few yards it changes to a white sand bed containing but a slight admixture of white clay about half way up it in the false-bedded sands. The false bedding inclines to the northward, whilst the beds themselves seem to incline to the south. At the bare-topped part of the cliff there is a superficial covering of reddish loam, 15 feet in thickness, with a dark soil on top. Some portions of the mixed sand and clay beds are partially consolidated, and almost resemble a friable sandstone. The Orealla savanna is precisely similar in soil and foliage to that of the Rupununi river. It is about 4 miles long, and from 2 to 3 miles wide, and is bounded by forests. Its surface is gently undulating, the highest part being 90 feet above high-water mark. Its soil is usually composed of a dark arenaceous loam, with brownish sand on top, blown into little patches by the wind; but above the mission it is devoid of any superficial covering.

No. 31.



Section of Cliff at Siparuta.

The Siparuta cliffs are composed of friable beds of partially consolidated coarse white and varied coloured sands, the cementing material being a white clay. There appears to be but little regularity connected with their deposition, the whole being thoroughly false-bedded, and sometimes exhibiting a slight dip to the south; but this latter feature may be owing to the disturbance of the face of the cliff. The direction of the false bedding, inclining as it does invariably to the northward, shows that the

current at the time of its deposition ran from south northward. Interstratified with these sand beds are layers of a fine white and sometimes brown clay in beds a few feet thick, and in others reduced to mere thin laminæ. These occur in one part of the cliff at the level of the water, and in another place close to the top. They likewise form small nodular patches, scattered irregularly through the beds. The sand beds are composed of a coarse sand, chiefly quartz, having a slightly bluish, opalaceous cast, being more or less waterworn, and sometimes exceedingly fine-grained, but never containing any pebbles larger than a pea. Where water trickles down the face of Siparuta cliff, or percolates through the sands which are partially cemented by white clay, it seems to wash out the clay and deposit a brownish vegetable matter in its stead, giving the sands a dark brown or black tinge. The interlaminated beds of clay are also discoloured in some degree by the vegetable infiltration, which has acted more strongly on portions of the cliff over which water is now trickling.

At Kayaiwa the cliffs are similar to those at Siparuta, except that the beds of white clay are wanting, and are represented by nodules and strings of the same substance. Near its southern termination, on the river's edge, there are beds of sand mixed with a sort of decayed vegetable matter of a brownish to deep black colour. This substance, intimately coating the small quartz grains, gives the rock a highly bituminous appearance. The grains are slightly opalaceous, and have a bluish cast when imbedded, which is lost on removing their brown coating. This quartz with an opalaceous appearance is probably derived from the decomposition of the granite at and above Wonotobo great cataract. These three cliffs do not present clear continuous sections, being clothed in their sloping portions with shrubs and trees.

Above Tomatai, on the northern side of the river, about half a mile inland, this same deposit, rising to a height of 60 feet above the river, is met with; its surface is covered with a dark soil mixed with iron gravel, while blocks of iron-cemented clay are embedded in it. Between its edge and the river is a level patch of alluvium of yellowish arenaceous clay, raised about 8 feet above the river's level.

In crossing from the Corentyne river above Wonotobo cataracts, I passed over a band of this deposit where the white sand formed the surface of the ground, and supported a low growth of trees and shrubs quite different to those of the surrounding forest.

3. Sandstone.

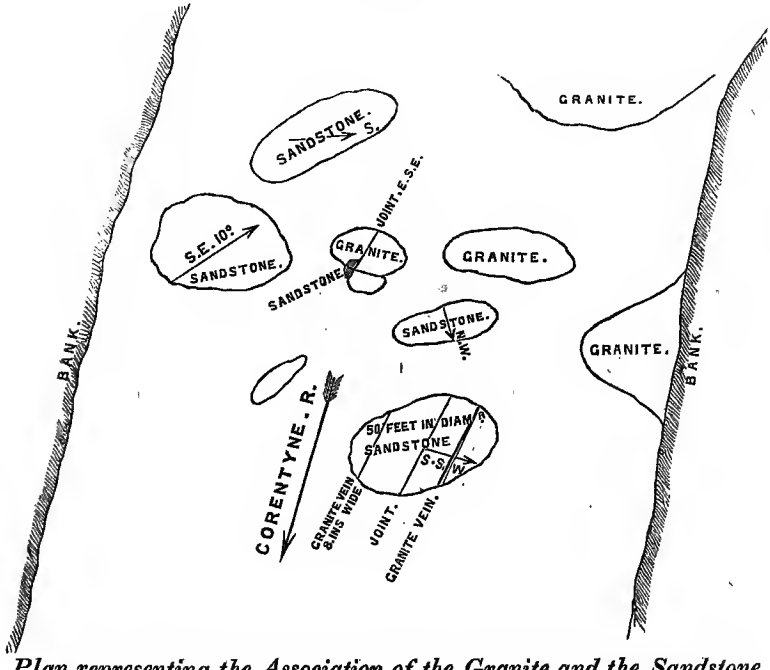
About a mile north of the mouth of the Cabalebo river, there is an exposure of whitish sandstone forming an island in the river. This rock is jointed and very friable, and is composed of angular compressed particles of white quartz, with very little cementing material. It contains scattered plates of silver-white mica through it, which have in some instances become of a brownish colour from decomposition. It is very difficult to make out the position of the bedding of this rock, but it appears to have a strike nearly north and south, and to dip west at an angle of 80°.

Near the mouth of Tomatai river there is a small rocky island of sandstone of an extremely hard jointed variety which does not show any signs of original bedding. It is of a grayish-white colour, and is undoubtedly the same sandstone as that at Cumuti and in the Pacaraima mountains. Its component quartz grains are much compressed and but slightly rounded, while the small cementing material it contains is a slightly reddish clay.

Near Akalikatabo island where two hills approach the river on either hand, there is a large development of sandstone, occupying portions of the river for a distance of almost one mile. It is of an extremely hard whitish and reddish variety, so completely cut up by jointage planes that it is almost impossible to trace its bedding. At the first place where it is met with it forms two rocky bluffs, which narrow the river considerably, and is composed of a coarse hard quartzose sandstone, so confusedly jointed that its bedding can be clearly made out in only one spot, where it appears to dip at an angle of from 50° to 90° in the direction of south 18° west. In some parts of it there are waterworn pebbles of quartz. The alteration produced in this rock seems to consist in the conversion of its white clay cement into a felspathic material together with the development in it of some small black crystals.

From this on for a short distance the river hides the subjacent rock, and then comes a continuation of the same sandstone of a finer texture, forming small rapids and isolated patches. Amongst this comes a boss of granite, and beyond it a small area of sandstone abutting against huge granite masses.

No. 32.



Plan representing the Association of the Granite and the Sandstone.

This last area has three large patches of sandstone appearing above the water, besides many smaller ones. Of these three the one seen nearest to the western shore is exceedingly altered, having been converted into a hard siliceous rock of a grayish colour, but still showing its laminated structure by weathering on its edges in lines, where its layers are of alternate hard and soft material. These lines also show the original false-bedded nature of the rock. This mass lies within 50 yards of a large granite boss, towards which it dips at an angle of 60° in a south-south-west direction. It is traversed by three small veins of granite from 1 to 6 inches wide, similar to that forming the granite mass of the south, but of slightly finer texture. This granite contains greenish mica, much opalaceous quartz, and but little felspar, and is similar of that of the Wonotobo falls. Some crystals of opalaceous quartz are seen in the sandstone, near its contact with the granite veins. The two other patches are very friable from the action of the water, but are also extremely jointed in every direction. They dip at gentler angles in south-east and southerly directions, and break easily along the lines of original bedding. They have a reddish iron crust upon them and filtered in their joints, between which the rock itself is soft and crumbles away, leaving little box like forms remaining. The most westerly patch has a few thin quartz veins in it. Almost midway between the three sandstone patches just described, there is a mass of granite running in a south-south-east direction, with a patch of sandstone firmly adhering to it. It would appear from this, and the fact of veins of granite (similar to the mass to the southward) traversing the sandstone, that the granite of this district has been forced up subsequent to the deposition of the sandstone. The sandstone is evidently a continuation of the Maccari mountain sandstone.

4. Quartz-Porphyry.

Nearly opposite the mouth of the Mawarli river there are some large rocks of a kind of quartz-porphyry or a variety intermediate between that rock and syenite. It is composed of grains of opalaceous quartz and green hornblende in a grayish felspathic base.

Not more than half a mile on there is another development of the same rock, though of a slightly different nature, containing crystals of green mica instead of hornblende, and resembling a mica-porphyry. Beyond this to the first small rapid there are numbers of rocks of this kind protruding above water of a schistose nature, but with few mica crystals in them.

In the easterly bend of the river above Temehri rock quartz-porphyry is again met with, and gives place to granite. It is a similar rock to that seen near Tomatai.

A short distance above the head of the great cataracts beyond Wonotobo falls, a change is perceptible in the form of the rocks, and the great rounded rolls and domes give place to oblong spindle-shaped and tabular masses rising vertically above water.

These are composed of a variety of felsitic porphyry, and are of a gray colour containing a little mica. Their texture is crystalline granular, and they appear to be of an intermediate variety between quartz-porphry and granite, or a very felsitic granite.

Some 10 miles beyond the last development quartz and felspar porphyry occur. It first appears in a dykelike form close to the coarse granite of the district, but beyond it spreads out at a surface rock, rising in irregular domes and obelisks above the river. One of these latter forms is a vertical rhombic prism having a rude pyramidal termination singularly like an enormous crystal, while another runs upwards for a height of some 10 feet, with irregular curved faces terminating in a point. This porphyry is composed of greenish-white crystals of felspar with slightly rounded edges as if compressed, together with irregular patches of a finely crystalline green mineral, arranged with a sort of parallelism in a vertical direction, and a gray felspathic base or matrix with crystals of opalaceous quartz, scattered sparingly throughout. The green mineral may be hornblende, but as the rock is slightly decomposed near its surface, it is soft and resembles mica. Owing to the area exposed being in the middle of the river amongst a labyrinth of islands and channels, its mode of occurrence with relation to the granite cannot be ascertained, but it probably lies upon the granite, and may be in some way connected with the greenstone dykes at the cataracts a little lower down river.

In the easterly bend of the river near the fourth parallel of latitude, quartz-porphyry of the intermediate variety occurs together with gray felsitic porphyry. The quartz-porphyry besides containing crystals of quartz has also a few mica crystals

On the New river close to the southern boundary of the colony two small developments of quartz-porphyry are met with, which must be extensions of the mass of that rock lying to the southward.

In crossing over from the head of the New river to the Essequebo, on approaching Amuccu mountains the quartz-porphyry sets in, and is the only rock to be met with from that onward. At the foot of Amuccu mountain it is of a variety of reddish felstone-porphyry, containing greenish crystals most probably of chlorite. On the side of the mountain it is very similar to the porphyry of Mora mountains on the Rupununi river, but contains more felspar and chlorite crystals. Clear quartz crystals occur but sparingly in it, and its quartz, as a general rule, seems to be distributed in a network of thin veins, ranging from white opaque to transparent varieties. Some enormous semi-detached blocks of this rock stood out from the side of the mountain, and in many places the bare mass of solid rock that formed the mountain was exposed. All along the base of the Amuccu mountain, which we skirted, the quartz-porphyry and felstone occurred, of various colours from gray to bluish, reddish and liver colour. In some pieces were small crystals of iron pyrites.

5. Schists and Gneiss.

In ascending the Corentyne river no gneiss is met with until the fourth parallel of latitude is passed; but from this on to the head of the Cutari river in the second parallel, and on the head water of the New river to about 2° 25′ north latitude, it forms the surface rock with only a few exceptions.

Where first met with there seems to be a gradual passage from the granite to true gneiss, the intermediate rock being of gneissose granite. It is foliated, but the foliation is not shown by weathering on the surface, and it is jointed in a plane lying east and west inclining south at an angle of 45°. This jointing or rude cleavage resembles bedding in some degree. It weathers into curved forms resembling granite, and lies in massive rolls across the river in a direction coincident with its foliation. The direction or strike of these rolls varies in short distances from east and west to north-east and south-west. The texture of this rock is coarse, and the felspar crystals have flattened forms. It there occupies a distance of about 15 miles in length of the river's bed, and passes into granite.

Beyond this granite the gneiss again appears and is much mixed up with granite veins, containing also a dark quartzose layer like that seen on the Rewa river at Ranidakeur, and in the Canucu mountains. Between this and King Frederick William IV.'s cataract the gneiss is massive, and seldom shows its lines of foliation on the surface. It contains rounded masses of green mica in small plates compressed together, sometimes sticking out from the rock at others leaving rounded cavities from which they have been dissolved. In one place this rock contained a few small crystals of garnet, and was pierced by a finely crystalline greenstone dyke.

The gneiss forming King Fredrick William IV.'s cataract is of the ordinary variety, and is foliated in an east and west direction having the planes of lamination dipping north at an angle of 60°. The foliation shown by weathering is very fine and but slightly contorted, in some cases being quite regular and parallel. It is traversed by veins of coarse quartz and felspar crystals, with sometimes large crystals of mica.

Some seven miles up the New river there is some hornblende schist, similar in outward appearance and foliation to the gneiss. Five or six miles further on the gneiss inclines towards mica-schist for a short distance becoming true gneiss again of a very beautiful variety, having its black mica in twisted layers round the felspar crystals, and containing large sized garnets. In many places this gneiss contains nests and strings of quartz. It is foliated in a vertical plane in a north-west and south-east direction, and its rolls usually lie in the same direction with one exception at a rapid just before approaching the hills on the west bank where they are north and south.

The set of falls just below the mouth of the second large branch stream on the west is composed of a very coarse gneiss with

garnets, and contains a large dyke of greenstone. This greenstone is of that beautiful variety wherein the hornblende crystals have a stellate form and the felspar a greenish tinge, and is the same rock as the Tacarierimore dyke in the Ireng district. It contains whitish iron pyrites in small patches. In the other branch of the Corentyne this same dyke is met with. The gneiss there lies in rolls trending with the greatest regularity in a north-west and south east direction, being also foliated in planes with the same strike. Above this garnet gneiss and common gneiss alternate for a considerable distance, and form large high rocks rising sometimes 20 feet above the river's surface.

Five miles north of the mouth of the first large river joining this on the east, there is a vein or layer of quartz-schist in the gneiss of the ordinary schistose-granular variety. Near it the gneiss is coarse, containing very little mica of a light green colour and a large proportion of flesh-red felspar with enclosed crystals of the same mineral of a white glassy variety. Just below the mouth of the above-mentioned river, where a ridge of gneiss extending across in a north-west and south-east direction forms some rapids, there is a high dome of this rock most beautifully foliated in every degree of contortion. A large nest of quartz, 8 feet wide and 20 feet long, is seen rising like a wall above the river in this gneiss. It is chiefly of a white colour, but parts are stained of an amber colour by iron. From this place on to the termination of the gneiss at the granite exposure, very little of it is to be seen in the bed of the river. In one place I observed a layer of coarse white rock, 2 feet in thickness, composed of felspar containing a little quartz and mica, resting on domes of gneiss. Beyond this the gneiss became slightly granitic containing light green mica, not far from a small roll of granite. Above the granite came a small development of true mica-schist foliated in vertical planes and followed by massive gneiss rocks for a distance of five miles to the edge of the granite. The last patch of gneiss is seen some distance on, and is about 4 miles in width flanked by granite. It is of a common foliated variety striking in a north-west and south-east direction; and in one place contains a large vein of quarz and felspar with large nodular patches of quartz along its centre, which is 6 feet wide in the middle tailing off to points at either end in a distance of 20 feet.

From the junction of the Corentyne and New river up to one of the sources of the former as far as I went the whole country is composed of gneiss and schists. At the point at which this river enters the other the foliation of the gneiss is vertical striking east-north-east and west-south-west, and is slightly contorted. It contains nests of quartz and is exteriorly of a uniform black colour with a slight metalic polish. This river at first follows the direction of the foliation of the gneiss thereby leaving wall-like and tabular forms of that rock rising up from its bed.

Some distance on, after passing a dyke of greenstone, this rock merges into a sort of dark mica-schist of coarse texture, composed of dark layers of mica and white felspar, whose foliation inclines

at an angle of 50° to the northward. Interfoliated with the schist is a band of exceedingly coarse granite composed of white felspar, semitransparent quartz and whitish mica. This granite is again seen some distance on in the same rock, in true layers and veins of from 1 to 2 feet in thickness. Some distance on beyond a development of dark coarse mica-chist there is a patch of gneiss, lying upon a boss of gray granite, having a thin layer, 1 foot thick, of a bluish-gray felspathic looking rock between them.

Near the great bend called Point Rightabout there is a patch of coarse white granite, containing much felspar and but little mica, resting upon gneiss. It contains small veins and separate crystals of schorl. Directly opposite the same point a blackish mica-schist, containing small crystals of felspar, occurs.

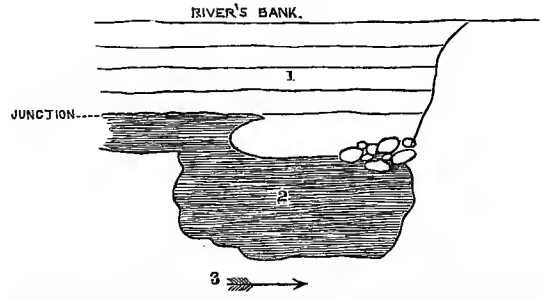
The gneiss round the bend in the long southerly reach has contorted foliation striking east and west, and contains in one place a large granite vein, 2 feet wide, of coarse felspar with a little quartz and mica and patches of crystals of schorl, some of which are an inch across. A short distance on the same granite veins containing schorl are seen intersecting the gneiss at obtuse angles to its foliation which is much contorted. Then the foliation is seen changing its strike from west to north and north-west. Where the gneiss on this river contains nests of quartz its foliation immediately becomes contorted, resembling the woody fibre round a tree knot.

Some distance beyond the Pani river there is a dyke of greenstone of some 5 yards in width, running north and south, above which the gneiss is foliated at a high angle dipping east and striking north and south, and contains green hornblende crystals arranged in foliæ together with nests of quartz. Further on it resumes its original east and west strike and becomes granitic, resembling in hand specimens true granite, but viewed in mass its true gneissic character becomes immediately apparent. The dyke appears in square and angular blocks, with slightly rounded edges, crossing the river, and on the western side alters its course to the south-south-west. Some of its blocks on the river's bank are exceedingly decomposed, weathering in concentric layers of a light brown rusty colour. Where not affected by decomposition it is exceedingly hard, ringing like metal when struck with the hammer. Its crystals are intimately mingled and its felspar crystals of a greenish colour are hardly distinguishable from the hornblende with which they are associated.

From this on to the rapids, some 12 miles below the Sipariwini river, the gneiss alternates with mica and hornblende-schist in the vicinity and to the south of a great mass of exceedingly coarse hornblendic rock most beautifully crystallized. This rock weathers in great blocks some of which are 20 feet in diameter, showing its coarse structure exteriorly. It is composed of large crystals of dark green pyroxene closely segregated in a fine crystalline base of felspar and pyroxene, and is a porphyritic greenstone. There appears to be also a light green semi-

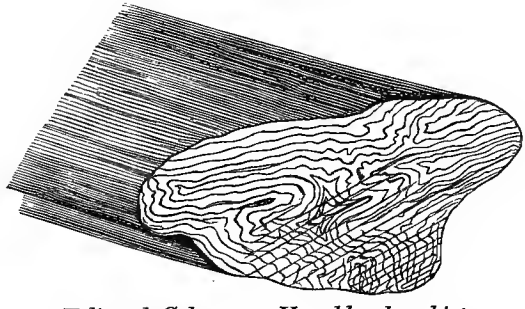
transparent mineral in the base, probably a green felspar. This rock resembles the hornblende rock of the Casowebie and Rupununi rivers on the Takutu savanna described in Report No. 10, but differs from it in having a felspar base. There appears to be some connexion between this rock and the occurrence close by of hornblende-schist in the gneiss. Immediately north of this mass or dyke true gneiss is again seen and continues as a surface rock up to the rapids about 12 miles above the Sipariwini river. At one place in that distance it contains two veins or large nests of quartz. The mica-schist above mentioned is of a dark variety foliated in a north-west and south-east direction, dipping to the north-east at a high angle, while some gneiss adjoining it is foliated in a similar direction, with a dip of 45 degrees.

No. 33.



Plan of Junction of Gneiss and Hornblende-schist.

No. 34.



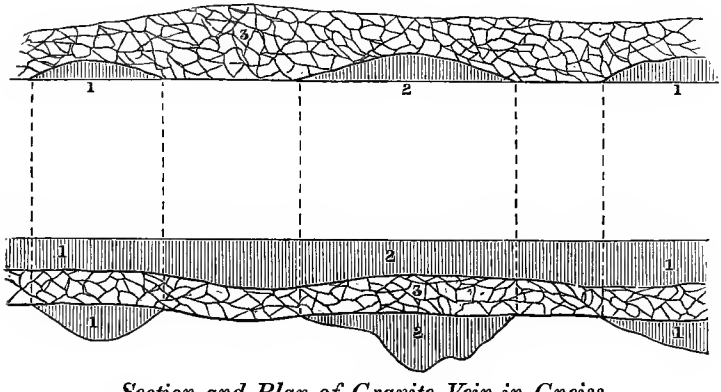
Foliated Columnar Hornblende-schist.

The hornblende-schist also agrees in foliation with the surrounding gneiss, and in one place its laminæ are highly contorted. There this rock weathers in irregularly rounded, leaning columns somewhat resembling petrified wood, where the contortion is extreme, but where it is not so intense it assumes a vertical position. This development abuts against a coarse gneiss foliated in an east and west direction like the schist, and at their junction the wavey texture of the latter conforms to the irregular wavey

edge of the gneiss. Near the same place there is a large surface of rock exposed where the schist is seen doubled backwards and forwards and intermingled with the gneiss in a most extraordinary manner. The association of the two is at once understood, if we suppose the existence of a wavey layer of schist in the gneiss, exposed by the horizontal slicing off of the rock by denudation. By this means the anticlinal waves are cut off and the synclinal ones are hidden so that all we see is the edges of the layer along the surface of the gneiss at different angles forming most curiously woven and intermingled lines. This hornblende-schist is composed of black hornblende intimately blended with lenticular grains of quartz, with here and there bands of pure quartz of different widths, from 1 line to 4 inches, continuing of even width for a long distance at times and tailing off or forming swellings at others.

Near the rapids 12 miles above the Siparuwini river there is a wide band of quartz-schist interfoliated with hornblendic gneiss in a north and south direction. The latter rock is exceedingly hard and quartzose and of a dark green colour, while the quartz-schist is grayish with small green crystals scattered thinly throughout. Its quartz-foliæ have a vitreous appearance and it contains iron pyrites. It is very similar to the development of the same rock on the Cotinga river described in Report No. 10.

No. 35.



Section and Plan of Granite Vein in Gneiss.

1. Gneiss. 2. Quartz-schist. 3. Granite.

From this on to the sources of the Cutari the gneiss is intersected with numbers of large and small coarse granite veins and dykes. One of these dykes, 54 feet in width, is seen at Sir. W. Raleigh's cataract where the planes of contact between it and the gneiss are easily seen. Along its southern edge the contact is very uneven and it envelopes completely a large lozenge-shaped piece of gneiss, clearly proving its injected origin. The gneiss there has its foliation in an east and west direction dipping north at an angle of 60 degrees.

On the Aramataw river the principal rock seen is gneiss, which is intersected by a dyke of greenstone lying along the river in a north and south direction for 8 miles. This greenstone contains large crystals of felspar and a few of hornblende, besides a glassy green mineral probably a felspar scattered sparingly throughout it.

The gneiss is of a common red variety at first with regular east and west vertical foliation. Higher up at the great cataract its foliation is contorted in a most marked manner and has a layer of interfoliated hornblende-schist, so that where the gneiss has been eroded in horizontal planes of a few feet square it has all the appearance of containing rectangular blocks of schist. In one place it contains a layer of a pale bluish-gray rock resembling a granite with bronze-coloured crystals of mica. It also has a band of quartz-schist containing iron pyrites.

The low hills on both banks of the river are composed of decomposed gneiss from which has resulted a deep red loam.

6. *Granite and Syenite.*

In ascending the Corentyne river to King Frederick William IV.'s fall four great granite areas are met with, and on the New river masses of the same rock come to the surface in three places.

The first commences at the bend of the river beyond the first rapids above Tomatai, where this rock is seen lying in huge rolls, in a north and south direction. It is composed of coarse crystals of opalaceous quartz, green mica, and two kinds of felspar, one of a pinkish and the other of a greenish colour. The great rounded masses and blocks of rock at Bacacai rapids are formed of a coarse variety of granite similar to that above mentioned. With the exception of the small area of sandstone upon it, this granite continues all the way to the rapids and cataracts above Tamehri rock.

Beyond the quartz-porphyry granite of the same variety becomes a surface rock, and continues so as far as the next band of quartz-porphyry, some 10 miles beyond Wonotobo cataract. That great range of cataracts is produced by rolls of a coarse granite lying in a north-east and south-west direction, composed of greenish mica, colourless and bluish opalaceous quartz, and white felspar. Above Wonotobo for three miles the same granite lies in rolls trending west-south-west and east-north-east. At the end of an island in a south-west bend of the river, not far from Wonotobo great cataract there is a patch of jointed granular quartz, somewhat resembling quartz-schist. Portions of it are white, opaque, and granular, whilst others in layers are colourless or opalaceous and semitransparent. At the foot of Wonotobo middle fall there is a large nest of a similar rock of an opalaceous variety. In the granite near the edge of the quartz-prophyry development, beyond the fourth parallel of latitude, there is another patch of jointed quartz, having a platystructure, and of

a semi-transparent milky variety, stained in parts with oxide of iron.

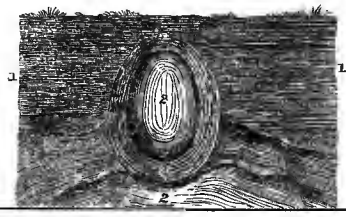
Above the small development of quartz-porphyry a very coarse variety of granite appears, which contains large crystals of felspar, and continues to the large cataract situated in the western bend of the river. Further on comes the same variety of rock as at Wonotobo cataracts, thickly studded with felspar crystals; and there a wide dyke of greenstone traverses it for a distance of 5 miles in a southerly direction. This greenstone is of a coarsely crystalline variety and greenish colour and is 30 feet in width. The next development is between this and King Fredrick William's falls where there appears to be a gradual passage from the gneiss, to a whitish granite, and then a further change into a dark granite. Just opposite the first hills of any size the granite is a coarse variety of the ordinary kind. In the granite opposite the hill with a peak there is a huge nest or short vein of quartz having a sort of schistoze structure of a white and pale amber colour. It is lying in a south-south-west and north-north-east direction, is some 50 yards in length, and forks at one end. Its greatest width is some 10 feet, and it is jointed at right angles to its strike.

Proceeding up the new river four developments of granite are passed over, the first being a narrow belt rising up from beneath the gneiss. The next development not far on, at the great bend of the river to the west, is composed of a dark granitic rock exactly like that I examined last year at the Taruma's field on the upper Essequebo. It occurs in one place apparently as a layer 8 feet thick, and in another in a large boss like ordinary granite. It is composed of bluish-gray quartz and felspar and black shining mica, rather coarsely crystalline. Next to this comes a kind of syenite, passing into hornblende-schist and diorite, and then the same dark granite again.

At a bend of the river there is a cliff 70 feet high, the upper 60 feet of which is composed of red loam, passing gradually into an extremely decomposed mass of granite, which in its turn passes into solid granite. The decomposed portion, 10 feet in thickness, is as soft and friable as loam, but retains its crystalline structure, as seen by the different colours of the mineral constituents; the deep red portions representing the mica, the soft greenish patches hornblende, and the white clay rhombs the crystals of felspar, while the quartz remains unchanged. When we see a hard rock like this thoroughly decomposed and rendered as friable as loam to such a depth from its surface, we may well wonder at the power of the chemical forces that have wrought such a change. It would appear that this granite runs in a narrow band in a north-east and south-west direction, and that it lies in the whitish granite of this district.

At the mouth of the large creek coming in on the east granite rocks are again seen, but only appear in the bed of the river in three places onwards to the edge of the gneiss. In the second place where it appears it has all the character of a vein, and is weathering in large nodular pieces with concentric layers.

No. 36.



Granite Weathering in Concentric Layers.

1. River loam. 2. Granite.

From beyond the narrow belt of gneiss to the furthest point of the river to which I ascended, the whole surface of the country is formed of granite, shown by small developments here and there in the bed of the river along the entire distance. In two places small dykes of greenstone occur, and in one spot a large dome of gneiss 10 feet high and 30 feet in diameter, of a porphyritic variety, is seen resting upon the granite. The granite over this area is usually of a common variety, but in one place contains greenish to black mica, and in another crystals of opalaceous quartz, and twin crystals of felspar. It is usually of a gray, coarse-grained description, passing sometimes into porphyritic varieties. The last granite seen on the river, forming a barrier of great water-worn blocks across it, is of a coarse ordinary description, and that seen for a short distance going westward to the Essequebo on the hill sides is precisely the same. In many places the granite is seen weathering in spheroidal blocks decomposing in concentric coats; in others large dome-shaped masses are also seen weathering in layers from a quarter of an inch to one inch in thickness.

No. 37.

Granite Mass Weathering in Layers.

At the small rapids beyond point Right About a coarse variety of granite forms veins or layers in the gneiss.

Between the junctions of the Sipariwini and the Cutari with the Curuni or Corentyne, numbers of large and small veins of coarse granite intersect the gneiss in various directions. The first of these occurs at the small rapid above the Sipariwini river, where it is seen as a ridge rising above the river, of a uniform width, and composed of a very coarse granite containing a large percentage of felspar. About two miles on three large veins of the same porphyritic granite cross the river. In these the crystals of felspar are of great size, some measuring 8 inches by 4 inches, and containing themselves small crystals of quartz and white mica. The felspar crystals of the mass of granite measure from ½ to 1 inch in diameter. In places where these dykes were seen

abutting against the gneiss, there is no perceptible change in the texture or arrangement of the constituents of that rock, and in one instance the dyke ran parallel to the planes of foliation. In another instance one of these dykes, 50 yards wide, ran at right angles to the foliation of quartz and hornblende-schist.

Sir Walter Raleigh's cataract is produced by a dyke of the same porphyritic, coarse granite lying between an east-south-east and south-east direction—of 18 yards in width—which sends off lateral branch dykes and veins into the surrounding gneiss, varying in width from two inches to many feet. The chief dyke is a curious and beautiful rock, very solid, and worn into a rounded mass at the western end of the fall. On its smooth surface the edge of the large silvery mica crystals are clearly shown, forming short black stripes in every direction, amongst the quartz and felspar crystals. The quartz crystals enclose part of the mica and are colourless, the felspar having a reddish tinge. To the north of the great dyke there is a smaller one at the head of an island which contains minute crystals of garnet, and crystals of a greenish-blue glassy mineral in a semi-decomposed condition.

At the junction of the Cutari with the Curuni there is a great jointed mass of very fine-grained granite of a reddish colour, containing a large proportion of felspar, and is probably a dyke in the gneiss, lying east-south-east and west-north-west. On the Cutari and Aramatau rivers granite of different kinds occurs in many places as dykes in the gneiss. In one place it contained hornblende crystals, and in another a bluish felspar resembling labradorite.

In crossing from the Corentyne river above Wonotobo to the Berbice granite rocks are met with only for a short distance from the river. They are of large rounded forms rising above the heavy clay soil, and in one place are traversed by a small dyke of greenstone.

7.—*Greenstone.*

The Matappi rocks — the first met with in ascending the Corentyne river—are composed of a grayish, crystalline-granular greenstone of extreme hardness. This exposure is evidently part of a great layer, and most probably underlies the sandstone which is seen not far to the westward dipping west. One mile beyond Cabalebo river a few blocks of this rock, of a greenish colour, and somewhat similar to the dyke at Cumararing in the Ireng river district, are seen. Beyond this, above the first rapids, greenstone hills approach the river on both sides, and that rock is seen in the river at their base, occupying a space 300 yards wide. It is coarsely crystalline in texture, and apparently rudely bedded. Near the northern edge of the sandstone at Akalikatabo island, there is a small patch of fine crystalline greenstone of a dark green colour.

REPORT No. 11.

Geological Report on the Berbice and Demerara Rivers.

By Chas. B. Brown.

January 1873.

CONTENTS.

PART I.

Physical Features.

On my arrival at New Amsterdam from the Corentyne I made preparations for a journey up the Berbice river, and after a delay of two days finally started on the morning of the 17th January 1872 with the flood tide.

We reached Mara estate that evening, and next afternoon came to the first rising ground at Bartika, where the land is raised some 8 or 12 feet above the high-water mark.

The banks of the river are low all the way to Mara, being at that place very slightly raised above ordinary high water, and are clothed with low trees, bordered on the muddy slopes by moco-moco and a small leafed prickly shrub called "Boodoorie bush." Just beyond Mara the river begins to narrow considerably, the estuary seeming to end there. The Bartika savanna is situated on the east side of the river, and continues almost up to the site of the old Dutch fort and town of Nassau, the former capital of Berbice. There the land is raised some 15 feet above the river, and on it in low forest growth are the remains of numbers of roofless brick buildings.

At Diluca river there is high ground raised some 50 feet on the western side of the river, which is the northern edge of the great deposit of sand beds which forms the face of country back to the highlands of the interior.

On the morning of the 20th we passed the mouth of the Wieroni river, a fine large stream on the west, and along the foot of high savanna land extending from Peereboom to the Etunie river, taking up our quarters at a small settlement opposite the Wickie river. At Peereboom the savanna is 69 feet above the level of the river, and is portion of a great elevated tract of slightly undulating land, which spreads out both north and south, as well as across almost to the Demerara river.

The Berbice just below the Wieroni mouth is not more than 150 yards wide, and the foliage along its banks up to this is low with a tall mora tree here and there.

Next day I went back on the savanna to an Arowaak village to obtain a guide to take me across to the Demerara river, and then returned to the boats. On the 22nd we reached the mouth of the Etunie, and ascended it as far as the Indian village spoken of, where we obtained a guide. That night we got to the Alteka river mouth and camped.

The Etunie near its mouth is not more than 25 yards in width, and like the Berbice contains very dark coloured water. It is exceedingly tortuous, and its banks are lined with low swamp bush, with the exception of that portion where it runs close to the open savanna, and expands in large rush-covered ponds in which the Itah palm grows. After passing the Alteka the Etunie is reduced to half its original width, and flows swiftly amongst swampy land, where the trees grow out of small clay hummocks. The influence of the tide is not felt above this at this season, and the water rushes down with considerable force. At 10 a.m. we reached the Arowma river mouth, and there stopped to make preparations for our land journey, upon which we started at 1.30 p.m.

We took a path leading in a westerly direction, rising gradually from the river till it became about 100 feet above its level, then over a level sandy tract of country studded with "Murie bush" and blackened stumps of trees and logs, the latter showing that at one time it was covered with forest, which has been destroyed by fire. We came to an Indian house at 3 p.m., situated on the edge of the forest. We passed over a less sandy soil through this forest, and across several small streams (one of which was the Etuni head), coming at 5.20 p.m. to a second Indian village, at which we remained for the night.

At 7 a.m. next morning we continued our journey over a path leading in a westerly direction, across numerous small streams, each of which ran in small deep valleys they had cut out for themselves. Emerging from the forest to open sandy country we crossed it in two hours, and once more our way lay through bush, and over a number of streams, all of which ran towards the Demerara river. We crossed a large creek in the afternoon called

Harewah three times, and at the third crossing struck an old timber path, which we followed for some distance to a cross path. Taking the cross path we came upon another timber path, then through an Indian provision field, and descending gradually came at 4.45 p.m. out on the Demerara river, at a small settlement close to the mouth of the Quitaro river, and above the Demerara rapids. We had frequent showers of rain on the way through.

We put up at the settlement for the night, and next day started in the rain for our boats in the Etunie, which we reached at 10.45 a.m. on the 26th. That afternoon we ran down the Etunie to the Arowaak village on the savanna, where we stopped for the night, and by 8.30 next morning were again on the Berbice river.

The banks of the river onwards are of their usual low nature, but the forest trees are more thickly interspersed with Moras. In a few places the river runs close to points of the edge of the elevated country, and in one place discloses a white cliff of 50 feet in height. I found the courses of the bends of the river very defective on the map. After leaving the Etuni we did not see a single Creole habitation or settlement on the river's banks, and only a few Indian inhabitants are to be met with higher up. At 5 p.m. we reached the mouth of the Eberoabo river and spent the following day (Sunday) there.

On Monday the 29th we came to Camacaboora village, situated on high ground, with a white sandy sterile soil, and the surrounding foliage is stunted and sparse. The river up to Manacca presented the same appearance as lower down, being of a width of from 90 to 100 yards, but beyond that it contained small islands and bays at its bends, at which it widened out to 150 and 200 yards. We passed a cliff on the west bank some four or five miles beyond Manacca where the banks approached within 40 yards of each other, narrowing the river exceedingly, but soon receding again to their usual distance.

Two miles below the Yuwacurie river, on the west bank, there is a high sloping cliff of white and reddish false-bedded sands, like that of Kaiyiwa on the Corentyne, which I ascended and found to be 90 feet in height. It is wooded along its edge for about 50 yards, and behind this comes a level table land of fine open grass country. Some few miles back the ground rises gently, culminating in a tree-clothed ridge, which hid my further view of the country. From the edge of the cliff a considerable tract of forest-covered country can be seen to the north-east, east, and south-east, which is low and level for a considerable distance, and then rises in ridges of about the same level as the cliff upon which we stood. Owing to the height of the river the tide did not flow past Camacaboora, though it had the effect of raising the water some 2 or 3 feet vertically.

Next day we passed Mappa lake in the forenoon, and came late in the day to a small Indian village on the west bank, the last human habitation on the river. I landed and made inquiries from a man there regarding the position of the path to the Demerara river, and learnt that there were two higher up, one coming out at

a village on that river, and the other at a creek head where there were no people nor means of descent. Obtaining a promise from him to come and guide us over on our return down river, we went on and camped. The river was very tortuous and bordered in many places by inlets.

The general course of the river passed over on the 31st was in a more southerly direction than hitherto, it having been almost south-west previously. Its banks were also higher, its width much reduced, and bordered by a vigorous growth of tall mora trees. Upon this day we met with the first rocks, which appeared at the landing of a path leading to the Demerara river; and camped at a spot just above the head of the tide when the river is low.

On the 1st of February we passed a small stream with a cascade at its mouth, called Idure-wadde, and in the forenoon came to the foot of Marlissa rapids, the first on the river. This rapid is very narrow and shallow, and it is difficult to see how the whole body of water passes down it, unless a good portion runs between the interstices of the rocks below. The granite rocks forming the rapids are externally of a black colour, from the oxide of iron coating upon them. The current above the rapids ran swiftly for a considerable distance. In the afternoon we reached a part of the river where it had a basin-like appearance above which both sides closed in with rocky points, leaving a passage for the river between of only 20 yards in width. Above this construction the river widened out again into a large basin, and bent round to the east. At the far end of this reach the river poured down a long narrow cataract into the basin forming a pretty sight. This cataract is called Itabru, and is some 50 yards long, 20 yards wide, and from 10 to 15 feet high. At the foot almost in the middle of the rush of water, is a large rock rising high above water. A conical hill 100 feet in height stands close to the west bank facing the fall. The northern side of the basin is a mass of rock, broken pieces of which line both sides of the fall, and form the two necks on either hand. On the south side of the fall there is a bay with a gently sloping sand beach, from which a narrow track devoid of rocks was found leading over the neck of land and down to a little sandy bay above, evidently the old portage. We arrived at the foot of the cataract at 4 p.m and had the portage path cut through by 5 p.m camping then on the sand beach.

Next day we carried the stores to the head of the fall, and took the boats on skids on the rocks up the north side. By 2 p.m we had the boats reloaded and continued our journey, coming almost immediately upon a small cataract; and after that passed up two rapids and a cataract, camping at 4.30 p.m at the foot of a third. From the top of Itabru cataract a high massive mountain to the west can be seen, which lies in a north and south direction and must be some 1,000 feet in height

On the following day we hauled up two cataracts, at one of which we had to make a portage; and in the afternoon passed up some rapids, where the river widened out and consequently became

so shallow that there was hardly enough depth of water for the boats.

At 9 a.m on the 6th we came to the foot of Christmas cataracts after passing numerous shallow rapids amidst rocks and islands, and succeeded in getting the boats up the first with much labour, having to portage the stores. This cataract is 8 feet in height and is immediately succeeded by another having a total height of 15 feet down which the water falls steeply in the centre, having cut back a deep recess, but with a long incline of 100 yards on each side. On the right hand the land rises abruptly forming a low ridge of about 100 feet. The river runs almost west from the falls foot, but above it has a sharp bend coming round from the south, across which are two more large falls.

From Itabu cataract almost the whole way to Christmas cataracts, the river runs at no great distance to the eastward of a high range of mountains, portions of which have mural precipices.

Here I determined to take on only one boat with a strong crew so as to economise time and ensure a successful journey to the point I was striving to gain, namely, the old camp at which Mr. Pollard and myself spent the night of April 14th last year, when we crossed over from the Essequebo.

Leaving one boat in charge of three men, and taking the other with a crew of 12 men and supplies for one month's consumption, over a portage which we made, we went on. It took us just two days to clear the whole set of cataracts, and gain still water above. The river, now reduced to little more than 50 yards in width, bent round to the west at the back of the hill spoken of, and then turned south for a considerable distance, where portions of its course were obstructed by small rapids, small islands, and rocks. At two cataracts we passed the river narrowed to a width of only 15 yards but widened out above them.

On the afternoon of the 9th the portion of river passed up became very narrow, and we met the first "tacooba" lying across it, which had to be cut through before a passage was effeeted. This was followed by three more, and the river divided into two channels, the main one being greatly reduced in size and very shallow. The mora trees became fewer in number, and the prickly soweri palm trees grew along the water's edge. Very few rocks were to be seen; and in the small ponds or basins at the bends the Victoria regia grew luxuriantly.

Next day the part of the river traversed was very narrow, and ran swiftly past ponds and itaboos. Its banks also were low being only a foot or two above the river, and were composed of a gray soft clay extending inland, forming swamps clothed with soweri palms and low twining bush. The total width was here not more than 10 yards. Floating patches of grass spread out on the surface of the water, where it lay comparatively still, and long trailing vines and creepers hung down from the trees, whose branches stretched across, forming beautiful wall like patches of foliage. Clusters of fallen trees or single logs lay across here and there, most of which had to be cut through to get the boat past. Many of these tacoobas of considerable size lay half submerged, and being

extremely hard caused serious delay in cutting them through with the axe, each requiring to be completely severed to allow one portion to sink down, and make a passage for the boat.

On the 11th we passed a large branch stream of black water coming in on the south-west, and above the junction the water of main river became much lighter in colour. On the following day after passing along a similar narrow portion of the river, we came to a place where it suddenly expanded to a width of 50 yards and ran with a very slight current. Here the banks on either side became high, and the channel was not obstructed by fallen trees. Traversing this open river we came at 4 p.m. to the end of the track we had cut when we crossed over from the Corentyne in December last, and camped not far beyond, so as to obtain the latitude of the spot by meridian altitudes of stars. This I found to be 4° 15′ 16″ north. The level of the water in the river was some 4 feet lower than on the occasion of our first visit.

The river for a distance of 3 miles beyond this lay still and smooth, with large patches of granite rock studding its bed, leaving narrow channels between them, with only sufficient water to enable us to pass. It then became winding, narrow, and shallow again, flowing swiftly in one or more channels, and having a depth of only 2 feet 6 inches and a width of 30 feet. The branches of trees met across over head and were so thickly clothed with drooping vines that they had to be cut off with cutlasses to allow the boat to pass. Eight of the men waded ahead of the boat with cutlasses and axes, cutting off tree limbs and fallen trees, whilst the other four brought up the boat. No prickly soweri palms (Astrocaryum jauari) grew in this swampy portion as they did lower down.

Owing to the number of "tacoobas" to be cut and branches to be cleared away, we did not go more than 1 mile by 10 a.m. next day, and during the afternoon for similar reasons our progress w extremely slow. Late in the afternoon the banks of the river became higher and the river widened and deepened a little.

On the 15th we traversed a portion with very little current, where it was some 40 yards wide and with few obstructions so that we made better progress than on the preceding day. We passed numbers of ponds or inlets on both sides marking the remains of old courses of the river, and the banks were high and lined with a tall growth of Mora trees. Later in the afternoon we again entered upon a narrow swift running portion.

Where the river is shallow and runs swiftly it is also very narrow, and this diminished width is owing to its passing through a low tract of country, which, when the river is flooded in the rainy season, allows the water to spread out over the neighbouring land, and so lose its widening and deepening power.

On the 16th, in the afternoon, we came to one spot where a bar of rock crossed the river, leaving a channel only 15 yards in width, and with not sufficient depth of water to float the boat when all hands were out.

On the 17th the river improved a little in width but "tacoobas" were so numerous that we only went a distance of 4 miles. Late

in the afternoon we reached a spot where the water ran in two channels in the hollows of large rocks, one being 3 feet wide and 2 feet deep, and the other 5 feet wide and 6 inches deep, the water in these two gutters flowing at the rate of 4 miles an hour, and representing the full amount of water contained in this part of the river. There we built a sort of dam of rocks and earth across the small channel, and unloading the boat hauled it up the larger one. In other rocky places the quantity of water in the river was represented by a width of 15 feet with a depth of 1 foot. At 5 p.m. we came to a place where the river ran between rocks, and was 11 feet 6 inches in width and 4 feet deep. It being late we camped for the night and obtained the latitude of the place (4° 4′ 41″ north), showing that we had made a southing of only 14 miles in five days. The river being exceedingly low, (and owing to the lateness of the season there was no chance of its rising,) I was induced to abandon my boat and try and perform the remainder of the journey on foot.

The following day was spent in making preparations for the journey, and on the morning of Monday 19th we started, 11 in number, leaving two men to take care of the boat in our absence. We had as usual to cut a track through vines and undergrowth with cutlasses, and kept as near the river as possible, striking across the bends when feasible. Soon after starting we crossed some low ridges, and then passed along a level tract of country to a ridge 100 feet above it. Crossing this we struck the river where it was narrow and very shallow, and camped.

The following day at noon we passed close along a portion of the river where it was lying in a large pool, its water apparently not running. The width of this lake-like expansion was from 50 to 60 yards for a distance of about one mile, when its banks became low and it narrowed once more. Along the western shore there was level tract some 30 feet above the river.

On the 21st we passed through a low country with no rocks to be seen, and on the 22nd at noon came to our old path leading from the Essequebo river, and soon gained our camp of April 14th 1871, on the edge of the Berbice. I found the river very much lower than on the occasion of my former visit, and lying in a pond-like expansion from 30 to 40 yards in width.

Leaving camp at an early hour next morning I commenced my return journey with feelings of great satisfaction, having accomplished the object with which I set out, and by walking with all possible speed reached the boat on the forenoon of the 24th. We commenced our descent of the river at 1.30 p.m., and after contending with many difficulties in shallows and tacoobas left dry by the subsiding of the river reached Christmas cataract on the evening of March 1st.

In the narrow portion of the river it was so shallow that all the men had to get out and drag the boat along by main force through the sand bars, and in some places dig channels with their paddles. The water in the wide portions showed no indications of running, and its surface was covered with a thin silvery scum in some

places, and a slightly rusty one in others, from the salts of iron in solution being oxidised by the action of the atmosphere and decomposed vegetable matter. A small green aquatic plant also formed a dusty green covering in many parts.

Next day we got the boat down Christmas cataracts, rejoining the other boat, and continued our descent of the river. Arriving on the 4th of March at a point opposite the high mountains where there was a steep rocky precipice we landed and struck off through the forest to them. After passing over a level wooded country for about one-eighth of a mile we came to the foot of the mountain, and ascended two small terraces with short levels on top of each. Then the ascent became steep up to the top to a level of 720 feet above the sea. On arriving there we made a slight detour to the left, coming to the top of the precipice, a short distance down the side of the mountain, from which a most extensive view presented itself, embracing a vast undulating tract of forest-covered country, from south-south-east through east to north-north-east. Away to the east-south-east a high dome-shaped mountain could just be discerned in the haze on the horizon, which I think must be situated on the Cabalebo river, in Surinam. The hills on the Corentyne at the great easterly bend, and some low ridges to the north-north-east, were the only hills of any consequence in that portion of the view to relieve the dead level of the country. Stretching out from the south of the hill we were on was a low range which dwindled away as it reached a point south-east of us at no great distance off, being evidently the one marked on the map as crossing from Maccari mountain to Christmas cataracts.

After spending a short time on the edge of the precipice we followed the ridge northward, and came to a deep gully lying east and west. We descended in the gully close to the precipice, to its foot, passing some enormous blocks of sandstone on the way, and gained our boats again.

Near Itabru cataract I descended the mountain on the west, which is a northern continuation of the above and of equal height. Its top is so thickly studded with trees that only glimpses of the surrounding country can be obtained. We passed Itabru cataract on the morning of the 6th, and Marlissa rapid the same afternoon, arriving next day at the landing of the path to the Demerara river. I remained there and sent on one boat to the village, not far below, to bring up the Indian guide, who had promised to show me the way to the Demerara, on my way up.

The men returned next day and reported that they found no people at the village, that it appeared to be permanently abandoned, and that there was a new made grave in the middle of one house. I therefore made up my mind to cross over by this path to the Demerara without a guide, taking my chance of its coming out at a village. During the remainder of the afternoon I had the necessary stores packed up in waiaries, and made arrangements with the men about their going down to Berbice and on to Georgetown with the boats as soon as they returned from accompanying me to the Demerara.

At 7.40 a.m. on the 9th I started with 11 men along the path, in a westerly direction over a slightly rising tract of country, and through some old clearings where we had great difficulty in finding our way. From that the country was level, and clothed with a low forest growth principally of "murie bush." The soil at the old clearings was a white sand, and on the level high portions of the path it was a yellowish sandy loam. We crossed a few creeks running in deep hollows or little valleys. At 2 p.m. we emerged from the forest on an open sandy tract clothed with coarse grass and small shrubs, amongst which were the blackened stems of large dead trees. This is evidently a "burnt ground" like that met with between the Etunie creek and Demerara river, extending north and south as far as I could see, but being not more than five miles in width. From it, looking south and south-west, were two ranges of tree-clothed hills some distance off, and a small ridge three or four miles to the north.

On the opposite side of the "burnt ground" we came to an old Indian field, partially grown over with low trees, where the path became so obscure that it was with the greatest difficulty we traced our way through it and got upon the well-marked path beyond. Were it not that some Indians had recently gone through and marked the track by breaking twigs and small trees here and there we never could have found our way so faint was the trail. Late in the afternoon we came upon a long and narrow natural savanna, with a light-brownish sandy soil clothed with fine grass and sprinkled over with numerous Cucurit and Ackaiuron palms. From this, looking south-west, there was a high wooded range some three miles off. At the far end of the savanna we entered this forest again, and descending slightly to swampy ground with a small creek running south, camped for the night.

The next day (Sunday, 10th) we left camp at 7 a.m. and going in a north-west-north direction came at 9.30 to a large stream of dark water running north. During the early part of the afternoon we crossed another large creek twice, and numerous small ones, and at 2 p.m. passed through an old Indian clearing. Descending slightly from this we came, at 2.45 p.m., to a large dark-water creek, some 10 yards wide and 3 feet deep, at which the path terminated. There, after a protracted search, we found some old woodskins hid in the swamp bordering the creek, one of which was good, a second was split nearly in two but could be repaired, whilst all the rest were mere remnants. The first woodskin was soon repaired, but the split one took us till dusk that night and an hour or so next morning before it was rendered serviceable.

Next day I had the stores, instruments, &c., placed in the two woodskins, which just held them and one man each to propel them, and sent nine of the men on their way back to the bateaux on the Berbice, keeping four with me. At 9 a.m. we started on our journey, two of the men and myself walking along the edge of the creek in a muddy swamp, the other two bringing down the woodskins. Rain fell heavily after we started and added to our discomfort. Our journey then wore a very dismal aspect on

account of all retreat to our boats in case of accident being cut off; besides this we did not know at what place we would meet the Demerara river, or whether there were any villages on that part.

Every now and then we shouted to the men in the woodskins so as to find each other's whereabouts, not being able to see through the thick jungle. After proceeding in this manner for some time the men on the creek discovered a woodskin, and hailing us we got together and repaired it in about two hours. We arranged the loads in this and the good woodskin, with myself and one man in the first and one man in the latter; the two other men going in the decayed woodskin, which leaked badly. In many places we passed under fallen trees, having to lie on our backs in the canoes to get under them; in others we had to evade or pass over some with barely sufficient water to enable our small crafts to pass, but fortunately most of the tacoobas had been cut by Indians or we never could have got along.

The stream was very winding, running through a swampy tract, where it spread out in many places in two channels or itaboos, the surrounding land being submerged, and the trees, chiefly cork wood, growing on small islands a few feet above water. If we had not found the third woodskin our situation would have been most perilous, for we would then have had to wade from tree-root to tree-root for miles. A short time before we stopped for the night we found an old water-logged corial, which was soon baled out, its leaks stopped, and the two men in the split woodskin transferred to it. For this piece of luck we felt very thankful, it being a most unusual thing to find abandoned corials or woodskins in even the most thickly inhabited portions of the colony. A little after 5 p.m. we camped on the edge of the creek on a spot where the high roots of a clump of corkwood trees had gathered a little loam and leaves, forming a sort of spongy island. We tied our hammocks to the trees, not being able to find any palm leaves to build a shelter.

Early next morning (at 4 a.m.) heavy rain fell, giving us all a good wetting. A short time after leaving camp we came out of the creek upon the Demerara river, where it was about 20 yards wide and flowing swiftly in a north-west direction. Running down stream we came to a village landing, and walked up to a small Indian settlement, situated on a slight rising ground, called Paintecobra. There we remained to rest and dry our sodden clothes and stores. That night I obtained altitudes of stars for latitude, giving me for the position of the village 5° 6′ 53″ north. These were obtained with difficulty owing to the thin vapour floating over the river, and the heavy dew which condensed on the horizon glass and sextant.

The following day was spent in exploring Wahmarra mountains and the district. This mountain lies on the northern side of the river, and its top, which is level, is 762 feet above the sea, running northwards as a sort of table land for many miles. Part of the ascent was along a hunting path, but the greater portion was up

the sides of a small stream which was precipitated down the rocky face of the mountain in a series of high cascades.

Early next day we left the village in our two old woodskins and corial, not being able to purchase any craft there, and commenced our descent of the Demerara river. It runs in a westerly direction at first for three miles through a low swampy tract, its banks here and there being raised two or three feet above the water and then turns west-north-west for a considerable distance. Its bends are short and very tortuous, with itaboos and inlets here and there along which the water ran swiftly, having been increased by recent rains.

In the afternoon the portion traversed had high banks which were clothed with Mora trees, whilst on the low swampy portions higher up the forest growth is chiefly corkwood. We passed two or three gravel beaches at the mouths of small streams where the river runs a northerly course, and in one place passed over a rapid where a bar of iron-cemented rock stretches across under water. From many bends glimpses of hills of from 300 to 500 feet in height, were obtained on both sides of the river. That evening we reached an Indian village called Anaimapeur, at which we remained for the night.

As we wished to purchase strong woodskins to carry over the great cataract of Ororu-malalli we stopped at a village called Booboo, where we bought two new ones; and at Pongabi, a partially deserted place lower down, we procured a third.

The river increased in size and had high clay banks during the forenoon, but about four miles below Pongabi it passed through a swampy tract, and ran swiftly, having numerous itaboos. At the end of the swampy portion there is a range of hills, some 500 feet in height, lying east and west, where the river is deflected to the eastward for over a mile, resuming its full width and height of banks with Mora foliage. After passing a large inlet on the east, of half a mile in diameter, we came to the village of Orura-cobra not far above the great cataract, whose roar we could distinctly hear, and put up for the night. This place I found to be in 5° 18′ 2″ north latitude.

We left the village next morning, and paddling down three bends of the river came to the head of the great cataract, over the portage of which we carried our woodskins, &c. Low hills approach the river on both sides, and in the gorge between them masses of greenstone rock forming barriers across the river produce this fine cataract. The river passes from the plain above in one channel at first down numerous steps of rock with great velocity, and then spreading out amongst the rocks around a group of small islands near its foot, empties itself by three mouths into a large pool below. The difference of level between the top and foot is 63 feet in a distance of about 500 yards. In the pool there is a large island with a sand beach, and a few rocks rise above the surface of the water. From this on to Enowdah village the river widens considerably, and its banks are high.

From Enowdah, on the 18th, I made an excursion to Mabouroo

mountain and rock, taking a guide from the village. The path led in a south-west direction along the level country bordering the valley of the Mabouroo river, at a height of about 80 feet above it, crossing the deep valleys of numerous small tributaries of that river. At noon we crossed the Mabouroo river and ascended a low ridge, some 200 feet in height, which we followed for a considerable distance, then turning north-west we ascended the mountain quickly to its summit, which we reached 1.10 p.m.

From the top of the precipice, at a height of 844 feet above the sea, we had a fine panoramic view ranging from north-north-west through east to south-south-east. The range of hills at the great cataract bore south-east and ran north-east and south-west stretching away to the eastward, for a long distance south of which the country appeared to be perfectly level. The hilly tract to the eastward seemed to continue northward for a long distance; but as the day was squally and dense masses of mist were constantly passing over it, the outlines of the country northward were rendered obscure. It was difficult to trace the valley of the Demerara river, and only one patch of its water could be seen far away to the north. After spending an hour on the rock we descended rapidly and arrived at Enowdah village at 5.45 p.m., having walked back in the rain.

Next day we were detained by heavy rain till noon and then continued our journey. Some distance down the river near the place where we stopped for the night, from a sand cliff 60 feet high, I obtained a good view of Mabouroo rock bearing south 40° west. A similar mountain of the same range lying north-west and south-east, called Sarabaru, bore south 72° west.

At this place I met Mr. Couchman, who kindly promised to lend me his bateau to go to town in if I waited till he returned down river in a day or two. As I was informed that we could not go beyond Dalgin in woodskins, owing to the roughness of the river, I very gladly accepted his offer.

Continuing our journey on the 20th we passed through a narrow portion of the river having numerous itaboos and low adjoining land. At Cumparu the river is deflected from its southerly course to the south-south-east for a distance of some 10 miles, and at a short distance from that place the greenstone rocks form three small rapids having gravel shallows below each. We ran these rapids in our woodskins with perfect safety having to keep just along the edge of the broken water. On reaching the village of Waburie-cobra in the afternoon rain began to fall, and we had to put up there for the night.

Next day we reached Mr. Couchman's wood-cutting grant at Camudi-cobra, and on his return down river we went, on the following morning, to his residence lower down. Hiring two men to bring back the small bateau he lent me, we continued our journey on the 23rd, passing the Quitaro river, and running down the rapids to their foot arrived late in the afternoon at Mr. Forsyth's, where we hung our hammocks for the night.

These rapids impede the navigation of the river for punts in

the dry season, and are at the head of its tidal portion. Though the tide does not actually flow up to the rapids' foot still its influence is felt, the water there being dammed back, and rising and falling about 12 inches.

On Sunday the 24th we got to Seba at 9.30 a.m., and to Ackraima in the evening, where obtaining leave from the owner, we hung our hammocks in the waterside "logie" for the night. From the extensive hill clearing at Seba there is a fine view of the country to the west disclosing a high range of hills to the south-south-west, belonging probably to the range of the Arridaro mountain on the west, and the Tiger hills on the east.

On the way down from Seba numerous small habitations are seen dotted here and there along the river's edge, giving an air of life and civilization to the otherwise gloomy river. The river at Seba is not more than 60 yards in width, but from that on it begins to widen gradually, and at Ackaima must be at least 100 yards. At the latter place the tide rose and fell about 2 feet 6 inches, but did not flow with a swift current.

In coming along next day I landed at Siberi hill and found its height to be only 153 feet, while on the map under the name of Rashwaima hill it is marked as 250 feet. We reached Christianburgh at noon, and went on to Dalgin. The level of the land above high-water mark at the latter place is about 4 feet, extending back from the river for 300 roods to the foot of the high sandy deposit. At New-Saw mills the river passes close to a cliff of the white sand deposit.

Opposite the Loo the water oontains sediments in suspension, and in the long reach at Kuliserabo creek the high water almost floods the land, this being the head of the estuary of the river, from which onwards it begins to widen rapidly. In the reach above this, and from that downwards, when the tide recedes it leaves narrow mud flats along the river's edge. The high sandy deposit approaches the river above Berlin, and continues as far down as Woodlands, where it recedes, coming out again at the Sandhills.

Leaving Dalgin we came down rapidly with the tide to the Sandhills, where I spent a short time, and then crossing over to Phillips's obtained shelter for the night. Next day the 27th we concluded our journey by arriving safely in Georgetown after an absence of seven months.

PART II.

Descriptive Geology.

1. *Alluvium and River Loam.*

The clayey alluvium of the coast extends along the Berbice river up to Baracarabana river, and is very slightly raised above the level of high-water mark. Beyond that place and at Bartika

the banks of the river are composed of a yellowish and grayish arenaceous clay, raised some 12 feet above it, belonging to the river loam deposit. It is easy to distinguish between the coast alluvium and the river loam, the former being composed of various thin layers of sand and gray and bluish clay, while the latter is in one layer of homogeneous structure. There being no actual contact seen it is very evident that they pass one into the other. The river loam as on other rivers in the colony forms the banks of the Berbice to its source, and is seen where the river is wide and flows slowly. Where it runs swiftly through itabo portions, on the other hand, it passes through low swampy lands of gray and dark coloured recent alluvia clays.

Some six miles beyond Mappa lake on the west bank there is a thick bed of impure iron oxide, similar to that seen in so many places in this colony. It very nearly resembles the iron rocks of Karanambo on the Rupununi river, but contains no sand grains or pebbles, being as it were a mass of clay riddled with holes and cavities in every direction, which are lined with hydrated oxide of iron, giving it in hard specimens somewhat the appearance of a coarse cinder or clinker. It is easy to see that water highly charged with iron salts, percolating through the clay has deposited the oxide upon the walls of the cavities, but what has produced the cavities is less easy of comprehension.

2. *Sandbeds and Clay Deposits.*

At Hitia hill this deposit is first seen upon the west side of the river, forming land raised to a height of 50 feet. The northern face of this elevated tract runs in a north-west direction across to the Madewini river on the Demerara. The Berbice river runs in a wide but shallow valley through these sandbeds, from this to the fifth parallel of north latitude, which narrows gradually up to that point. These sandbeds are the western extension of the great Oreala deposit, which vary very slightly in their lithological characters in different parts.

About half a mile below the Wickie river on the west bank, where the lower part of this deposit is seen at the level of low-water mark, I found it composed of pure white clay without any admixture of silicious grains. Its upper portion is much discoloured by red oxide of iron, and passes upwards into a gray or white clay containing grains of sand. From this it passes into white sandbeds, and in places to a reddish loam. Owing to the foliage on the hill side hiding the structure of the sandbeds, I could not ascertain whether they were false-bedded or otherwise. Upon the savanna above the soil alternates in patches, sometimes of white sand, but more frequently of hard reddish loam with a fine brownish sand on top. At the edge of the savanna on the Etunie river the white arenaceous clay is again seen.

One would be led to believe by the map that the "Sand hills," as they are called, were long narrow ridges lying in an easterly direction across the low alluvial tract of country spreading from the coast inland, but this is not the case. They are in reality the

points of a slightly elevated tract of country seen only at intervals from the river when in its winding course it approaches their base. Near Alteka creek on the Etunie river there are some large blocks of rock, and on the opposite side of the river a low cliff of red earth. These rocks are isolated blocks of large size, composed of grains of sand cemented firmly in layers by a blackish material composed of oxide of iron and decomposed vegetable matter, and resemble the black rocks of a similar nature in Siparuta cliff on the Corentyne river. They differ somewhat in having a reddish tinge and bright red patches of a fine grained mineral substance scattered through them. These at one time formed part of the sandbeds.

From the Etunie river to the Demerara this deposit forms an undulating country of from 90 to 180 feet above the sea, covered chiefly with a poor white sandy soil, but near the Demerara river with a darker soil in the valleys along the watercourses. Not far from the Demerara river the land rises and the subsoil is of a whitish clay, with numerous blocks of iron-cemented sands on top, and lumps of a reddish white friable pisolitic rock.

The high cliff below the Eberoabo river on the east bank is composed of white clay and sand, the clay at the base being almost pure white; the band about half way up the cliff contains a large per-centage of sand. The next section shows a thickness of about 50 feet, of which the first foot above water is white clay, then comes white sand with a thick layer of red sand, and with small quartz pebbles on top forming a thickness of 15 feet. Upon this rests 11 feet of white arenaceous clay interstratified with layers of pure clay; the remainder of the cliff above is a pure white sand containing small nodules of white clay.

Beyond the Manacca river, and between it and the Yuwacuri, are two more cliff sections. The first consists of a white clay base with a curved surface, upon which rests reddish and white sandbeds. The second is composed entirely of false-bedded sands, chiefly of a pure white colour from top to bottom. About one quarter of the way up there is a band of a partially consolidated sandbed, of a brownish colour, held together by a large proportion of brownish clayey matter, and containing pebbles of white quartz. This section is 90 feet in height. The last section of sandbeds appears in low cliffs above the second development of greenstone rock.

On the Demerara river not far below Enowdah village, there is a section of the sand and clay beds in the river's bank, showing 10 feet of false-bedded sands in thin layers resting on white clay. The upper part of the clay is of a light drab colour, passing into mottled purple and white or pink and white. Not far from Sarubaru river on the east bank there is a cliff 140 feet in height of white sandbeds resting on clay, which only appears at the water's edge. In some layers the clay contains coarse white sand and quartz pebbles, and has in one or two places beds of partially consolidated sand, highly charged with brown vegetable matter.

At Curicuyah pond the thin-bedded drab-coloured clay is seen, the beds having slight dips east and west, which may have been produced by a sort of slip. In these beds there is a carbonized tree stem of 6 inches in diameter, lying in a horizontal position.

Frazer's cliff, Kashwima, Kuliseerabo, and many other hills, are formed of these sandbeds. The last spot where this deposit occurs in descending the river is below Sans-Souci, at a place known as the Sand hills. These hills, some 60 feet in height, are composed in their lower portion of clay, and in their upper of white sand. Besides these there are minor divisions of both, varying in composition laterally like these at Orealla. The clayey portion at the south end of the section passes upwards into a bluish drab-coloured fine-bedded clay and from that into a coarse, black, sandy bed, impregnated with bituminous matter, like that of Siparuta. This layer at the north end of the section, where it is 2 feet thick, is very hard and composed of finer sand materials. The drab-coloured clay beneath it is of a similar thickness, and in layers of about 2 inches each. This passes downwards into a white clay having a small amount of silicious particles, and into drab-coloured clay again. The white sand portion which occupies half the height of the cliff is very fine grained, but contains a few angular pieces of quartz, and is extremely false bedded. Resting upon its top is a dark sandy loam of 2 feet in thickness in one part, thinning out to the northward, which contains pieces of bones of small animals in so friable a condition that they cannot be separated from the sand without crumbling to pieces. This evidently shows that the spot was the site of an ancient Indian village. The top of the clay portion at the northern end is at a lower level than the other, so that there the sand portion occupies two-thirds of the height of the cliff. At the base of the sand beds are two small springs of water, produced by the drainage of the sandbeds accumulating on the top of the impervious clay, and forcing its way out at the face of the cliff.

3. *Ironstone Beds.*

From the level land bordering the Demerara river near the fifth parallel of north latitude, rises the mountain of Wahmara 750 feet in height, composed entirely of beds of impure brown ironstone (hydrated sesquioxide of iron), similar to that so frequently noticed and mentioned in reports on other portions of the colony. The sloping ravine, down which runs a small stream, gives an almost continuous section, but at the same time the water running down obscures portions of its bedding.

At a cave under a cascade the bedding is clearly shown by a layer 10 feet thick, resting horizontally, or nearly so, upon a similar bed of unknown thickness. At the base of the mountain these beds are undoubtedly of sedimentary origin, containing angular grains of quartz. About half way up the mountain the beds for some thickness are pisolitic, whilst some are made up of aggluti-

nated masses of waterworn blocks and pebbles, of the same ironstone cemented in a less hard though similar material. Some beds are very compact in parts, and are of brownish and brownish-red colours. This rock occurs generally near or upon greenstone hills and mountains, as at Cumuti, Arriosano, and elsewhere.

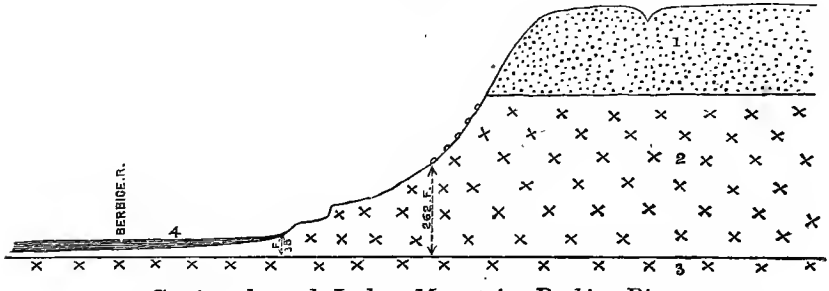
Further down the Demerara the ironstone beds are seen on the river's edge in many places, and in one of these contain partially water-worn pebbles of quartz, forming a sort of conglomerate.

On the way to Mabouroo mountain these rocks are met with forming portions of the high ground in that region, and on the top of the mountain they are met with enclosing grains of quartz. This latter feature proves that they are of sedimentary origin and could not, in this instance at least, have been formed of decomposed greenstone.

4. *Sandstone.*

On the western side of the Berbice river above Itabru cataract there is a mountain range not far from the river, the upper portion of which is composed of horizontal sandstone beds, resting on quartz-porphyry. They bear a close resemblance to those at Maccari mountain, and are evidently the eastern extension of the same beds. Ascending the mountain side beyond the terraces to a height of 262 feet, I came to the first blocks of sandstone conglomerate, at first in small numbers, but higher up becoming exceedingly numerous, and lying in confused heaps. At a height of 481 feet the true base of the sandstone formation is reached, and this rock continues to the top.

No. 38.

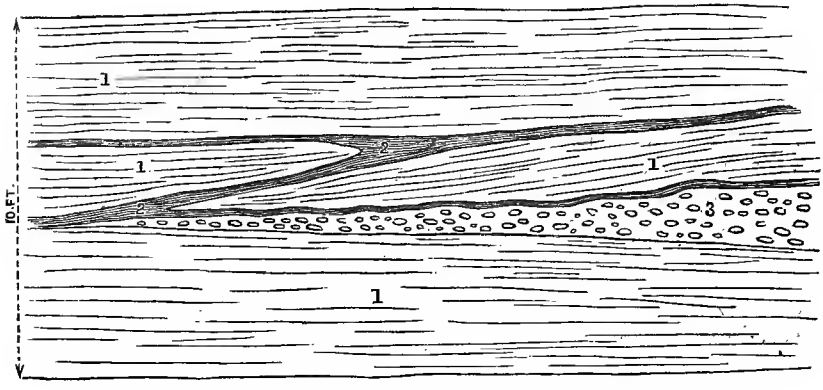


Section through Itabru Mountain, Berbice River.

1. Sandstone. 2. Grey felsitic rock. 3. Felstone. 4. Alluvium.

On the surface of the sandstone on the top of the mountain there is some red and brown iron oxide, and amongst it I observed a decomposed iron-stained rock, exceedingly like a decomposed greenstone. On the eastern face of the mountain a great section of sandstone is exposed, of thick beds of sandstone and pebble conglomerate, having a very slight dip to the west with a north and south strike. Between some of these beds were thin wavy layers of fine red shale, containing plates of silvery-white mica.

No. 39.



Section of Sandstone at Itabru Mountain, Berbice River.

1. Sandstone. 2. Red shale. 3. Conglomerate.

On the face of the mountain in a gully there are a few flat slabs of coarse greenstone, which must either have been washed down from the top, or are part of a small layer at the base of the sandstone.

Some 8 miles below Marlissa rapid there is a small patch of coarse white sandstone on the eastern side of the river in a northerly bend, which is jointed and friable, and its dip and strike cannot be made out. Its surface rises, when the river is very low, only a few inches above water, and on either side is covered with a heavy grey loam. It is precisely similar to the sandstone crossing the river just below Cumuti mountain on the Essequebo, and the same kind of rock as crosses the Corentyne at Cabalebo.

5. *Greenstone.*

The first rocks met with on ascending the Berbice river appear near the fifth parallel of north latitude, and are composed of greenstone of a coarse variety and dark grey colour, similar to that of Cumuti mountain, but not of so coarse a texture. They protude in small masses and water-worn blocks just above the level of the alluvium, and in the section of the river's bank.

The next occurrence of this rock a few miles on is of a different variety, containing a greenish-tinted felspar and some iron pyrites. Beyond this are some beds of sandstone. No more rocks appear until a place is reached where the river makes a bend to the west and north-west, at the spot marked on the map as the head of the tide, where greenstone is again seen. Then comes an interval of alluvium, and beyond a small development of curious rock, which appears to be partly of igneous and partly metamorphic origin. It is apparently bedded dipping south-south-west at an angle of 20°, and its eastern portion is evidently an ancient amygdaloid (in greenstone), of a pale purplish colour, containing cells lined with a white mineral incrustation. The middle portion showing a dip

is more elevated, and of a pale whitish and purplish tint, having an ashy appearance, but with a laminated arrangement of its constituents, which have rounded irregular shapes. In one part it contains a round water-worn flint pebble. This middle portion appears to be a metamorphosed conglomerate, and if so, it indicates the intrusive character of the greenstone.

Close to the edge of the alluvium of the river's west bank there is a third variety of this rock of exceeding beauty, of a deep purple colour, spotted with light-red patches of angular fragments and crystals of felspar. Portions of it are also amygdaloidal with filled cells, and have small veins of a soft white wavy mineral, together with small circular pieces of transparent silica. The length of the whole development seen is not more than 20 yards, and 5 yards in width, raised to a height of 4 feet above the level of the river.

A few hundred yards to the eastward are rude beds of a fine-grained purplish and light-red rock, also resembling an altered sandstone or red shale, retaining its jointed shale-like structure, and breaking easily along its planes of stratification. It contains a yellowish opaque silica blended with it in irregular little veins, and also some of the white wavy mineral before mentioned.

Close beyond this, greenstone of a greenish gray colour is seen, which forms the west bank of the river up to the edge of the quartz-porphyry and granite at Marlissa rapids. At Idure-wadde cascade in this portion the greenstone is composed of rude layers, forming high land on that side of the river, in the lower part of which there is a band of crystalline purplish igneous rock, similar to that described above, and differing only in being of a more crystalline texture.

The rocks forming the second step of Christmas cataracts are composed of greenstone, forming a dyke of some 200 yards in thickness, rising through quartz-porphyry, and probably spreading out on its surface. In it there is a small vein of grey granite having minute branches. The surface of the greenstone on the hill to the south is exceedingly decomposed into a soft rusty rock, preserving its crystalline texture; and some blocks 2 feet in diameter have been thus decomposed throughout.

In crossing over from the Berbice to the Demerara river, in the bed of a tributary of the latter river, I observed some coarse greenstone rocks.

Near the top of Wahmana mountain, on the Demerara river, I found one small water-worn block of coarse greenstone, and on the east bank of the river in the long westerly bend below it, there were some blocks of the same rock, which must underlie the iron rock of that mountain. Layers of a coarse variety of greenstone appear further down the river, where a high hill approaches the river on the west. This rock evidently spreads out over a considerable tract of country.

Below this greenstone there is a patch of fine-grained, green, hornblendic rock, weathering unequally in parallel and wavy lines on its surface, from the unequal hardness of its component parts.

This rock again appears at Anaimapeur village landing, and there contains a vein of whitish granite, one foot in width, lying north and south.

From the hills above Oraru village down to the foot of the great cataract, greenstone rocks are the only ones seen, and they constitute the clusters of mountain ranges in the vicinity. At the end of the portage at the foot of Ororu Mallali great cataract, a small patch of the rock underlying the greenstone is seen, having been bared by denudation. It is a sort of porphyritic syenite, being coarsely crystalline and composed of felspar crystals, placed close together with rounded edges, in a hornblendic base. The greenstone at the plane of contact is of a compact variety, becoming coarsely crystalline as it is traced upward from the syenite. Along the eastern side of the basin the syenite rests partly against and beneath the greenstone, and in one place is seen in a small round boss enveloped in the latter rock. In one part of the syenite rock there is a small vein of greenstone, showing evidently that the latter rock has been forced up through the syenite, and spread out upon its surface.

Between Enowdah village and Mabouroo mountain the same greenstone is seen, resting upon the syenite and syenitic-granite, at a height of 324 feet above the sea, and from that to the top of the mountain this rock forms great massive layers, having a total thickness of 520 feet.

Just below Cumparu on the north side of the river the greenstone comes to the river's edge, forming low hills, and continues for some distance crossing it in three places.

At Hamacuyah landing there is a mass of this rock, and from that on to Yaramacuyah it is seen in many places. It also forms the rapids below the Quitaro river mouth, and continues from that to the Tiger hills.

6. *Gneiss and Hornblende schist.*

On the Berbice not far from the highest point reached there is a small patch of gneiss on the granite of a reddish colour containing veins of reddish felspathic granite.

There is a very small development of hornblende-schist about half way down the Itaburro creek near the Demerara river.

7. *Quartz-porphyry and Felstone.*

Before reaching the granite near Marlissa rapid, on the east bank, there is some greenish quartz-porphyry, which appears to be continuous with the greenstone.

Beyond the granite again above Marlissa there are numerous rocks of felstone and quartz-porphyry, forming small islands and rapids. The first development of it is a liver coloured rock of fine grain, exceedingly jointed and hard, containing small thin veins of white quartz and little clear grains of quartz crystals, with greenish patches throughout the matrix. At another spot above this the true greenish quartz-porphyry appears containing rounded and perfect crystals of transparent quartz facets, of felspar, and a green

mineral in a felspathic base. These rocks weather of reddish and white colours, are much jointed, and probably bedded, or in layers.

Just before turning the bend to the eastward, which forms the basin at the foot of Itabru cataract, large rocks run out in two points on both sides of the river, continuous with the mass of rock along the north side of the basin, up to the fall itself. This rock belongs to the felstone and quartz-porphyry series, and is of a very curious variety, which I have not met with elsewhere. It appears to have a rude bedded structure dipping due south at a high angle, and is jointed and irregularly broken. It is of a pale greenish white colour and coarse globular structure, being apparently a compressed mass of felspathic nodules. On examination I found it to be composed of circular pieces of pale yellowish or greenish white quartz-porphyry, embedded in a matrix of pure white felspar, of not so firm a texture as the balls themselves. The balls contain a great quantity of transparent rounded quartz crystals, besides small crystals of white felspar, and form the greater portion of the rock; the cementing material being of about half a line in width, filling the spaces between the balls, some of which are over an inch in diameter. In some instances two balls have run together as it were, and become united. I have little doubt but this is a layer in the quartz-porphyry and not a dyke. The surface of this rock at the cataract has large circular pot holes worn in it by the stream, and these contain sand and quartz-pebbles of different varieties.

The rocks on the south side of the cataract are of a gray and reddish felsite composed of a felspar base with embedded crystals of white opaque felspar, jointed in every degree and breaking into squares and cuniform pieces. Quartz porphyry and felstone continue up to the edge of the granite and are of many varieties. Beyond Itabru some distance the weathering of the quartz-porphyry gives its surface a schistose or foliated appearance.

Between Itabru and Christmas cataracts to the west of the river, the surface of the quartz-porphyry exposed in the forest is decomposed for some depth, losing its colour and assuming a soft earthy texture. It is much jointed, having an earthy fracture, and passing upwards into a light greenish rock of a similar nature containing discoloured patches. In its upper part at a height of from 200 to 262 feet above the sea, at the base of the sandstone, it resembles an indurated grayish-white clay, enclosing pebbles of quartz, and its surface is covered with blocks of slaggy looking iron oxide.

At the cataracts further on it is of a beautiful purplish colour with foliated texture, containing quartz crystals of the usual double hexagonal pyramid, and crystals of white opaque felspar. At an island one mile on from this the quartz-porphyry is of a greenish colour, and exactly the same as that of Ouropocari on the Essequebo river, containing white crystals of felspar and glassy quartz. There is a dyke of greenstone near this.

Immediately below Christmas cataracts the rocks are of a light green compact felstone, entirely devoid of quartz crystals or grains. The compact reddish gray felstone forming the first step of the

Christmas cataract is massive, and minutely jointed in vertical planes. Westward of this beyond the greenstone dyke the rock of the third and fourth cataract is a quartz-porphyry of a reddish gray colour, containing well-formed crystals of white felspar, besides quartz, and is extremely fissile. Its main jointed planes agree with those of the greenstone dyke. Some miles on this rock passes into a porphyrite of a greenish colour, being composed of a green felsitic base containing crystals of white opaque felspar. It continues for some distance to a small rapid, where there is another dyke of greenstone beyond which it changes gradually into a coarse quartz-porphyry, containing green crystals of hornblende. This development of quartz-porphyry assumes many varieties of texture and colour, and in one place its felspar crystals are of a red colour. Some distance beyond this comes a third dyke of greenstone, in a coarse variety of quartz-porphyry containing iron pyrites.

8. *Granite and Syenite.*

About one mile below Marlissa rapids on the Berbice river granite is met with forming a high roll, lying north-east and south-west, and from that to one mile above the rapids it appears in many places. It is finely crystalline and composed of two kinds of felspar, transparent quartz and dark green mica; the whole rock having a reddish tinge.

Beyond the quartz-porphyry some 20 miles above Christmas cataracts granite again becomes a surface rock, and continues as far up the river as I went. Where it first occurs it is of a coarse variety containing two kinds of felspar of reddish and greenish white colours, dark green mica, and opalaceous quartz. Its quartz further on changes to a semi-transparent colourless variety. In many places it consists of a common gray variety, and in one place is porphyritic.

Near the junction of the large branch with this river, amongst many domes of this rock, is a long roll trending south-south-west and north-north-east. In two places there are large nests or veins of quartz in the granite.

Some distance beyond this the coarse granite contains a large proportion of felspar, the crystals of that mineral being set closely together, almost to the exclusion of the quartz. Not far from the highest point reached the granite assumes a slightly gneissose texture and contains veins of felspathic granite, which are also seen piercing the granite where I had the last opportunity of examining it. In one place there is a small patch of finely crystalline greenstone, weathering in spherical balls with concentric coatings, close to a boss of granite.

On the Demerara river a short distance below Anaimapeur village granite rocks are seen occurring here and there, and from the base of the country upon which the alluvium and greenstone rests, down to the gneissic developments at Seba. Near Anaimapeur this rock is of a white colour containing very little mica, a few large scattered crystals of felspar, and some hornblende, being

a syenitic granite. A small dyke of greenstone pierces it in this portion.

At Pongabi there are some large syenite rocks containing large crystals of pinkish felspar.

The rock on which the Mabouroo greenstone rests is a syenite-granite, usually of fine texture, but when it becomes coarse it passes into true granite. Below the foot of Ororu Malalli, in the basin 200 yards in front of the fall, syenite rises above the surface of the river, and is there very similar to that at Pongabi, containing the same large pink felspar crystals, and having a sort of linear arrangement of its felspar crystals.

Just below Yaramacuyah a coarse white porphyritic granite is seen for about one mile, and in one spot is apparently resting upon greenstone. At the foot of Tiger hills the same white granite appears and continues as far as Arowakie creek. Near Arisaribo river mouth on the east bank it is again seen at a point. At Seba there is a great mass of granite gneiss rising 100 feet above the general level, the imperfect foliation of which lies north 73° west and south 73° east. It has a few jointage planes coinciding with the foliation, and some highly porphyritic bands running parallel to the same planes. Traversing it in every direction are veins of coarse and fine grained granite, of widths from a few inches to two or three feet. Some of these veins are fine-grained along their sides, and coarsely crystalline at their centres.

REPORT No. 12.

Geological Report on the Mazaruni River.

By Chas. B. Brown.

January 1873.

CONTENTS.

PART I.

Physical Features.

The object I had in view in undertaking this journey was to determine the actual geographical position of the Mazaruni river, which I found had been placed upon the map furnished to the Geological Survey far south of its true course. Also if possible to determine the position of the heads of the Ireng and Potaro rivers, which were said to have their sources in a mountain called Ayangcanna.

The Mazaruni was originally laid down by Mr. Hillhouse, probably from a sort of sketch survey, and Sir Robert Schomburgk had adopted Mr. Hillhouse's work as regards the lower course of this river, but had I believe moved the position of its upper course considerably to the north, after having found it occupying the position of the Roraima mountain.

Having procured two pocket chronometers from the Imperial Government, which, with the instruments already in the possession of the Survey, completed all that was required wherewith to obtain astronomical observations, I started on the 9th of September last from the penal settlement with my two boats and the usual number of men, and was accompanied by Mr. John Bagot, whose services I had engaged as assistant.

As we ascended the river I procured the latitude and longitude of its various points, by altitudes of the sun and stars, filling in the intermediate portions by a sketch survey.

From the head of the tide at Curutuba rapid up to Turisie, which we reached on the afternoon of the 17th, the river's course was impeded by cataracts and rapids, with still water between each; and so studded with tree-clothed islands that in no part of it could both banks be seen at the same time. The boatmen followed the main channel, and this led sometimes along the main land on one side, sometimes on the other, but chiefly amongst the labyrinth of islands and rocks which occupy the river's bed. These cataracts are not of a formidable nature, with but one exception in Yaninzaec, where there is a short portage for luggage, of which we availed ourselves. The others we towed the boats up in the usual manner.

Before reaching the Puruni river I found that my surmises were correct, and that both latitude and longitude of the different cataracts were exceedingly incorrect. As we proceeded the error of course assumed gigantic proportions, till at Teboco, the most southerly point of the Mazaruni, between the 59th and 60th degrees of longitude, the river is actually some 40 miles to the north of the position marked upon the map. I need only remark that from that on to the source of the river the error never decreased in magnitude. This cannot be wondered at when we remember that from the Carabung river mouth (on the lower Mazaruni) onwards the whole of this magnificent stream has been placed down in maps by guess work, gathered from accounts given of it by Indians.

When we reached Turisie cataract we saw for the first time the full width of the river, but only for a short distance above and below the place where it swept rapidly down the cataract. Above islands and rocks became as numerous as below, the water running slowly amongst them; and so continued till we came to the Issano river mouth on the evening of the 18th. Here near the close of the day we obtained a glimpse of some of the jutting ends of the great table land which extends southward to the Ireng river, eastward to the Potaro, and westward into Venezuela. These seemed such an infinite distance off that one would think they could not be reached for a week, creeping slowly up stream as we were. Our course up to this had been in a south-west direction, but here it became west for a considerable distance; and though passing a small island at long intervals, the river was remarkably free from obstructions, with both banks in view. Heavy forests lined these, the undergrowth encroaching on the water. On the north side of the river were low hills, which a little further on stretched southwards for 10 miles or so, causing the course of the river to be deflected from due north to west. Passing this north and south portion, we rounded the quick bend to the westward, cleared Teboco cataract on the morning of the 19th, and turned northwards for a distance equal to that we had traversed south. The long tongue of hills here is called Karanang, and averages

about 500 feet in height. Two large streams, the Semang and Karanang, join the Mazaruni, one above and the other below Teboco, both coming off the mountains to the south. Amongst these southern mountains is a high peak backing a flat-topped mountain, which Mr. Hillhouse has called Sir W. Raleigh's peak. These mountains are also part of the face of the sandstone mountains continuous with those seen on ascending the Potaro river.

Our course on leaving the Karanang mountain bend was almost due west for some 15 miles over a broad expanse of river of about half a mile in width running parallel to the mountains on our left, at distances varying from 6 to 12 miles from their base. The river then had a bend northwards past Sororieng, where a low cluster of hills on its northern side is crowned by a curious high dome of rock to which the name is attached, "Sorori" meaning swallow, and "eng" nest.

We camped on Saturday the 20th on the opposite side of the river to Sororieng village landing, and next day Mr. Bagot and I went to the village some 3 miles in the forest to try and get to Sororieng rock; but though we had a man who had promised to guide us, yet on reaching the village he said there was no path to it, that we could not go and return in one day, besides various other excuses. None of the other men at the village would go, so we had to give up the trip and return to our camp. I hired an Indian here, who professed to know all about the river as far up as Peaimah fall, to come with me to that place to show where any villages were, in case I found it necessary to get woodskins for the rest of the journey, but he left us two days after.

Just beyond the Sororieng the Merumé joins the Mazaruni river, coming, like the Semang and Karanang, from the high mountains to the south, and like them is a fine large stream of almost 100 yards in width at its mouth. The Mazaruni river then winds about the plain keeping a general north-west direction gradually approaching the base of the sandstone escarpment till at a distance of about 60 miles from Sororieng it is fairly in amongst them, and high frowning cliffs approach it on either side. Its course here suddenly alters and it no longer flows in a south-east direction, but comes due north down the valley, or wide flat-bottomed ravine. In this distance it is joined by three more large rivers, named respectively Aping, Carabung, and Weynamow. After passing all these large branches the Mazaruni is greatly reduced in size though still a large river.

In traversing the river from Sororieng onwards day after day, we never tired gazing at the mountains on our left when the clouds and mists that often veiled them passed away, and saw new beauty in them at every turn. There is some uniformity in the general level of their tops, which shows clear indications of a table-land edge, but small rivers and streams have during countless ages marked them with indentations and ravines, and left wedge-shaped points jutting out from the face of the mass in all directions. The upper portion in general is precipitous, while the

lower part comes down in a slope to the great wooded plain below. Where trees and shrubs can get a footing on their sides there they flourish, looking in the distance like moss upon a wall, but in many places where the rock is quite perpendicular, or it may be overhanging, the pinkish white sandstone beds show themselves as great precipices sometimes of 1,000 feet in height. Rain fell frequently as we passed along, and when the sun burst out after a shower it lit up rills of water tumbling down the walls of the rock, which added to the beauty of the view. The castellated tops of some were very singular and almost artificial looking.

Turning the bend to the south before mentioned we came to the foot of Peaimah great fall near the 61st degree of west longitude, and in 6° 21′ 57″ of north latitude, on the 1st October. I had been up as far as this before with Mr. Sawkins in November 1868, and knew the position of the portage path, so we fell to work to open it out wide enough for a bateau to be dragged through, to place rollers, and prepare it generally.

We were four days in getting our boat with stores, &c. over the portage a distance of three-quarters of a mile, passing over a steep hill 100 feet above the river, and descending 50 feet again to the river above.

I knew too well that there must be other and higher falls above, but not knowing where to look for Indians to get information or woodskins from, forced me to adopt one course whereby the most time would be saved, and that was to take one boat with 12 men and go on to see for ourselves. We went on at midday on the 5th between high bare sandstone cliffs bounding the valley on either hand, and low flat-topped hills flanking them. As evening closed in we came to a place where the flanking hills hemmed in the river on both sides, rising steeply from it. We arrived soon after at a large cataract bounded on both sides by steep rocky hills, then returned to a path end on the north bank a short way back and camped. This proved to be the portage path of Indian travellers.

Sunday the 6th was spent in following it through to the head of the fall, in tracing the river's edge backwards half way to camp over a rough rocky country, in striking across from that point till the portage path was met, and camp afterwards reached late in the afternoon. From this day's explorations we learned that the portage path was of great length, and that as it led round a long set of very large falls it could not be shortened; that it led from our camp up a hill 165 feet high at an angle of 56° amongst large rocks, and that from the hill top it passed over uneven rocky ground rising gradually to a height of 289 feet above its foot, descending to the head of the falls at a level of 275 feet above its starting point.

This set of falls we afterwards found is called Aruwai, and occupies a distance of two miles of river. It is composed of two large perpendicular falls each of 40 feet, and a number of slightly smaller ones having a total height of 270 feet.

There was nothing left for us to do but to begin work at once by widening the path and lashing skids up the hill side, and placing rollers all the way to the upper end. On Monday the 7th we commenced our task, and by midday on the 15th finished it. We measured the portage and found it to be one mile and seven-eighths in length. Mr. Bagot and I had constructed a rude sort of sledge by which all the stores were hauled up the hill side by blocks and tackle. We then hauled the bateau up the hill, also by block and tackle, in two hours; and next day by 1 p.m. had the satisfaction of launching it on the river above. We had all our stores carried over and continued our journey at midday on the 17th.

Whilst we were employed as above stated two Indians passed through the portage going up river. From them we learnt that beyond this we would meet with another set of great falls called Sericoeng, where the portage was too steep and high to allow us to take our boat over. I got them to promise to return to the head of this fall, show us the way on, and provide woodskins above Sericoeng for our further journey. They had a woodskin above the fall, hidden somewhere, and left the one they came up in.

We found a fine open river above for many miles, bounded as before by high precipice walls a mile or two from either side, but with no flanking hills. We were now above them. Away to the south was a most singularly-shaped mountain, like a great box standing on the top of the level of the high table land whose edges approached the river.

Next day, at 9 a.m., we came to the foot of Sericoeng falls, and found the portage path, Thinking it was not long I followed it with two men for a long distance up to 1.50 p.m., imagining every moment we would come out on the river; but we had to turn back without doing so, getting to camp at 5 p.m. On the 19th I organized a walking party, taking instruments and as much provisions as possible, and started to walk along it. As we did not get under weigh till late we had to camp before getting through. The following day, at 10 a.m., we came on the river at the foot of a large fall, at a fine extensive sand beach, and sat down to rest. We had hardly been there five minutes before we saw three Indians coming over the rocks alongside the fall above us. One proved to be the man who had promised to come and meet us. He at once told the interpreter that he had only one woodskin at his place, and could get no more. He promised to go up to another village for woodskins, which would take him five days.

Mr. Bagot, myself, and the interpreter remained meanwhile encamped at Sericoeng, and the men were employed in making two journeys to the boat and back with loads of stores, it being my intention to take on as many men with me as I could get crafts for.

The foot of Sericoeng falls, from which we started, was 520 feet above the sea, and the place where we again came upon the river was 1,246 feet, leaving 726 feet for the height of the Sericoeng set of falls. Of the falls occupying this height I saw only the

upper and lower ones, which would account for 250 feet of height. This was owing to the path being upon mountains at some distance away from the river's edge, but still not too far to admit of our hearing at times the muffled roar of the various great falls. Whilst there we followed the river's edge downwards for a few miles, and came to a large and singular fall where the river descended to a lower level by three great steps, the bottom one being over 100 feet in height, and perpendicular. There was a large and almost circular basin below, bounded by high cliffs. From the north side of this basin we cut down some low bush to get a good view of the fall, and thereby disclosed the box-shaped mountain before spoken of. It was not far off, and bore due east. Its shape here was very singular, and resembled an enormous cathedral in ruins, without a spire, and with ivy clinging to its walls. Singularly enough its position was on a forest-covered glacis, seen above the hills to the south, immediately above the fall, so that it added greatly to the beauty of the view.

On the 24th the Indians returned, saying that they had brought two woodskins and had a third at their village above. I immediately altered my plans, and determined to go on with three of my men and some of the Indians, and send back the bateau to Peaimah to join the other. Then for both to go down to the Merumé river, and ascend it to the path landing, at which place I would join them by crossing over from the upper Mazaruni by the Merumé path, when my work on this river was finished. I gave all the necessary instructions to Mr. Bagot, who took charge of the return party.

On Sunday the 27th, at noon, I bid adieu to Mr. Bagot, and walking to the end of the next fall, went on in one of the two woodskins with three of my men and two Indians, and took with me provisions for one month. Our course was southerly up the river, which lay smooth and broad in a wide tree-covered valley, flowing at a height of over 1,200 feet above the sea, with high sandstone escarpments still not far off from both sides. I got another Indian with his woodskin to join our party, and carry some portion of the stores.

We came to two villages, and at the second met a party of Indians who had come down, they alleged, to place their services at my disposal. One of them who spoke a little English was of the greatest service, not only on the portion of the river with which he was acquainted, but also during the remainder of the journey. The first set of Indians went with us as far as they knew the river; then this man and another went on with us to the head of the next great set of falls, called Chichi, the foot of which we reached on Sunday the 3d November.

On the second day of our voyage after leaving Sericoeng falls we passed a large river running into the Mazaruni on the west, called Camarang, and on the same day in the afternoon passed the end of the path which leads across the mountains to the head of the Carabung river, and which Mr. Sawkins and myself traversed in November 1868. Next morning early we passed the mouth of

the Cako river, on the left hand. There the course of the Mazaruni river altered suddenly, coming from the eastward instead of the south. Looking up the Cako river we saw the edge of the upper sandstone escarpment again, which we had not seen on either hand since meeting the Camarang. The same evening we camped opposite the mouth of the Cukine, a large stream, also on the left hand.

The following day we came to the savanna portion of the river, where it flows in a broad undulating valley of grass and fern land, surrounded by sloping hills on the north, east, and south, but open on the west. From a ridge on the savanna I had a fine view of the surrounding country. In the afternoon we passed two large rivers coming in from the north, named the Partang and Carowouring. Looking up the valley of the former river from the savanna, you see the mountains at the head of the Apeng river.

On the 31st day of October we came to a village called Ackar, but not knowing at the time what was the nature of the great fall which the guide said was not far ahead, I did not engage men to come to help to carry the woodskins over, but went on. Next morning we met a number of Indians coming down river from a fishing excursion, who told the guide he would require assistance if we were going to carry our woodskins across Chi-chi portage, and that they were willing to help. Some of them went up the mountain side to the face of the sandstone precipice to show me a cave where the Salico or Guacharos (a large gray bird) live. The cave was large, and so dark that I could not see any of the birds; but when the Indians made a noise it disturbed them, and they uttered a sort of squeaking and chattering cry, as if impatient at our intrusion.

From the mouth of the cave, at an elevation of 1,882 feet above the level of the sea, a magnificent view was obtained of Roraima and its surrounding mountains, distant about 30 miles. But great masses of fleecy clouds drifted slowly along them, completely enveloping 200 feet of their upper portions. Once or twice these clouds broke away and gave an uninterrupted view of the great portion of the northern parts of Roraima, disclosing to my astonished gaze what I took to be a great fall pouring down its side. It looked like a white thread against the dark blue side of the mountain. The Indians said that it was a fall, and could be plainly seen from their village on a mountain more to the westward. One man said that he came from a village not far from it, and that he thought it was on a branch of the Cotinga river. If it is really a fall, of which I have no doubt, it must be a grand one, and probably the highest in the world, for the perpendicular portion of Roraima is 2,000 feet in height, and it passes down the upper half of this as straight as a plumb line, and then has a slight slope outwards. The remaining 3,000 feet of the mountain to the valley below slopes at an angle of 45°, and being tree-covered the rest of the fall is hidden. It must be of considerable width to be seen at such a distance. I afterwards met an old Arecuna Indian who came from beyond Roraima, and appeared thoroughly

acquainted with that district. On questioning him about this fall he informed me that it was very wide as well as high, and that it was formed by the Caroni river (a tributary of the Orinoco river), whose chief source was in Roraima mountain. How I longed to make a journey to it to be able to speak positively about its size and appearance can easily be understood, but to make a digression from my route would risk the attainment of the original object with which I set out.

I went back to Ackar village and got three men there to promise to come up on the following Monday to carry a woodskin and loads over Chi-chi portage, and then went to Cowaeng and Camooda villages, where I got six more people, and also obtained another glimpse of Roraima. The day was dull and misty, and the clouds never left its sides uncovered for a moment. (See sketch on page 264.)

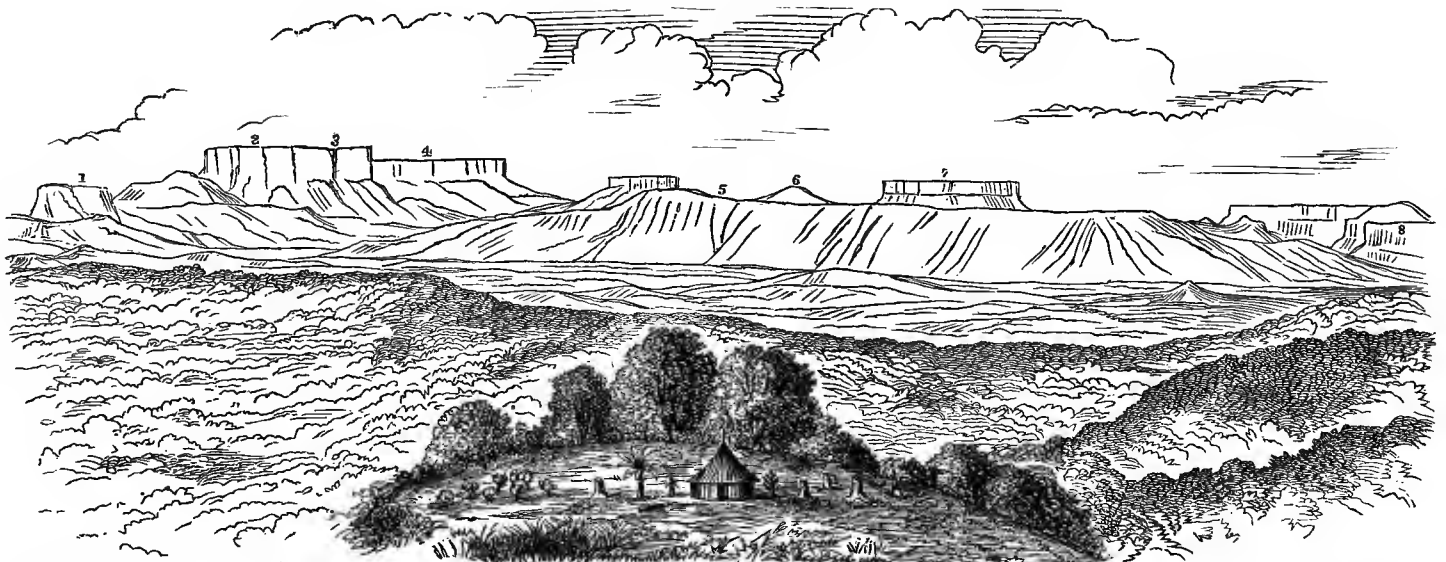
As before stated we got to the foot of Chi-chi on the 3rd of November, and the two succeeding days were engaged in carrying the three woodskins and provisions over the portage, a distance of four miles. The path led up a steep ascent to the level of the top of the mountain, which had closed in on both sides of the Mazaruni some six miles below the fall, and formed high precipices on either hand. Then in a south-west direction over grass-covered lands to the river, on its upper valley, where it flowed smoothly along at a height of 2,084 feet above the level of the sea.

Paying off the Indians they returned, and we went on as they directed to a large branch river called Haiacker, where they said we could get guides. Ascending the Haiacker we met Indians who explained the route to their village on the savanna mountains, where we got a guide, and returning to the Mazaruni followed it for two days more, arriving on the afternoon of the 9th at the utmost limit of our journey, where the river was only 12 yards wide and a few inches in depth at the foot of a fall. For some six miles before coming to it we could hardly get the woodskins over, and sometimes under, the large dead trees across the river. The guides said that no Indians ever go past the fall, and the last two villages we passed were the only ones on this part of the river. The rain began to fall heavily at 11 p.m. on the night we remained at the fall, and continued till daylight next morning. Having no tent or awning I had to take down my hammock and crouch over the fire in a sitting position, under the poor shelter of a small old banaboo that we found there. This made the second night spent in this way, the first being at Chi-chi.

Our course was generally west, but some distance below the fall the river had a long curve flowing from north-west and north. The guide said that it must turn completely round, because we will cross its source in the Merumé mountains on our way back to the Merumé river. We seldom had a night or day without rain from that time, the short rainy season having thoroughly set in, and were obliged to build a shelter of leaves every night.

Having determined the latitude and longitude of the spot we turned about next day and ran down to Haiacker river again.

No. 40.



View of Roraima and Mountains to the North, from Camooda Mountain, looking west-south-west across the Valley of the Cukine River.

1. Marima mountain. 2. Roraima. 3. Great fall. 4. Kukenam mountain. 5. Haiamahtewick mountain. 6. Illebeaper mountain. 7. Waiacker-paiaper mountain. 8. Caraway mountain.

From the savanna on the Haiacker, and bearing south 60° east from our camp, a high massive mountain 5,000 feet in height was seen with a wide gap in one part of its top where some enormous pointed rocks stick up. This is Ayangcanna mountain, in which, according to the map, the Ireng, Potaro, and Mazaruni have their sources. It, however, only gives rise to the Potaro river. It rises considerably above the level of the mountains bounding, the wide valley of the Mazaruni to the south, which forms the watershed between the southern and northern rivers, and these are, where I crossed them, 3,327 feet above the sea.

From the village on the savanna at Haiacker I made a journey overland to Orinedouik fall, on the Ireng river, and had the satisfaction of passing the Ireng river at its head, where it was only 6 feet wide and 3 or 4 inches deep. I was lucky enough to get observations for latitude by stars upon the first night I got there, and for longitude by the sun next morning. During the rest of my short stay dense banks of murky clouds hid the sky, and rain fell at intervals. The nights were very chilly, the thermometer falling as low as 69°, and as I took no blanket with me I felt the cold exceedingly. The path across is one of the roughest I ever travelled, but comes second in that respect to the Merumé path. Tree roots grow across it, and trees and logs lie upon it in all directions.

I got back to the Haiacker river village on the 20th, and commenced my return journey on the 21st. It was now too late in the season to make a walking journey to Roraima, and besides I could not think of remaining in this part longer whilst there was the expense of the wages of so many men who were waiting for me on the Merumé river doing nothing.

I hired five Indians to assist us and act as guides. We ran down the Haiacker to the Mazaruni, and down the Mazaruni to the head of the Chi-chi set of falls. Landing on the west side we carried the three woodskins for one mile over open savanna, in a north-west direction, to a large broad river flowing south-west, which joins the Mazaruni amongst the Chi-chi falls. We ascended this river one day's journey and came to the landing at the upper end of the Merumé path. We then walked through the forest in a north-west direction for one day, crossing the head of the Mazaruni river flowing east, and where it was some 6 yards in width, and coming to the brow of the great sandstone escarpment, near the head of the Merumé river, at a height of 2,353 feet above the sea. We descended the mountain in a gully for 1,000 feet of its height over a most precipitous track amongst large rocks, where the footing was extremely precarious. In two places we descended the face of the rock on short ladders made of poles lashed together, and camped under an overhanging wall of rock in the evening. On the way down the mountain through gaps in the tree tops, I obtained views of the great level tree-covered plain, in which the Mazaruni river winds eastward. It appeared of a uniform level generally, with a cluster of hills to the

north-east at Sororieng, and in one or two places to the north faint blue hills could just be distinguished.

Next day (24th) we descended the remaining portion of the mountain to the wooded plain below, coming out at the landing on the Merumé river at 11 a.m. Here at a level of only 258 feet above the sea we hoped to meet the bateaux, but found instead one of the canvas awnings erected and a fire still burning, showing that some of the men had been there the night before. We had not been there more than an hour when three of my men came up river in a woodskin. They soon explained how matters stood, how the men had been taking turns in threes, stopping there a week at a time for us, the shallow state of the river not admitting the bateaux to come up this far.

I immediately started with them down river, and at 4.30 p.m. reached the camp, where I found Mr. Bagot with the boats and men.

Next day I paid off the Indian guides and we commenced our homeward journey.

Mr. Bagot informed me that he got down the Mazaruni, and up the Merumé river, by the 9th of November, which was sooner than I expected and had been waiting there for me just two weeks.

Gaining the mouth of the Merumé on the 26th we entered once more on the Mazaruni river, just four and a quarter days since leaving it, flowing west amidst the mountains to the south, and two and threequarter days since crossing its source, flowing eastward, on the level top of the Merumé mountains.

The water of the Mazaruni being now high and swollen by recent rains, ran swiftly, so that we made rapid progress, running down all the cataracts with the exception of Yaninzaec, and arriving at the penal settlement on Monday the 2nd of December.

PART II.

Descriptive Geology.

1. *Alluvium. River Loam.*

Everywhere on the river where there are few rocks the banks are composed of a heavy gray argillaceous loam, as seen on all the other rivers of the colony.

In the savanna portion of the Upper Mazaruni, at certain bends of the river at the base of the alluvium, is a dark brown rock containing layers of angular quatz which is of recent origin.

2. *Sand and Gravel Beds.*

At the bend of the river turning up to Sororieng on the west bank at an island, and also at Camacusa, sand and gravel beds

similar to those on the Curiebrong and Demerara rivers are seen of 25 feet in height. At Oranapai white sand beds are again seen.

A short distance below the Carabung river the banks of the Mazaruni on the south are 15 feet in height, and composed of a semi-consolidated dark brown sand somewhat similar to that seen at Siparuta on the Corentyne river.

3. *Sandstone.*

One mile and a half beyond the Weynamou river there is a patch of purplish slaty rock rudely cleaved in a north-west and south-east direction in vertical planes and much jointed, portions of which are soft and others extremely hard.

Between the Weynaman river and the place where the Mazaruni enters the great plain at the foot of the sandstone mountains the purplish slaty rock again occurs. It appears to be a red thin-bedded altered shale of the sandstone series, and is in layers of different colours from purple to light yellow and red, of different textures, striking south 30 degrees east, and dipping in a northerly direction at an angle of 52 degrees. It is traversed by a wide fissure filled with a yellowish clayey material, containing horizontal lines of quartz and soft blackish-brown manganese. Stains of the same mineral appear all through the shale, whose beds vary in thickness from one foot to parts of an inch.

Not far past the Wakawa river at the second cataract the first blocks of coarse conglomerate are seen in the river's bed, which have fallen down the hill sides upon the edge of the schist, and are thus seen here and there up to within 100 yards of the foot of Peaimah fall. At that place large slabs of conglomerate rest upon the upturned foliation of the schist, which inclines south at angles varying from 40° to 60°. From that spot on great tumbled

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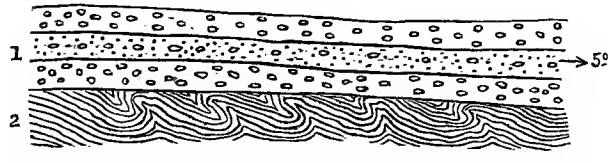

Junction of Schist and Sandstone at Peaimah Fall.

1. Sandstone and conglomerate. 2. Schist.

Schist at Peaimah Fall.

masses of conglomerate hide the schist completely. Although one layer in the schist has undoubted water-worn quartz pebbles, and greatly resembles an extremely altered sandstone, yet owing to

the great unconformability of the two formations it cannot be an altered portion of the sandstone series.

Above Peaimah the great escarpment along the northern foot of which the river runs is composed of great horizontal sandstone beds, and the low hills further on are of the same rock, with coarse conglomerate beds at their base. At the first cataract above Peaimah, the sandstone appears to have been thrown up in one spot at a high angle. The Aruwai cataracts are produced by beds of coarse whitish false-bedded sandstone conglomerate.

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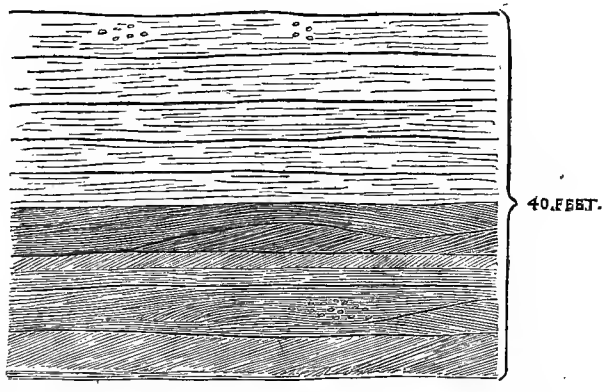
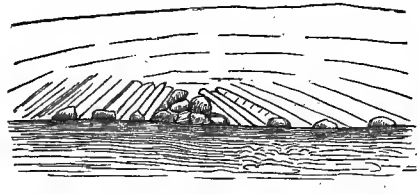


Section of Sandstone at Aruwai Falls, showing false Bedding of that Rock.

No. 43.



Sandstone Beds below Aruwai Fall.

At the upper landing of Aruwai portage these beds dip south 62° west at an angle of 2°, and are of a silicious sandstone containing a few pebbles of quartz. They are vertically jointed, the joints of some beds not passing into those above. The sandstone beds between this and the foot of Sericoeng falls are usually horizontal, but some show a decided dip to the north-west at an angle of 3°, and the sandstone forming the escarpments bordering the river have also horizontal bedding. At the foot of Sericoeng falls the sandstone on the river's edge appears to have been tilted up, whilst the beds on either side some 10 to 20 feet above it are undisturbed. The lower portion appears altered as well as disturbed, and is composed of angular water-worn quartz, as well

as grains and pebbles of an indurated red fine-grained sandstone or shale. The sandstone appearing on the slope of the mountain along the path, about half way up, is of a light yellowish friable variety, whilst that near the top is a white, soft, coarse sandstone. On the level top of the mountain there is a coating of slaggy looking ironstone, and small iron pellets in the soil. The soil is a gray clayey loam with quartz gravel.

Siparimer falls are produced by horizontal beds of coarse conglomerate of about 30 feet in thickness resting on sandstone, and containing pebbles of red sandstone and jasper as well as those of quartz. In the sandstone beds above them there is a thin bed of pebble conglomerate which shows a slight contortion, and proves that the sandstone usually so horizontally bedded has been affected by local disturbances. From Siparimer fall to the great

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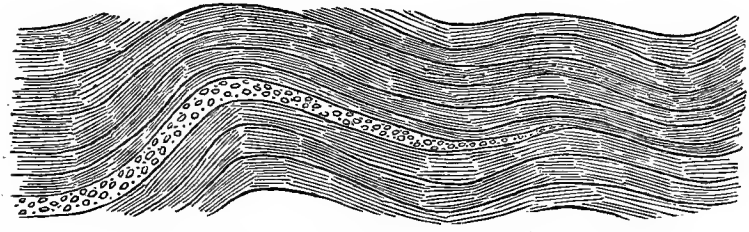

Section of undulating Sandstone Beds, Siparimer Fall.

fall below, the sandstone beds have a general dip to the north-east at an angle of 5°, showing also some local curved strata. One bed 10 feet in thickness is made up of large rounded blocks of sandstone containing small quartz pebbles. A bed of fine-grained quartzose sandstone having a vitreous appearance lies under this.

The fall above Siparimer is produced by beds of coarse conglomerate, which I think correspond with those at Amailah fall on the Curiebrong. From this on to the village of Mokaparu beds of sandstone showing extreme forms of false bedding, dipping north at an angle of 5°, form low cliffs along the river. Just beyond the village the sandstone disappears and is replaced by a layer of greenstone. From opposite Marudima mountain to the westerly bend near the Camarang river, sandstone beds are again met with which probably underlie the greenstone. The last exposure at the above-mentioned bend is composed of white semi-transparent quartz grains, with very little cementing material, the quartz particles having taken a semi-crystalline structure as if forced together, and the whole rock is extremely hard. Not far from the river on both sides along this portion are high escarpments of sandstone, apparently bedded horizontally, and the base of these rests upon the greenstone layer. At the Woosowter cataract beyond the Cukuie river, beds of white sandstone again make their appearance for a distance of 200 yards, rising to a

height of 4 feet above the river and dipping south-west at an angle of 5°. Lying conformably upon it is the greenstone layer,

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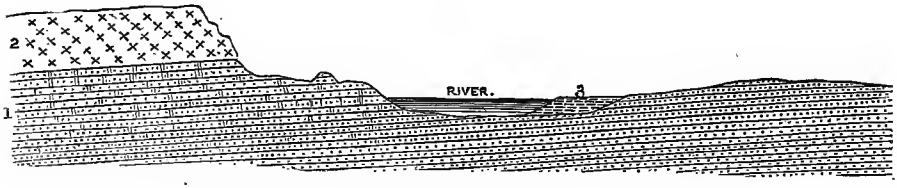

Section showing Junction of Greenstone and Sandstone.

1. Sandstone. 2. Greenstone. 3. Alluvium.

the sandstone retaining its usual outward appearance at the plane of contact, but on examination it is found to contain numerous small crystals of white felspar. A short distance on it rises to a height of 10 feet above the river on the north bank, where trees and alluvium conceal its further development.

Beyond the greenstone, which again occurs at a distance of a quarter of a mile, sandstone cliffs of about 20 feet in height line both sides of the river, and so continue all through the savanna portion. The beds in these are of the usual white and pinkish varieties with few quartz-pebbles, and are extremely false bedded; the general direction of which shows that the currents at the time of its deposition flowed southwards. The beds have slight dips in various directions, but more commonly to the south. On the sandstone on the savanna at the Partang river there is a layer of conglomerate, and the sandstone dips south-west at an angle of 3°.

Beyond Ackar village there are some compact white argillaceous sandstone beds, dipping south at an angle of 15°; while not far beyond the sandstone beds dip south-west at an angle of 10°.

From the landing along the path to Cowaeng village the first mile is sandstone, and from that onwards is greenstone, which rests upon the sandstone. Turning south from Cowaeng to Camooda, about half-way sandstone is again met with evidently resting on the greenstone.

The sandstone forms high precipices on both sides of the river from the savanna portion up to Chi-chi falls. It is of a white colour, but the outside has a reddish and yellowish cast, from *lichens* of those colours growing upon it. This sandstone is horizontally bedded, and has not been disturbed by the small exposure of greenstone in the beds of the river in that portion.

The section of sandstone disclosed at the face of the fall shows coarse sandstone and conglomerate beds on top, 20 feet of hard purple shale between, and thin-bedded brownish and white sandstones at the base. In these latter beds are fine even surfaces of ripple marks so clearly formed that they show the direction of the current that produced them flowed from east to west. Examples of sun cracks in the thin laminæ of purple shale between the

rippled beds also occur, but no trace of the remains of any form of life whatever.

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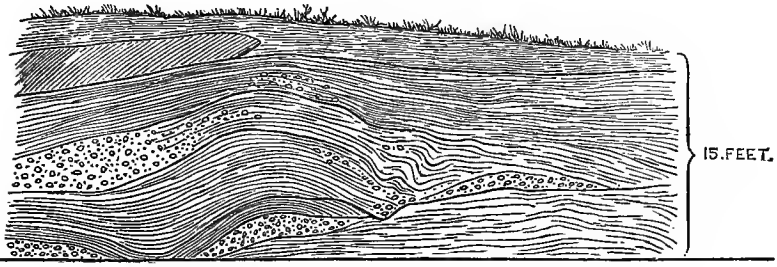


Section of false-bedded Sandstone, near Chi-chi Fall.

Near the top of the precipice on the portage at Chi-chi fall, the sandstone in one place dips south at an angle of 10°, but soon resumes its horizontal position again. The surface of the country from the top of the precipice onwards to the valley of Wailah-paru, is composed of hard coarse conglomerate having an inclination to the west and containing pebbles of jasper. Beyond the Wailah-paru to the head of the Chi-chi falls where rocks occur they are of white sandstone.

From a short distance above the latter spot to half-way up Haiacker creek no rocks are to be seen, being hidden by alluvium, then comes greenstone which continues to a branch river at the village landing. In this branch white sandstone beds are again seen, dipping west at an angle of 2°. The savanna ridges and all the surrounding hills beyond are of sandstone and conglomerate.

From the mouth of the Haiacker creek to the fall on the Mazaruni at which I turned back, the sandstone beds are seen in the river's banks in many places, chiefly in a horizontal position, but in one place they dip south-west at an angle of 5°. The fall just mentioned is formed of horizontal beds of coarse quartzose sandstone in an extremely altered condition, even more so than on the Corentyne below Tomehri. Here it contains large and small crystals of felspar, and semi-crystalline patches of a grey mineral. No layer of greenstone can be seen, but some small water-worn blocks of that rock lie at its foot, which have been washed down by the river, clearly proving that a layer of this rock exists not far above it.

Between the Haiacker river and the village of Waioclay-palenta the path leads over an undulating country of pebble sandstone, containing beds of white argillaceous sandstone dipping slightly to the west. Not far from the village there is a low hill composed of the slaggy-looking ironstone resting on sandstone. The junction can only be traced by the difference in colour of the soil, which is a dark-brown clay on the ironstone and a light sandy loam on the sandstone; and also by iron-stained water trickling out of the ironstone. The village is also situated on low ironstone hills which flank a low range of greenstone.

From Waioclay-paleouta village in a southerly direction along the valley of the Haiacker, the sandstone continues to the base of the mountains or narrow table-land forming the watershed between the Mazaruni and Ireng rivers, where there is a great layer of greenstone capped with sandstone. The top of the sandstone beneath the greenstone is again met with in the valley of the Ireng river further on, and continues all the way to Ourindouik fall on the Ireng. In one place along this latter portion there is a bed of red jasper.

The savanna across from the Mazaruni to the Ow-weang river is composed of white sandstone, and the fall on the latter river is produced by coarse false-bedded conglomerate. From the landing on the Ow-weang the path led upon sandstone at first, and then ascending steeply came to an escarpment of greenstone and along it for some distance, then down almost to the level of the starting point to the sandstone again. The remainder of the way to Merumé mountain was all sandstone.

Descending the steep face of the Merumé, the first 500 feet is composed of white sandstone, beneath which is 300 feet of reddish sandstone resting upon 100 feet of coarse conglomerate, the upper part of which is composed of large boulders and the lower of finer materials. Then comes a layer of brecciate conglomerate of five feet in thickness resting upon a hard red shale. The next 400 feet is composed of reddish and brown sandstone upon a boulder conglomerate, below which is a layer of rock resembling quartz-porphyry, and a greenish compact rock upon white sandstone and conglomerate. At the base of the section is 50 feet of coarse greenstone. Between this and the landing on the Merumé river comes white sandstone, and at the landing a compact light green rock. On the way down the Merumé river sandstone is seen in three places, the first two of which are small developments of hard red sandstone dipping north-east at an angle of 10°. The third forms the small fall, and is composed of a very hard red thin-bedded sandstone dipping north-east at an angle of 30° having a strike in a north-west direction. Just beyond it in the river are blocks of conglomerate, and a hill composed of sandstone and conglomerate. Further down river are small exposures of red shaly rock slightly contorted.

4. *Greenstone.*

At the Turisie cataract a dyke of greenstone 100 yards in width crosses the river from east to west. On weathering it breaks up into most curious shapes, and is pitted with large and small circular basin-shaped depressions. It is fine grained, of a greyish green colour, and much jointed. Beyond it the river is studded with rocks, some patches of which have a schistose structure, but are essentially hornblendic, and in one spot resembles hornblende schist. About one mile above Turisie cataract the rocks assume rounder forms, are coarser looking, and darker coloured, and are composed of coarsely crystalline felspar with hornblende, evidently a true diorite. This rock with little change of form continues

quite up to Issano river, from which onwards all rocks are hidden by alluvium and water for a considerable distance. In one place the diorite contains scattered crystalline grains of quartz of an opalaceous variety; but as it occurs only in one portion of the rock it must be looked upon as merely a local difference in composition not altering the true nature of the rock. Iron pyrites crystals are very numerous all through this rock.

At an island near Issano a fine-grained decomposed greenish jointed rock, thoroughly impregnated with iron pyrites, contains a large quartz vein, and is I think a greenstone. This quartz vein contains an abundance of a black mineral running in lines through it parallel to the walls of the lode, in some places one-eighth of an inch thick, but in others a mere line. There are numbers of drusy cavities of various sizes in it from which iron pyrites crystals have been dissolved leaving a little earthy rust. This vein is similar to that near the mouth of the Curiebrong river, and at Warrerie gold mines on the Cuyuni river. Although a most promising looking vein I could see no gold in it. This reef runs in a north 20° west direction, and has a side branch about 2 feet in width lying north-west. The main vein is from 6 to 10 feet in width, and is surrounded by great blocks which once formed part of the vein above. There is a vein of white quartz in the greenstone opposite the Ockuwa river of a milky variety and rusty looking in parts, but does not contain any black mineral.

Between Issano river and the bend of the Mazaruni to the southward the only rocks seen are fine-grained greenstone, and in one place a dyke of granular rusty quartz resembling quartz-schist. Close to the same bend there is a dyke, 30 yards wide, of greenstone like that of Turisie.

From that onwards for some distance down the southerly bend the rocks are all of coarse diabase, which in one place contains large crystals of augite disseminated in a base of diabase with thin veins of quartz.

The Karamang mountains are composed of coarse greenstone exactly like that of Arissaro mountain on the Essequebo river. In the great westerly course of the river there are some patches of coarse greenstone rising above the river, and the ridges near Sororieng village are composed of a finely crystalline greenstone which decomposes on its surface to a reddish rusty rock.

Above Ouranapai there is some greenstone, and a few miles below the Carabung river a dyke of the same rock crosses the river from south to north, having a branch running north-west. This is a coarse green porphyritic variety, with large light-green crystals of felspar scattered here and there through it.

Near Arasoucou and Mazaruni mountains greenstone of a coarse crystalline texture occurs here and there for a space of some miles. In one place this rock has some crystals of mica and a few grains of quartz, and is pierced by quartz veins. The greenstone occurring south of the great bend of the river beyond is described under the heading of schist.

About one mile above Peaimah fall there are a few large blocks of greenstone of a coarse variety on the west side of the river, which must be part of a layer in the sandstone. The layer to which these belong extends across the point of land coming out just above our upper landing at Peaimah fall. Near the latter spot it seems to dip to the north-west, whilst the sandstone conglomerate 200 yards from it is lying in a horizontal position. To the east of the greenstone at the same place, and within 300 yards of it, in the middle of the river, the compact greenstone is seen weathering exteriorly in schistose forms, like that seen further down the river.

Here and there along the banks of the river from Mokayparu village up to half a mile beyond Woosouter cataract, greenstone rocks are seen. Near the former place the banks of the river in some places are composed of red, yellow, purple, and white clays, resulting from decomposed greenstone. Near Apiopai village there is a large curiously-shaped rock, of the greenstone layer, left on one side of the river, having resisted the eroding action of the water. It is some 60 feet in diameter and 20 feet high, the lower part being formed of coarse greenstone passing abruptly upwards into a finely crystalline rock of the same composition. Along that portion of the river from the Cako to a little beyond the Cukuie river, slaggy-looking ironstone rocks occur in many places, associated with the greenstone. One or two developments are composed of reddish earthy ore, presenting smooth botryoidal or mammilated surfaces on a large scale. One portion is vertical and one foot wide, resembling a vein. The greenstone there seems to rise considerably and forms low hills on the south, but has been entirely denuded from the sandstone to the north, over the extensive valley.

On descending the eastern end of Comooda mountain the greenstone outcrop is hidden, but in the valley of the Iruwa river I saw two small blocks of that rock.

Near the Terpong creek below Chi-chi falls there is a large boss of greenstone, which appears to have suffered considerable disturbance subsequent to its consolidation by the injection of true white granite, which encloses broken blocks of the greenstone, and is twisted up with it in a most curious manner. This greenstone is finely and distinctly crystalline composed of white felspar and green hornblende.

The great layer from the watershed of the Mazaruni and Ireng rivers to the bed of the Ireng beyond, mentioned under the sandstone heading, is similar in composition to that so frequently described before, being of a greenish-gray colour, and of coarse and fine textures.

5. *Mica-schist.*

Tupacu cataract is formed of a belt of mica-schist of a dark grayish-green colour, which is foliated in an east-south-east and west-north-west direction, inclining at an angle of 60° to the northward. In the midst of it are two rolls of white granite containing

silvery-white mica. At the junction of the schist is exceedingly quartzose, containing nests of quartz, minute specks of garnet, and thin lines of iron pyrites, parallel to its foliation.

A greenish-gray schistose rock occurs below Sororieng landing, forming a small island, and is again seen near the landing, where it contains a large vein of quartz, and strings and nests of that mineral. It is very difficult to say whether this is a true quartzose schist or a schistose variety of quartz-porphyry.

About one and a half miles beyond the Weynamon river mouth, just beyond a large development of greenstone, there is a mass of bluish-gray rock, which appears to be a sort of coarse mica-schist.

Near the termination of the north-western course of the river schists of greenish-gray colours occur, containing lines and nests of quartz, and some mica, being a rock intermediate between mica and hornblende schist. It is in most places foliated at an angle of 45° to the horizon, dipping north; but round the great bend at the foot of a cataract its foliation is almost horizontal. This rock is a finely crystalline hornblende schist, greatly resembling a fine greenstone, save that it contains nests of quartz, and shows its foliation upon weathered surfaces. It is in close proximity to a mass of greenstone on the north bank of the river, evidently overlying it, while another mass of greenstone forms a cataract to the south. Upon this latter rock rest large blocks of a hard, compact, greenish rock, like that last described, and showing a foliated structure or weathering, which is not a schist but resembles the rock at the contact of the greenstone and sandstone at Cumuti mountains. From this on to the next cataract, which is produced by a mass of greenstone, this apparently foliated rock is seen in many places, and at the cataract appears to pass into the greenstone. A somewhat similar but more schistose rock forms a vertical dyke one foot wide in the greenstone at the same place.

Between the latter-mentioned cataract and Peaimah fall the rocks in the bed of the river are of a slate-coloured schist, in contorted layers, which is an argillaceous mica-schist. It contains a great quantity of quartz in nests and veins, and in parts contains rounded knots of a brown mineral. Its colour is bluish and slaty-gray with a silky lustre. It is minutely contorted in places, and flat and slate-like in others. The strike of its foliation is in a north 35° west direction to east and west, varying in dip from horizontal to 40° and 50°, lying in fact in short anticlinal and ynclinal curves. Its foliation appears to coincide with the original bedding of the rock. In one of its layers of coarse schistose texture I observed true water-worn pebbles of quartz.

6. *Gneiss.*

The small cataract immediately above Ousayway rock is composed of gneissose syenite, but the rocks do not pass into true gneiss till Carawaramu cataract is reached. At Epikereek cataract the gneiss is fine-grained and foliated in an east and west

direction. It is crossed by a dyke of columnar greenstone lying in a north and south direction, and at the contact of the two rocks the gneiss is exceedingly coarse; this rock continues to Itakie cataract, where it gradually changes into syenite.

About one mile above Itakie the syenite and granite pass again into true gneiss, and beyond at Curabirie cataracts it becomes granitic, but resumes its true structure further on. At Paccapacca it is foliated at an angle of 5° to the horizon inclining towards the north, and is of a white variety. It is there apparently bedded, with its foliation parallel to the planes of bedding. Near Cabowara cataract there are two dykes of greenstone in the gneiss, and at a distance of half a mile on there is a third.

Cartowerie cataract is produced by gneissose syenite, which becomes true syenite, and a little below Turisie cataract changes again to syenitic gneiss, having its foliation in a north-west and south-east direction.

7. *Quartz-porphyry and Felstone.*

The rocks at and in the vicinity of Teboco cataract are of quartz-porphyry of a greenish colour, weathering white and reddish white. The first development is light green, and of fine texture, with numerous small quartz crystals scattered throughout.

Teboco cataract is formed by a light grey-coloured coarsely crystalline quartz-porphyry, containing scattered crystals of light-greenish white felspar, besides small clear pyramidal quartz crystals.

A broad dyke or mass of greenstone crosses the quartz-porphyry above Teboco, just at the bend of the river. From about one mile on the porphyry is represented by a purplish felspathic rock containing small lenticular patches of a light-green mineral.

Nearly opposite the Carubung river mouth there is a development of bluish felstone, without any embedded crystals, which passes beyond into a quartz-porphyry of a slightly reddish colour, containing quartz crystals, and continues for some distance in the river's bed. Some way beyond the Weynamou river there is a green-banded compact felstone.

8. *Granite and Syenite.*

From the mouth of the Mazaruni river up to Osayway cataracts the only rocks, with one exception, appearing at the surface, are of granite. The rapids of Curutuba, Marshall's cataract, and the Kesterbrake are produced by rolls of a fine-textured grey granite, which at the second-named locality are traversed by coarse and fine-grained granite veins. The granite of Warimambo cataract is of a coarse variety, containing scattered crystals of hornblende and opalaceous quartz.

At Crab cataract the granite is of a coarse variety containing a large proportion of light-green mica, and is traversed by fine-grained granite veins. At Waipopekai it contains nests and veins

of quartz, some of which are slightly opalaceous. The granite of the small cataract above Mari is slightly gneissic, breaking into irregular squares, while that of Parowacassie contains thin lines of quartz, traversing it in all directions.

The granite varies greatly over small areas, being often syenitic, and at Maccarie contains an excess of quartz. A little beyond this it has a small vein of greenstone. Approaching Ousayway rock the granite becomes gneissose-syenite, of a coarse texture, containing patches of black mica in the crystals of green hornblende.

About one mile above Cabowaro cataract syenite occurs, containing a large proportion of dark-green hornblende, being in fact almost made up of that mineral, with a little pink felspar and white quartz. In some places it is porphyritic.

Grey granite occurs at Sororieng village, and a little below Camacusa village there is a patch of granite. Below Ouranapai there is a mass of syenite which contains a few crystals of black mica, while at Ouranapai itself the rocks are all of granite.

REPORT

ON THE

Kaieteur Waterfall in British Guiana.

By Chas. B. Brown.

August 1870.

During the last expedition of the Geological Survey, whilst descending the Potaro river, in April, I came quite unexpectedly upon a large fall which the Indian guides called Kaieteur. At the time our provisions were extremely low, from our having made a land journey of 19 days, during which time all our stores were carried in packs by the men, and were necessarily very limited in quantity at starting. As we were only able to obtain supplies of cassava bread at each village through which we passed, we then had only that article of food to subsist upon. We had come from the Burro-burro river, viâ the valley of the Ireng, round the head of the Siparuni river and on to this, and were striving to regain our boats, which we expected to meet us at Tumatamari cataract; thus we were obliged to hurry forward after only two hours' stay at the head of the fall, during which time I made a sketch of it, and took its elevation above the sea level with an aneroid barometer.

I was much struck with the beauty and grandeur of this fall, and regretted extremely that I could not remain longer to make proper observations of its height, width, &c. I had therefore to content myself with mere estimations, which at best are exceedingly doubtful and unsatisfactory. When we reached the river again at a distance of 3 miles below the foot of the fall, I of course took the height of it above the level of the sea, and by subtracting the number of feet from that of my last observation, and making some allowances for intermediate cataracts, arrived at the conclusion that the height of the fall was about 900 feet. In the geological report which I furnished to the Government on my return to Georgetown, I gave a short account of the fall, and my estimate of its height, to which I added the following remark:—

"These measurements I give as the result of my short and hurried "investigations, and as such they must be regarded until future "explorations determine them with accuracy."

His Excellency Governor Scott, deeming it advisable to have the exact measurement of this fall made known, directed me, on the 24th of June last, to make preparations for a journey to it, for the purpose of making a thorough examination of it with regard to its height and width; stating at the same time that Sir

George Young, Mr. Mitchell, and Mr. E. King would accompany me. I therefore at once procured the necessary supplies for one month's consumption for our party, and the number of men which I thought it necessary to take.

Our party left Georgetown in the contract steamer on the 28th of June and arrived at the penal settlement the same afternoon. Captain Kerr, the superintendent there, very kindly placed the despatch-boat Lady Woodhouse at our disposal, which with the small survey bateau Victoria, and two small corials hired on the following day, formed our means of transport. I engaged 15 river men who had been with me on former journeys, amongst whom were my captains Peterson and Deeges. These, together with our cook and my Ackawais interpreter, composed the crews of our four boats, eight going in the Woodhouse, five in the Victoria, and two men in each of the corials.

On Friday the 1st of July we started on our journey, and directing our course across the mouth of the Mazaruni river, entered upon the broad waters of the Essequebo, up which we paddled till 5 p.m., reaching a deserted place called Ouyah, where we spent the night. We found the stream running against us all the afternoon from the time we passed Bartika point at the confluence of the two rivers, there being no ebb or flow of tide owing to the great height of the river. In the dry season the tide flows as far up as the foot of the first rapid above Camakaserima, some 18 miles above the Grove.

On the following day we reached the above-named place at 10 a.m., and during the afternoon hauled the boats by tow ropes up three cataracts, through other channels amongst the islands than those I had previously passed; their names were Woodalliquihaha, Moorie, and Itaball. The first-mentioned one lies in a line with Aretaka rapid, but to the east of it. Late in the afternoon we made an unsuccessful attempt to get up a channel in Tabinetta cataract, but failed owing to the force of the current, and were obliged to camp on an island at its foot. Our progress being so very slow, having to fight our way against the angry stream, we determined not to lose the whole of the next day (Sunday), and so worked up to 11 a.m., thereby getting up Tabinetta cataract.

On Monday we hauled up Marihi, the largest of the whole set of cataracts in this part of the river, and the same afternoon up Itaballia cataract, keeping close to an island, and directly over the spot where I once camped in December 1868. Only one or two of the many high massive rocks of the neighbourhood were left with their points above water. That evening we camped at the foot of Ahara rapid, now swollen to the dimensions of a cataract.

Early next morning we hauled up this rapid and along a channel where we usually paddle with ease in ascending, but along which we now had to drag the boats by the low branches of the trees overhanging the water. Getting soon after into water unbroken by rapids, but running with great velocity, we made slow progress against the stream. The clay banks of the river were entirely covered with water, which we found reached as far

inland as could be seen, and as we proceeded further on we found that it was only here and there in the neighbourhood of low hills that there were spots of dry land. Along both sides of the river where the banks are low there are usually low narrow ridges lying parallel to the river, a few yards from its edge, raised some two or three feet above the top of the bank, which have been deposited in time of flood like the present by the deposition of sediment from the still water covering the land. Next to this, inland, comes level land slightly lower than the banks, which reaches for a long distance back. When the water overflows the ridge it floods the surrounding country to a depth of 3 or 4 feet. It was only in a few places that we could find land, and in order to cook our meals were often obliged to camp at earlier hours than we should have done under ordinary circumstances.

On the evening of the 5th we found a resting place for the night only a few yards long and two inches above water. We sighted first the mountain on the river called Arissaro on the 6th, and at 3.35 p.m. on the same day came to Yucurit island opposite Yucurisi creek, and landing at the house of a half-bred Brazilian determined to pass the night there. The owner and his family had deserted the place, owing, I suppose, to the height of the river, which covered one half of the earthen floor, and completely surrounded the house. Fortunately one-half of the house had a staging of Ita palm planks raised 3 feet above the ground, which furnished us with a dry floor, and made our waterbound condition more bearable than it would otherwise have been. Insects abounded here, being driven in by the rising waters, foremost amongst which were termites and small centipedes.

We passed Dahalibani river at noon next day, and in the afternoon experienced a heavy rain and thunderstorm. At 5.30 p.m. we came to the mouth of the Curi-curu river, where we expected to find land, but to our great disappointment all was covered with water. We took the small corials and penetrated a short distance inland as far as we could get through tangled vines and "bush ropes" amongst the stems of the trees, but found that the water became deeper the further we went, so we returned to the boats, and had to sleep in them.

On the 8th, at noon, we had a heavy fall of rain, and the same afternoon reached the first rapid in this part of the river called Curatoka, which was hardly discernible, owing to the height of the river.

At 2 p.m. on the 9th we entered the mouth of the Potaro river, and found it extremely high, but with very little current, being dammed back by the great body of water flowing down the Essequebo past its mouth. The change in the colour of the water was very apparent, the boats gliding from a turbid stream laden with sediment in suspension, at once upon water of a translucent brownish-black, which had a clean pleasant appearance. Viewed in a body the water resembled an infusion of tea in colour, this tint arising from the tannin in it derived from vegetable matters. At 5 p.m. we reached Tumatamari cataract some 5 miles up the Potaro, and found though a great body of water rushes over it,

yet from the water at its foot being so high it is itself greatly reduced in height, being only 6 or 8 feet at its southern side and a few feet at its northern. The water of the river washed the foot of the hill at the end of the portage, so we had to run the boats some distance amongst the trees to get a landing place, and then camped on the hill top on the side of the path.

It will be seen by a perusal of the foregoing that it took us eight days and a half to reach the Potaro river instead of five, the usual length of time it has taken to perform this journey on my three previous expeditions up the Essequebo.

Early on the morning of the 10th I went with my captains and examined both sides of the cataract, selecting a channel on the south side up which to haul our boats. We also crossed to the northern shore, below the cataracts, to the spot where we camped on the 28th of April, which was all under water. Sounding at a spot which was the edge of the river I found a depth of 13 feet of water. We were all the forenoon engaged in packing up the provisions for our further journey, which was to be performed in the two corials and the small bateau it being considered impracticable to haul the large bateau up the cataract, and in the afternoon the boats were taken up and their loads carried over the portage.

Leaving Peterson and three men with the large bateau, and taking 13 men as the crews of the three boats, we started onwards from the head of the cataract at an early hour the following morning; and not having a swift current to contend with made a good day's journey, passing the Curiebrong river at 3 p.m., hauling up Chowrah rapid at 4.30 p.m., and camping at the foot of Cobanatout cataracts at 5 p.m., at the end of the long portage.

Though none of us knew anything about the Cobanatout cataracts, having on our way down river come across this portage, yet we determined next morning, if possible, to haul the boats up them. Soon after starting we came to the first of these cataracts, named Morowaseema, and unloading the boats, carried the stores along a portage the whole length of an island, a distance of about half a mile; then dragged the boats up and crossing to the mainland, carried a portion of the things over another portage, 594 yards in length. The boats were then taken up two more cataracts of no great size, the first being called Cobanatout, which is in two steps, with a total height of three feet, and the second being called Auritout. If the river was lower these two cataracts would not present much of an obstruction in the ascent. The river here separates into small channels, amongst a number of small islands; and a group of low hills lie on its northern side. Proceeding on we passed the upper end of the long portage; and a mile or two further we came to Pacutou falls. It being late when we reached this place, we camped after landing everything, to be in readiness for the morrow's work. This fall presented rather a formidable appearance, but we thought that we might be able to get the boats up the four cataracts of which it is composed.

At 6.30 a.m. on the 13th we commenced carrying the loads over, all the party working with the men; and in three hours and

a half all the stores, &c., were placed at the upper end of the path, at the head of the falls. We then got the boats up through a narrow channel to the top of the first cataract, about three feet high; and coming to the second, some eight feet in height, took one of the small corials up with difficulty, and reconnoitred the third. To our disappointment it was found that this cataract was impassable, on account of its steepness, and of the force with which the water rushed down it. The fourth cataract was still more formidable, so we had to return to the end of the portage, above the first cataract, and from thence drag the boats one by one up the steep hill to a height of some 50 feet above the river, then along the even path, a total distance of 1,078 yards, to where the luggage was deposited, and there launch them. In this work the whole strength of the party was called into action; and everyone working cheerfully and well, rollers or skids were cut and laid, and the boats dragged across on them. It was 4.30 p.m. by the time we had the boats loaded and ready to start again. From the upper end of this portage the flat-topped sandstone mountains are first seen; they form the northern escarpment of the table land. Continuing onwards we cleared a small rapid, and bivouacked immediately above it at my old camp of April 26th. Here I observed that the water was about three feet lower than it was at that time.

Starting early next day we continued our journey. At almost every bend of the river fine views of the sandstone mountains were disclosed, uniformly covered with dark green foliage, excepting here and there, where the steep bare patches of whitish rock formed great precipices. In some places the almost uniform flatness of the mountain tops was relieved by deep gorges and gaps. We made good progress against the stream, the current not flowing with much rapidity; and by mid-day reached Amutu fall, the approach to which up a long reach of river is very beautiful. This fall is divided by an island, and on its eastern side, where the greater body of water pours over, is almost perpendicular for some 15 feet. Unlike the other cataracts mentioned, this one is formed by ledges of sandstone, and is close to the foot of the mountains. The standard barometer here stood at 29·968 inches, temperature 84 degrees, giving a height of only 84 feet above the level of the sea. At this portage, which is only 440 yards in length, there is one hill to haul up from the river, which is steep and very rocky, so that much time was here consumed in cutting skids on which to run the boats. As usual all hands set to work, and by half-past 5 o'clock in the afternoon the boats were all above the portage, and reloaded for an early start on the morrow. This fall can never be ascended by boats on account of its height.

At 7 o'clock next morning, the 15th, we entered the end of the valley, with high mountains on either side, partially shrouded in dense clouds of mist. Soon after the rain began to fall heavily and did not cease till after 10 a.m., at which time we reached Warratu. As soon as the rain commenced all the grand views of mountain scenery were hidden by the mist; and on its clearing off as the rain ceased, some fine cascades pouring down a precipice on our right hand were disclosed. Warratu is not a large cataract,

its portage being about 100 yards long, so that we found it only necessary to carry the stores and luggage over, and consequently were not detained there any length of time. As the rain-clouds broke away the sun came out brightly, driving away the mist and fog clinging to the mountain gorges, and thereby disclosing to our delighted gaze a portion of the object of our journey, a view of the great fall, far off at the head of the valley, pouring its foaming water over the precipice edge into the depths below, as it has done for ages past. One is struck with awe, and impressed by the greatness of nature's work, when he sees the great power that is here revealed; which through unnumbered ages has been cutting its way unnoticed back from the mountain edge at Amutu to its present position, thereby forming this broad and deep valley. As it receded from its first position, when it probably poured its waters into the ocean, then washing the base of the sandstone cliffs, its branch streams running in at right angles helped in the great work of denudation by cutting side gorges and widening the whole valley. Viewed from where first seen I should say that some 400 feet of it, from the top downwards, can be seen, and about one half of the width of the top, a bluff hiding the rest. Every now and then clouds of thin white mist from the foot rose up and covered it like a veil, and then passed away to the eastward, the breeze being westwardly at the time; but one cloud I observed always crept along the precipice under its western edge as far as could be seen from here, and is the one that rises from its western foot, which, in early morning, I saw on my first visit.

Before passing Partamona village we met some Indians, to two of whom I communicated, through the interpreter, that we wanted guides on the following day to the foot of the fall, and as much fresh provisions as they could supply. Soon after this we reached the "landing" at 2.30 p.m., at the foot of Tukuie cataract, about three miles from the foot of the fall, at which we landed all the stores, knowing that we could proceed no further in our boats. Another Indian came up to us, and from him I learnt that on account of the number of small cataracts beyond Tukuie we would have to pursue our further journey on foot.

Sir G. Young and Mr. Mitchell were anxious to return to town as soon as possible after seeing the fall, while it was necessary for Mr. King and myself to remain until all the required measurements were taken. Consequently it was arranged that we should all visit the foot of the fall together on the following day, Mr. King and myself remaining there while Sir G. Young and Mr. Mitchell would return to the landing and ascend to the head of the fall on the day after, taking the standard barometer with them. By this arrangement they could see the views there presented, and at the same time take simultaneous barometrical observations with myself, the times of such being arranged by flag signals. We would then all return and meet at the landing on Sunday afternoon, and they would leave the next morning on their return journey.

The Indians brought us on the following morning a large quantity of sweet potatoes, plantains, &c., which we bought with beads

and knives. By 8 a.m., everything being ready, we started with two Indians as guides, and five of our men as carriers of provisions, &c., and were accompanied by 11 Indians, who escorted us of their own accord. We traversed the well-beaten path which leads to the head of the fall for a few hundred yards, and then struck off to the river, coming out on its western side at Orimedouk cataract. Here the path ended, and we followed the river's edge, sometimes amongst blocks of rock and boulders close to the water, at others some few yards in the forest amongst great massive rocks, and having often to cut our way through thickets of tangled vines. At 10.45 a.m. we reached a spot about a quarter of a mile from the foot of the fall, at a point from which its whole face could be seen. This is perhaps the best view of the actual fall and precipice on either side that can be obtained, and one can here fully realise its immense height. The day was dull and cloudy, and some rain fell soon after we reached the spot, causing a dense mist to hang about the fall. Some of our men lost their way, and taking the wrong path at starting reached the head of the fall, and returned to the landing; only one joined us at 5 p.m. The man carrying the canister containing my sketch book, &c., also lost his way, and did not arrive till 2 p.m. Meanwhile I chose a good barometrical station, 13 feet above the level of the water, and compared the two barometers so as to get the difference between them. I then commenced a pencil sketch, at which I made slow progress, being repeatedly interrupted by light showers of rain. At 3.30 p.m. Sir G. Young and Mr. Mitchell, who had visited the basin of the fall, left for the landing camp, the latter carrying the standard barometer with him, after settling about our signals and the station for the barometer above on the morrow. All but two of our Indians returned also, so that the party at our bivouac that night consisted of Mr. King, nine men, three of them Indians, and myself. We had poles rigged up and lashed together under a large flat rock in a kind of cave, and there slung our hammocks for the night in this most romantic spot, with a frowning precipice on either side and the fall in front, with its ceaseless roar sounding in our ears.

Sitting over the fire that night the interpreter related to us a tradition connected with the fall from which it derives its name. The story commences as usual with "Once upon a time" there lived an old Indian at a village above the fall, an exceedingly feeble old man, whose feet became infested with Chigoe fleas to such an extent, that he gave his friends and relatives an immense amount of trouble in picking them out for him every morning. So they determined to rid themselves of the nuisance, and accordingly placed the old man in a woodskin, just above the edge of the fall, and shoved it out into the stream. The strong current hurried him to the brink, and swept him over into its foaming water, and he was seen no more. But not long after, strange to relate, his woodskin appeared at the end of a small island, in the smooth water just below our camp, in the form of a long slab of rock, while on a slope on the right-hand side of the fall a large square rock represents his canister similarly petrified. After this tragedy

had been enacted the Indians named the fall Kaieteur, which means old man fall. Lying in my hammock that night I could just discern the fall through the deep darkness which prevailed, looking like a huge ghostly apparition. The night being chilly and damp, and having no rug to wrap up in, I could get but little sleep, and continually dozed off and woke up at short intervals; every time therefore my eyes opened I saw the fall before me. Just before the moon appeared above the mountain on the left two bright stars rose in the sky beyond the edge of the fall above, seeming to come out of the very water, and then the first light of the moon rested on its crest, shedding a golden light across it, which had a most beautiful and charming effect. After this till morning broke all the water was lit up by the moon's rays, and could be seen with great distinctness.

Early next morning, as the sun shone on the mist, on the right-hand of the fall, a beautiful rainbow was produced, reaching from its foot to almost half-way up the precipice. The day was fine, and I continued my pencil sketch. At 8.45 a.m. Mr. Mitchell and some of the men appeared at the edge of the head of the fall, on the western side, looking extremely small. We exchanged signals to set up barometers, and soon after signalled each observation, taking five simultaneously, during the interval between 9 a.m. and 10.30 a.m. We next tried to measure the width and take the depth of the river, Mr. King swimming with the line, but the current was too strong and swept the line down stream with such force that we could not manage it. In the afternoon I twice observed that a strong breeze issued from the cave behind the falling water, driving the eastern edge of the fall outwards, and giving a quarter turn to the bottom of the column of water. Mr. King, the men, and myself walked back to the camp at the landing, which we reached at 5 p.m., and met Sir G. Young and Mr. Mitchell there. Getting the result of the upper observations I made a rough calculation from the mean of both, and found to the satisfaction of all that the height came almost up to our expectations. In this I did not allow for the mean difference between the two barometers, which was subsequently taken into the calculation.

On the following morning, the 18th, Sir G. Young and Mr. Mitchell started on their return in the two small corials with six men, and were accompanied by two Indians in a woodskin. At Tumatamari they were to leave the corials, and descend the Essequebo in the "Lady Woodhouse." Mr. King and myself started for the top of the fall at 10.15 a.m., taking six men and an Indian with us. The path is good and the ascent gradual for some distance, then becomes rather steep for a few hundred feet to a gully filled with immense blocks of sandstone, between the interstices of which a small stream runs. From this the path leads up the mountain at a steep angle for a distance of about 400 feet, then the ascent becomes gradual again to the top of the table land, over 1,000 feet in vertical height above the starting point. It then leads along the table land in a south-westerly direction for a considerable distance, coming out of the forest about

three quarters of a mile from the head of the fall on a small open tract of country. The walking is then over flat rocks, through low shrubs and bush to the head of the fall. We arrived there about an hour after mid-day and commenced a series of measurements. We tried to measure the height of the fall with a line and weight run through a pulley over the edge of the precipice; but when over 500 feet had been payed out, the mist given off by the side of the fall completely hid the weight and lower portion of the line from view, and we had to abandon the experiment. We found an old woodskin in a small creek near by, in which I crossed over with a man to the other shore, at a distance of 250 yards above the edge of the fall, carrying the end of a line with us to measure the width; but the line became entangled in the rocks at the bottom of the river, and we had to cast it off and go on without it. I next visited the edge of the precipice on the eastern side, and found that the width of the edge of the fall is 30 feet less than it was when I was here in April, by measuring from it to a rock which I then observed was surrounded by water. On the other side the width is 66 feet narrower than it then was. That evening we encamped in some low bush close to the fall. Late in the afternoon the swallows (which I mentioned in my last report) came in from all points of the compass in large flights, and here gathering into two or three immense flocks, kept wheeling above us closely packed together, at a height of about 100 yards. I can only convey an idea of the multitude of these birds by saying that they were in myriads. Every now and then as the flocks passed above the fall, thousands would swoop down almost perpendicularly, with extraordinary velocity, and passing close over the edge drop till opposite the great cave, then suddenly change their direction and shoot through the mist on either side into their roosting places. Just before dusk these birds came down in greater numbers, attracting our attention by the strange rushing sound they produced by their downward flight; sometimes pouring down in a continuous stream for five minutes at a time. Then single birds and small flocks kept arriving till it was quite dark. When a single bird shot down only a black line marking its course could be seen. I was unable to procure a specimen of one of these swallows to ascertain their size, but as far as I could judge they appear to be almost as large as the common gray plover, and are of a black colour with a white patch under the throat.

At 6 o'clock next morning the thermometer stood at 70°, whilst the water at the same time was 73°. The great valley below the fall was filled with mist up to 8 a.m., when the breeze sprang up and dispersed it. I continued my observations at an early hour, assisted by Mr. King. We measured a base line of 2·42 chains, and then with a good compass took the angles to a mark on the other side (the rock before mentioned), from which I calculated the width of the fall as it was in April last to be 370 feet.

We then took four observations of the velocity of the current before it passes over the fall to within 50 yards of its edge. Setting two compasses at two points 66 yards apart I directed

them both at right angles to the base line. Light pieces of wood were carried out in a canoe some distance above and allowed to float down. Mr. King observed at one compass while I watched at the other, and timed the floating objects as they passed. I also took five observations with the mountain barometer at the upper station at the same time as before.

We again took out the line in the woodskin to measure the width of the river 200 yards above the fall, and were successful. Making the line fast to a tree on the opposite bank we went back and hauled it in straight, and thus got the true width, viz., 134 yards. The remainder of the day was spent in making a water-colour sketch of the front of the fall, and of the country from which the river comes, from a spot on the western precipice edge, not far from where the path emerges from the forest. The day was extremely fine and the sun shining on the spray caused many beautiful rainbows at different periods, one reaching quite from the top to the foot of the fall. Next morning (the 20th) we sounded the depth of the water at 200 yards above the fall, and found 15 feet 2 inches to be the greatest depth (see Section 3). On the river's edge there are trees upon which the high-water mark has been left, the water having recently, and evidently for a length of time, stood at a height of 5 feet above its present level. Returning to the same spot as yesterday I finished my sketch, and then we all descended the mountain, and arrived at the camp at the landing at 5 p.m. Just as we left the open table-land above, the rain descended in torrents upon us, and did not cease till after we had got to the camp.

On the 21st I took five men and an Indian with me and proceeded to the foot of the fall to take the height of the cataract, from the river below to the edge of the basin. I could not take a barometer with me beyond my first station on account of the difficulty of carrying it and the chances of getting it broken, as well as the impossibility of suspending it amongst the rocks. I therefore had to take my aneroid. We reached the barometrical station of the 16th, and continued along the western side of the river, amongst enormous boulders of sandstone and conglomerate, amongst which grew shrubs, low trees, and agaves, all interlaced with tangled vines. Through these we had to search for an accessible track to pass along, and had to clear our way with a cutlass. As we approached the basin this growth gave place to a coarse moss growing on the soft earth, which covered the flat portions of the rocks and rendered the walking slippery and difficult. Sometimes we were brought to a standstill by a perpendicular face of rock, and had to retrace our steps and try a new track; at others we had to pass through narrow subways and under great rocks. It took us about an hour and a half to walk the distance, which I estimate at 350 yards in a straight line from the barometer station to the outer edge of the basin. As we approached it we felt the breeze coming outwards, and soon became enveloped in mist. At this point the Indian guide refused to go further, and then turned back. The sun cast its rays upon our

backs, and produced small rainbows in front of our faces, which were most dazzling, and almost prevented our seeing the way in passing over deep fissures amongst the rocks. At the basin the mist and spray completely surrounded us, quite hiding the sun, like a dark cloud. Here we had to take shelter behind the rocks from the blinding storm of mist and rain which assailed us, driven outwards by the hurricane produced by the falling water, and through gaps witness the strange scene before us. The water in the basin most truly resembled a huge boiling cauldron, to which I before likened it, being lashed into great irregular waves, whose crests were blown into spray, and as they drove outwards in an irregular semicircle were dashed against the rocks in front and the walls of the cave on either side, beating over one rock that I am sure was 15 feet high. The foot of the descending column of water was rendered indistinct by the mist, but great fleecy masses of white foam spurted upwards many yards high in clouds mixed with spray and mist.

Standing there, I imagined that it exactly resembled a sea storm raging on a rock-bound lee coast. When I went in amongst the reeking wet rocks to the storm I left the sun shining brightly and the neighbouring forests unstirred by any wind whatever. Returning again, I came out of the mist into the sunlight, and by the time I reached the barometer station and looked back, I could hardly believe that such a disturbance of the water in the basin as I had witnessed still continued.

The aneroid gave unsatisfactory readings, from the mean of which the difference of level between the edge of the basin and the barometrical station below is 68 feet. To this 13 feet, the height of the barometer station above the level of the foot of the cataract, must be added, which gives 81 feet as the total height of the cataract.

At the lower end of the smooth water below the fall, at a distance of three quarters of a mile, there is a long sloping cataract, for which the Indians with me said they had no name. The roar of this cataract drowns that produced by the great fall, on account of its proximity to the path along which we went, so that the sound of Kaieteur can only be heard at a distance of half a mile from its foot. I may here remark that at about a mile above it on the river I could just hear it on my approach in April last. Next to this come three smaller cataracts between it and Tukine cataract, which are respectively called Serikabam, Orimedouk, and Oriedouk. At the first-mentioned one, on the eastern side of the river, there is a beautiful large cascade, part of which falls perpendicularly for some 200 feet. Near this cascade there is an enormous stone pillar on the edge of a precipice, with two flat slabs on top, resembling a gate-post. There is also a fine cascade opposite the landing place.

Having taken all the necessary observations, and completed the work for which this journey had been undertaken, we determined to start upon our return on the following day.

I made inquiries about the upper fall on the Potaro from some Indians who had just come down from it, and from their descrip-

tion it is a long sloping succession of cataracts which, taken together, give a height almost as great as Kaieteur.

From similar inquiries I learnt that the fall on the Curiebrong, the existence of which I pointed out in a former official report, fully realised all my expectations, being, according to the Indian account, quite as high as Kaieteur, and also perpendicular. Its Indian name is Amailah. Feeling satisfied as regards the truth of this account, I think I may without hesitation lay claim to the discovery of the existence of this fall. I also think it not improbable that the Semang and Merumé rivers, coming from the same sandstone table land, have similar falls upon them.

We left the landing at 8 a.m. on the 22d in the bateau *Victoria*, accompanied by six Indians in woodskins, whom I hired to help in hauling our boats over the portages. In running down Warratu cataract on its western side we met with an accident which might have had a very serious termination. As the boat shot over and cleared the dip of the fall at full speed, she struck on some hidden rocks with such force that the bowman, who was standing up at the time guiding the bow with his paddle, was thrown overboard. Grasping the gunwale of the boat, he saved himself. There we were, the boat grinding and thumping on the rocks in the midst of waves and foam, and I had little hopes of the boat's holding together. The men all jumped over, and so kept her from broaching, and with extreme difficulty we got out of our perilous situation. By the time we reached the shore the boat was half full of water. Unloading we found that the bottom mid-plank was completely shattered, and water was pouring through in many places. These leaks we stopped with tallow and oakum after hauling the boat up. Continuing on, we hauled over Amutu portage, and camped about half way between it and the next set of cataracts.

We reached the Pacutou portage at an early hour next morning, and carried everything over by noon. In running the boat over on skids the shattered plank burst through in two places, and we experienced considerable delay in patching it up by first caulking, then spreading osnaburg over it on the outside, upon which we nailed pieces of wood. We reached Cobanatout cataracts at 2 p.m., and lowered down all but the last one, named Morowaseema, where we unloaded, put skids on the rocks, and ran the boat a distance of 10 yards on them before launching it at the foot. We encamped at the foot of Chowrah rapid, and the following day being Sunday we remained there all day. The river was here very much lower than when we came up, and was falling gradually.

Next morning, 25th, we ran down the river till we came to the Curiebrong, up which we turned. We went two days' journey up it, and finding that our stores would not hold out if we went further returned, and reached Tumatamari cataract at 2 p.m. on the 28th, lowered down our boats on skids, and camped below it on the northern side. The river above the cataract was two feet lower and below the fall four feet lower than when we went up on the 11th.

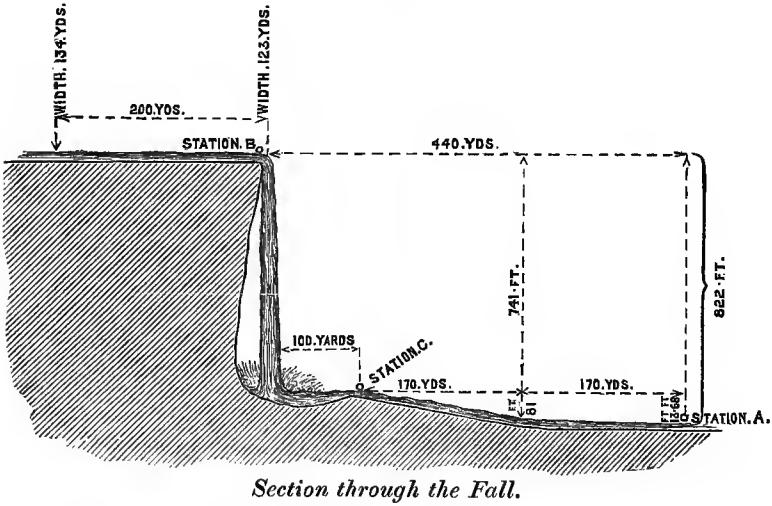
Starting at 6 a.m. next day we reached the Brazilian house on Yucurit island at 4.30 p.m., and remained there for the night. The water there had fallen a good deal, and land was now everywhere to be found. The mosquitoes being very numerous prevented all from sleeping, so that at 4 o'clock next morning we were glad to leave the place and continue our journey. We ran all the falls that afternoon except Marihi and part of Tabinetta, which were evaded by running down side channels. Having no tide or wind below the falls to contend with we made a good day's run of 46 miles, arriving at Bartika Grove at 5 p.m. on the 30th. Here we were kindly received by P. Grant, Esq., the stipendiary magistrate, and next day went over to the penal settlement, where we became the guests of Captain Kerr, who extended his generous hospitality to us.

We left the settlement on Monday morning, August 1st, in the contract steamer, and arrived at Georgetown in the afternoon, after having been away for 35 days.

In giving an account of this fall only a slight idea of its beauty or of that of the scenery which surrounds it on all sides can be conveyed. I will now give its actual dimensions as I made them out, together with an outline of its geological structure.

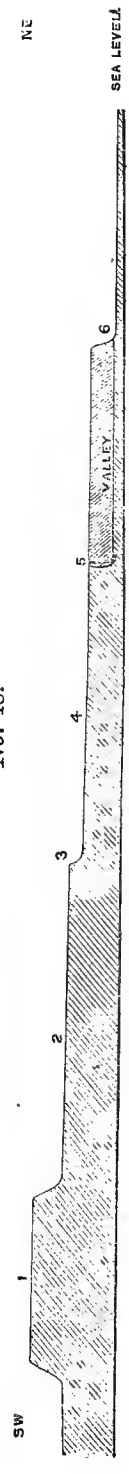
Kaieteur fall, as I have placed it on the map from my sketch survey of the Potaro river, taken from its mouth up, is in 59° 19′ west longitude, and 5° 8′ north latitude. It is produced by the Potaro river flowing over a sandstone and conglomerate table-land into a deep valley below, with a total fall of 822 feet. For the first 741 feet the water falls as a perpendicular column into a basin below, from which it continues its downward course over a sloping cataract in front 88 feet in height, and through the interstices of great blocks of rock to the river bed below. The head of the fall is 1,130 feet above the level of the sea.

No. 47.



Section through the Fall.

Scale, 200 yards to an inch.



No. 48.

Section along the Potaro River to its Junction with the Curiebrong.

Horizontal scale, 14 miles to an inch; vertical scale, 8,000 feet to an inch.

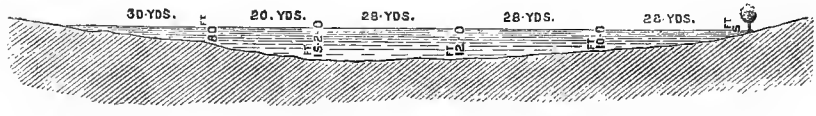
The accompanying section will enable the reader to understand the way in which this fall has been produced, and also give some idea of the nature of the table lands. The river rises in Ayangcanna mountain, some 40 miles to the south-west of the fall, and flows from an uneven plateau down a succession of immense cataracts above Enapowou village to an extensive table land. At one time it must have run over the edge of the table land near Amutu cataract, but during the lapse of time it has cut its way back to its present position at the upper end of the valley. The river comes due north for a mile or so before reaching the head of the fall, with no great force of current, and has a smooth surface; but at a distance of about 200 yards from the fall it seems to hasten forward with greater speed and becomes slightly rippled, breaking into little patches of foam here and there as it nears the edge and then rushes over. As it curves over it is of a dark reddish-brown colour in its deepest portions, through which can be seen patches of foam forming beneath and passing out to the surface of the water, changing it into a heavy column of foam of a white colour with a slight reddish tinge. This may be described as descending in seven great systems of inverted rockets of foam so close to each other, both vertically and laterally, that no actual break takes place between them, so that the river falls in one great continuous whitish column of jagged foam. These seven systems are strikingly observable from the contrast of colour presented between them and their interspaces; the foam of the latter joining edge to edge across being of a pure white colour and of much thinner substance than the former. Where this column of water beats into the basin below dense masses of foam spurt upwards in all directions, while the actual contact is rendered indistinct by clouds of mist.

The water then flows away as a cataract over and through the interstices of the great boulders, which form the outer edge of the basin, into the river below, and runs onwards with a strong current of a dark brownish-black colour; the water in the basin is also of a deep brownish colour, and the rocks surrounding it are all stained of a similar tint.

In the shallow portions of the lip of the fall the reddish colour of the water is lost the moment it begins to fall. The western side of the descending column of water forms an even edge, but on the eastern side the water falls thinly from the top, forming thin rockets, which shoot out in thin spray and mist, and widening as they slowly descend, form a beautiful veil of gray mist over the edge of the cave on that side, whose outline can then be hardly traced. This mist rises to the top of the fall, and keeps moving outwards along the side of the precipice, and soon becomes invisible vapour. When the sun is shining a most beautiful rainbow is formed, which reaches from the top to the foot of the fall, and moving outward with the mist gradually fades away; and with each accession of mist a new one is formed. The edge or lip of the fall is even on the eastern, but has a second ledge on the western side, and some rocks protrude above water there, now that the river is low. It is curved or angled inwards, and at the angle the greatest body of water flows over.

The width of the river at a distance of 200 yards above the edge of the fall is 134 yards, and at the edge itself is 123 yards.

No. 49.



Section across the River, 200 *yards above the Edge of the Fall.*

The depth of the same place was 15 feet 2 inches when measured, the level of the water then being 5 feet below its highest level when in flood. The accompanying section gives its depth at various distances across. There are no means of measuring the width and length of the basin, but I have estimated them at 200 and 100 yards respectively.

The velocity of the stream just above where the greater body of water passes over is 4·09 miles per hour, and 3 miles per hour between that and the western shore.

The lip of the pool or basin is formed by the meeting of two sloping piles of rock banked against the foot of the precipices on either side, the ends of which meet almost together at the middle of it. The cave behind must be of immense size from the glimpses of it on both sides. The fact of the enormous flocks of swallows that find a roosting place and home there also leads to this conclusion. It is now inaccessible, both of the precipices on each side of the fall being perpendicular at their foot, and washed by the water of the basin. On both sides of the fall the beds of sandstone form even, perpendicular precipices of gray and reddish rock void of trees, but as they curve round away from the fall they become sloping and tree-covered.

The vegetation about the immediate neighbourhood is very beautiful. All the surrounding country is covered with dense forests, with the exception of a small savanna close to the western

side of the fall. On this savanna are scattered groves of low trees with patches of grass, and bare stretches of level rock. The vegetation of this is very curious, there being numbers of small flowering grasses and rushes, while representatives of the orchid family, of singular beauty, mosses, and ferns grow in great luxuriance over it. Amongst the *Orchidaceæ* are three species which I imagine are quite unknown elsewhere; they grow on decayed wood lying on the rocks, have large roots, and grow very high; their flowers are large, delicately scented, and in form resemble those of the Cattleya. A large species of agave grows in great numbers here. Its leaves are more of a yellowish-green colour, and their points are of a rounder form than those of the *Agave vivipara*. Growing along the track from the landing to the foot are great quantities of ferns and mosses, and on the rocks close to the edge of the basin are small scarlet bell flowers and a fine sack-shaped orchid. All the rocks near the basin are covered with a coarse moss, and beyond on the rocks washed by the waves this growth gives place to a small water plant. Small clusters of dark green shrubs cling in patches to the lower portion of the precipice on either side, and look like ivy on a castle wall. A long kind of grass grows in the water on the western edge of the lip.

The scenery of the great valley below when viewed from near the head of the fall is extremely fine. Late in the afternoon when the sun is sinking in the west great shadows are cast across it which have a magnificent effect, and the colouring is then very beautiful, the end of the valley being lit up by the golden reflection of the sky over the plain beyond, and the strips of river winding in the depths below look like bands of silver. Viewed from this spot none of the bare precipices on the valley side are disclosed, but all appear to be covered with a rich dark-green clothing of trees.

From the small savanna looking south and south-west the mountains of the first plateau are seen in the distance, as also are Cowatapeur and Salieng (two flat-topped mountains), far off in the west.

With regard to the geological structure of Kaieteur fall, I may here mention that the table land over which the Potaro river flows is composed of sandstone and conglomerate beds belonging to the upper portion of the great sandstone formation of Guiana. In my last report I have given a description of the lithological characters of this formation, and have there stated that it is probably the equivalent of the new red sandstone. The lower portion is not here represented, and the sandstone rests upon the quartz-porphyry. The upper beds of this rock are here extremely hard, and are formed of a coarse pebble conglomerate lying in a synclinal curve in which the river runs just as it passes over the precipice. This conglomerate is some 20 feet in thickness, and is underlaid by beds of reddish-gray sandstone which are not so durable as the conglomerate. It is owing to these circumstances that the fall is of a perpendicular form, for the great hardness of the conglomerate resisting the action of the water for a longer period than the underlying sandstone, is left as a protruding ledge; while the

wash of the column of water cuts away the softer sandstone below.

The back splash of the fall has cut out the great cave behind, and as the conglomerate ledge above breaks away from time to time, as it must do, and the column of water is thereby moved back, so in the same ratio must the cave be cut back, and the perpendicular form of the column preserved. These conditions will probably remain in force for ages to come, so there is no reason to anticipate the destruction of the vertical portion of this beautiful fall.

There is a great fault in the strata on the eastern side of the precipice, which has produced a great change in this dip of the beds beyond the line of the fall.

The conglomerate is composed of waterworn blocks and pebbles of quartz, cemented together by a white clay with quartz grains, of the same reddish-gray material as constitutes the sandstone, and of such great hardness that the embedded quartz splits evenly in two with the fracture of the rock. Besides quartz, these contain pebbles of jasper, quartz-porphyry, and sandstone.

The sandstones vary much in durability, texture, and colour, and invariably exhibit lines of false bedding.

There is a layer of trap rock not far from the landing on the hill side crossing the path that leads to the top.

I feel sure that the elevated tract of country about the head of the fall is extremely healthy, and that a journey to it and a short time spent there would be found a beneficial change to those who reside on the low land along the coast.

The Indians say that in the dry season the river becomes very low, and consequently the fall narrows greatly. In the month of October it reaches its lowest point, and then the fall is only about one third of its full width. They say it then falls in a continuous column as at present. After October it rises with the autumnal rains, and for a month or two is at its full width; it then decreases till March, and again is filled up by the spring rains.

A small sum of money judiciously expended in improving the portages and in making a pathway to the foot of the fall would reduce the time of the journey there and back considerably. The Indians living near by, if directed and paid, could easily fell trees amongst the large rocks, flatten their upper sides and lash hand-rails to them, whereby the walk from the landing to the edge of the basin would be greatly facilitated. Small thatched sheds could be erected at the various camping places to protect travellers from rain and dew at night.

The nearest and best route is undoubtedly the one by which we travelled, but a more convenient way might be opened up for those who wish to evade the cataracts on the Essequebo river. This could be done by cutting a road 18 miles in length, from Christianburg due west to the Essequebo river, and parties could then ascend the Demerara river to Christianburg in the steamer, and cross over to boats kept on the Essequebo above Ahara rapid.

To this report I have attached a map which is the one used by the Survey, and was traced from Schomburgk's large map. I have

added my sketch survey of the Potaro river to it, so that the position of the fall can be seen at a glance. They are reproduced on a smaller scale in the accompanying sketch map.

CALCULATION of TOTAL HEIGHT of the FALL by simultaneous Observations of Standard and Mountain Barometers.

Standard Barometer (Casella's, No. 566), at top of fall, Station B., 5 feet above level of river.

Mountain Barometer (Baker's), near foot of cataract, Station A., 13 feet above level of river.

Difference of Barometer,	At Sea Level.	Foot of Fall.
Standard	30·056	29·650
Mountain	30·038	29·626
	·018	·024

Mean of difference to be added to Mountain Barometer, ·021.

Time.	Standard Barometer.	Attached Barometer.	Mountain Barometer.	Attached Thermometer.
1st observation, 9 a.m.	28·868	74°	29·714	73°
2nd ,, 9.10 ,,	28·900	74°	29·708	73°
3rd ,, 9.30 ,,	28·892	75°	29·706	74°
4th ,, 9.45 ,,	28·888	76°	29·709	75°
5th ,, 10.30 ,,	28·888	76°	29·711	75°
	5)144·436	5)375°	5)148·548	5)370°
	28·887	75°	29·709	74°

Mean of Standard Barometer - - - 28·887 75°

,, Mountain ,, 20·709 + ·021 = 29·730 74°

29·730 29·730 75° = 944·7 in table.

28·887 28·887 74° = 942·9 ,,

58·617 ·843 1887·6

2)58·617 ·843 2)1887·6

29·308 943·8

·843

28314

37752

75504

795·6234

30

·308) 23868·7020 (814 ft.

234464

42230

29308

129222

117232

Total height by observations - -		814 ft.
Height of Standard above river -	5 ft.	
„ Mountain „ -	13 ft.	8 ft.
„ Fall and cataract =		822 ft.

CALCULATION of HEIGHT of CATARACT by Aneroid Barometer, Station C., 5 feet above the edge of basin.

Time.	At Station A.	At Station C.
1st observation, noon -	29·748	—
3rd „ 3.30 p.m. -	29·660	—
2nd „ 2.30 „ - -	—	29·620
	2) 59·408	
	29·704	

29·620 = 337 feet.
29·704 = 264 „
73 feet.

Height of Station A. above river = 13 feet.
„ C. „ = 5 „
8

Height of cataract = 73 + 8 = 81 feet.

Total height of fall :—

Height of fall - -		822 feet.
„ cataract -		81 „
Height of perpendicular portion		741 feet.

Calculation of width of edge of fall :—

Base line A B = 159·72 feet.
√ C = 22° 30′
√ B = 62° 30′

Log. Cosec. C =	10·4171603
„ Sin. B =	9·9479289
„ A B =	2·2033593
Feet	2·5684485
A C = 370·21 =	2·5684481

Width of fall at edge = 370·21 feet.

Height above the sea level taken with the Standard Barometer :—

Foot of Tumatamari cataract -	65 feet.
„ Aniutu ditto - -	84 „
Landing place - - -	196 „
Top of Kaieteur fall - - -	1,130 „
Foot „ - - - -	308 „

I have taken the following quotations from Sir John Herschel's "Physical Geography," for the purpose of allowing the reader to draw his own comparisons between the chief waterfalls of the world and Kaieteur.

With regard to Yosemite and Ruikam Fossan it will be seen

that their exact width is not given, one being mentioned as being the "width of the Thames at Richmond," and the other "a large river." The height also of the former seems to have been taken by guess, and the words "unless exaggerated" cast some doubts upon the truth of the statement.

"The loftiest waterfall in the world (unless exaggerated) is to be found in the Yosemite valley, in Mariposa county, California, where a river as large as the Thames at Richmond makes a single leap of 2,100 feet perpendicular, the total height being 3,100 feet.

"The communication along the chain of lakes is broken between lakes Erie and Ontario by the stupendous fall of Niagara, the largest and most magnificent, though far from the highest, in the world, the total breadth of river (which is divided into two great cataracts by Goat island) being 3,225 feet, with a descent of 162 feet in one fall, and 149 in the other."

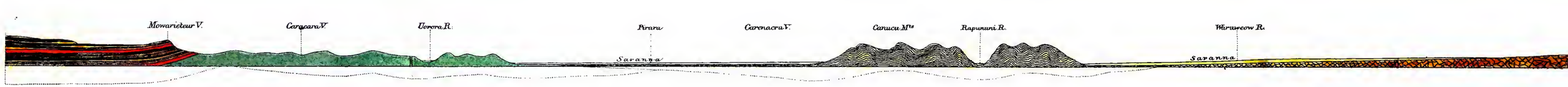
The Victoria falls on the Zambesi river are thus spoken of:—
"The falls referred to are perhaps the most striking after
"Niagara which exist. The river 1,000 yards in breadth is
"suddenly swallowed up in a narrow perpendicular cleft 100 feet
"deep" . . . "in which the river takes its new course compressed
"in a deep channel of 15 or 20 yards."

The most notable European waterfalls are those of the Rhine at Schaffhausen, not lofty—being only 70 feet in height—but very picturesque; those of the Velino at Terni, and the Anio at Tivoli, both artificial, but of exquisite beauty; that of Riukan Fossan, where the Maanelvan, a large river flowing out of the Miosvatu lake in Tellemarken, in Norway, springs 946 feet at a single leap; the Glommen falls, and those of the Moxa near Stav, in the same county. The falls of the Clyde in Scotland are not wanting in grandeur or beauty. Those of Gavarnie (1,400 feet) in the Pyrenees, and of the Staubbach (1,004 feet as measured barometrically by the writer of the article), in Switzerland, are mere rills, remarkable only for their height, in which, however, both are surpassed by that of the Orco, a stream which springs 2,400 feet from Monte Rosa, on the Italian side of the Alps, and of which some further account would be desirable.

LONDON:
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.
[P. 92.—500.—1/75.]

I. SECTION *from* MOCO-MOCO POINT *in a southerly direction to the source of the* ESSEQUEBO RIVER.

Continuation of above Section

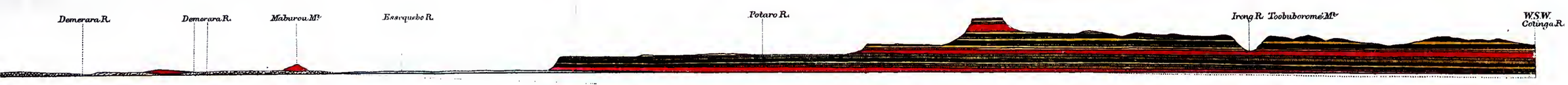


II. SECTION *from the mouth of the* CORENTYNE R. *in a* W.S.W. *direction to the* COTINGA R.

MOCO-MOCO POINT *in a southerly direction to the source of the* **ESSEQUEBO RIVER.**

Continuation of above Section

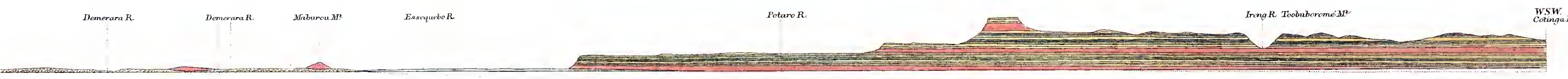
ECTION *from the mouth of the* **CORENTYNE R.** *in a* **W.S.W.** *direction to the* **COTINGA R.**



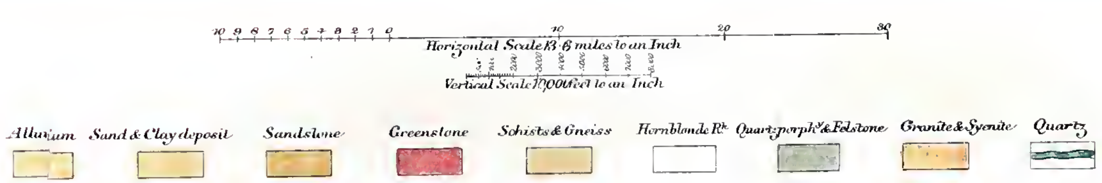
II. SECTION *from the mouth of the* CORENTYNE R. *in a* W.S.W. *direction to the* COTINGA R.

III SECTION *from the* MAZARUNI R. *near Peaimah Fall in a* S.S.E *direction to the* IRENG R.

SECTION *from the mouth of the* CORENTYNE R. *in a* W.S.W. *direction to the* COTINGA R.



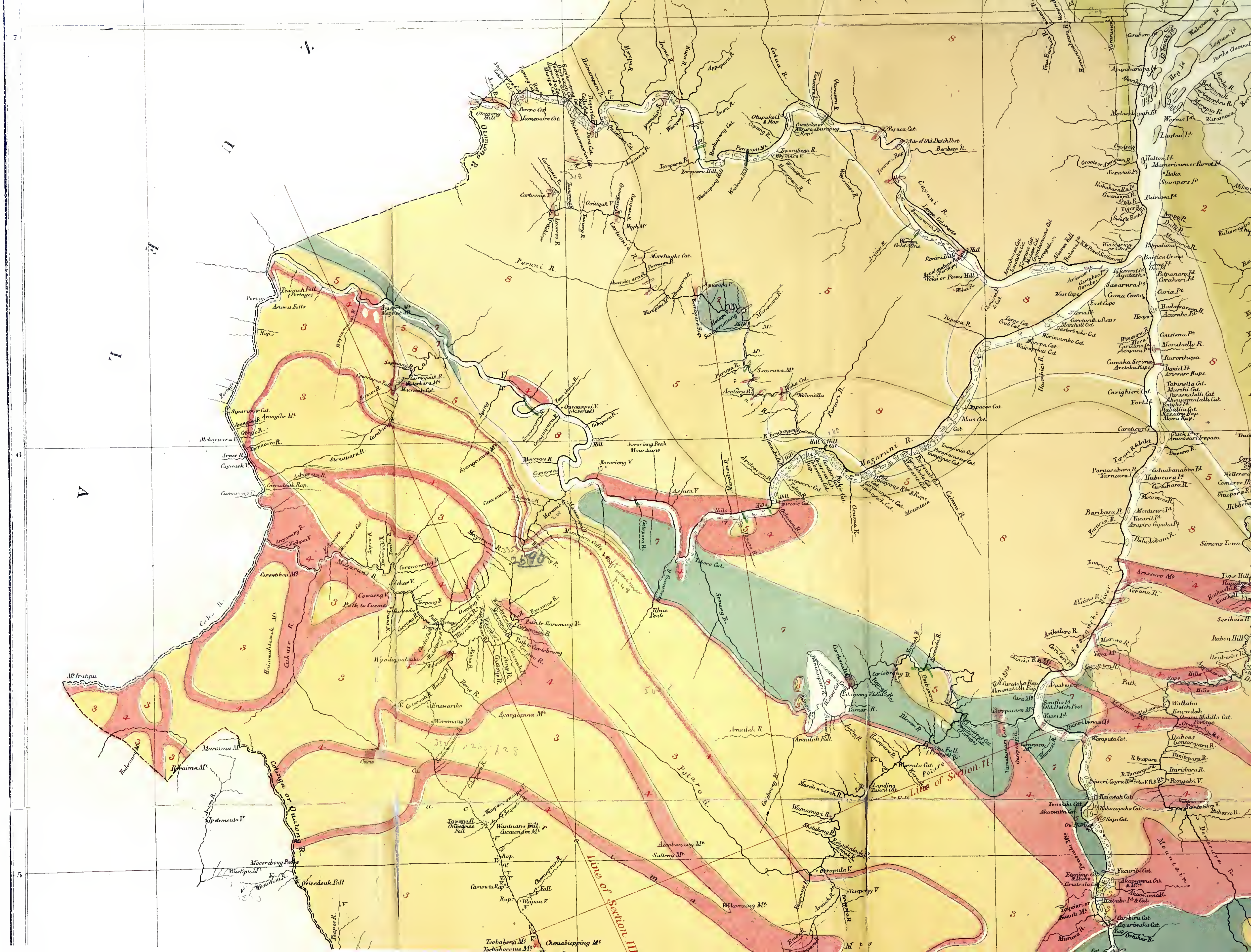
SECTION *from the* MAZARUNI R. *near Peaimah Fall in a* S.S.E *direction to the* IRENG R.



Dangerfield, Lith 22 Bedford St. Covent Garden.

Mouth of Orinoco R.
Sabunetta Pt
Pt Barima
Mocomoco Pt
Playa Point
Shell Beach
Amacura R.
V
E
N
E
Z
U
Barima River
Waini or Guainia R.
Cocali Point
Mora Passage
Waiaicuru R.
Eckanabaa R.
Sahuruni R.
Kaituma R.
Barama R.
Mt Arikita
Manapari Mt.
Warina R.
Subaina R.
Moroko R.
Haimarani R.
Barabara R.
Kamwatta R.
Santa Rosa Mission
Warucahura R.
Maroca R.
Cape Nassau
Bird Id
Pomeroon R.
Hill Mission
Tapacooma Lake
Tapacooma R.
Belle Alliance
Quakabaka Lake
Capoey R.
Oani R.
Tiger Id
The Lakes
Arabisce Coast
Imanicurru R.
Schiruru R.
Waini R.
Wailara R.
Mariwaru R.
Anaparie V.
Wahpanna V.
Amilevah R.
Anarlwo R.
Terimbono V.
Moraquiapura R.
Arawapai R.
Pairawa R.
Cutua R.
Appaparu R.
Rupa R.
Irama R.
Marupa R.
Haimaraparu R.
Otoraong Hill
Otonong R.
Poropo Cat.
Jamemure Cat.
Quashima Cat.
Paruaparu Mt.
Otupakai Id & Rap
Curatoka or Wararaahurupug Rap
Payuca Cat.
Site of Old Dutch Post
Beribece R.
Wakenaam Id
Leguan Id
Hog Id
Worms Id
Luxdan Id
Halton Id
Parika Channel
Parika R.
Waramaca
Tiger Id
1
2
5
8
61
60
59
8
7


Geological Map of
BRITISH GUIANA,
BY C.B. BROWN,
1873.
Scale 1 Inch to 13·6 Geographical Miles
Dangerfield, Lith, 22, Bedford St. Covent Garden.
59
58
57
Cocali Point
Cape Nassau
Bird Id
Tapacooma Lake
Tiger Id
Essequebo R.
Wakenaam Id
Leguan Id
Hog Id
West Coast
Demerara R.
GEORGETOWN
East Coast
Mahaicony R.



Cuyuni R.
Large Cataracts
Mazaruni R.
Mazaruni R.
Paruni R.
Parang R.
Otomong R.
Otomong Hill
Poropo Cat.
Iamemure Cat.
Haimaraparu R.
Maruya R.
Iroma R.
Ruya R.
Appapuru R.
Gitua R.
Yarecuru R.
Quareuru R.
Arawana R.
Toroparu R.
Toroparu Hill
Wackupang Hill
Wailaue Hill
Paruapu Mt
Tupurakena R.
Wamapate R.
Manaruparu R.
Copang R.
Otupakoi Id & Rap
Poynea Cat.
Site of Old Dutch Post
Beribece R.
Tenuma Rap
Wagarimpo R.
Suwaraima Id
Warren Gold Mine
Arimu R.
Simiri Hills
Woka or Powis Hill
Woka R.
Hill
Aracabasa Cat.
Emataba Cat.
Coomlamama Cat.
Seregaliva
Alianni Fall
Balaria Ids
H.M. Penal Settlement
Arawani Pt
Cartaboo Pt
Oorabo
West Cape
East Cape
Saearura Pt
Cuma Cuma
Tipuru R.
Tarpe Cat.
Grab Cat.
Marshall Cat.
Hesterbroke Cat.
Warimambo Cat.
Morrpa Cat.
Waipopehuu Cat.
Ikurubici R.
Tupacoo Cat.
Mari Cat.
Towapanie Cat.
Parowacassie Cat.
Yarugaec Cat.
Ocuma R.
Cabani R.
Mountain
Epiloreck Cat.
Una Barwa R.
Hammanabona R.
Yurunaru R.
Caraburo Id
Wakenaam Id
Leguan Id
Parika Channel
Hog Id
Worms Id
Luclan Id
Halton Id
Mamoricura or Parrot Id
Itaka
Stampers Id
Pairama Id
Groote or Abenyam R.
Saxacali Pt
Babahara R. & Id
Owenanna R.
Tiger R.
Swarte Rock Pt
Ampa R.
Dalli R.
Macouria R.
Patpalima
Bartica Grove
Lime Id
Dee Id
Patpanaro Id
Girahari Id
Curia Pt
Badafvareen R.
Acurabo Id
Houya
Coustena Pt
Morabally R.
Iuroruhaya
Cumaka Serima
Aretaka Raps
Daniel Id
Arissaro Raps
Tabinella Cat.
Marihi Cat.
Abewyamatalli Cat.
Itaballia Cat.
Sassara Rap.
Akaru Rap.
Carighieri Cat.
Fort Id
Caraticuri I
Gluck Id or Aramasari Irapaca
Tipuri R & Inlet
Aronimo R.
Paruacabara R.
Yarncara I.
Cutuabanaboo Id
Hubucuru Id
Curtuhara R.
Mocomoco R.
Baribara R.
Monticuri Id
Yucurit Id
Arapiro Gayaha Pt
Dahalabani R.
Simons Town
Arissaro Mt
Copana R.
Essequebo River
Arikalaro R.
Yaya Mt
Path
Hills
Raps
Wallaba
Enowdah
Orurucobra R. & V.
Itaboos
Timiteparu R.
Itarichara R.
Pongabi V.
Paintaobra V.
Itaburro R.
Demerara R.
Mountains
Haiowah Cat.
Twusiaku Cat.
Akaiwatta Cat.
Saya Cat.
Yucuribi Cat.
Etanime Cat. & Itabo
Akaiwanna Cat.
Akaiwanna R.
Itabobo Id & Cat.
Caribiru Cat.
Ortuhar R.
Murawa R.
Smiths Id
Old Dutch Post
Yacsi Id
Pampacoru Mt
Waraputa Cat.
Potaro R.
Line of Section II.
Line of Section III.
Amailah Fall
Amailah R.
Tumatumari Cat.
Landing
Mureh wuereh R.
Wamamuri R.
Shetukeng R.
Orapula V.
Taiepong V.
Aruich R.
Wokomung Mt
Aceobenang Mt
Salteng Mt
Ilhue Peak
Semang R.
Toboco Cat.
Ochawa R.
Hills
Asapura V.
Sororieng Peak Mountains
Sororieng V
Merume R.
Marabieu R.
Apotoacuru R.
Cabeparu R.
Oranapai V. (deserted)
Aping
Ayangcanna Mt
Ayangcanna Mt
Carowonring R.
Wyodugvalu
Enawariko
Warrumatto V
Path to Karamang R.
Path to Cariebrong
Panamoo R.
Cako R.
Cukuie R.
Carowtibou Mt
Cowaeng V.
Path to Cucuie
Mt Irutipu
Maraima Mt
Roraima Mt
Kukenaam Mt
Cotinga or Quatong R.
Arum R.
Ipetemouta V
Mocorebong Peaks
Waetipu Mt
Weaumou R.
Orinedouk Fall
Peepee R.
Wantuana Fall
Cucaienim Mt
Camowta Rap
Chemapour R.
Waupan V
Toebaheng Mt
Toebuborome Mt
Chemabiepping Mt
Curw
Arawa Falls
Peaimah Fall (Portage)
Portage
Rap
Weynamura R.
Araseri Mt
Mayone Mt
Sagenung R.
Carruquah R.
Waterbaru Mt
Macreah Cat.
Cowmaroo Fall
Sarun R.
Siparimar Cat.
Avangike Mt
Donacoro R.
Mekayparu V.
Arnie R.
Caywaek V.
Stenaparu R.
Ashuparu R.
Corrudeak Rap.
Camarong R.
Arecamung R.
Mishpa V.
Mazaruni R.
Ichar V.
Terpong R.
Oweang R.
Marewyeng R.
Cartoome V.
Cartoonee R.
Orituqah V.
Cartwonie R.
High Mt
Marehughi Cat.
Parenow R.
Awendaiara R.
Warapimi Mt
Bomboura Rap.
Apiarapu V.
Saigoromung V.
Maramara R.
Sacarawa Mt
Piruma R.
Acotura R.
Woka Cat.
Wahmalla
Puriari R.
R. Turubengeng
Hill
Hill Cat.
Mazaruni R.
5
8
7
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4
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8
5
8
3
3
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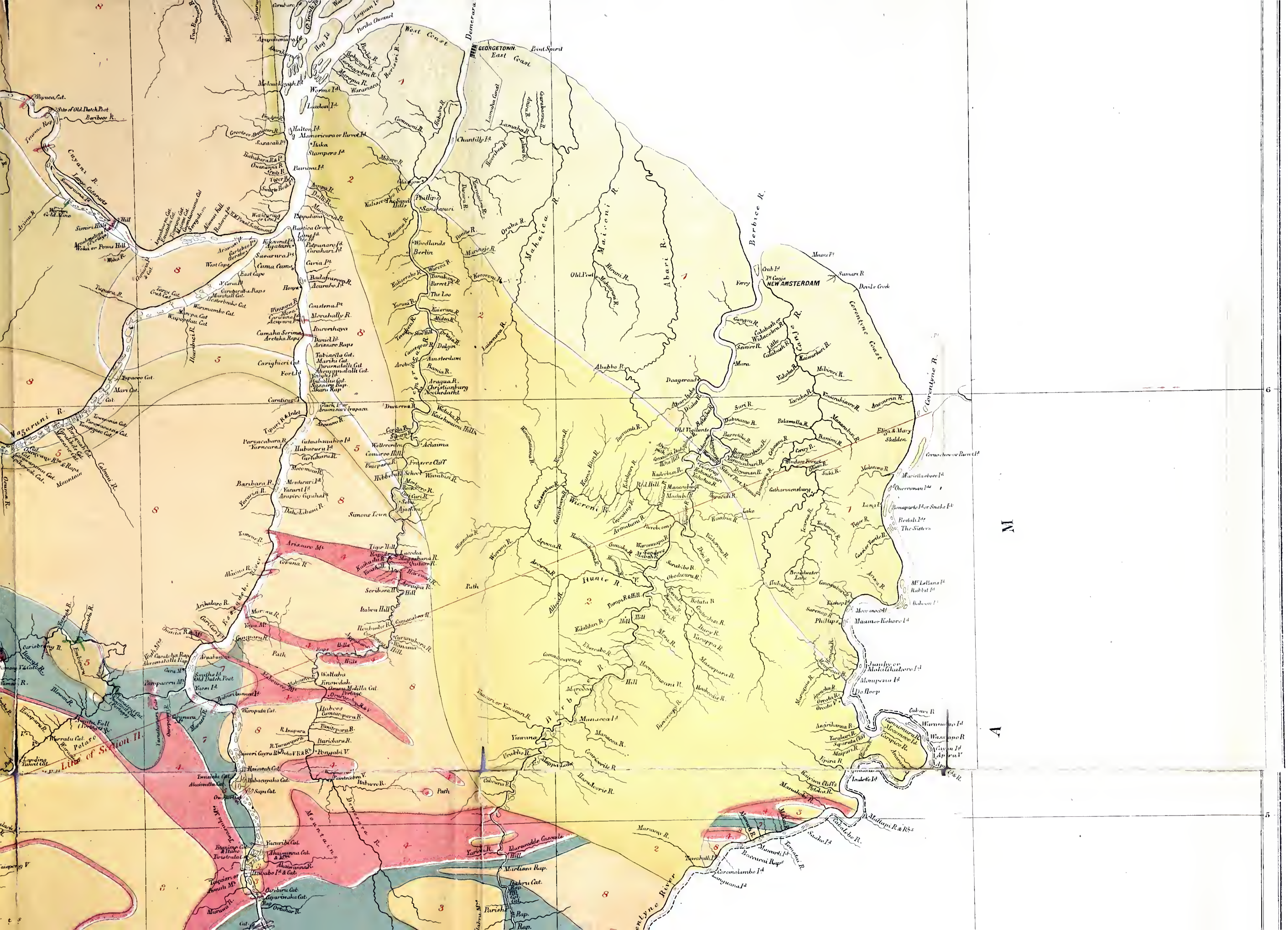
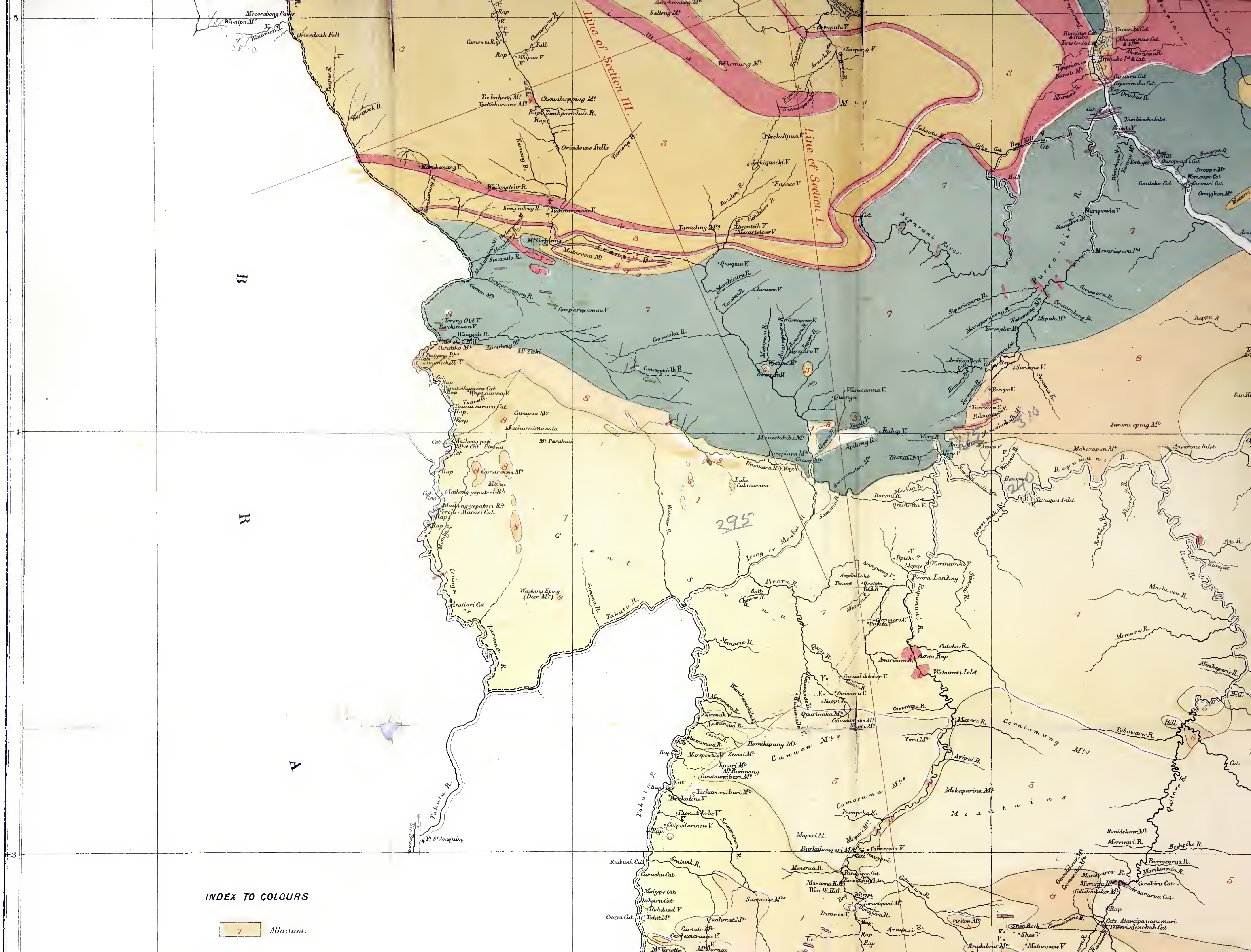
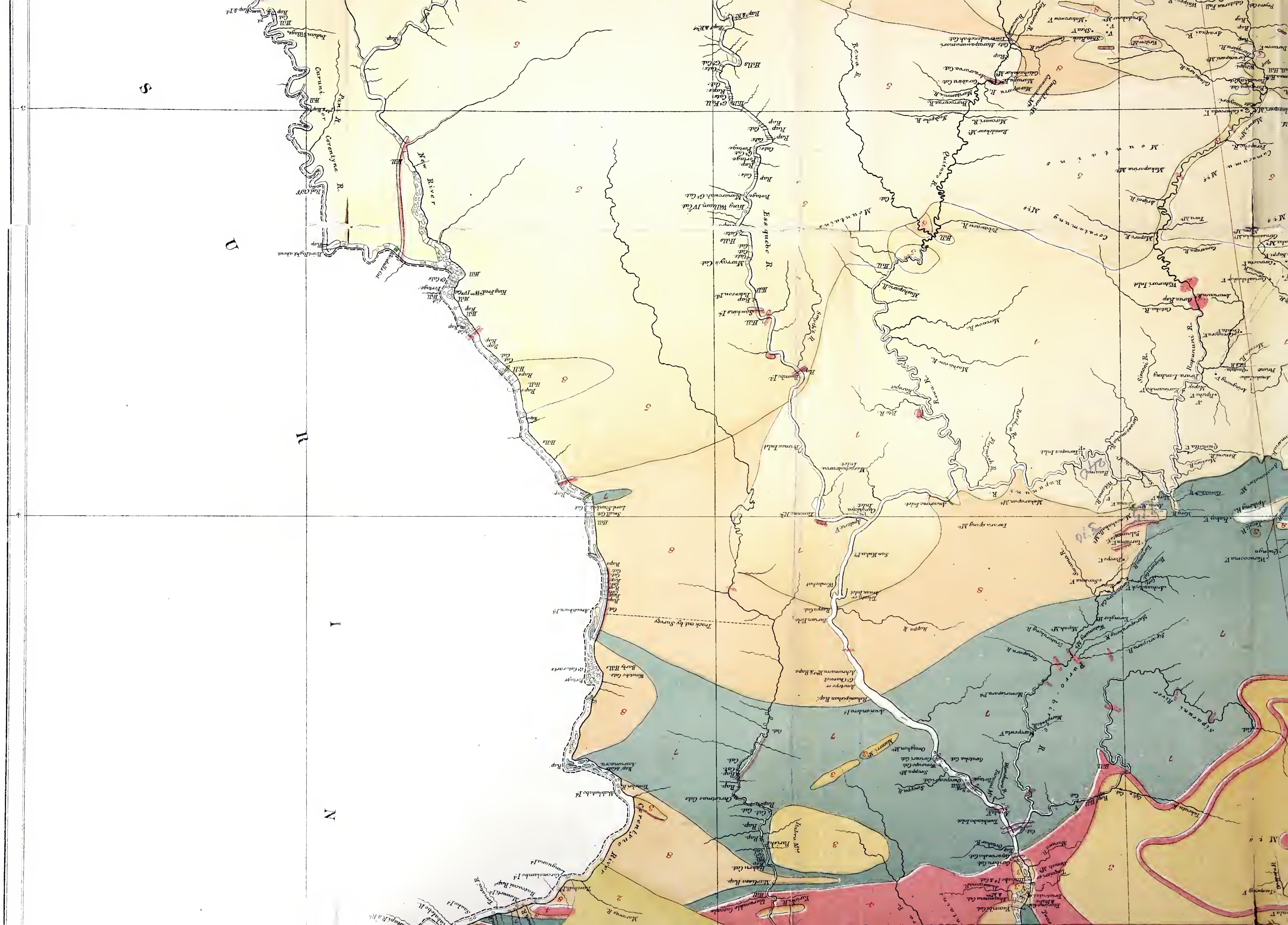
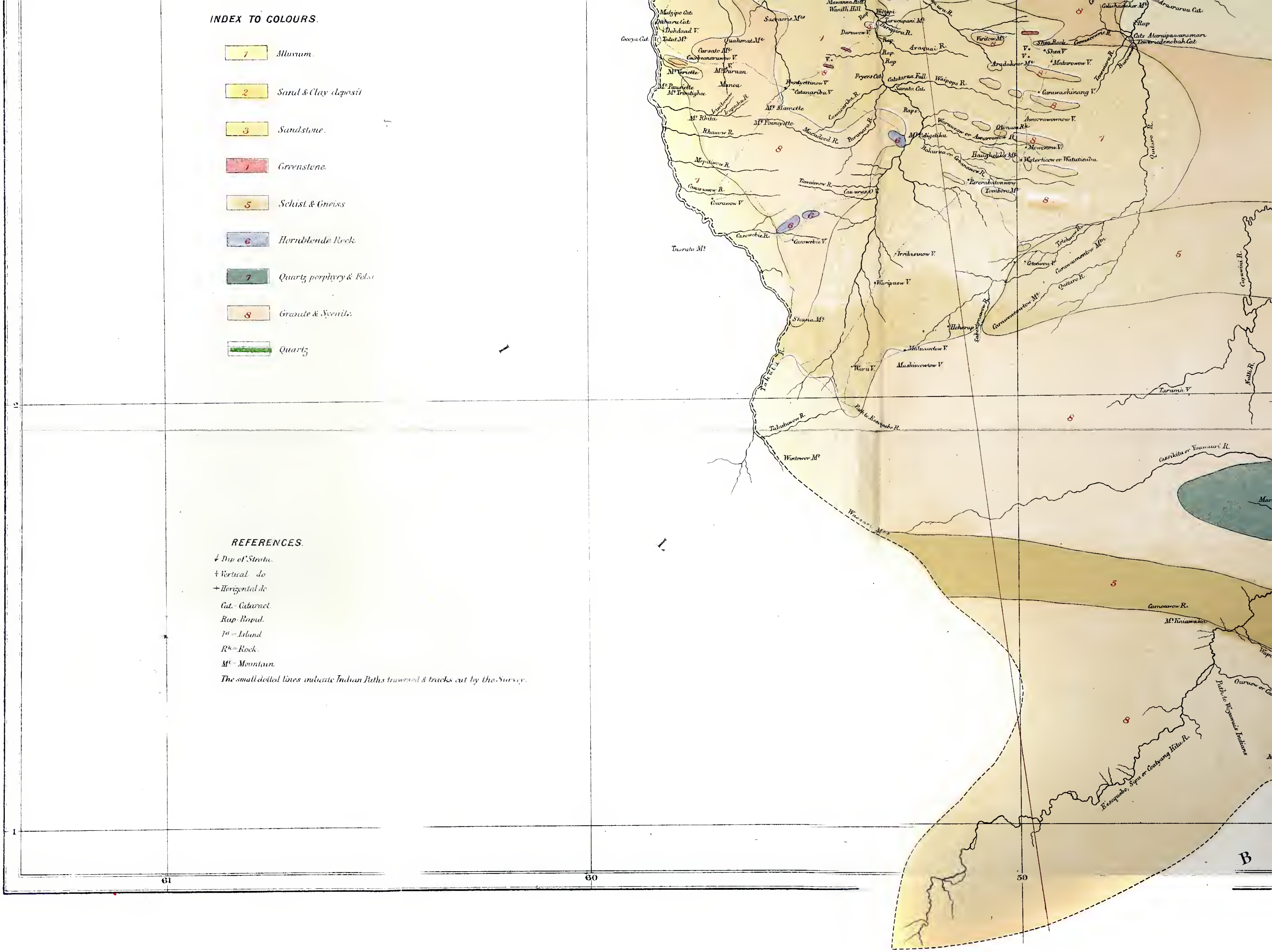
7

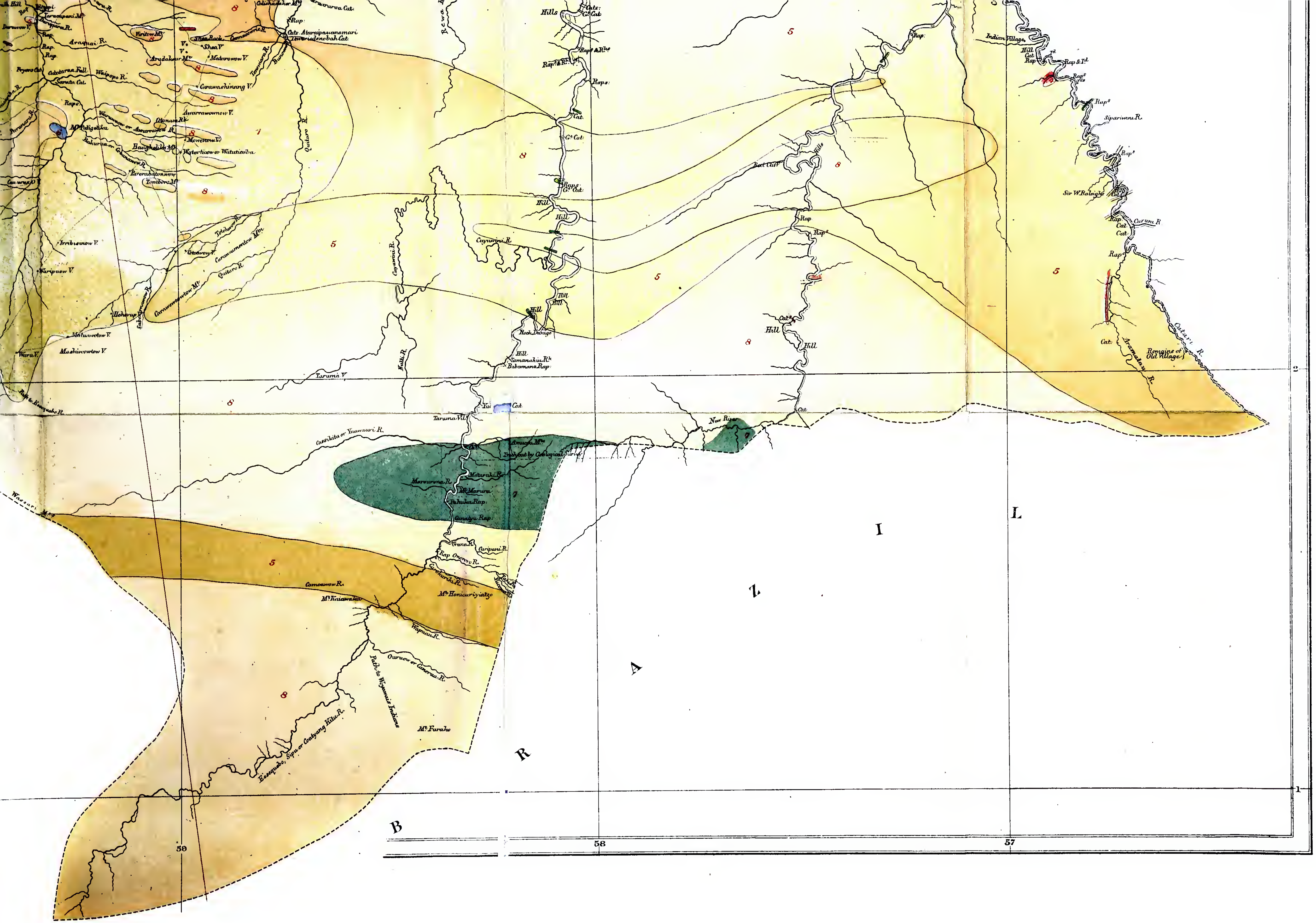


GEORGETOWN.
East Coast
West Coast
Demerara
Berbice R.
NEW AMSTERDAM
Corentyne Coast
Corentyne R.
Mahaica R.
Mahaicony R.
Abari R.
Canje R.
Cuyuni R.
Mazaruni R.
Essequibo River
Demerara R.
Berbice R.
Hunie R.
Wieroni R.
Wismar
Woodlands
Berlin
Amsterdam
Christianburg
Arisaro Mt.
Line of Section II.
Potaro
Old Dutch Post
Mountains
Path
Lake
Wattaba
Tiger Hill
Corentyne River
M
A
6
5


Line of Section III.
Line of Section I.
B
R
A
Great Savannah
INDEX TO COLOURS.
Alluvium.
Mocorobong Peaks
Waetipu Mt
Waumon R.
Orivedouk Fall
Peeper R.
Wayanock R.
Camowta Rap
Chemapour R.
Fall
Waipan V
Toobaheng Mt
Toobaboroine Mt
Chemabiepping Mt
Uwahparoduie R.
Orindouie Falls
Karanang R.
Tamong R.
Karakanang V.
Wailongteiur R.
Irongwatong R.
Tuduarrimone V.
Salleng Mt
Wikemung Mt
Arauch R.
Carapula V.
Taipong V
Emoy R.
Mts
Fechilipua V.
Jerkiquocki V.
Encaco V.
Taculing R.
Echilebar R.
Tawailing Mts
Qwentaik V.
Mararieteur V.
Mt Curyaring
Mataroeca Mt
Ireng R.
Sacacuta R.
Camau Mt
Comparuwamou R.
Comparuwamou V
Torong Old V.
Purchitewan V
Waiquah R.
Moroboy Hill
Curatiko Mt
Amidong Mt
Mt Zicki
Curewaka R.
Conewyhtelh R.
Quaqua V.
Marebicuru R.
Tarawa R.
Tarawa V.
Comapour V.
Matapau R.
Awarapauru R.
Wyetipu Mt
Caroun Fall
Takoutu R.
Cat.
Hill
Siparuni River
Purro-bibi-R.
Marepowta V
Mowarieparu Pd
Curieparu R.
Siparieparu R.
Mariepuruheng R.
Watamung Mt
Mipah Mt
Yucuribi Cat.
Akawanna Cat.
Itababo Id & Cat.
Murawa R.
Caribiru Cat.
Tambicabo Inlet
Arinda V.
Siroppa R.
Ouropocari Cat.
Curatoka Cat.
Omughon Mt
Mountains
Rappu R
Surama V.
Surama R.
Peropo V.
Tarramu V.
Palouraouta V.
Tarara eping Mt
Waracooma V.
Quonga
Yacuti R.
Itabay V.
Apikong R.
Mora R.
Annai Mt
Annai V.
Mora V.
Makarapun Mt
Rupununi R.
Awarime Inlet
Maraetshiba Mt
Purepiapa Mt
Unamara R.
Lake Culucurana
Curupua Mt
Mackunaima outa
Mt Parakua
Maikong pati Mt & Cat
Canarauna Mt
Maikong yepatori Rk
Cotinga
Aratiari Cat.
Waiking Eping (Deer Mt)
Somena R.
Takutu R.
Zuruma R.
Wararu R.
Ireng or Mowhu R.
Samaria R.
Pirara R.
Pirara Landing
Rupununi R.
Simoni R.
Bononi R.
Quimatta V.
Wotama R.
Hauwa
Taruqua Inlet
Flemush R.
Rewa R.
Poto R.
Karapot
Mashieow R.
Merewow R.
Musheparie R.
Manarie R.
Catoka R.
Curua Rap
Watowari Inlet
Quaye R.
Camarapa R.
Mapare R.
Coratamung Mts
Pobawaow R.
Hill
Cat.
Canucu Mts
Quariwaka Mt
Hamikipang Mt
Aripai R.
Cumucumu Mts
Makaparina Mt
Mountains
Quitaro R.
Perapoke R.
Mapuri M.
Burlaluauwari Mt
Cabarooda V.
Ranidekeur Mt
Merewari R.
Nochpoko R.
Burrocurua R.
Maritamnia R.
Carabiru Cat.
Takutu R.
Ft St Joaquim
Rio Branco
Scabunk Cat.
Scabunk R.
Menerua R.
Sacraerie Mts
Quahmat Mt
Viritow Mt
Shea Rock
Shea V
Arudakeur Mt
Matarowow V.
Cats. Ataraipawanamari
Tewericlenobah Cat.




INDEX TO COLOURS.
1 Alluvium.
2 Sand & Clay deposit
3 Sandstone.
4 Greenstone.
5 Schist & Gneiss
6 Hornblende Rock.
7 Quartz porphyry & Fels.
8 Granite & Syenite.
Quartz
REFERENCES.
Dip of Strata.
Vertical do
Horizontal do
Cat. - Cataract.
Rap - Rapid.
Id = Island.
Rk = Rock.
Mt = Mountain.
The small dotted lines indicate Indian Paths traversed & tracks cut by the Survey.
Taruma V.
Wantower Mt
Shana Mt
Waru V.
Caravenatowton Mt
Path to Essequebo R.
Camoaswow R.
Path to Woyawais Indians
Essequebo, Sipu or Coatyang Kitu R.
61
60
59
2
1
B


B R A Z I L
Taruma V.
Taruma Vil.
Cassikitu or Yuawauri R.
Amucu Mts
Track cut by Geological Survey
Merewrwa R.
Mt Marura
Pahuka Rap.
Canatyu Rap.
Matarudi R.
Urana R.
Curipani R.
Rap Onoro R.
Carokuriki R.
Mt Honicuriyiatzo
Camoawow R.
Mt Kaiawaka
Wapuau R.
Ouruow or Caneraa R.
Path to Woyawais Indians
Mt Furako
Essequebo, Sipu or Coatyang Kitu R.
Wassari Mts
Path to Essequebo R.
Wara V.
Mashiwowtow V.
Maluwowtow V.
Heheray V.
Waripuow V.
Irribisinow V.
Sabeyarnawow R.
Carnaweneowtow Mt
Quituro R.
Curawumentow Mts
Otoarow V.
Totohwow R.
Quitaro R.
Tomboro Mt
Parerabatonnow
Baughelika Mt
Watertioow or Watuticaba
Mowenow V.
Otonam Rk
Amarrawownow V.
Curawashinang V.
Matorowow V.
Arydakaur Mt
Shea V.
Shea Rock
Viritow Mt
Araquai R.
Waipopo R.
Rap.
Raps.
Mt Pidigetika
Taruapani Mt
Cats. Atarraipawanamari
Rewa R.
Hills
Cats.
Gt Cat.
Raps.
Cat.
Raps.
Hill
Cayuwini R.
Cayuwini R.
Rock Dabago
Tamanahiu Rk
Buhumana Rap.
Kuitu R.
Yuc Cat.
Red Cliff
Hills
Rap
Raps
Cat
Hill
New River
Indian Village
Hill
Cat.
Rap
Rap & Id.
Raps
Sipariwini R.
Raps
Sir W. Raleigh's
Curuni R.
Rap.
Cat.
Cat.
Raps
Cat.
Aramatau R.
Remains of Old Village
Cutari R.
5
8
7
6
2
1
59
58
57